MODELING FOREST PROTECTION VALUES FOR THE SOUTHERN APPALACHIAN SPRUCE-FIR FOREST

by

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(ABSTRACT)

Household economic value for southern Appalachian spruce-fir forest protection may be sensitive to changes in the forest's physical condition. Further, different recreation groups may hold significantly dissimilar values for forest protection. Household and recreation group willingness to pay for southern Appalachian spruce-fir forest protection was estimated using responses from a mail-out referendum style contingent valuation survey. To test the hypothesis that willingness to pay for forest protection is not sensitive to the condition of the forest's physical condition, 1,000 southeastern households were randomly assigned one of two different forest protection scenarios. Households in the first sample were asked to value a protection program for a forest showing no visible sign of impact from insect or atmospheric disturbance. Households in the second sample were asked to value a protection program for a forest already experiencing impact from insect infestation and air pollution. Logit analysis of the two samples revealed no statistically significant difference in willingness to pay between the two forest protection programs. These results suggest that, over the range of forest conditions tested, a household's value for forest protection may be insensitive to the forest's physical condition.

To determine the relationship between forest protection values and respondent preferences, our general sample was disaggregated into forest user groups according to household participation in specific recreation activities. Tests of within-group value sensitivity to forest condition revealed that consumptive recreation groups' (i.e., hunters and anglers) forest protection values changed significantly when initial forest condition declined, whereas

nonconsumptive forest users (i.e., campers and hikers) held protection values that were insensitive to the same decline in initial forest condition. Further analysis revealed between-group differences in WTP for forest protection. Households who fish (one type of consumptive recreationist) were willing to pay significantly less for forest protection than households who do not fish. Conversely, households who hike or camp (i.e., nonconsumptive forest users) were willing to pay significantly more for forest protection than households who neither hike nor camp. Between-group variation in forest protection value may be explained by differences in the ability of recreation groups to utilize a range of forest health conditions.

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INTRODUCTION AND JUSTIFICATION

Southern Appalachian spruce-fir forests are biologically diverse, high elevation ecosystems in the southeastern United States. Ranging in elevation from approximately 4,400 to 6,684 feet, spruce-fir forests occur in a series of island-like stands, occupying the southern Appalachian's tallest mountain peaks and ridges. Red spruce (*Picea rubens* Sarg.) dominates the ecosystem's lower elevations, while Fraser fir (*Abies fraseri* (Pursh) Poir.) becomes increasingly frequent at higher elevations. Associated tree species include yellow birch (*Betula lutea* Michaux f.) and mountain-ash (*Sorbus americana* Marsh.).

The southern spruce-fir ecosystem is an exceptionally valuable resource both economically and biologically. Spruce-fir forests are a premier feature of the Great Smoky Mountains National Park, the North Carolina State Park System, the Jefferson and Pisgah National Forests, the Blue Ridge Parkway and the southern leg of the Appalachian Trail. While red spruce and Fraser fir are no longer significant timber species, recreational demand for spruce-fir forests is very high. Southern Appalachian parks and forests are among the most frequently visited recreation areas in the world. Money spent by recreationists visiting the southern spruce-fir region may be the most significant factor contributing to the health of many local economies. The ecosystem's biological wealth is reflected by its rich species diversity, including 11 threatened and endangered plant species and 17 species or subspecies of endemic plants and animals (White 1984). However, the economic and biological integrity of the southern spruce-fir forest may now be jeopardized. An introduced insect, the balsam woolly adelgid (*Adelges piceae* Ratz.), continues to cause the severe deterioration of the region's Fraser fir population, threatening the existence of Fraser fir and of the ecosystem (Zedaker *et al.* 1993). In addition, Adams *et al.* (1985) report finding significant decreases in red spruce diameter growth over the past twenty years. The decline of the high elevation spruce-fir ecosystem is thought to be exacerbated by air pollution from regional urban and industrial centers (Johnson and Taylor 1989; White 1984).

Having extreme physical limitations (i.e., southern edge of spruce-fir forest's range and high elevation), southern spruce-fir forests and their associated amenities are especially sensitive to natural and anthropogenic disturbances. Hence, monitoring southern spruce-fir dynamics may illuminate how natural and man-caused perturbations influence economic values for natural resources. Most research examining the impacts of global climate change is biologic; little is known about the influence of climate change on economic values for natural resources. This study was funded under the U.S.D.A. Forest Service Southern Global Climate Change Project to investigate the possible links between climate induced changes in southern spruce-fir forest attributes, e.g., incidence of standing dead basal area, and the public's economic value for the forest. Since the 1960's, the relationship between individual and group aesthetic preferences for a wide range of forest types, conditions, and attributes has been exhaustively investigated (Ribe 1989). However, little progress has been made in translating preferences for different forest conditions into economic terms. By revealing the links between changing forest conditions and consequent changes in economic value, policy makers and resource managers would be able to make better informed decisions regarding this unique resource.

Keeping in mind the objective of establishing the relationship between forest condition and economic value for the southern spruce-fir forest, this study examined the following questions. The first question examined was the relationship between a household's economic value for forest protection and the forest's physical condition. Specifically, the study considered whether forest protection values change given a decline in spruce-fir forest health. The second question considered was whether recreation groups' economic values for spruce-fir forest protection are sensitive to changes in the forest's physical condition. Finally, the study considered whether willingness to pay for forest protection varies significantly between households that participate in a given recreation activity and households that do not participate in that activity. To examine these questions, the general hypotheses tested in this research were:

H_o: The economic value a household places on spruce-fir forest protection is not sensitive to changes in the forest's physical condition.

H_o: The economic value a recreation group places on spruce-fir forest protection is not sensitive to changes in the forest's physical condition.

H_o: Willingness to pay for forest protection does not vary significantly between households that participate in a given recreation activity versus households that do not participate in that activity.

This thesis is organized as follows. Chapter 1 reviews the relevant nonmarket valuation literature with the intent of identifying contingent valuation as the most appropriate valuation method for revealing the economic value households and recreation groups place on spruce-fir forest protection. In Chapter 2, household protection value sensitivity to changes in forest condition is investigated. Chapter 3 builds on the results of the previous chapter by examining the role of forest condition on recreation group valuation behavior, and also by investigating possible between-group differences in economic value for forest protection. Chapters 2 and 3 were written to be submitted for publication. Consequently, some of the information in these chapters is redundant. Results from Chapters 2 and 3 are summarized in Synopsis and Conclusions. Finally, the mail-out questionnaire, coverletters and model input and output files appear as a series of appendices.

CHAPTER 1
LITERATURE REVIEW

Resources Without Prices

The economic value of southern Appalachian spruce-fir forest protection is not explicitly registered by any existing market. In addition, personal satisfaction, i.e., utility, gained through visits to the southern Appalachian region and nonconsumptive benefits derived from the spruce-fir ecosystem's existence are not readily measured using market data. Therefore, a non-market valuation technique was used to examine the social benefits of protecting forest quality in the southern Appalachian spruce-fir forest. Past attempts to reveal the value of non-market goods have yielded several methods for estimating the monetary values people place on commodities falling outside traditional markets, e.g., recreation experiences, pollution abatement, and natural resource protection. In this chapter, the non-market valuation literature is reviewed with the goal of identifying the most appropriate non-market valuation method to reveal the economic value of southern spruce-fir forest protection.

Indirect Versus Direct Valuation of Non-Market Goods

Economic values for non-market or public goods may be derived *indirectly* from individuals' actual spending behavior, e.g., from costs incurred traveling to a recreation destination, or may be elicited *directly* via individuals' responses to surveys, interviews and questionnaires. By observing the public's behavior in existing markets, indirect methods derive monetary values for non-market goods from cost and demand functions, observed changes in activity of market goods or variations in the prices of goods or factor inputs (Bentkover, Covello and Mumpower 1986; Cummings, Brookshire and Schulze 1986).

Direct methods of non-market good valuation rely on individuals' spending behavior in hypothetical markets (Bishop and Heberlein 1979). Using survey tools such as one-on-one interviews and mail-out questionnaires, direct valuation methods ask economic agents how they would behave, e.g., modify their spending patterns, given a specific increase or decrease in the level of the public amenity being provided. Other direct techniques ask individuals to order alternative bundles of environmental amenities in order of desirability (Bentkover, Covello and Mumpower 1986). These ranking techniques often use visual images to elicit interview responses. Because direct valuation techniques use hypothetical situations to elicit values responses, the validity of interpreting these responses as economic measures of value hinges on one basic supposition: what individuals say they would do in a hypothetical situation is highly correlated to what their behavior would be in an actual market environment (Bishop and Heberlein 1979; Cummings, Brookshire, and Shultze 1986).

Indirect Valuation Methods

Travel Cost Method

The travel cost method (TCM) of assigning monetary values for non-market goods has been used extensively in the valuation of recreational sites (Seller, Stoll and Chavas 1985). TCM uses travel and other costs incurred by recreationists at varying distances from a recreation site as surrogates for recreationists' willingness to pay for admission and use of the site (Bishop and Heberlein 1979; Howe 1979). Other factors remaining constant, TCM infers a site or resource demand curve from time and travel costs. Assuming that time and travel costs to a recreation site accurately reflect recreationists' willingness to pay for the use of the site, recreationists will make fewer trips to the study site as travel and time costs increase (Walsh 1986).

The value of each trip may be inferred by measuring how many trips are taken by individuals travelling from different distances to the site. Travel costs of the last trip an individual is willing to make to the site are then equal to the price the individual would be willing to pay to use the site. Subtracting all direct, out-of-pocket travel costs incurred en route to the site, the value of the recreation site to a particular individual is the area under his demand curve for the site (Walsh 1986; Peterson, Driver and Gregory 1988). The major assumptions of TCM are: trips to a site are made to the point where marginal costs incurred travelling to the site equal marginal benefits gained by visiting the site; substitute sites either do not exist or are accounted for; little variation exists in preferences and tastes of persons travelling different distances to use the site; and trips are made for the sole purpose of visiting the study site (Seller, Stoll and Chavas 1985; Bentkover, Covello and Mumpower 1986).

While TCM may appear straightforward, many questions concerning potential sources of bias have been raised. Sources of bias often involve violations of the major assumptions of TCM. For example, significant variations in visitors' tastes and preferences and the availability of substitute sites have been found to be difficult to control for when modeling demand for a particular recreation site (Bishop and Heberlein 1979; Seller, Stoll and Chavas 1985). The further a recreationist must travel to a site, the greater the chances that alternative sites exist. When substitute sites exist and are not taken into account in the estimation of study site demand, missing variable bias may overestimate site value (Seller, Stoll and Chavas 1985).

Additional problems are encountered when assigning values to time en route to the site. Bishop and Heberlein (1979) point out that prices are not easily attached to these time costs. Adult wage rates tend to overvalue potential earnings from second jobs. In addition, the opportunity cost of leisure time must also be considered when placing values on recreation site demand. People who opt not to travel to the site may spend that time engaged in other recreational activities. Hence, questions arise as to what value should be assigned to the next best leisure opportunity. An important consideration of travel time cost is that travel time may not be a cost at all. Indeed, persons gaining pleasure from the travel experience itself may reap more benefits than costs in terms of time expended travelling (Bishop and Heberlein 1979; Allen, Stevens and Barrett 1981; Walsh 1986). Another difficulty in estimating recreationists' demand curves for a site is encountered when individuals take multi-purpose trips. When travel to the site includes reasons other than simply visiting the site, the travel costs specifically associated with the site must be differentiated from the total trip cost (Seller, Stoll and Chavas 1985; Peterson, Driver and Gregory 1988).

Perhaps the most limiting feature of TCM is that valuations of sites derived using this method must be attributed to the entire site *per se*, and not to individual site characteristics. TCM does not distinguish values between alternate parts of the site, nor are changes in values from altering the site taken into account (Bentkover, Covello and Mumpower 1986). Additionally, when determining the value of a site, TCM fails to take into account indirect consumption values (Walsh 1986). For example, the values placed on a site by people who intend to visit the site in the future (option value), by people who value the site simply because it exists (existence value) and by people who value the site for the sake of future generations (bequest value) are excluded from site value considerations with TCM (Bishop 1982; Bentkover, Covello and Mumpower 1986; Walsh 1986). Obviously, excluding so-called "nonuse" values from TCM site values results in a lower total value for the site than if these values were included.

Although the problems of multi-purpose trips, assigning value to travel time, availability of substitute sites, and differences in consumer tastes may be difficult to overcome, TCM has been used to estimate the value visitors place on recreation sites. However, the objective of this study is to determine the values households and recreation groups place on protecting a dynamic forest ecosystem, not the worth of a forest condition *per se*. For this reason, TCM is a poor candidate for revealing the relationship between forest protection values and the physical condition of the southern spruce-fir forest.

Hedonic Price Method

Similar to TCM, the hedonic price method (HPM) uses observed market behavior to reveal values for non-market goods (Bentkover, Covello and Mumpower 1986; Cummings, Brookshire and Schulze 1986; Peterson, Driver and Gregory 1988). Using HPM, the value of a non-market good, such as air quality or scenic beauty, is differentiated from the value of a market good, such as property, whose total value is assumed to be the sum of a defined bundle of attributes which includes the non-market good in question. When all factor inputs constituting the market price of property are accounted for, the contribution of air quality or scenic beauty to property values may be determined (Brookshire *et al.* 1982; Bentkover, Covello and Mumpower 1986; Cummings, Brookshire and Schulze 1986). Fundamental to the HPM approach is the assumption that peoples' preferences and behavior, such as purchasing property in a given neighborhood, is based on a site's objective attributes (Peterson, Driver and Gregory 1988). Environmental public good amenities like air quality are assumed to be one of the tangible attributes which factor into an individual's decision to live in a specific area.

For example, Brookshire *et al.* (1982) examined the Los Angeles housing market to reveal the price of clean air in southern California. Using HPM, they accounted for the following differences in property values to reveal air quality's value: (1) housing structure variables, e.g., age, living area, bathrooms, pool and fireplaces; (2) neighborhood variables, e.g., crime, school quality, ethnic composition, housing density and public safety expenditures; (3) accessibility variables, e.g., distances to beaches and workplace; and (4) air pollution variables, e.g., total suspended particles and NO_2 concentration. As evidenced by the Los Angeles housing market study, extensive amounts of data are required for HPM to derive accurate values for non-market goods. Inadvertent exclusions of market good attributes (explanatory variables) will tend to overestimate the value of the non-market good being examined (Bentkover, Covello and Mumpower 1986). In addition to all attributes of the market good having to be accounted for, all market players must have access to and use information regarding the degree to which these attributes are offered regionally. Cummings, Brookshire and Schulze (1986) warn that small regional changes in environmental quality may be so subtle that the non-market amenity being analyzed drops from the package of factors people consider when making choices in the market.

Hedonic approaches assume that the entire value of an environmental good is captured in one market, i.e., property (Maler 1977; Brookshire *et al.* 1982). Maler (1977) suggests that part of the value of air quality may reside in golf club fees and wage rates. However, in the Los Angeles study, alternative markets for capturing air quality value, such as wage rates, varied negligibly with respect to neighborhood differences in air quality.

Brookshire *et al.* (1982) concluded that HPM results are most credible when the non-market and market goods being examined are well defined regionally and are thoroughly understood by all players in the market, as is the case with air quality levels and housing markets in the Los Angeles area. The large data requirements and the absence of a prominent well-established market good from which the value of forest protection may be inferred makes HPM an inappropriate method for determining the value recreationists place on protecting the Southern Appalachian spruce-fir ecosystem from further degradation.

A Direct Valuation Method: Contingent Valuation

Unlike TCM and HPM, which use observable market behavior to estimate the economic value of non-market goods, contingent valuation (CV) employs hypothetical markets and survey techniques to elicit the values individuals place on non-market goods (Cummings, Brookshire and Schulze 1986). Because of its reliance on hypothetical rather than observable market behavior, the fundamental assumption of CV is that individuals are both able and willing to honestly respond to CV questions (Peterson, Driver and Gregory 1988). When utilizing CV to determine the value of an environmental amenity, the researcher must subscribe to the assumption that an individuals' intentions correspond to their actual behavior (Bishop and Heberlein 1979; Cummings, Brookshire and Schulze 1986). The second major assumption of CV is that respondents will not answer survey questions strategically (Rowe and Chestnut 1983). Believing that responses may be used to set prices for the non-market good where no out-of-pocket cost currently exists, some respondents may bias their values downward, below what they actually believe the good is worth. Other situations may occur where, believing that costs will not be incurred by the population interviewed, individuals may willfully skew their values upward, i.e., free ride (Rowe and Chestnut 1983; Bentkover, Covello and Mumpower 1986). The validity of CV's central assumptions continues to be the subject of great debate in both the economic and social psychological sciences (Peterson, Driver and Gregory 1988).

CV estimates of non-market amenity value are elicited via responses to direct interviews or mail-out/mail-back questionnaires. Principal features of the survey tool include a clear explanation of the survey and its objectives, an explicit description of the non-market good to be valued, and the willingness to pay (WTP) or willingness-to-accept (WTA) question (Dasgupta and Pearce 1978; Bentkover, Covello and Mumpower 1986). CV surveys are designed around the WTP/WTA question. In this question, the non-market commodity to be valued and the method of payment are described in detail. WTP questions ask individuals either how much they would be willing to pay for a specified increase in the provision of the public good or how much they would be willing to pay to prevent a decrease in the good's provision. WTA questions ask individuals how much they would accept as compensation for a given decrease in the provision level of the public good (Cummings, Brookshire and Schulze 1986). Generally, surveys contain either a WTP or a WTA question, but not both. Survey questions which are optional, but are often used to clarify the WTP question, include the respondent's prior knowledge of the good being valued, income and spending patterns, demographic data, and attitudes towards environmental issues (Dasgupta and Pearce 1978).

Potential Sources of CV Estimate Bias

Since the 1970's, CV has undergone a significant evolution with respect to question design and survey application (Smith 1993). Careful question design and survey implementation, particularly the WTP/WTA question, continue to be the most critical factor in eliciting uninfluenced and unbiased value responses. Nevertheless, numerous critiques of the method have concluded that CV value estimates may be prone to a range of biases either from deficiencies in survey design, or from the behavior of individuals surveyed (Rowe and Chestnut 1983). Frequently cited sources of CV bias include strategic bias, response bias, starting point bias, information bias, hypothetical bias, and part-whole bias (Thayer 1981;

Schulze, d'Arge, and Brookshire 1981; Rowe and Chestnut 1983; Mitchell and Carson 1989; Boyle *et al.* 1994). Because of the potential for significantly influencing CV value estimates, possible sources of strategic, response, starting point, information, hypothetical and part-whole biases should be identified during survey design and tested for after survey implementation. The following discussion briefly describes these various biases and their potential influence on CV value estimates of nonmarket goods.

Strategic Bias. Strategic bias occurs when respondents attempt to influence the outcome of the study by declaring a value response different than what they would actually be willing to pay for the amenity in question (Schulze, d'Arge and Brookshire 1981; Rowe and Chestnut 1983). Both "free riding" and attempting to steer the study outcome in a direction more favorable to the respondent have been cited as incentives for strategic bias (Rowe and Chestnut 1983). While both Thayer (1981) and Schulze, d'Arge, and Brookshire (1981) state that strategic behavior has been thoroughly examined and has generally been found to be absent in experimental studies, Rowe and Chestnut (1983) caution that the evidence on strategic bias is encouraging but inconclusive.

Response Bias. Related to strategic bias, response bias, also termed *self-selection bias*, occurs when individuals attempt to influence study results either by responding or failing to respond to the survey. In general, lower response rates have been observed for the general population while the highest response rates have been found for more specialized populations (Mitchell and Carson 1989). Aggregate CV estimates of social benefits from public goods may be especially prone to response bias in that certain segments of the population not only hold different values for public goods, but are also more apt to respond to requests for survey information. For example, in a study conducted by Whitehead (1991), mail survey response rates and economic values for wetlands preservation were significantly greater for an environmental interest group sample than for a general population sample. Response bias may cause a significant directional bias in WTP estimates when several individual groups that hold heterogeneous preferences are aggregated into what the researcher assumes is a "general" population sample (as is common practice in CV studies).

Starting Point Bias. Direct interview applications of CV WTP questions often use a bidding process to arrive at the value an individual places on a non-market good. The starting point at which the bidding process begins may influence an individual's ultimate response in two ways. First, the starting bid may imply that a certain range of values is appropriate. Hence, a person's stated value may be influenced by the magnitude of the starting bid. Second, from the respondents' perspective, the bidding process may take too much time if starting bids are sufficiently different than the value individuals place on the good. Assuming that recreationists place a high value on time, individuals interviewed at recreation sites may wish to minimize the time spent on arriving at their value for the good, thereby giving a response different than the value they actually believe the amenity is worth (Schulze, d'Arge and Brookshire 1981; Thayer 1981; Rowe and Chestnut 1983; Boyle, Bishop and Welsh 1985). Starting point bias may significantly influence the accuracy of CV results (Schulze, d'Arge and Brookshire 1981).

Information Bias. People make decisions based on the amount of information and experience they have relevant to the decision at hand. Information gained through a survey about the study good or substitute goods may influence the responses of individuals who were, prior to the survey, uncertain about their true valuation of the good in question (Rowe and Chestnut 1983). Thus, survey information could increase or decrease an individual's value for a non-market good depending on the individual's initial perception of the good. Thayer (1981) gives the example that if a respondent is given information via the survey about an alternate site, with attributes of equal quality to the study site, but closer in distance than initially perceived, then the person would tend to devalue the study site, i.e., decrease his willingness to pay to prevent degradation of the study site. Information bias may also occur when an individual is given information on how other respondents answered questions or when questions are asked in alternative sequences (Schulze, d'Arge and Brookshire 1981).

Hypothetical Bias. When survey questions insufficiently portray real world situations, respondents may be unable to place themselves in the hypothetical situation posed by the survey. Consequently, individuals may be unable to accurately predict how they would actually behave in the situation described to them. If the respondent can not sufficiently identify with the hypothetical situation, i.e., think of themselves as behaving in a market context, they may respond with a meaningless bid (Thayer 1981). Another type of hypothetical bias occurs when the hypothetical situation envisioned by the study is not the same the respondent visualizes (Rowe and Chestnut 1983). That is, the respondent envisions themselves as purchasing a particular non-market commodity, but not the one intended by the study. Hypothetical bias may also arise when the method of paying for the good is unfamiliar or unrealistic. For example, in a market context, individuals are price takers. Similarly, individuals vote yea or nay in political contexts. Rarely do individuals set prices or influence political agendas. Consequently, WTP questions which use a bidding technique may be both unfamiliar and unrealistic enough to generate biased value responses relative to referendum formats (Rowe and Chestnut 1983; Diamond and Hausman 1993).

Part-Whole Bias. Part-whole bias occurs when individuals understand that they are to value a particular non-market commodity, but fail to perceive the geographical or provisional limits on the good as defined by the study (Mitchell and Carson 1989; Boyle *et al.* 1994). As a consequence of respondent misperception, final value estimates may be skewed either upward or downward. Relative to market goods, the perception of environmental resources as "boundless," and the inexperience of individuals in valuing public goods in economic terms may cause respondents to overlook the geographic limits of a good as defined by a WTP question. For example, respondents may misperceive a WTP question designed to elicit household value for spruce-fir forest protection in the southern Appalachian Mountains as a request to value the protection of all forests in the southeastern United States. Consequently, value estimates for forest protection in the southern Appalachian Mountains would be skewed upward. The imposition of larger limits on the good, e.g., geographic, quality, or quantity, than defined by the study is called *embedding* (Mitchell and Carson 1989; Kahneman and Knetsch 1992). A related phenomena occurs when the public good to be valued is perceived by respondents as a cause in which to support rather than as a commodity to purchase. That is, individuals may ignore all physical limits on the good in question. Such a phenomena is called the *warm glow effect* (Shavell 1993). Mitchell and Carson (1989) suggest that the inclusion of visual aids in a survey's design, e.g., maps and photographs, may help to focus respondent's attention on the good to be valued as defined in the survey an help to minimize the potential for part-whole biases.

Advantages of Contingent Valuation

Accounting for the weaknesses of CV just discussed, CV has at least two distinct advantages over TCM and HPM. First, because CV is not based on observed market behavior, valuations of different levels of environmental damage may be assessed before they actually occur. Schulze, d'Arge and Brookshire (1981) note that contingent market studies were created partly because assessing the economic impact of future energy resource exploitation in pristine environments necessarily excluded market techniques from being used. With the advent of sophisticated video technologies, CV studies may now be able to use electronically manipulated visual images (rather than waiting to use images of actual damage) to elicit value responses. An added benefit of using advanced video technologies is that hypothetical bias may be minimized, i.e., both the interviewer and respondent will be able to visualize the same hypothetical situation.

A second advantage attributable to the hypothetical nature of CV is that this technique is well suited to quantify nonuse or indirect consumptive benefits (Bentkover, Covello and Mumpower 1986). As noted earlier, neither TCM nor HPM take into account option, existence or bequest values, that is, the values which are placed on non-market goods by those not directly consuming the good. In assessing the total benefits derived from reducing sulfur emissions, Bishop and Heberlein (1984) observe that:

> Existence benefits from reduced sulfur emissions could, of course, be estimated using CV. Even if small on a per household basis, such benefits, when added up over millions of households, could be quite large. In fact, we suspect that, given the widespread concern about acid rain and the relatively limited extent of documented current and probable, near-term future damages, existence benefits estimated using CV will dwarf use benefits. The direction that the economic scales tip could well depend, at least over the next decade or two, on whether existence benefits have credibility. Thus, economic conclusions about a major national policy issue may depend on whether CV estimates of existence values are accepted as valid or not.

Given the strong advocacy for the health of the spruce-fir forest region, existence and other nonuse values may be of great importance to the Southern Appalachian spruce-fir study. Future studies investigating the use of CV to estimate the social benefits of public good provision will undoubtedly attempt to estimate the nonuse component of public good values in order to more accurately reflect the total economic value of non-market goods.

Summary

In the absence of markets for many environmental resources, economists and social psychologists have developed techniques for estimating the values of non-market goods. Techniques used to derive monetary values for non-market goods rely either on observed market behavior (TCM and HPM) or on elicited responses to hypothetical situations (CV). All methods used to reveal economic values for non-market goods contain mechanical concerns and assumptions which must be addressed before matching an application with the appropriate valuation method (Rowe and Chestnut 1983).

Studies comparing hypothetical valuation methods with market-based approaches have produced mixed conclusions. While Rowe and Chestnut (1983) warn that, due to sources of bias, CV should be used with "great caution," Schulze, d'Arge and Brookshire (1981) and Brookshire *et al.* (1982) conclude that, when appropriately applied, CV studies yield credible results. Regardless of the controversy over CV's ability to estimate the economic value of non-market goods, CV holds some distinct advantages over TCM and HPM in attempting to reveal the economic value of protecting the southern Appalachian spruce-fir forest. These advantages include the ability to measure nonuse (i.e., existence and bequest) benefits of protecting the spruce-fir forest, and the relative ease of estimating values given i) the expanse of the study region, ii) the lack of market goods from which the value of forest protection can be differentiated, and iii) the study objective of valuing a change in forest condition, rather than a forest condition *per se*.

CHAPTER 2

SENSITIVITY OF PROTECTION VALUE TO FOREST CONDITION IN THE SOUTHERN APPALACHIAN SPRUCE-FIR FOREST[1]

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ABSTRACT

This pilot study examines the feasibility of linking the impacts of climatic change to economic protection value for the southern Appalachian spruce-fir forest. Using alternative questionnaire scenarios, we attempt to assess how economic value for forest protection fluctuates as initial forest conditions are altered. A first sample of southeastern households was asked to value a forest protection program for a forest showing no sign of impact from insect or atmospheric disturbances. The second sample was asked to value a protection program for a forest described as already experiencing impact from insect infestation and air pollution. Logit analysis of the two samples revealed no statistically significant difference in willingness to pay between the two forest protection programs. These results suggest that a household's value for forest protection may be insensitive to changes in forest condition.

Key words: contingent valuation (CV), willingness to pay (WTP), forest condition, forest damage, forest protection, economic value.

Disturbance of the Spruce-Fir Forest

The southern Appalachian Mountains have a history of natural and anthropogenic disturbance. Widescale clearcutting of the region's high elevation red spruce (*Picea rubens* Sargent) and Fraser fir (*Abies fraseri* (Pursh) Poiret) forests began in the late 1800's and continued until the early decades of this century. By the 1920's, most of the southern Appalachian's accessible spruce-fir had been mined for timber, reducing the spruce-fir forests

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from one half to one tenth their pre-European settlement extent (Korstian 1937, Saunders 1979). Occupying nearly 20,000 hectares, the rugged high elevation forests of the Great Smoky Mountains National Park comprise the largest expanse of uncut spruce-fir. Nearly all of the remaining southern spruce-fir forests have been cut at least once and occur in and around the Black and Balsam Mountains of North Carolina and Mount Rogers, Virginia (Dull *et al.* 1988; Pyle and Schafale 1988).

Although logging has long since ceased in the region's higher elevations, the southern spruce-fir forests now suffer from a number of relatively recent disturbances. The current Fraser fir population is under attack from the balsam woolly adelgid (*Adelges piceae* Ratz.), an insect introduced to this country by 1908 from Europe (Kotinsky 1916). First detected in 1957 on Mt. Mitchell in the Black Mountains of North Carolina (Speers 1958), the adelgid has spread throughout the entire southern Appalachian Fraser fir population (Nicholas *et al.* 1992a). To an extent, climate changes such as increased ambient air temperature and humidity are favorable for adelgid reproduction. Elevated ambient CO_2 levels and increased droughts could both increase the rate of insect population growth and its impact to the region's fir population (Hollingsworth and Hain 1994; Eager 1984) as well as impact fir growth rates even without adelgid infestation (Samuelson and Seiler 1992). Even without long-term increases in atmospheric temperature, mature Fraser fir are highly susceptible to adelgid attack, and the continued integrity of the spruce-fir ecosystem is uncertain (Nicholas *et al.* 1992a). Further, Adams *et al.* (1985), McLaughlin *et al.* (1987), and LeBlanc *et al.* (1992) report finding significant decreases in red spruce diameter growth over the past twenty years. Severe deterioration of red spruce crowns has also been recorded during the mid to late 1980's (Zedaker *et al.* 1989; Nicholas and Zedaker 1990). The deterioration of high elevation spruce-fir forests is thought to be exacerbated by air pollution from regional urban and industrial centers (Eager and Adams 1992; Johnson and Taylor 1989; White 1984).

While timber production no longer plays a significant role in the high elevation region, southern spruce-fir forests are now a key producer of scientific, biologic and recreational resources. Southern spruce-fir forests are a premier feature of the Great Smoky Mountains

National Park, the North Carolina State Park System, the Jefferson and Pisgah National Forests, and the Blue Ridge Parkway. Much of the southern leg of the Appalachian Trail runs through the spruce-fir stands of the southern Appalachians. Additionally, the spruce-fir forest is home to several threatened and endangered plant species, as well as 17 species or subspecies of plants and animals endemic to the southern Appalachian Mountains (White 1984). Isolated from related northern vegetation, southern Appalachian spruce-fir forests occur as a series of individual stands that occupy the region's highest mountain tops and ridges. Located at the extreme southern edge of the forest's range, southern spruce-fir forests and their associated amenities are especially sensitive to natural and anthropogenic perturbations. Hence, the southern spruce-fir ecosystem may be a valuable laboratory for understanding how natural and man-caused disturbances influence natural resource values.

Forest Condition and Economic Value for Forest Protection

This study seeks to develop a pilot model that links forest conditions that might be associated with global change to the economic value households place on protecting the southern spruce-fir forest. Contingent valuation (CV) is used to reveal the value that southeastern U.S. households place on protecting southern Appalachian spruce-fir forest quality. Numerous studies have used CV to estimate values for changes in forest condition. For example, in a study conducted by Crocker (1985) recreationists were surveyed to determine the economic values of alternative air pollution-induced health states of southern California national forests. Walsh *et al.* (1990) surveyed Colorado residents to determine the value that residents place on preservation of forest quality in the national forests of Colorado. While these models are useful for predicting values for non-market good conditions *per se,* they are limited in their ability to monitor fluctuations in economic value given changes in the individual factors, e.g., basal area, degree of insect infestation, downed woody debris, etc., which constitute a forest's condition.

Holmes and Kramer (1995, *forthcoming*) conducted a study of the economic value of protecting different areas of the southern Appalachian's remaining spruce-fir forests. Respondents were asked their willingness to pay (WTP) to protect remaining undamaged forests along roads and trails versus their WTP to protect all remaining undamaged spruce-fir forests. The principle difference between the Holmes and Kramer study and this study is the resource being valued. Holmes and Kramer varied the area of protection, whereas this study varied initial forest quality in forest protection scenarios. Alternative damage scenarios were used to examine how household WTP for forest protection is influenced by the initial condition of the forest being protected. That is, we attempt to assess whether households would be willing to pay a different amount to protect a forest that is altered somewhat by an external factor such as global change, than they are willing to pay to protect a forest in a pristine condition.

Willingness to Pay for Forest Quality Changes

CV is a non-market valuation method that is an accepted technique for revealing the economic values of natural resources. Many environmental goods, including southern Appalachian spruce-fir forest quality, may be categorized as non-market, i.e., public, goods. Non-market goods are not traded *per se*, consequently, their economic value, i.e., prices, are not explicitly revealed in conventional markets. The following discussion is adapted from Fisher (1994) and briefly outlines the theoretical framework supporting the use of CV in eliciting economic values for non-market goods.

CV is based on consumer theory and the concept of *utility*. A basic assumption of consumer theory is that an individual maximizes the satisfaction or utility received from goods consumed, subject to his or her budget or income constraint. An individual's *utility function* may be represented as follows:

$$u = f(m,z,y) \qquad [1]$$

where the utility (u) an individual receives is derived by consuming both market goods (m)

and non-market goods *(z)* using income *(y)*, and can be maximized subject to the individual's budget constraint *(mp=y)*, where *mp* is the product of market goods consumed and associated prices. From the first order conditions of utility maximization, demand functions for every market good an individual consumes may be estimated:

$$m_i = g_i(p,z;y) \quad i=1,\ldots,n, \qquad [2]$$

where *i* indexes the *i*th market good, and *n* is the number of different market goods consumed. An individual's indirect utility function may now be defined as:

$$h(p,z;y) = u^*[g(p,z,y),z], \qquad [3]$$

so that utility is represented as a function of market prices, income, and environmental goods consumed.

Suppose that, all other factors remaining constant, the level of one non-market commodity, denoted z_f for forest quality, is decreased (the decrease in spruce-fir quality is represented by superscripts denoting forest health condition so that $z_f^0 > z_f^1$, where z_f^0 is the original undegraded state of the forest and z_f^1 is the forest in a damaged state). The individual's satisfaction as a function of forest condition can now be compared:

$$[u^0 = h(p,z_f^0;y)] \neq [u^1 = h(p,z_f^1;y)]. \qquad [4]$$

Thus our main empirical hypothesis is that, given a perceived change in forest condition, the individual experiences a change in satisfaction when forest health declines. Using the individual's indirect utility function, [3], and the assumption in [4], and recalling that an individual's goal is to maintain a maximized level of satisfaction through goods consumed, an individual's WTP to prevent a decline in forest quality (z_f^0 to z_f^1) is now represented as:

$$h(p,z_f^0;y-WTP) = h(p,z_f^1;y), \qquad [5]$$

where an individual's WTP is the amount of income that a person who values forest health would forego to prevent the original forest condition z_f^0 from degrading to z_f^1. In summary, if forest health is one of the goods an individual values, then the individual may be willing to pay some amount of their income to prevent the forest from degrading to any level below the forest's original condition.

Study Design

The sampling frame for this study includes all households in telephone directories within the seven state southern Appalachian region (North Carolina, South Carolina, West Virginia, Virginia, Tennessee, Kentucky, and Georgia). Households were sampled proportionally to population per zip code. To assess the values that both visitors and households who have never visited the region hold for southern spruce-fir forests, households were sampled over entire states rather than from mountain region counties. Each household was mailed a CV questionnaire built around a referendum type WTP question. As opposed to other types of WTP questions where respondents are asked to choose their WTP for a non-market good from a given set of bid values (payment card) or are asked to write in their WTP value (open ended), referendum type questions present each household with one value, i.e., price, for the resource they are being asked to value. Respondents are then asked to either accept or reject the given resource price. Each household is randomly assigned one value from a prespecified set of resource prices. In the empirical analysis, the mean value, i.e., mean WTP, for the resource is a function of the probability of each household accepting their given price.

Relative to other value elicitation formats (e.g., open-ended and payment card), referendum type WTP questions because they most closely resemble the market and political processes to which individuals are accustomed (Diamond and Hausman p. 33). That is, individuals do not normally bargain for prices; rather they are presented with a price and then choose either to buy or not to buy. In a similar sense, political referendums generally present voters with a specific tax change or bond price which individuals may vote for or against. Given the similarity of referendum questions to political and market processes, CV values elicited using yes/no WTP formats may be influenced by *yea-saying*. Yea-saying may be defined as the phenomena of individuals accepting their given bid without fully considering their true value for the good (Mitchell and Carson pp. 240-241). More simply, referendum questions may be "too easy" to answer. In a study comparing forest protection values estimated using open-ended versus dichotomous choice, i.e., referendum, WTP questions, Holmes and Kramer (1995) identified yea-saying as a cause of significant value variance between the two elicitation formats, i.e., the referendum format yielded significantly greater WTP estimates.

Making a complete link between changes in many individual forest stand attributes and economic value for the spruce-fir forest was beyond the available resources of this study. Therefore, this pilot study was designed to examine the influence of a change in initial stand condition on a household's value for spruce-fir forest protection. To test the null hypothesis that WTP for forest protection programs does not vary with the forest's initial condition, 1,000 households were randomly assigned one of two different forest protection scenarios. Households receiving the first scenario were asked to value a protection program for a fir forest in an "unimpacted" state i.e., 5% dead basal area. Households receiving the second scenario were asked to value a protection program for an "impacted" fir forest that was described as already beginning to show signs of damage from balsam woolly adelgid attack and air pollution i.e., 30% dead basal area. Each household received two photos with a written description of their protection program scenario: the first photo corresponded to the initial forest condition (either 5% or 30% dead basal area), and the second photo depicted a future forest condition without implementation of a forest protection program (75% dead basal area). Aside from the difference in protection scenarios, the two survey versions were identical. Using survey responses, a test was conducted to determine if a household's WTP for forest quality is influenced by the initial condition of the forest.

Survey Design

Scenic Beauty Estimation, Pretesting, and Final Sample

The questionnaire for this study borrowed heavily from the Holmes and Kramer (1995, *forthcoming*) Forest Quality Survey, and consequently, we did not use focus groups to guide the design of survey format or question wording. However, the spruce-fir photos taken as part of this study were used in a related analysis to develop scenic beauty estimates (SBE) (e.g., Daniel and Boster 1976), which aided us in selecting photos for the WTP section of the CV questionnaire. That analysis used approximately 80 subjects, who registered their preferences (on a 10-point scale) for 85 photos of spruce-fir study plots. Photos represented the possible range of forest quality conditions now occurring in the southern Appalachian spruce-fir forests. Based on a scenic preference index derived from subjects' photo-based responses, three photos (two initial conditions and one end condition) were chosen to represent two perceptibly different forest protection scenarios. The three photos represented the mid-point (30% dead basal area), and two extremes (5% and 75% dead basal area) of the scenic beauty index derived for our photos. Given the construction of SBE indices, it is not possible to identify the significance of differences between SBE values. However, using photo-based responses, Daniel *et al.*(1989) found a high degree of correlation between campers' WTP and scenic beauty values for the same variations in forest condition.

To identify potential difficulties that final sample respondents may have encountered when responding to the survey instrument, a draft questionnaire was mailed to 150 randomly sampled households within the study region. Pretest WTP questions used an open-ended format to establish the range of referendum bids used in the final sample. Based on pretest responses, minor changes were made to survey format and question wording, and the range of referendum bids for the final sample was established. Final survey design and implementation closely followed the Dillman (1978) method. The initial mailing was sent to all final sample households in March 1995, followed by a post card reminder. A second and third survey packet were mailed to non-respondents.

Survey Questions

The survey booklet gathered information on household environmental attitudes, familiarity with spruce-fir forest quality and protection, recreation activity participation, and demographic characteristics. To establish household attitudes regarding forest protection, respondents were asked to rate the importance of several reasons for protecting spruce-fir forests. Information gathered on household recreation activities included households' past and planned future visits to the southern Appalachian Mountains, and whether respondents had ever noticed large forested areas with dead or dying evergreen trees. Demographic questions included age and sex of respondent, number of people in the household, years of education and income. Two additional questions were asked to establish a household's time and financial contributions to conservation and environmental organizations.

To aid respondents in assessing their WTP for forest protection, households were given information on southern Appalachian spruce-fir forest features, history, health, and decline, and were provided a map showing the study region and the location of three popular spruce-fir forest sites, i.e., Mount Mitchell, NC, Great Smoky Mountains National Park, and Mount Rogers National Recreation Area. Respondents were also given a description of a spruce-fir forest protection program that included two color photographs (one photo of an initial forest condition and another depicting a damaged forest without protection. The photo-based forest protection scenarios were designed to cue respondents on the physical attributes of the forest protection program they were being asked to value.

The WTP question immediately followed the photo and protection program description, and was worded as follows:

> ***Based on the two color photographs provided, please answer the following questions:***
> Would your household pay $X each year in additional taxes to provide protection programs for the southern Appalachian spruce-fir forests? That is, your household would be paying to prevent the spruce-fir forests in PHOTO A from becoming like the forests in PHOTO B.

Each household received one of nine possible prices to which they either responded yes, they would pay the given amount for the forest protection program, or no, they would not pay. The information section, forest protection scenario descriptions, and complete WTP question are included in the Appendix.

Households that responded that they were not willing to pay for forest protection were asked a follow-up question to establish the reason for their negative response. The purpose of the follow-up question on "no" responses was to check for *protest bids*, i.e., households that indicated they would not be willing to pay either because "people should not have to pay to protect forest quality," or because "[they] objected to the question." The concern with protest bids is that it is unknown to the researcher whether the respondent truly does not hold as much value for the non-market good as the given price, or if the respondent is protesting the method of payment (in this case, additional taxes) or some other aspect of the survey (Diamond *et al.* pp. 54-55).

Households that accepted their resource price were also asked a follow-up question about the percentage of the program price they would assign to each of four reasons for protecting spruce-fir forests: use of forests for themselves, use of forests for others (including future generations), protection of the forests even if no one uses them, and other. Past CV studies have shown that non-use values (i.e., the value placed on a resource so that others, including future generations, may use the resource (bequest value), or for the knowledge that the resource is protected (existence value)), may represent a large part of some respondent's total economic value for a non-market resource (Bishop and Heberlein 1979; Walsh *et al.* 1990, Holmes and Kramer *forthcoming*).

Biologic Data

Biologic and visual data for this study were collected from a series of plots developed during the mid 1980's as a component of the Spruce-Fir Research Cooperative in the National Acidic Precipitation Assessment Program's Forest Response Program (Nicholas *et al.* 1992b). From June 21 through July 21, 1994, a total of 33 plots near Mount Mitchell, North Carolina and Mount Rogers, Virginia were visited to photosample and to gather data on stem mortality, i.e., balsam woolly adelgid (BWA) infestation.

Photosampling

Photos were taken towards plot center from each plot corner (a total of eight photos per plot). Human focal length was mimicked using a 35 mm Nikon 6006 camera with a 50 mm lens. All plots were photographed using 200 ASA Kodak Ektachrome® slide film. Photographs were taken at a height of approximately 1.6 meters parallel with plot slope from plot corner to plot center. To minimize the influence of subjective compositional judgements, all photographs were taken on automatic focus and aperture settings. Most photographs were taken between the hours of 10:00 a.m. and 3:00 p.m., however, hours of photography were extended beyond 3:00 p.m. (not later than 5:30 p.m.) contingent on the presence of favorable lighting conditions, e.g., slope with southwestern aspect. From the approximately 260 photos taken, 85 were used to estimate a scenic beauty index for the study plots, and three were chosen to create the two forest protection scenarios.

Basal Area and Stem Mortality

Live versus dead basal area varies widely between plots, and has been shown in scenic beauty studies to be a dominant attribute on which individuals cue to form their aesthetic judgements for forest scenes (Buhyoff *et al.* 1982). Changes in this forest attribute are one of the primary manifestations of natural and anthropogenic disturbances in the southern Appalachians, and further decline of the region's Fraser fir is expected (Nicholas *et al.* 1992b). Consequently, forest protection scenarios and photo descriptions were worded to reflect the degree of forest damage in terms of stem mortality.

To estimate these basal area parameters for our plots, each 20 meter square plot was divided into four quadrants, and one sampling point per quadrant was located seven meters towards plot center from each corner along diagonal transects connecting opposing plot corners. Live and dead basal area parameters were recorded for the following tree categories: spruce, fir, other softwoods, and hardwoods. Based on the scenic beauty index estimated from plot photos, fir dominant plots were separated into either an *unimpacted* or an *impacted* category. Unimpacted fir plots were defined as having less than 30 percent of the plot's total basal area composed of standing dead fir.

Empirical Results

Descriptive Statistics

Households were randomly assigned one of two forest protection scenarios: either a protection program for a forest which had very little visual evidence of BWA/air pollution induced tree mortality (5% dead basal area), or a protection program for a forest beginning to show signs of damage (30% dead basal area). Overall response rate for sample households was 40.3 percent of delivered surveys, while response rates for the 5% damage and 30% damage survey versions were 42.4 percent and 38.2 percent, respectively. Based on the recommendations of Freeman (pp. 152-153), 44 protest bids were identified (21 for the 5% damage scenario and 23 for the 30% damage scenario) and excluded from the observations used in the final model estimations.

Differences between samples were tested using two sample *t*-tests (Table 3.1). Past visitation to the southern Appalachians differs between the 5% and 30% damage samples at the 0.05 significance level. While the difference in visitation habits is significant, both groups appear to have more than a moderate familiarity with the resource they were being asked to value; more than half of the households in both groups had either read or heard about an increase in spruce-fir forest mortality. Additionally, more than 80% of households in either sample had visited the southern Appalachians sometime in the past.

In their study measuring the contribution of existence and bequest values to total economic value, Walsh *et al.* (1990) found that non-use or public benefit values constitute approximately 72.6 percent of a Colorado resident's WTP value for forest protection. Likewise, bequest and existence values represented nearly 86 percent of the total value households place on protecting southern Appalachian spruce-fir forests (Haefele *et al.* 1991) Non-use values are the set of benefits derived from a good other than value derived from its direct use or consumption. Non-use values may include bequest value (valuing a good for future generations) and existence value (the satisfaction gained from simply knowing a good

TABLE 2.1
DESCRIPTIVE STATISTICS OF SELECTED CHARACTERISTICS OF RESPONDENTS[a]

CHARACTERISTIC	DESCRIPTIVE STATISTICS[b]		
	INITIAL CONDITION[c]		
	5%DAMAGE	30%DAMAGE	t-VALUE[d]
Read/heard about increase in damage to spruce-fir forest (yes=1, no=0)	0.58 n=131	0.56 n=101	0.4215 (0.3262)
Participation in recreation activities 10+ miles from home (no. of days/year)	27.64 (32.27) n=131	26.87 (37.18) n=101	0.1686 (0.1337)
Plan to visit southern Appalachians in future (yes=1, no=0)	0.86 n=131	0.88 n=101	-0.3836 (0.2984)
Visited southern Appalachians in past (yes=1, no=0)	0.84 n=131	0.93 n=101	-2.0613** (0.9596)
No. of recreational trips to to the southern Appalachians in past three years	4.99 (9.70) n=131	4.47 (6.14) n=101	0.4708 (0.3581)
If bid amount accepted, percentage of bid amount assigned to following reason for protecting forest:			
Use for self (use value)	16.40 (13.51) n=78	20.15 (17.76) n=64	-1.4276 (0.8444)
Use for future generations (bequest value)	33.63 (22.79) n=78	33.83 (20.48) n=64	-0.0491 (0.0391)
Protection of forests even if no one uses them (existence value)	46.48 (27.03) n=78	44.06 (25.20) n=64	0.5476 (0.4152)

TABLE 2.1
(continued)

CHARACTERISTIC	DESCRIPTIVE STATISTICS[b]		
	INITIAL CONDITION[c]		
	5%DAMAGE	30%DAMAGE	t-VALUE[d]
Age (years)	47.73 (16.02) n=131	50.32 (13.67) n=101	-1.2932 (0.8028)
Sex (proportion female)	0.28 n=131	0.25 n=101	-0.5471 (0.4152)
Household (no. people)	2.69 (1.49) n=131	2.80 (1.21) n=101	-0.5869 (0.4422)
Education (years)	14.15 (3.20) n=131	14.88 (3.12) n=101	-1.7206* (0.9133)
Income ($)	43,989 (29,335) n=131	50,817 (32,959) n=101	-1.6654* (0.9028)

[a]Protest responses were not included in the calculation of descriptive statistics.

[b]Descriptive statistics for each characteristic are mean, standard deviation, and sample size, respectively. Standard deviations are not reported for characteristics that have (0/1) responses.

[c]Initial condition refers to initial forest condition presented in each forest protection scenario, i.e., 5%DAMAGE refers to five percent dead basal area initial forest condition (unimpacted sample); 30%DAMAGE refers to thirty percent dead basal area initial forest condition (impacted sample).

[d]Probability $|t| \geq x$ in parentheses.

* Significant at $\alpha=.10$.
** Significant at $\alpha=.05$.

exists) (Mitchell and Carson pp. 63-67). Consistent with results from previous studies, non-use values in this study constitute approximately 79 percent of the total value households place on protecting spruce-fir forest quality. Recognizing that individuals may not be able to accurately decompose their total WTP for forest protection among different value components (Holmes and Kramer *forthcoming*), the use and non-use values reported above are for comparative purposes only.

Model Specification

Variables used to explain valuation behavior for forest protection programs in the final models include bid amount, household income, and trips to the southern Appalachian Mountains (Table 3.2). Bid amount recorded the program protection price each household received. Based on the range of WTP responses received from the open-ended pretest survey, households in the final sample were given one of nine bid levels for forest protection, i.e., 1, 2, 5, 10, 25, 50, 100, 200, or 400 dollars. Economic theory suggests that a household's budget constraint, i.e., income, is an important explanatory variable in predicting the amount a household will pay for a commodity. From ten income categories, respondents were asked to check the level which best described the total income, before taxes, received by the respondent and other adult household family members in 1994. Household familiarity with the southern Appalachian spruce-fir forest was measured by recording the number of recreational visits to the region in the past three years.

Following the independent subsample design, i.e., households were asked to value only one forest protection scenario, two models explaining household valuation behavior were analyzed. Model parameters were estimated for the following logistic equation:

$$P_i = \frac{1}{1+e^{-X_i\beta}} \qquad [6]$$

where P_i is the probability of a household accepting their given referendum WTP price for a forest protection program, X_i is the matrix of independent variable observations (i.e., bid

TABLE 2.2
ESTIMATED LOGIT MODEL COEFFICIENTS[a,b]

VARIABLE	COEFFICIENT[c]		
	INITIAL CONDITION[d]		
	5%DAMAGE (n=131)	30%DAMAGE (n=101)	COMBINED (n=232)
Constant	0.332 (0.802)	0.329 (0.684)	0.440 (1.445)
Bid Amount	-0.110×10^{-1}*** (-4.115)	-0.951×10^{-2}*** (-3.794)	-0.100×10^{-1}*** (-5.594)
Income	0.2183×10^{-4}*** (2.604)	0.1031×10^{-4} (1.329)	0.1667×10^{-4}*** (2.952)
No. of recreational trips to southern Appalachians	-0.3818×10^{-2} (-0.195)	0.1222* (1.837)	0.9740×10^{-2} (0.532)
Model χ^2 statistic	36.626***	28.334***	59.662***
Likelihood ratio test χ^2 statistic[e]		5.42	
Mean WTP	\$137.23	\$169.38	\$150.63

[a]Protest bids not included in observations used for final model estimations.

[b]Model coefficients were estimated using the LIMDEP econometric program (Greene 1992).

[c]*t*-statistics in parentheses.

[d]Initial condition refers to initial forest condition presented in each forest protection scenario, i.e., 5%DBA is initial condition for unimpacted sample; 30%DBA is initial condition for impacted sample. COMBINED refers to model estimated using observations from both survey versions.

[e]Critical value is 9.48 at $\alpha=0.05$.

* Significant at $\alpha=.10$.
** Significant at $\alpha=.05$.
*** Significant at $\alpha=.01$.

price, income, and number of recreation trips), and β is the coefficient matrix.

Coefficient signs in logit models indicate the direction that the probability of a household accepting their WTP referendum value changes for right hand side variable changes. As seen from the *t*-ratios, the referendum bid amount that a household was asked to pay for their forest protection program is a significant predictor of the probability of bid acceptance. The negative coefficients for bid amount indicate that, as the given referendum price increases, households are less likely to accept that bid. The significant positive coefficients on income in the 5% damage and combined models give evidence that higher income households were more likely to accept their referendum bid. These results are consistent with the downward sloping demand curve of economic theory. The variable representing familiarity with the spruce-fir resource, i.e., the number of recreational trips taken to the southern Appalachians in the past three years, was insignificant in explaining household valuation behavior for forest protection in all models at the 0.05 significance level.

Model coefficients were examined jointly for significance of their difference from zero. The χ^2 statistics for all models reveal that the null hypothesis that all coefficients are equal to zero can be rejected at the 0.01 significance level, indicating that WTP values vary significantly from zero. A likelihood ratio test was used to examine the difference between the coefficients of the 5% and 30% damage models, testing the null hypothesis that coefficients were identical across models. Based on the calculated χ^2 statistic for this test, no significant difference between forest protection value models can be claimed at the 0.05 level. That is, over the range of initial forest damage considered (5% to 30%), a household's likelihood of accepting their given price, and hence their WTP, for a spruce-fir forest protection program does not appear to be sensitive to the initial condition of the forest.

To calculate mean WTP values for forest protection, we integrated the estimated function [6] numerically, using the referendum bid level that yields a 1% probability of acceptance as the upper limit of integration. The mean WTP for forest protection estimated by this study, \$150.63 (both survey versions combined) is somewhat larger than the mean referendum values of $59.22 to $99.57 (depending on the area of forest protected) estimated by Holmes *et al.* (1992). Discrepancies in WTP values between the two studies may be explained by geographic differences in sampling, integration limits for calculating mean WTP, and other issues. Holmes *et al.* sampled households within a 500 mile radius of Asheville, NC, an area which extends into Michigan, New York, Missouri, Louisiana, and Florida. Households in this study were sampled only from states that contain a portion of the southern Appalachian Mountains (i.e., VA, WV, NC, SC, GA, KY, and TN). Consequently, our sample is probably more familiar with the resource and may have a greater interest in protecting the spruce-fir forests.

Discussion

The phenomenon of individuals yielding statistically similar economic values for dissimilar public goods and for different provision levels of the same public good has been observed in previous CV studies of public good values (Kahneman and Knetsch 1992; Kahneman *et al.* 1993; Boyle *et al.* 1994). As possible explanations for invariant WTP values, these studies point to deficiencies in survey design, respondent misperceptions of the resources being valued, and the propensity of CV to elicit support responses rather than purchase values for environmental goods. Adopting some of the same arguments, possible causes of the condition-invariant protection values reported here include the influence of bias caused by questionnaire wording, respondents' inability to identify with the resource being valued, and an insufficient range of forest conditions tested.

Deficiencies in survey wording and respondent misperception of the good to be valued may have interacted to influence forest protection values. Inadequate or unrealistic portrayal of the spruce-fir resource may have caused respondents to visualize a commodity different than the resource envisioned by the study. To familiarize respondents with the resource they were being asked to value, surveys contained a detailed information section on southern Appalachian spruce-fir forest history, health, and decline. This section was placed immediately before the forest protection scenario description and WTP question. Wording in the forest information section was designed to avoid biased and alarmist language. Graphic aids were included with mail-out surveys to minimize the incidence of respondents perceiving a good different than the one envisioned by the study. Households were provided with an explicit description of their forest protection program, including a map of southern Appalachian spruce-fir region and two color photographs depicting the forest conditions described. Further, the WTP section instructed respondents to focus specifically on the physical forest condition change represented by the two photos. Nevertheless, respondents simply may not have been able to understand or relate to the resource changes that were described. Further, information regarding a forest in decline is, by nature, cause oriented. As a consequence, when asked to value a forest protection program, the placement and nature of the information section may have unintentionally cued households' value judgements on forest protection as a cause rather than on the specific level of forest protection provided.

This same effect may have been caused by respondents seeking a sense of moral satisfaction, or warm glow, from the opportunity to value an environmental good (Shavell p. 375). Such a suggestion is plausible to the degree that individuals viewed the survey as an opportunity to register their support for an environmental cause. If survey wording and design or a warm glow effect prompted households to perceive forest protection as a cause to be supported rather than a commodity to be purchased, then WTP values for forest protection could be expected to be invariant regardless of the physical condition of the forest. Unfortunately, we have no information on the psychological processes respondents used when answering the WTP question and have no way of determining the influence of survey wording versus respondent perceptions of the commodity on final WTP estimates.

A third possible explanation for invariant WTP values for different forest conditions is that the range of damage tested may have been too small to elicit a change in economic value for forest protection. Photographs used to depict our forest protection scenarios represented the mid-point and end-points of the scenic beauty index derived using plot photos, providing evidence that the photos selected to represent forest protection scenarios depicted a perceptible difference in forest conditions. Because the correlation between WTP values and scenic beauty estimates for the photos used in this study is unknown, it could be argued that the range of conditions tested by this study was insufficient to elicit a significant difference in WTP responses between the two protection scenarios. That is, from 5% to 30% damage, WTP for forest protection may be flat relative to scenic beauty values over the same range.

Recent studies comparing WTP and scenic beauty estimates of the same good have found high correlations between the two value metrics. In a comparison of campers' photo-based aesthetic preferences for forest areas versus other campers' photo-based economic judgements for the same sites, Daniel *et al.* (1989) found a nearly perfect relationship ($\rho=0.96$) between the two indexes of value. Similarly, in a study comparing the ranking of 16 social issues using five different metrics of preference (including WTP), Kahneman *et al.* (1993) report between-metric correlations of $\rho=0.52$ to 0.97. Given the evidence of high correlation between WTP and other measures of preference (including scenic beauty estimates), it is difficult to support the hypothesis that the range of damage which represented the end-point and mid-point of scenic beauty judgements was insufficient to elicit a change in economic value between forest protection scenarios.

Finally, we can not rule out the possibility that our results were influenced by non-response bias. Non-response bias occurs when people who return the questionnaire are different in some important way from the people who do not return the questionnaire. Given the similarities between our respondent average income level ($46,962) and the regional household average ($44,670) (Department of Commerce 1994), we have no evidence, at least on the basis of income, that non-response bias exists in our sample.

Implications

This pilot study was conducted to estimate the influence of forest condition on the economic value households place on southern Appalachian spruce-fir forest protection.

Although a photo-based scenic beauty study revealed differences in aesthetic preference for the scenes used in two forest protection scenarios, results from our CV study suggest that household economic values for spruce-fir forest protection may be insensitive to non-marginal changes in the physical condition of the forest. While the results of this study do not allow the conclusion that, via WTP responses, households "purchased moral satisfaction" (Kahneman and Knetsch 1992), they do indicate that respondents failed to cue on the physical attributes of forest protection as intended by the study. The inability of this CV experiment to capture values for forest protection that are sensitive to the forest's physical condition is problematic in predicting the influence of potential global changes on southern Appalachian spruce-fir forest value. If economic values for forest quality are governed by a household's support for forest protection as a cause, or if households do not focus on the physical condition of the forest when forming their value responses, then WTP for forest protection may not be sensitive to the manifestations of global change on the forest.

For the current study, there is no information on the psychological processes respondents used to formulate their valuation responses. Also, because WTP for forest protection was examined between 5% and 30% dead basal area, conclusions regarding the sensitivity of household forest protection values can not be made beyond the range tested. Further research is needed to determine the range of damage over which WTP is invariant, the role of the survey instrument in contributing to the apparent invariance of protection values, and the psychological processes individuals use when valuing environmental goods. Future work should also investigate the correlations between aesthetic and economic value preferences for forest scenes and the dynamics of WTP values when responses from the general public are disaggregated into different social groups.

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SECTION C. **In the section below, you are provided with some background information on the southern Appalachian spruce-fir forests. Please read the information carefully and then answer the questions which follow.**

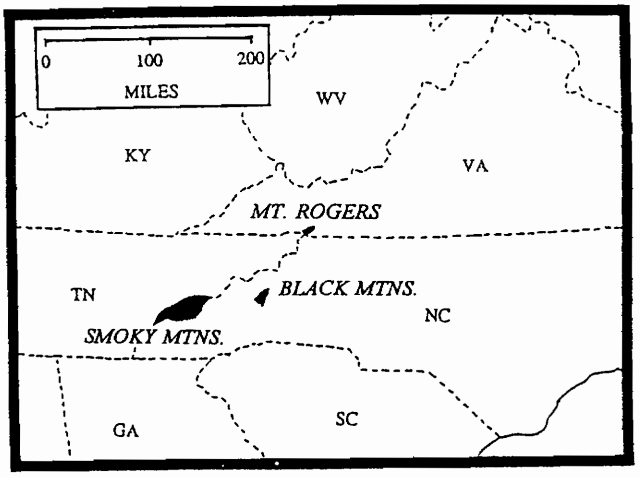
Features of the southern Appalachian spruce-fir forests

The southern Appalachian spruce-fir forests are unique ecosystems in the southeastern United States. Ranging in elevation from approximately 4,400 to 6,700 feet, spruce-fir forests occur in a series of island-like areas, occupying the southern Appalachian mountains' tallest peaks and ridges. While similar forests exist in the northern United States and Canada, the southern Appalachian spruce-fir forests are distinct due to their diversity of plant and animal species, including 11 threatened and endangered plant species and 17 species of plants and animals found nowhere else in the world.

The southern spruce-fir forests are a premier feature of the Great Smoky Mountains National Park, the North Carolina State Park System, the Jefferson and Pisgah National Forests, the Blue Ridge Parkway, and the southern leg of the Appalachian Trail. Southern Appalachian parks and forests are among the most frequently visited recreation areas in the world.

Spruce-fir forest history, health, and decline

During the early part of this century, the spruce-fir forests were heavily logged and were often subject to wildfire, reducing the spruce-fir forests to 10 percent of their original area. Locations of the remaining southern Appalachian spruce-fir forests are indicated as darkened areas on the map below:



Location of the three major southern Appalachian spruce-fir forests: Mt. Rogers National Recreation Area, the Black Mountains, and the Great Smoky Mountains.

To preserve the southern Appalachian spruce-fir ecosystem, most of the remaining spruce-fir forests were designated as state and national parks and forests. However, damage to the spruce-fir forests continued with the accidental introduction of an insect from Europe in 1956. This insect, the balsam woolly adelgid, kills fir trees over 30 years old. Insect-caused damage is easily recognizable, and trees usually die within one to seven years after being infested.

In addition, some scientists believe that acid rain and other air pollutants cause a loss of soil nutrients which slows the growth of spruce-fir and increases the chance of damage from insects and storms. Forest damage from air pollution and acid rain is not always immediate; the effects of air pollution may take decades to become visible.

Spruce-fir forest protection

Forest protection programs (such as removing infested trees, planting insect-resistant trees, and using environmentally safe pest control) could be undertaken to decrease the amount of tree damage occurring in the forests due to the balsam woolly adelgid. Also, lime could be applied to forest soils to reduce the ill effects of acid rain on forest health. These forest protection programs are *preventative* in nature. That is, the protection programs are designed to stop spruce-fir forests from declining any further, and are not designed to reverse forest damage that has already occurred.

Please look at the two color photographs included with this survey. The photos show two different levels of forest quality. A description of each photo follows:

PHOTO A: ***(scenario 1)***	**A spruce-fir forest where 5 percent of the trees are dead. The forest in this photograph shows no impact from insects or air pollution.**
PHOTO A: ***(scenario 2)***	**A spruce-fir forest where 30 percent of the trees are dead. The forest in this photograph is beginning to show impact from insects and air pollution.**
PHOTO B: ***(both scenarios)***	**A spruce-fir forest where 75 percent of the trees are dead. The forest in this photograph is completely impacted by insects and air pollution.**

Suppose the only way to provide for the forest protection programs described above is to pay a yearly tax which would be used *specifically* to prevent the forests in PHOTO A from becoming like the forests in PHOTO B. Although much of the southern Appalachian spruce-fir forests are like those shown in PHOTO A, without protection programs, most of the spruce-fir forests will eventually decline to the level seen in PHOTO B. All southern Appalachian spruce-fir forests are at risk from insect and pollution damage.

Based on the two color photographs provided, please answer the following questions:

10. Would your household pay $______ each year in additional taxes to provide protection programs for the southern Appalachian spruce-fir forests? That is, your household would be paying to prevent the spruce-fir forests in PHOTO A from becoming like the forests in PHOTO B.

____ NO ------> If no, please check why:

____ FOREST PROTECTION IS NOT WORTH THIS MUCH TO ME
____ PEOPLE SHOULD NOT HAVE TO PAY TO PROTECT FOREST QUALITY
____ I CANNOT AFFORD TO PAY TO PROTECT FOREST QUALITY
____ I OBJECT TO THE QUESTION
____ OTHER (please specify):

____

____ YES -----> If yes, please answer the following question:

What percentage of the amount above would you assign to each of the following reasons? (write a percent in each blank)

_____% USE OF FORESTS FOR MYSELF
+_____% USE OF FORESTS FOR OTHERS (INCLUDING FUTURE GENERATIONS)
+_____% PROTECTION OF THE FORESTS EVEN IF NO ONE USES THEM
+_____% OTHER (please specify)

____

= 100% total

CHAPTER 3

WILLINGNESS TO PAY FOR SPRUCE-FIR FOREST PROTECTION: THE IMPORTANCE OF FOREST CONDITION AND TYPE OF RECREATIONAL USER[1]

Dylan H. Jenkins, Jay Sullivan, and Gregory S. Amacher[2]

ABSTRACT

Household and recreation group willingness to pay (WTP) values for forest protection are estimated using a referendum-type, contingent valuation (CV) questionnaire. Using alternative questionnaire scenarios, tests are conducted to examine i) household and recreation group value sensitivity to forest condition, and ii) between-group differences in WTP for forest protection. A first sample of southeastern U.S. households was asked to value a forest protection program for a spruce-fir forest showing no sign of impact from insect or atmospheric disturbances. The second sample was asked to value a protection program for a forest already experiencing impact from insect infestation and air pollution. Logit analysis of the two samples revealed no statistically significant difference in household WTP between the two forest protection programs. Further analysis indicated that consumptive forest users (i.e., hunters and anglers) hold forest protection values that are sensitive to a change forest condition, while nonconsumptive forest users (i.e., campers and hikers) hold values that are insensitive to the same condition change. Between-group comparisons reveal that consumptive forest users hold lower values for forest protection than nonconsumptive recreationists. These results demonstrate the importance of estimating public values for forest protection in terms of heterogeneous groups rather than as a homogeneous whole.

Key words: contingent valuation (CV), willingness to pay (WTP), forest condition, forest protection, recreation group, consumptive, nonconsumptive.

Introduction

Isolated from related northern vegetation, southern Appalachian spruce-fir forests occur as a series of individual stands occupying the region's highest mountain tops and ridges. Located at the extreme southern edge of the forest's range, southern spruce-fir forests and their associated amenities are especially sensitive to natural and anthropogenic perturbations. Extensive clearcutting of the region's high elevation red spruce (*Picea rubens* Sargent) and

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Fraser fir (*Abies fraseri* (Pursh) Poiret) forests began in the late 1800's and continued until the early decades of this century. The current Fraser fir population is under attack from the balsam woolly adelgid (*Adelges piceae* Ratz.), which has spread throughout the entire southern Appalachian Fraser fir population (Nicholas *et al.* 1992a). To an extent, climate changes such as increased ambient air temperature and humidity are favorable for adelgid reproduction. Elevated ambient CO_2 levels and increased droughts could both increase the rate of insect population growth and its impact to the region's fir population (Hollingsworth and Hain 1994; Eager 1984) as well as impact fir growth rates even without adelgid infestation (Samuelson and Seiler 1992). Even without long-term increases in atmospheric temperature, mature Fraser fir are highly susceptible to adelgid attack, and the continued integrity of the spruce-fir ecosystem is uncertain (Nicholas *et al.* 1992a). The deterioration of high elevation spruce-fir forests is thought to be exacerbated by air pollution from regional urban and industrial centers (Eager and Adams 1992; Johnson and Taylor 1989; White 1984).

While timber production is no longer of significant value in the higher elevations, recreational opportunities are abundant in the existing spruce-fir forests of the Great Smoky Mountains National Park, the North Carolina State Park System, the Jefferson and Pisgah National Forests, and the Blue Ridge Parkway. The spruce-fir forest is also habitat for several threatened and endangered plant species as well as 17 species or subspecies of plants and animals endemic to the southern Appalachian Mountains (White 1984). Given the diversity of the resource, recreational pressure is increasing from several heterogeneous groups of users, both consumptive and nonconsumptive.

The purpose of this paper is to estimate the value households and recreation groups place on the protection of forest quality in the southern Appalachian Mountains. We use a contingent valuation (CV) model based on a referendum-type questionnaire to estimate these values. Willingness to pay (WTP) is computed from the estimates, and hypothesis tests are conducted to determine if WTP values are i) sensitive to initial forest condition, and ii) differ significantly among various recreational user groups. To determine how a nonmarginal change in forest condition affects WTP, results are obtained for unimpacted and impacted (insect damaged) forests through use of mail-out questionnaires. These results may be useful to policy makers in determining budget allocation priorities for recreational and protection activities in the region.

CV studies of forest condition and recreational use are not extensive. While existing work has focused on changes in forest condition, the values different forest recreation groups hold for changes in forest quality have not been distinguished. Holmes and Kramer (1995, *forthcoming*) conducted a study of the economic value of protecting different areas of the southern Appalachian's remaining spruce-fir forests. Respondents were asked their WTP to protect remaining undamaged forests along roads and trails versus their WTP to protect all remaining undamaged spruce-fir forests. Principle differences between the Holmes and Kramer studies and this study are the focus on different segments of the public, and the resource that is valued. Holmes and Kramer (*forthcoming*) examined differences in protection values between forest users and nonusers, and varied the area of protection being valued. In the current study, alternative damage scenarios were used to examine how household and various recreation groups' values for forest protection are influenced by the initial condition of the forest being protected. That is, we attempt to assess whether households and forest user groups would be willing to pay a different amount to protect a forest that is altered somewhat by an external factor such as global change, than they are willing to pay to protect a forest in a pristine condition. We also attempt to identify differences in WTP for forest protection between forest recreation groups.

Other CV estimates of forest protection value include Crocker (1985), where recreationists were surveyed to determine the economic values of alternative air pollution-induced health states of southern California national forests, and Walsh *et al.* (1990), where Colorado residents were surveyed to determine the value of preserving forest quality in Colorado's national forests. Daniel *et al.* (1989) compared camper's photo-based economic value and aesthetic judgements for different forest conditions. These studies have focused on the values held by the general public, or by a particular group, but have not been used to distinguish differences between forest user groups.

The importance of respondent preferences has been well documented in previous work[3]. Estimates of the values that various individual interest groups hold for environmental goods may be more useful than aggregate benefit estimates in assessing policy effects on various segments of the public and in addressing equity concerns (Krutilla 1981; Just *et al.* 1982; McConnell and Bockstael 1984; Swallow *et al.* 1994). However, the values obtained for protecting forest quality from CV studies are frequently generated for the public as a whole (Bennett 1984; Crocker 1985; Walsh *et al.* 1990; Holmes *et al.* 1992). The accuracy of aggregate estimates in representing the diversity of values held by different groups within the population is questionable. For example, when certain segments of the public hold dissimilar environmental values than the public as a whole, over-representation of particular groups in the survey sample may cause significant directional biases in final value estimates (Whitehead 1991). Also, when nonmarket good values are generated for the general public, inferences about the public's value sensitivity to changes in the condition or provision of nonmarket goods may be confounded when subpopulation preferences are heterogeneous. Determining how preferences affect protection values for forest quality is important to policy makers in targeting uses of the forest for budget priorities, and in determining what uses of the forest represent the largest social gain from protection.

Willingness to Pay for Forest Quality Changes

Household economic value (i.e., WTP) for forest protection was estimated using a contingent valuation (CV) survey. CV is based on consumer theory and the concept of *utility*,

[3] Since the mid-1960's, individual and group aesthetic preferences for a variety of forest types, conditions, and attributes has been extensively investigated (Ribe 1989). These studies provide considerable evidence that different segments of the public hold dissimilar aesthetic values for forest resources. For example, in a study of French social group preferences for a range of forest conditions, Brun-Chaize (1976) found that men, the elderly, rural people, farmers and industrial workers preferred forests managed for timber, i.e., tall straight trees, over unmanaged stands while women, younger people, urbanites, and the highly educated preferred more natural, unmanaged stands and irregularly shaped trees. Other studies examining preference behavior for forest resources have identified differences among gender groups (e.g., Cook 1972; Levine and Langenau 1979), student and professional groups (e.g., Rutherford and Shafer 1969; Willhite and Sise 1974; Buhyoff and Leuschner 1978; Yeiser and Shilling 1978), and recreational interests (Daniel and Boster 1976; Patey and Evans 1979). Given the strong evidence of variability in aesthetic preferences between social groups, it is reasonable to hypothesize that economic values for forest protection are heterogeneous as well.

or satisfaction gained through the consumption of goods. Following Fisher (1994), suppose an individual's *utility function* is given by,

$$u = f(m,z;y) \quad [1]$$

where the utility *(u)* an individual receives is derived by consuming both market goods *(m)* and non-market goods *(e)* using income *(y)*. Nonmarket goods include the recreation activity the individual participates in. Letting *p* denote the price of marketed goods, demand functions for every market good an individual consumes are given by,

$$m_i = g_i(p,z,y) \quad i=1,\ldots,n, \quad [2]$$

where *i* indexes the *i*th market good, and *n* is the number of different market goods consumed. The individual's indirect utility function may now be defined as,

$$h(p,z;y) = u^*[g(p,z,y),z], \quad [3]$$

so that utility is represented as a function of market prices, income, and environmental goods consumed.

The value an individual places on forest quality can be introduced into the basic model by computing the compensating variation for a change in the quantity of the nonmarketed good in [3]. Suppose two forest quality levels (low and high) are defined that are consistent with two vectors of nonmarketed goods consumed, z_f^0 and z_f^1, where z_f^0 is the original high state of forest quality, and z_f^1 represents the forest in a low quality, or damaged state (i.e., $z_f^0 > z_f^1$). By definition,

$$[u^0 = h(p,z_f^0;y)] \neq [u^1 = h(p,z_f^1;y)]. \quad [4]$$

Thus our main empirical hypothesis is that, given a perceived change in forest condition, the individual experiences a change in satisfaction when forest health declines. Using the individual's indirect utility function, [3], and the assumption in [4], the individual's WTP to prevent a decline in forest quality is now the compensating variation defined by:

$$h(p,z_f^0;y\text{-}WTP) = h(p,z_f^1;y), \quad [5]$$

where an individual's WTP is the amount of income that a person who values forest health would forego to prevent the original forest condition z_f^0 from degrading to z_f^1. In summary, if forest health is one of the goods an individual values, then the individual may be willing to pay some portion of their income to prevent the forest from degrading to any level below the forest's original condition.

Survey Design and Data Collection

The questionnaire for this study borrowed heavily from the Holmes and Kramer (1995, *forthcoming*) Forest Quality Survey, and consequently, we did not use focus groups to guide the design of survey format or question wording. However, the spruce-fir photos taken as part of this study were used in a related analysis to develop scenic beauty estimates (SBE) (e.g., Daniel and Boster 1976), which aided us in selecting photos for the WTP section of the CV questionnaire. That analysis used approximately 80 subjects, who registered their preferences (on a 10-point scale) for 85 photos of spruce-fir stands near Mount Mitchell, North Carolina and Mount Rogers, Virginia. Photos were taken from 33 plots developed during the mid 1980's as a component of the Spruce-Fir Cooperative in the National Acidic Precipitation Assessment Program's Forest Response Program (Nicholas *et al.* 1992a) and represented the possible range of forest quality conditions now occurring in the southern Appalachian spruce-fir forests. Based on a scenic preference index derived from subjects' photo-based responses, three photos (two initial conditions and one end condition) were chosen to represent two perceptibly different forest protection scenarios. The three photos represented the mid-point (30% dead basal area), and two extremes (5% and 75% dead basal area) of the scenic beauty index derived for our photos. Given the construction of SBE indices, it is not possible to identify the significance of differences between SBE values. However, using photo-based responses, Daniel *et al.*(1989) found a high degree of correlation between campers' WTP and scenic beauty values for the same variations in forest condition.

To identify potential difficulties that final sample respondents may have encountered when responding to the survey instrument, a draft questionnaire was mailed to 150 randomly sampled households within the study region. Pretest WTP questions used an open-ended format to establish the range of referendum bids used in the final sample. Based on pretest responses, minor changes were made to survey format and question wording, and the range of referendum bids for the final sample was established. Final survey design and implementation closely followed the Dillman (1978) method. The initial mailing was sent to all final sample households in March 1995, followed by a post card reminder. A second and third survey packet were mailed to non-respondents.

The sampling frame for this study included all households in telephone directories within the seven state southern Appalachian region (North Carolina, South Carolina, West Virginia, Virginia, Tennessee, Kentucky, and Georgia). A random sample of 1,000 households was conducted proportional to population per zip code. To assess the values that both visitors and households who have never visited the region hold for southern spruce-fir forests, households were sampled over entire states rather than from mountain region counties.

Each household was mailed a CV questionnaire built around a referendum-type WTP question, where each household was presented with one value, i.e., price, for the resource they were being asked to value. Each household was randomly assigned one value from a prespecified set of resource prices. The mean value, i.e., mean WTP, for the resource is then a function of the probability of each household accepting their given price. Relative to other value elicitation formats (e.g., open-ended and payment card), referendum-type WTP questions more closely resemble the market and political processes to which individuals are accustomed when making decisions (Diamond and Hausman p. 33)[4,5].

To test the null hypothesis that WTP for forest protection programs does not vary depending on the forest's initial condition, households in the sample were randomly assigned

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[4] For example, consider political referendums where voters are presented with a specific tax change or bond price for which they may vote for or against.

[5] Some recent CV studies indicate that WTP values estimated using referendum-type elicitation formats may be biased by *yea-saying*. Yea-saying is the phenomenon of individuals accepting their given bid without fully considering their true value for the good (Mitchell and Carson pp. 240-241). That is, referendum questions may be "too easy" to answer. In a study comparing forest protection values estimated using open-ended versus referendum WTP questions, Holmes and Kramer (1995) identified yea-saying as a cause of significant value variance between the two elicitation formats, i.e., the referendum format yielded significantly greater WTP estimates.

one of two survey versions that represented different forest protection scenarios. Households receiving the first scenario were asked to value a protection program for a fir forest in an "unimpacted" state (i.e., 5% dead basal area). Households receiving the second scenario were asked to value a protection program for an "impacted" fir forest that was described as already beginning to show signs of damage from balsam woolly adelgid attack and air pollution (i.e., 30% dead basal area). Each household received two photos with a written description of their protection program scenario: the first photo corresponded to the initial forest condition (either 5% or 30% dead basal area), and the second photo depicted a future forest condition without implementation of a forest protection program (75% dead basal area). Aside from the difference in protection scenarios, the two survey versions were identical. Using survey responses, tests were conducted to determine if a household's WTP for forest quality is influenced by the initial condition of the forest (a function of dead basal area)[6].

Other data from the survey included demographic information for each household such as age, sex, number of people in household, education and income. Data on household volunteerism and donations to conservation and environmental organizations were also collected. In addition, information was collected about respondents' familiarity with the southern Appalachian spruce-fir forest, attitudes towards forest protection, and recreation behavior, including participation in specific recreation activities (both in the spruce-fir forest and in other parts of the country) and number of past and future visits to the southern Appalachian region. All households were identified either as a participant or nonparticipant in each of the following recreation activity groups: hunters, anglers, campers, and hikers. This data was used to test i) the sensitivity of within-group WTP for forest protection to initial forest condition, and ii) between-recreation group differences in WTP for forest protection.

Relevant descriptive statistics are presented in Table 3.1. The column labelled "5%DAMAGE" represents those households asked to value a protection program for a forest

[6] In studies examining aesthetic preferences for forest condition, tree mortality has been a dominant predictor of visual preferences (Buhyoff *et al.* 1982, Hollenhorst *et al.* 1993). Changes in this forest attribute are one of the primary manifestations of natural and anthropogenic disturbances in the southern Appalachians, and further decline of the region's Fraser fir is expected (Nicholas *et al.* 1992b).

TABLE 3.1
DESCRIPTIVE STATISTICS OF SELECTED CHARACTERISTICS OF RESPONDENTS[a]

CHARACTERISTIC	DESCRIPTIVE STATISTICS[b]		
	INITIAL CONDITION[c]		
	5%DAMAGE	30%DAMAGE	t-VALUE[d]
Read/heard about increase in damage to spruce-fir forest (yes=1, no=0)	0.58 n=131	0.56 n=101	0.4215 (0.3262)
Visited southern Appalachians in past (yes=1, no=0)	0.84 n=131	0.93 n=101	-2.0613* (0.9596)
No. of recreational trips to to the southern Appalachians in past three years	4.99 (9.70) n=131	4.47 (6.14) n=101	0.4708 (0.3581)
Age (years)	47.73 (16.02) n=131	50.32 (13.67) n=101	-1.2932 (0.8028)
Sex (proportion female)	0.28 n=131	0.25 n=101	-0.5471 (0.4152)
Household (no. people)	2.69 (1.49) n=131	2.80 (1.21) n=101	-0.5869 (0.4422)
Education (years)	14.15 (3.20) n=131	14.88 (3.12) n=101	-1.7206 (0.9133)
Income ($)	43,989 (29,335) n=131	50,817 (32,959) n=101	-1.6654 (0.9028)

[a]Protest responses were not included in the calculation of descriptive statistics.

[b]Descriptive statistics for each characteristic are mean, standard deviation, and sample size, respectively. Standard deviations are not reported for characteristics that have (0/1) responses.

[c]Initial condition refers to initial forest condition presented in each forest protection scenario, i.e., 5%DAMAGE refers to five percent dead basal area initial forest condition (unimpacted sample); 30%DAMAGE refers to thirty percent dead basal area initial forest condition (impacted sample).

[d]Probability $|t| \geq x$ in parentheses.

* Significant at $\alpha=.05$.

which had no visual evidence of tree mortality (5% dead basal area), while "30%DAMAGE" represents those asked to value a protection program for a forest beginning to show signs of damage (30% dead basal area). Overall response rate for sample households is 40.3 percent, while response rates for the unimpacted and impacted survey versions are 42.2 percent and 38.2 percent, respectively. Differences between samples are tested using two sample *t*-tests. Past visitation to the southern Appalachians differs significantly between unimpacted and impacted samples ($\alpha = .05$). While the difference in past visitation habits is significant, both groups appear to have more than a moderate familiarity with the resource they were being asked to value; more than half of the households in both groups had either read or heard about an increase in spruce-fir forest mortality. Additionally, more than 80% of households in either sample had visited a southern Appalachian Mountain recreation area sometime in the past.

Empirical Model

Because the mail-out survey follows a referendum format (i.e, yes/no response), the model used to predict WTP for forest protection can be based on a binomial logit specification. The dependent variable is the probability that a household accepts the presented bid level, while independent variables include the stated bid and household demographic variables (i.e., income and trips to the southern Appalachians). The model to estimate becomes,

$$P_i = \frac{1}{1+e^{-X_i\beta}} \qquad [6]$$

where P_i is the probability of a household accepting their given referendum WTP price for a forest protection program, X_i is the matrix of independent variable observations (i.e., bid price, income, and number of recreation trips), and β is the coefficient matrix.

Variables used to explain valuation behavior for forest protection programs in the final models include bid amount, household income, and trips to the southern Appalachian Mountains. Bid amount recorded the program protection price each household received. Based on the range of WTP responses received from the open-ended pretest survey, households in the final sample were given one of nine bid levels for forest protection, i.e., 1, 2, 5, 10, 25, 50, 100, 200, or 400 dollars. Economic theory suggests that a household's budget constraint, i.e., income, is an important explanatory variable in predicting the amount a household will pay for a commodity. From ten income categories, respondents were asked to check the level which best described the total income, before taxes, received by the respondent and other adult household family members in 1994. Household familiarity with the southern Appalachian spruce-fir forest was measured by recording the number of recreational visits to the region in the past three years.

Empirical Results

Household Sensitivity to Initial Forest Condition

Following the independent subsample design (i.e., households were asked to value only one forest protection scenario) three versions of [6] were estimated to determine household WTP for forest protection, and how this WTP depends on initial forest condition[7]. The model was estimated separately for households in the sample that received the 5% damage scenario, and for households that received the 30% damage scenario. A combined model also was estimated using all households sampled (Table 3.2)[8]. Coefficient signs in logit models indicate the direction that the probability of a household accepting their WTP referendum

[7] Model coefficients were estimated using the LIMDEP econometric program (Greene 1992).

[8] Based on the recommendations of Freeman (1986), *protest responses* were excluded from final model estimations. Protest responses were identified as households that stated they would not be willing to pay either because "people should not have to pay to protect forest quality," or because "they objected to the [WTP] question." The concern with protest responses is that it is unknown whether the respondent does not hold as much value for the non-market good as the given price, or if the respondent is protesting the method of payment (in this case, additional taxes) or some other aspect of the survey (Diamond *et al.* pp. 54-55).

TABLE 3.2
ESTIMATED LOGIT MODEL COEFFICIENTS

VARIABLE	COEFFICIENT[a]		
		INITIAL CONDITION[b]	
	5%DAMAGE (n=131)	30%DAMAGE (n=101)	COMBINED (n=232)
Constant	0.332 (0.802)	0.329 (0.684)	0.440 (1.445)
Bid Amount	-0.110×10^{-1}*** (-4.115)	-0.951×10^{-2}*** (-3.794)	-0.100×10^{-1}*** (-5.594)
Income	0.2183×10^{-4}*** (2.604)	0.1031×10^{-4} (1.329)	0.1667×10^{-4}*** (2.952)
No. of recreational trips to southern Appalachians	-0.3818×10^{-2} (-0.195)	0.1222* (1.837)	0.9740×10^{-2} (0.532)
Model χ^2 statistic	36.626***	28.334***	59.662***
Likelihood ratio test χ^2 statistic[c]		5.42	
Mean WTP	$137.23	$169.38	$150.63

[a]*t*-statistics in parentheses.

[b]Initial condition refers to initial forest condition presented in each forest protection scenario, i.e., 5%DBA is initial condition for unimpacted sample; 30%DBA is initial condition for impacted sample. COMBINED refers to model estimated using observations from both survey versions.

[c]Critical value is 9.48 at $\alpha=0.05$.

* Significant at $\alpha=.10$.
** Significant at $\alpha=.05$.
*** Significant at $\alpha=.01$.

value changes for right hand side variable changes. As seen from the *t*-ratios, the referendum bid amount that a household was asked to pay for their forest protection program is a significant predictor of the probability of bid acceptance. The negative coefficients for bid amount indicate that, as the given referendum price increases, households are less likely to accept that bid. The significant positive coefficients on income in the 5% damage and combined models give evidence that higher income households were more likely to accept their referendum bid. These results are consistent with the downward sloping demand curve of economic theory. The variable representing familiarity with the spruce-fir resource, i.e., the number of recreational trips taken to the southern Appalachians in the past three years, was insignificant in explaining household valuation behavior for forest protection in all models at the 0.05 significance level.

Model coefficients were examined jointly for significance of their difference from zero. The χ^2 statistics for all models reveal that the null hypothesis that all coefficients are equal to zero can be rejected at the 0.01 significance level. A likelihood ratio test was used to examine the difference between the coefficients of the 5% and 30% damage models, testing the null hypothesis that coefficients were identical across models. Based on the calculated χ^2 statistic for this test, no significant difference between forest protection value models can be claimed at the 0.05 level. That is, over the range of initial forest damage considered (5% to 30%), a household's likelihood of accepting their given price, and hence their WTP, for a spruce-fir forest protection program does not appear to be sensitive to the initial condition of the forest.

To calculate mean WTP values for forest protection, we integrated the estimated function [6] numerically, using the referendum bid level that yields a 1% probability of acceptance as the upper limit of integration. The mean WTP for forest protection estimated by this study, \$150.63 (both survey versions combined) is somewhat larger than the mean referendum values of \$59.22 to \$99.57 (depending on the area of forest protected) estimated by Holmes *et al.* (1992). Discrepancies in WTP values between the two studies may be explained by geographic differences in sampling, integration limits for calculating mean WTP, and other issues. Holmes *et al.* sampled households within a 500 mile radius of Asheville, NC, an area which extends into Michigan, New York, Missouri, Louisiana, and Florida. Households in this study were sampled only from states that contain a portion of the southern Appalachian Mountains (i.e., VA, WV, NC, SC, GA, KY, and TN). Consequently, our sample is probably more familiar with the resource and may have a greater interest in protecting the spruce-fir forests.

Forest User Group Preferences

Econometric testing of user group valuation behavior can be conducted by subjectively placing recreation activities into consumptive (hunter and angler) and nonconsumptive (camper and hiker) categories based on household responses to the recreation participation question. The sample is then divided into observations within each category, and then equation [6] is estimated within each group. The results are used to test, first, whether WTP in each group varies with changes in initial forest condition, and, second, whether WTP for forest protection differs significantly across user groups.

Tables 3.3 and 3.4 report estimates of equation [6] within each recreational group by damage scenario. These models were used to test whether value varied between damage scenario in each of the various recreation groups. With the exception of hunters who received the 30% damage scenario, *t*-ratios indicate that the referendum bid amount any forest user was asked to pay for a protection program is a significant predictor of the probability of bid acceptance. That is, as the cost of a forest protection program increases, forest users are less likely to accept their given protection price. Coefficients on income are positive for all models except hunters in the 30% damage scenario, however, the significance of income in explaining valuation behavior varies between groups and damage scenarios, and trends of significance are not obvious. Similar to the sample as a whole, the number of recreational trips taken to the southern Appalachians in the past three years was insignificant in explaining group valuation behavior in all models at the 0.05 significance level.

TABLE 3.3
ESTIMATED LOGIT MODEL COEFFICIENTS
FOR CONSUMPTIVE FOREST USERS

VARIABLE	COEFFICIENT[a]			
	HUNTERS		ANGLERS	
	5%DAMAGE (n=31)	30%DAMAGE (n=22)	5%DAMAGE (n=59)	30%DAMAGE (n=35)
Constant	-0.129 (-0.112)	2.091 (1.237)	0.289 (0.431)	-0.196 (-0.196)
Bid Amount	-0.998×10^{-2}** (-2.218)	-0.538×10^{-1} (-1.550)	-0.257×10^{-1}*** (-3.318)	-0.258×10^{-1}** (-2.398)
Income	0.616×10^{-4}* (1.784)	-0.190×10^{-4} (-0.620)	0.378×10^{-4}** (2.230)	0.871×10^{-5} (0.460)
No. of recr. trips to S. Appalachians	-0.354×10^{-3} (-0.005)	0.985 (1.414)	-0.190×10^{-1} (-0.548)	0.570* (2.183)
Model χ^2 statistic	12.076***	13.532***	28.895***	19.783***
Likelihood ratio test χ^2 statistic[b]	9.94**		12.42**	
Mean WTP	$265.94	$83.19	$75.60	$91.27

[a] *t*-statistics in parentheses.

* Significant at $\alpha=.10$.
** Significant at $\alpha=.05$.
*** Significant at $\alpha=.01$.

[b] Critical value is 9.48 at $\alpha=0.05$.

TABLE 3.4
ESTIMATED LOGIT MODEL COEFFICIENTS
FOR NONCONSUMPTIVE FOREST USERS

VARIABLE	COEFFICIENT[a]			
	CAMPERS		HIKERS	
	5%DAMAGE (n=48)	30%DAMAGE (n=32)	5%DAMAGE (n=48)	30%DAMAGE (n=35)
Constant	1.111 (1.387)	-0.937 (-0.633)	0.557 (0.719)	1.919** (1.972)
Bid Amount	-0.932 x 10^{-2}** (-2.358)	-0.137 x 10^{-1}** (-2.487)	0.937 x 10^{-2}** (-2.575)	-0.969 x 10^{-2}** (-2.228)
Income	0.152 x 10^{-4} (0.944)	0.980 x 10^{-4}** (2.064)	0.341 x 10^{-4}* (1.859)	0.507 x 10^{-5} (0.361)
No. of recr. trips to S. Appalachians	-0.242 x 10^{-1} (-0.766)	0.424 x 10^{-1} (0.239)	-0.358 x 10^{-1} (-1.158)	-0.645 x 10^{-2} (-0.105)
Model χ^2 statistic	9.689**	15.427***	15.872***	7.291*
Likelihood ratio test χ^2 statistic[b]	4.40		2.16	
Mean WTP[c]	$221.53		$201.91	

[a]*t*-statistics in parentheses.

* Significant at α=.10.
** Significant at α=.05.
*** Significant at α=.01.

[b]Critical value is 9.48 at α=0.05.

[c]Given no significant difference between models, mean WTP for campers and hikers was estimated by integrating the logit function specified for a model combining observation from both survey versions.

Model coefficients were examined jointly for significance of their difference from zero. The χ^2 statistics for all models reveal that the null hypothesis of coefficients equal to zero can be rejected at the 0.10 significance level. Next, the null hypothesis that coefficients were identical across damage scenarios was tested for each user group. Likelihood ratio tests were conducted for each forest user group and differences between model coefficients of the 5% and 30% damage subsamples was examined. Based on the calculated χ^2 statistic for these tests, a significant difference between forest protection value models can be claimed at the 0.05 level for both hunters and anglers. Conversely, we fail to reject the null hypothesis of no difference between valuation behavior models for campers and hikers at the 0.10 level. Thus, over the range of conditions tested (5% to 30%), the values consumptive forest users (i.e., hunters and anglers) hold for forest protection appear to be sensitive to initial forest condition, while the values of nonconsumptive users (i.e., campers and hikers) were not sensitive to forest condition.

Mean WTP values for forest protection were calculated for all forest user groups by treatment (i.e., 5% or 30% initial damage condition). Because nonconsumptive forest user group values were insensitive to forest condition, [6] was estimated and then integrated using within-group observations from both survey versions. WTP for forest protection was $211.53 and $201.91 for campers and hikers, respectively. While consumptive forest user values for forest protection were sensitive to forest condition, hunters and anglers differ with regard to the direction in which their values shift given a change in forest condition. Hunters' values for forest protection decreased as initial forest condition declined (i.e., $265.94 to $83.19), whereas anglers' values increased given the same decline in forest condition (i.e., $75.60 to $91.27).

Estimated parameters of equation [6] for participants and nonparticipants of consumptive and nonconsumptive forest recreation activities are reported in tables 3.5 and 3.6. Models are estimated by pooling observations across treatments (i.e., 5% and 30% damage scenarios) for each forest user group, and are used to test for differences in WTP for forest protection between participants and nonparticipants in each recreation category. Referendum bid

TABLE 3.5
ESTIMATED LOGIT MODEL COEFFICIENTS
FOR PARTICIPANTS AND NON-PARTICIPANTS OF CONSUMPTIVE
FOREST RECREATION ACTIVITIES

VARIABLE	COEFFICIENT[a]			
	HUNTING		FISHING	
	PARTIC. (n=53)	NONPARTIC. (n=179)	PARTIC. (n=94)	NONPARTIC. (n=138)
Constant	0.859 (1.016)	0.300 (0.908)	0.418 (0.844)	0.406 (0.993)
Bid Amount	-0.111×10^{-1}*** (-2.852)	-0.101×10^{-1}*** (-4.743)	-0.198×10^{-1}*** (-3.942)	-0.741×10^{-2}*** (-4.149)
Income	0.189×10^{-4} (1.109)	0.167×10^{-4}*** (2.744)	0.215×10^{-4}** (2.171)	0.151×10^{-4}** (2.092)
No. of recr. trips to S. Appalachians	0.418×10^{-1} (0.661)	0.824×10^{-2} (0.441)	-0.106×10^{-2} (-0.040)	0.567×10^{-1} (1.357)
Model χ^2 statistic	15.899***	44.633***	36.346***	33.834***
Likelihood ratio test χ^2 statistic[b]	3.66		12.68**	
Mean WTP[c]	$150.63		$81.93	$215.61

[a] *t*-statistics in parentheses.

* Significant at $\alpha=.10$.
** Significant at $\alpha=.05$.
*** Significant at $\alpha=.01$.

[b] Critical value is 9.48 at $\alpha=0.05$.

[c] Given no significant difference between hunting participant and nonparticipant models, mean WTP for hunters was estimated by integrating the logit function specified for a model combining observation from both survey versions.

TABLE 3.6
ESTIMATED LOGIT MODEL COEFFICIENTS
FOR PARTICIPANTS AND NON-PARTICIPANTS OF NONCONSUMPTIVE
FOREST RECREATION ACTIVITIES

VARIABLE	COEFFICIENT[a]			
	CAMPING		HIKING	
	PARTIC. (n=80)	NONPARTIC. (n=152)	PARTIC. (n=83)	NONPARTIC. (n=149)
Constant	0.666 (1.032)	0.182 (0.508)	1.212** (2.109)	0.119 (0.313)
Bid Amount	-0.934×10^{-2}*** (-3.333)	-0.109×10^{-1}*** (-4.413)	-0.102×10^{-1}*** (-3.552)	-0.102×10^{-1}*** (-4.338)
Income	0.317×10^{-4}** (2.007)	0.164×10^{-4}** (2.545)	0.192×10^{-4}* (1.778)	0.167×10^{-4}** (2.351)
No. of recr. trips to S. Appalachians	-0.231×10^{-1} (-0.754)	0.161×10^{-1} (0.698)	-0.303×10^{-1} (-1.167)	0.295×10^{-1} (0.982)
Model χ^2 statistic	20.890***	42.150***	22.344***	38.463***
Likelihood ratio test χ^2 statistic[b]	9.16*		8.48*	
Mean WTP	$221.53	$122.11	$201.91	$126.37

[a]*t*-statistics in parentheses.

* Significant at $\alpha=.10$.
** Significant at $\alpha=.05$.
*** Significant at $\alpha=.01$.

[b]Critical value is 9.48 at $\alpha=0.05$, and 7.78 at $\alpha=0.10$.

coefficients for forest protection are significant and negatively correlated to the probability of bid acceptance for all groups (α=0.01). With the exception of hunters, household income is a positive predictor of bid acceptance for all groups at the 0.10 significance level. Again, our proxy for respondent familiarity with the spruce-fir forest (i.e., number of recreational visits to the southern Appalachian Mountains in the past three years) was not a significant predictor of valuation behavior for any forest user group (α=0.10).

Based on the calculated χ^2 statistics, the null hypothesis of valuation behavior coefficients equal to zero was rejected at the 0.10 significance level for all groups. Likelihood ratio tests were conducted for each forest recreation activity to test the null hypothesis of no difference between recreation participant and nonparticipant models. Calculated χ^2 statistics are significant for fishing (α=0.05), camping, and hiking (α=0.10). For these recreation activities, the null hypothesis of no significant difference between participant and non-participant forest protection values is rejected. Conversely, we fail to reject the null hypothesis of no difference between valuation behavior models for hunters and nonhunters (α=0.10). Therefore, over the range of conditions tested (5% to 30%), the values that anglers, campers, and hikers hold for forest protection appear to differ from nonparticipants of these recreation activities, while differences in protection values between hunters and nonhunters can not be distinguished.

By integrating [6], mean WTP values for forest protection were calculated for all forest user groups. Given no difference between hunter and nonhunter models, WTP for hunting is identical to the forest protection value calculated for all sample households in aggregate (i.e., $150.63). Comparisons of forest protection values between participants and nonparticipants of fishing, camping and angling indicate that consumptive and nonconsumptive forest user protection values differ in magnitude. Anglers (one type of consumptive forest user) hold protection values that are less than half the value of respondents who do not fish (i.e., $81.93 for anglers versus $215.61 for nonanglers). For participants and nonparticipants of nonconsumptive activities, the opposite trend is observed; both campers and hikers hold significantly higher forest protection values than nonparticipants of these recreation activities (i.e., $221.53 for campers versus $122.11 for noncampers and $201.91 for hikers versus $126.37 for nonhikers).

Discussion

Considering the sample as a whole, households held protection values that were insensitive to a change in forest condition. The phenomenon of individuals yielding statistically similar economic values for dissimilar public goods and for different provision levels of the same good has been observed in previous CV studies of public good values (Kahneman and Knetsch 1992; Kahneman *et al.* 1993; Boyle *et al.* 1994). As possible explanations for invariant WTP values, these studies point to deficiencies in survey design, respondent misperceptions of the resources being valued, and the propensity of CV to elicit support responses rather than purchase values for environmental goods. Various survey bias and respondent misperception of the amenity being valued may be the only plausible explanations for WTP invariance when values have been estimated for a sample with homogeneous preferences. However, when a sample is represented by groups who hold heterogeneous preferences (Swallow *et al.* 1994), invariant forest protection values for the sample as a whole may result from counteracting differences among these subpopulations' value for resource changes.

We attempted to minimize the incidence of respondents perceiving a good different than the one envisioned by providing households with an explicit description of their forest protection program, including a map of southern Appalachian spruce-fir region and two color photographs depicting the forest conditions described. Further, the WTP section instructed respondents to focus specifically on the physical forest condition change represented by the two photos. While wording in the forest information section was designed to avoid biased and alarmist language, information regarding a forest in decline is, by nature, cause oriented. As a consequence, when asked to value a forest protection program, the placement and nature of the information section may have unintentionally cued households' value judgements on forest protection as a cause rather than on the specific level of forest protection provided. If survey wording and design prompted households to perceive forest protection as a cause to be supported rather than a commodity to be purchased, or if respondents could not visualize the resource changes that were described, then WTP values for forest protection could be expected to be invariant regardless of the physical condition of the forest. Unfortunately, we have no information on the psychological processes respondents used when answering the WTP question and have no way of determining the influence of survey wording and respondent perceptions of the commodity on final WTP estimates.

Another possible explanation for condition-insensitive protection values is that the range of damage tested may have been too small to elicit a change in economic value for forest protection. Photographs used to depict our forest protection scenarios represented the mid-point and end-points of the scenic beauty index derived using plot photos, providing evidence that the photos selected to represent forest protection scenarios depicted a perceptible difference in forest conditions. Because the correlation between WTP values and scenic beauty estimates for the photos used in this study is unknown, it could be argued that the range of conditions tested by this study was insufficient to elicit a significant difference in WTP responses between the two protection scenarios (i.e., from 5% to 30% damage, WTP for forest protection may be flat relative to scenic beauty values over the same range).

Recent studies comparing WTP and scenic beauty estimates of the same good have found high correlations between the two value metrics. In a comparison of campers' photo-based aesthetic preferences for forest areas versus other campers' photo-based economic judgements for the same sites, Daniel *et al.* (1989) found a nearly perfect relationship ($\rho=0.96$) between the two indexes of value. Similarly, in a study comparing the ranking of 16 social issues using five different metrics of preference (including WTP), Kahneman *et al.* (1993) report between-metric correlations of $\rho=0.52$ to 0.97. Given past evidence of high correlation between WTP and other measures of preference (including scenic beauty estimates), it is difficult to support the hypothesis that the range of damage which represented the end-point and mid-point of scenic beauty judgements was insufficient to elicit a change in economic value between forest protection scenarios.

Finally, the invariance of household protection values to a change in forest condition may be the result of grouping many heterogeneous groups into one sample. Preferences for forest condition changes may differ between certain distinct groups within our population. If so, between-group differences in the way protection values shift given a forest condition change could have counteracted to produce the condition-insensitive protection values observed for our general household sample. Policy objectives provided the focus for deciding how to best disaggregate our sample into subpopulations that represent potentially heterogeneous preferences for forest condition changes. Because recreational forest users may be some of the greatest beneficiaries of forest protection actions in the region, we examined our sample with respect to household recreational preferences. Indeed, when the general sample was disaggregated according to recreational preferences, between-group differences in both the sensitivity to forest condition changes and values for forest protection were identified.

Within-group differences in value sensitivity to forest condition and variations in forest protection values between consumptive and nonconsumptive groups indicates that these two categories of forest user groups differ with regard to their preference for forest conditions. This is consistent with Levine and Langenau (1979), who found that preferences towards clearcutting differed among groups exhibiting different patterns of recreational activities. They concluded that individuals able to make use of clearcuts or who are diverse in their recreational interests were the most likely to hold positive views towards intensively managed and highly modified forests. Similarly, in a study of 18 public interest and professional groups, McCool *et al.* (1986) found that nearly all groups tested held similar ranking preferences for a range of forest conditions, but that the groups differed in the absolute value of their ratings. Environmental groups held the most negative rating for highly modified forests while timber harvesting groups rated the same conditions more positively.

Results from these studies may also explain why some consumptive recreationists (i.e., anglers) placed a lower value on forest protection than participants of nonconsumptive activities. Anglers may hold relatively low forest protection values due to their ability to utilize a variety of forest conditions including stands with a greater degree of tree mortality, or no forest cover at all. Hence, anglers, who may not demand any particular type of forest condition in which to successfully accomplish their recreational goals, probably would not benefit from forest protection programs to the degree of nonconsumptive recreationists. Conversely, nonconsumptive recreationists may place a higher value on forest protection because the absence of forest protection programs could negatively impact most camping and hiking experiences.

Implications

Conclusions from this study regarding household and recreation group preferences for forest condition are limited by the lack of information on the psychological processes respondents used to formulate their valuation responses, the range over which WTP for forest protection was examined (i.e., between 5% and 30% dead basal area), and small sample sizes. Given these limitations, the results of this study indicate that important information about group preferences may be overlooked when economic values for public goods are estimated for general rather than sub-populations. As suggested by Swallow *et al.* (1994), data regarding group preferences (which is often collected in CV questionnaires) may be used to reflect the values individual subpopulations hold for a given resource. Studies designed to elicit forest protection values for different recreation groups may also provide valuable insights into the effects of proposed forest protection policies.

Forest protection demands appear to differ between consumptive and nonconsumptive recreation groups. In addressing the equity issues of specific management prescriptions, nonconsumptive recreationists such as campers and hikers may be the greatest beneficiaries from policies designed to protect southern Appalachian spruce-fir forests. Further, mechanisms designed to raise funds for forest protection programs, e.g., political tax referenda and user fees, may be viewed by certain forest user groups as excessive, depending on the degree to which a recreation group seeks and utilizes damaged forest stands in their recreation activities. While anglers may place a high degree of consumptive pressure on the forest resource, these "condition-sensitive" recreationists' lower WTP values for forest protection could indicate that they will be less likely to demand specific forest recreation conditions than their more condition-sensitive counterparts. The high forest protection values of non-consumptive recreationists indicate that campers and hikers are likely to expect more specific types of forest conditions and a higher degree of forest protection than consumptive recreationists.

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SYNOPSIS AND CONCLUSIONS

The objectives of this research were i) to determine the sensitivity of household and recreation group forest protection value to a change in forest condition, and ii) to investigate possible differences in forest protection values among various forest recreation groups. Forest protection values were elicited via southeastern U.S. household responses to a mail-out referendum-type contingent valuation (CV) survey. The sensitivity of household and recreation group protection values to forest condition was examined by randomly issuing households one of two different forest protection scenarios. Protection scenarios varied in the degree of forest protection offered. Households receiving the first survey version were asked to value a protection program for a forest unimpacted by insects and air pollution (5% standing dead basal area). Households in the second sample were asked to value a protection program for a forest experiencing a moderate degree of insect and air pollution damage (30% standing dead basal area).

Logit analysis revealed no significant difference in household WTP between the two forest protection programs. This suggests that, over the range of conditions tested, household forest protection values are not sensitive to changes in the physical condition of the forest. The perceptual context in which forest protection programs were valued may explain the insensitivity of household and recreation group forest protection values to changes in forest condition. Language contained in the survey regarding the decline of the spruce-fir forest and the public's probable unfamiliarity in valuing forest protection in an economic context may have prompted respondents to assess their willingness to contribute to forest protection as a cause rather than their willingness to purchase forest protection as a commodity. To the degree respondents viewed the survey as an opportunity to register their support for forest protection as a cause, changes in the physical attributes of the forest could be expected to have little influence on forest protection values. Invariance of forest protection values may also have been the result of subpopulations within the sample differing in the values they hold for forest protection.

As evidence for this last hypothesis of condition-invariant household protection values, when households were grouped according to their recreation preferences, within-group forest protection values varied depending on the type of recreation activity in which a household engaged. That is, consumptive forest users (i.e., hunters and anglers) held forest protection values which were sensitive to a change in forest condition. Conversely, nonconsumptive forest users (i.e., campers and hikers), were insensitive to the same change in forest condition. Further, hunters and anglers differed with regard to the direction in which their values shifted given the same change in forest condition.

A final test of survey data was conducted to investigate differences in protection values between various forest recreation groups. Anglers (one type of consumptive recreationist) held significantly lower forest protection values than participants of nonconsumptive recreation activities, i.e., camping and hiking. Relative to nonconsumptive recreationists, significantly lower forest protection values for anglers may indicate that consumptive recreationists utilize a wide range of forest conditions, both damaged and undamaged, in their recreation activity. As a consequence, consumptive recreationists may receive fewer benefits than campers or hikers from management activities designed to prevent large open areas or stands of predominantly dead trees.

Conclusions from this study regarding household and recreation group preferences for forest condition are limited by the lack of information on the psychological processes respondents used to formulate their valuation responses, the range over which WTP for forest protection was examined (i.e., between 5% and 30% dead basal area), and small sample sizes. Given these limitations, the results of this study indicate that important information about group preferences may be overlooked when economic values for public goods are estimated for general rather than sub-populations. Data regarding group preferences (which is often collected in CV questionnaires) may be used to reflect the values individual subpopulations hold for a given resource. Studies designed to elicit forest protection values for different recreation groups may also provide valuable insights into the effects of proposed forest protection policies.

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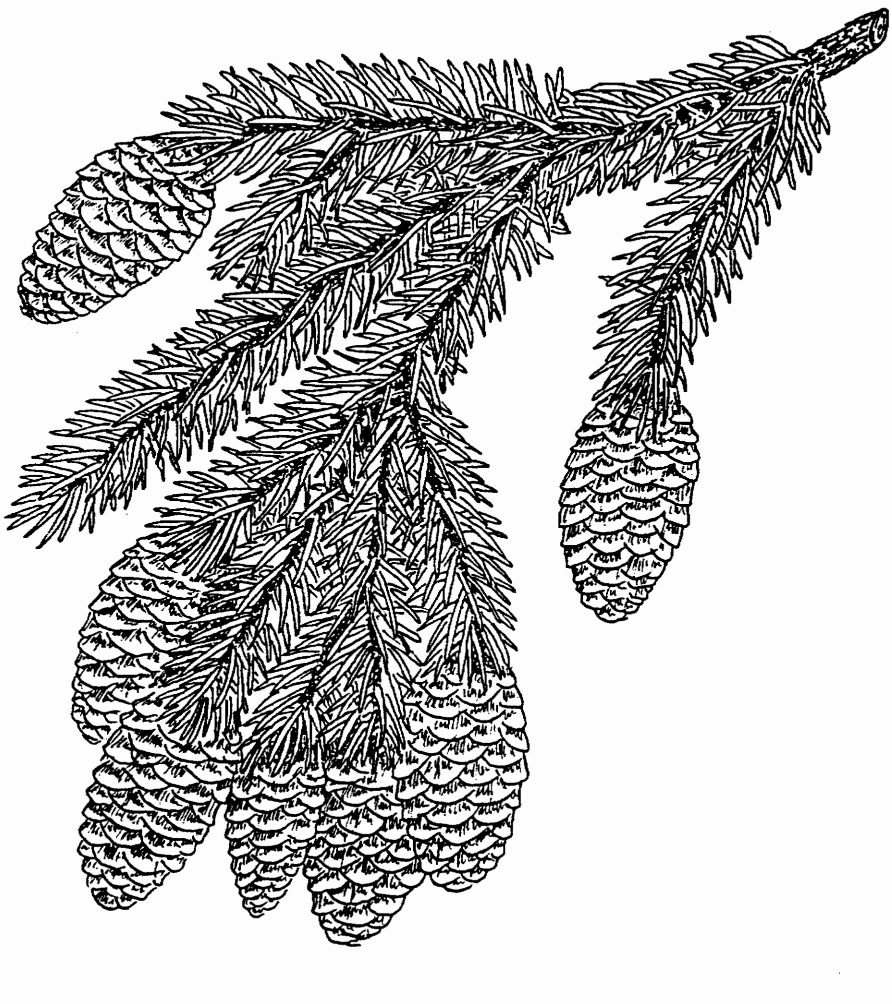
APPENDIX 1
Mail Out Survey

FOREST QUALITY IN THE SOUTHERN APPALACHIAN MOUNTAINS

A SURVEY OF PUBLIC OPINION



Conducted by the
Virginia Tech Department of Forestry

SECTION A. **In the section below, we are interested in learning about your knowledge of the southern Appalachian spruce-fir forests.**

1. Have you read or heard about an increase in the number of dead trees in the southern Appalachian spruce-fir forests? (check one)

   ___ NO
   ___ YES -------->If yes, have you read or heard anything about the possible causes of this forest damage? (check one)

   ___ NO
   ___ YES -------->If yes, which of the following possible causes of forest damage have you heard about? (check all that apply)

   ___ DROUGHT
   ___ INSECTS
   ___ FIRE
   ___ AIR POLLUTION/ACID RAIN
   ___ ICE AND WIND
   ___ OTHER___________________

2. Many reasons have been suggested for protecting forest quality. For each reason below, please check the line which describes how important it is to you to protect the southern Appalachian spruce-fir forests. (check one line for each reason)

	Not Important	Somewhat Important	Very Important
a. PROTECTING HABITAT OR AREAS FOR WILDLIFE	____	____	____
b. PROTECTING SCENIC BEAUTY	____	____	____
c. PROVIDING RECREATION OPPORTUNITIES	____	____	____
d. PROTECTING RARE AND ENDANGERED SPECIES	____	____	____

	Not Important	Somewhat Important	Very Important
e. PROTECTING THE FORESTS FOR THEIR EXISTENCE	____	____	____
f. CONSERVING AREAS FOR SCIENTIFIC STUDY	____	____	____
g. PROVIDING FOREST PRODUCTS AND JOBS FOR PEOPLE IN THE FOREST INDUSTRY	____	____	____
h. PROVIDING SERVICES SUCH AS EROSION CONTROL AND WATER-SHED PROTECTION	____	____	____
i. PRESERVING AREAS FOR FUTURE GENERATIONS	____	____	____
j. OTHER (please specify) ______________________________	____	____	____

SECTION B. **In the section below, we are interested in learning about your recreation activities and your visits to the southern Appalachian mountains (both past and possible future visits.)**

3. About how many days each year do you participate in outdoor recreation activities at places 10 or more miles from your home? (fill in number of days)

   _______ DAYS

4. Which of the following recreation activities do you participate in (in the southern Appalachians or in any other areas of the country)? (check all that apply)

   ___ SIGHTSEEING OR DRIVING FOR PLEASURE
   ___ HIKING OR BACKPACKING
   ___ HUNTING
   ___ FISHING
   ___ PHOTOGRAPHY

___ BIRD WATCHING OR NATURE STUDY
___ CAMPING
___ PICNICKING
___ BICYCLING
___ SKIING
___ WHITE WATER ACTIVITIES
___ OFF-ROAD VEHICLE USE
___ OTHER (please specify) ____________________

5. Do you plan to visit the Great Smoky Mountains National Park, the Blue Ridge Parkway, or other recreation areas in the southern Appalachian mountains at any time <u>in the future</u>? (check one)

___ NO
___ YES

6. <u>In the past</u>, have you ever visited the Great Smoky Mountains National Park, the Blue Ridge Parkway, or other recreation areas in the southern Appalachian mountains? (check one)

___ NO --------------> **IF NO, PLEASE GO TO SECTION C**
___ YES

7. During the past three years, how many recreational trips did you make to the southern Appalachian mountains? (fill in the number of trips)

______ TRIPS

8. During your trips, what was your primary destination in the southern Appalachians? (check all that apply)

___ GREAT SMOKY MOUNTAINS NATIONAL PARK
___ GRANDFATHER MOUNTAIN / BOONE, NC AREA
___ MT. MITCHELL / ASHEVILLE, NC AREA
___ MT. ROGERS, VA AREA
___ OTHER (please specify) ____________________________

9. During any of your visits, did you notice large forested areas with dead or dying evergreen trees? (check one)

___ NO
___ YES

SECTION C. **In the section below, you are provided with some background information on the southern Appalachian spruce-fir forests. Please read the information carefully and then answer the questions which follow.**

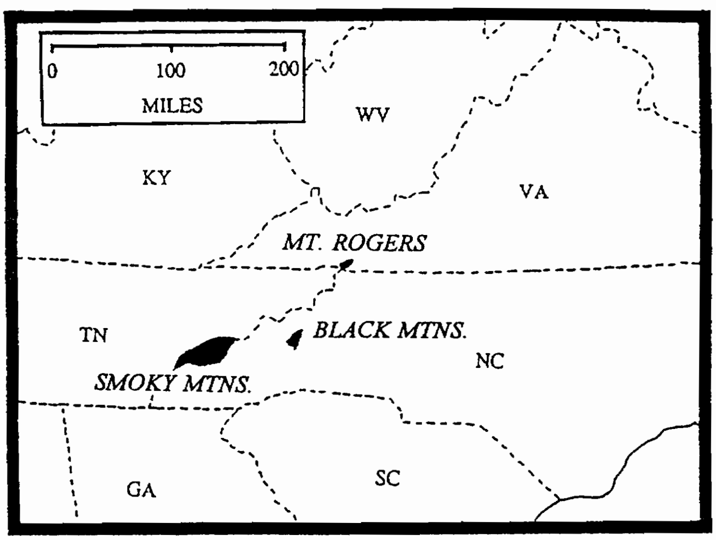
Features of the southern Appalachian spruce-fir forests

The southern Appalachian spruce-fir forests are unique ecosystems in the southeastern United States. Ranging in elevation from approximately 4,400 to 6,700 feet, spruce-fir forests occur in a series of island-like areas, occupying the southern Appalachian mountains' tallest peaks and ridges. While similar forests exist in the northern United States and Canada, the southern Appalachian spruce-fir forests are distinct due to their diversity of plant and animal species, including 11 threatened and endangered plant species and 17 species of plants and animals found nowhere else in the world.

The southern spruce-fir forests are a premier feature of the Great Smoky Mountains National Park, the North Carolina State Park System, the Jefferson and Pisgah National Forests, the Blue Ridge Parkway, and the southern leg of the Appalachian Trail. Southern Appalachian parks and forests are among the most frequently visited recreation areas in the world.

Spruce-fir forest history, health, and decline

During the early part of this century, the spruce-fir forests were heavily logged and were often subject to wildfire, reducing the spruce-fir forests to 10 percent of their original area. Locations of the remaining southern Appalachian spruce-fir forests are indicated as darkened areas on the map below:



Location of the three major southern Appalachian spruce-fir forests: Mt. Rogers National Recreation Area, the Black Mountains, and the Great Smoky Mountains.

To preserve the southern Appalachian spruce-fir ecosystem, most of the remaining spruce-fir forests were designated as state and national parks and forests. However, damage to the spruce-fir forests continued with the accidental introduction of an insect from Europe in 1956. This insect, the balsam woolly adelgid, kills fir trees over 30 years old. Insect-caused damage is easily recognizable, and trees usually die within one to seven years after being infested.

In addition, some scientists believe that acid rain and other air pollutants cause a loss of soil nutrients which slows the growth of spruce-fir and increases the chance of damage from insects and storms. Forest damage from air pollution and acid rain is not always immediate; the effects of air pollution may take decades to become visible.

Spruce-fir forest protection

Forest protection programs (such as removing infested trees, planting insect-resistant trees, and using environmentally safe pest control) could be undertaken to decrease the amount of tree damage occurring in the forests due to the balsam woolly adelgid. Also, lime could be applied to forest soils to reduce the ill effects of acid rain on forest health. These forest protection programs are *preventative* in nature. That is, the protection programs are designed to stop spruce-fir forests from declining any further, and are not designed to reverse forest damage that has already occurred.

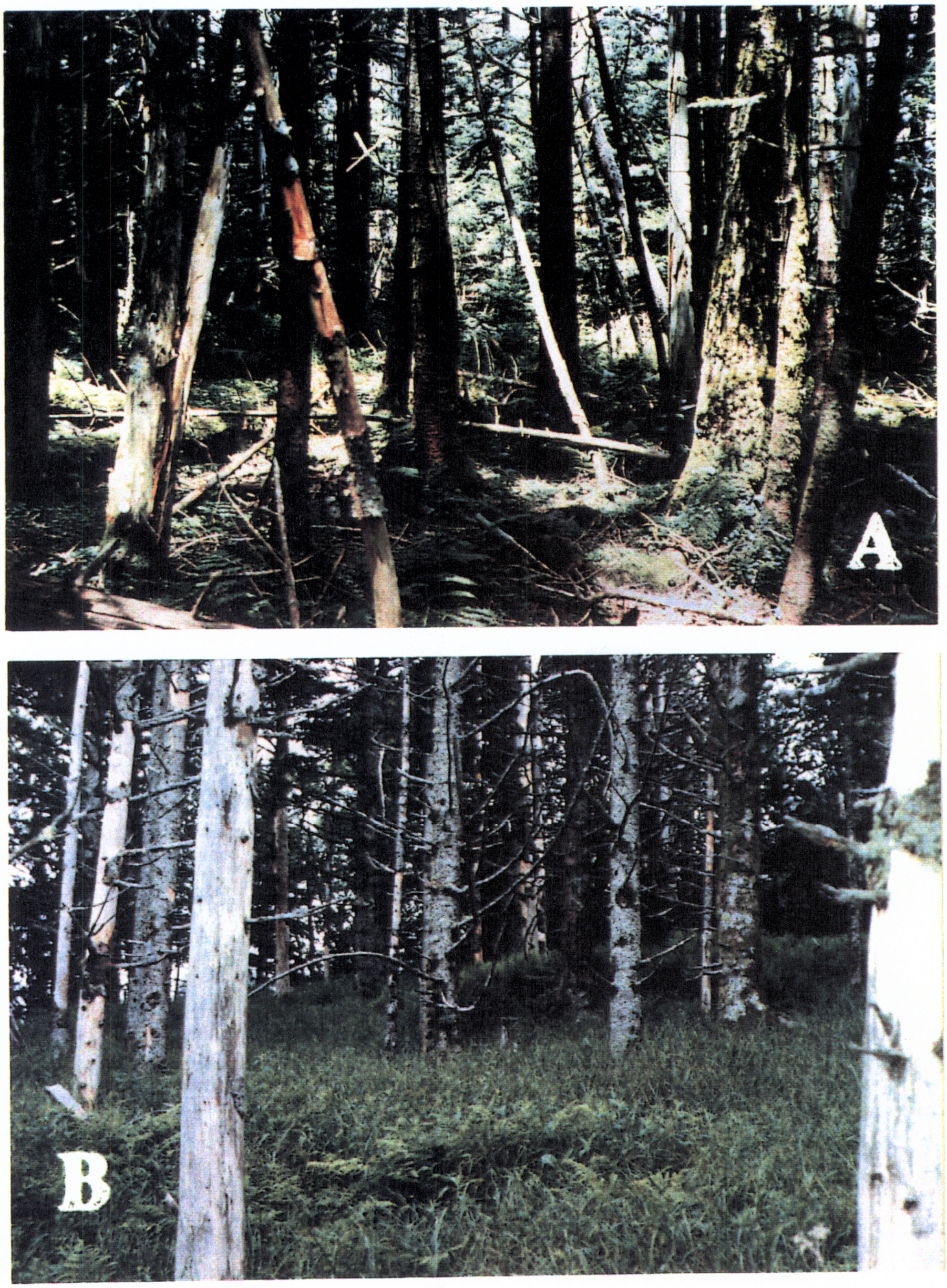
Please look at the two color photographs included with this survey. The photos show two different levels of forest quality. A description of each photo follows:

PHOTO A: *(scenario 1)*	**A spruce-fir forest where 5 percent of the trees are dead. The forest in this photograph shows no impact from insects or air pollution.**
PHOTO A: *(scenario 2)*	**A spruce-fir forest where 30 percent of the trees are dead. The forest in this photograph is beginning to show impact from insects or air pollution.**
PHOTO B: *(both scenarios)*	**A spruce-fir forest where 75 percent of the trees are dead. The forest in this photograph is completely impacted by insects and air pollution.**

Suppose the only way to provide for the forest protection programs described above is to pay a yearly tax which would be used *specifically* to prevent the forests in PHOTO A from becoming like the forests in PHOTO B. Although much of the southern Appalachian spruce-fir forests are like those shown in PHOTO A, without protection programs, most of the spruce-fir forests will eventually decline to the level seen in PHOTO B. All southern Appalachian spruce-fir forests are at risk from insect and pollution damage.

SCENARIO 1

Set of photos given to households in the "UNIMPACTED" subsample. Photo A depicts a forest exhibiting no impact from insects or air pollution, i.e., 5 percent standing dead basal area. Photo B represents a forest completely impacted by insects and air pollution.



SCENARIO 2

Set of photos given to households in the "IMPACTED" subsample. Photo A depicts a forest beginning to show impact from insects or air pollution, i.e., 30 percent standing dead basal area. Photo B represents a forest completely impacted by insects and air pollution.

Based on the two color photographs provided, please answer the following questions:

10. Would your household pay $______ each year in additional taxes to provide protection programs for the southern Appalachian spruce-fir forests? That is, your household would be paying to prevent the spruce-fir forests in PHOTO A from becoming like the forests in PHOTO B.

____ NO ------> If no, please check why:

____ FOREST PROTECTION IS NOT WORTH THIS MUCH TO ME

____ PEOPLE SHOULD NOT HAVE TO PAY TO PROTECT FOREST QUALITY

____ I CANNOT AFFORD TO PAY TO PROTECT FOREST QUALITY

____ I OBJECT TO THE QUESTION

____ OTHER (please specify):

____

____ YES -----> If yes, please answer the following question:

What percentage of the amount above would you assign to each of the following reasons? (write a percent in each blank)

_____% USE OF FORESTS FOR MYSELF

+_____% USE OF FORESTS FOR OTHERS (INCLUDING FUTURE GENERATIONS)

+_____% PROTECTION OF THE FORESTS EVEN IF NO ONE USES THEM

+_____% OTHER (please specify)

____

= 100% total

SECTION D. **In this last section, we would like to ask you some questions about yourself. This information will only be used for summary purposes. We stress that all of your answers are strictly confidential.**

11. What is your age? ______

12. Are you: ____ FEMALE?
____ MALE?

13. Including yourself, how many people are in your household?

_______ PEOPLE

14. How many years of school have you completed? (circle one number)

GRADE SCHOOL	HIGH SCHOOL	COLLEGE	GRADUATE SCHOOL
1 2 3 4 5 6 7 8	9 10 11 12	1 2 3 4	1 2 3 4 5+

15. Are you a member of any conservation or environmental organizations?

___ NO
___ YES -------->If yes, please list:

____
____

16. Do you volunteer your time and/or make donations to any conservation or environmental organizations (volunteer time could include time spent with other civic organizations in roadway clean-up days, tree planting days, etc.)?

___NO
___YES --------->If yes, please indicate how many volunteer hours per year and/or dollars donated per year:

________VOLUNTEER HOURS/YEAR
________DOLLARS/YEAR

17. Which of the following best describes the total income, before taxes, received by you and other adult family members (18 years or older) living with you in 1994? (please check one)

___ LESS THAN $9,999
___ $10,000 TO $14,999
___ $15,000 TO $29,999
___ $30,000 TO $44,999
___ $45,000 TO $59,999
___ $60,000 TO $74,999
___ $75,000 TO $89,999
___ $90,000 TO $104,999
___ $105,000 TO $119,999
___ $120,000 OR MORE

IF YOU WOULD LIKE TO MAKE FURTHER COMMENTS, PLEASE DO SO BELOW.

THANK YOU.

APPENDIX 2
Mail-Out Correspondence:
First Mailing Coverletter

March 7, 1995

FIELD(2)
FIELD(3)

FIELD(4)

We are writing you to ask your opinions about what actions, if any, should be taken to restore natural resources in the southern Appalachian Mountains. The southern Appalachian region is home to many parks and forests including the Blue Ridge Parkway, the Great Smoky Mountains National Park, and Mt. Mitchell State Park. These parks and forests are located in the mountains of Tennessee, Kentucky, Virginia, West Virginia, North Carolina, South Carolina and Georgia.

Even if you have little or no concern about forest quality in the southern Appalachian Mountains, your participation in our survey is important. You are part of a small, randomly chosen group of people within the seven state southern Appalachian region. If you choose not to participate in our study, you cannot be replaced.

Please take about ten minutes to complete the enclosed questionnaire and return it in the stamped envelope provided. The photos included with the survey are yours to keep. Your individual responses will be kept absolutely confidential and will never be connected to your name. Overall results of this study will be presented to state and federal forest management officials. At the conclusion of our study, you will not be contacted again by us or anyone else as a result of your response. We invite your comments on this survey and on natural resource protection in general. Space for your comments is provided on the last page of the survey booklet. If you have any further questions about the survey, feel free to call me at (703)951-0896.

Thank you for sharing your opinions on this important regional issue. Your input is valued and appreciated.

Sincerely,

Dylan Jenkins
Department of Forestry
Virginia Tech

APPENDIX 3
Mail-Out Correspondence:
Postcard Reminder

March 16, 1995

Last week, I mailed you a questionnaire seeking your opinions on forest protection in the southern Appalachian Mountains.

If you have already completed and returned the survey, please accept my thanks. If not, please do so today. Your name is part of a small but representative sample of individuals from the seven state southern Appalachian region. By completing and returning the questionnaire, you are helping to ensure that the results of this study are accurate in representing the true opinions of all individuals in the southern Appalachian region.

If you did not receive the questionnaire, or if it got misplaced, I will send you another one in the next couple of weeks. Please take about ten minutes to fill out and return the survey. Your opinions on forest protection are important. Thank you.

Sincerely,

Dylan Jenkins
Department of Forestry
Virginia Tech

APPENDIX 4
Mail-Out Correspondence:
Second Mailing Coverletter

April 3, 1995

FIELD(2)
FIELD(3)

FIELD(4)

About three weeks ago I wrote to you seeking your opinion on what actions, if any, should be taken to protect natural resources in the southern Appalachian Mountains. As of today, I have not received your completed questionnaire. If it is in the mail, please accept my thanks. If you have not yet completed and returned the questionnaire, please take a few minutes to do so today.

I am writing to you again because of the significance each completed questionnaire has to this study's usefulness and success. The purpose of this study is to survey the public's opinion on natural resources in the southern Appalachians, and then use this information to help guide forest management activities in the region. For the results of this study to be truly representative of all southern Appalachian households, it is essential that each person in the sample return their questionnaire. If you have additional comments or opinions about natural resource management which are not addressed in the questionnaire, please include your comments on the last page of the survey booklet.

Please be assured that your name will never be attached to your answers. The number which appears on your survey booklet will only be used to remove your name from our mailing list so that you will not receive follow-up mailings.

If you never received a questionnaire, or if your questionnaire was misplaced, a replacement is enclosed.

Your opinions are valued and your assistance is greatly appreciated.

Sincerely,

Dylan Jenkins
Department of Forestry
Virginia Tech

APPENDIX 5
Mail-Out Correspondence:
Final Mailing Coverletter

May 3, 1995

FIELD(2)
FIELD(3)

FIELD(4)

I am writing to you about our study of public opinions on what actions, if any, should be taken to restore natural resources in the southern Appalachian Mountains. We have not yet received your completed questionnaire.

The large number of questionnaires returned is encouraging. However, whether we will be able to accurately describe how citizens in your region feel on natural resource issues depends upon you and others who have not yet responded. Our past experiences suggest that those of you who have not yet responded may have quite different ideas about natural resources than those who have responded. We would very much like to hear your opinions.
Some of those who have already mailed back their questionnaires indicated their hesitance to respond because they knew little about the southern Appalachians. We are interested in your opinions regardless of your prior knowledge regarding the southern Appalachian region's natural resources. All opinions are important to this study.

The results of our study are of particular importance to the many citizens, public land managers and policy makers now considering the best management programs for your region's natural resources. The usefulness of our results depends on how accurately we are able to describe the views of all the citizens in the southern Appalachian region.

It is for these reasons that I am sending you this letter. In case our other correspondence did not reach you, a replacement questionnaire is enclosed. May I urge you to complete and return it as quickly as possible. If you would like a summary of the results, please write your name, address and "RESULTS" on the last page of your survey booklet.

Thank you for sharing your opinions on southern Appalachian natural resources. Your time and interest in the success of this study are greatly appreciated.

Sincerely,

Dylan Jenkins
Department of Forestry
Virginia Tech

APPENDIX 6
Input Command File for Chapter 2 Models

```
? Sample input command file for LIMDEP Econometric Program (Greene 1992)?

FAST

READ ; NVAR=8 ; FILE=C:\DYLAN\SURV1.TXT ;
NAMES=HEARD,HABITAT,SCENIC,RECREATE,RARESPP,EXIST,SCISTUD,
PRODUCT $
SAMPLE ; ALL $

READ ; NVAR=8 ; FILE=C:\DYLAN\SURV2.TXT ;
NAMES=EROSION,CHILDREN,RECDAYS,SIGHT,HIKE,HUNT,FISH,PHOTO $
SAMPLE ; ALL $

READ ; NVAR=8 ; FILE=C:\DYLAN\SURV3.TXT ;
NAMES=BIRD,CAMP,PICNIC,BIKE,SKI,WHITEH20,OFFROAD,OTHER4 $
SAMPLE ; ALL $

READ ; NVAR=8 ; FILE=C:\DYLAN\SURV4.TXT ;
NAMES=ACTINDEX,FUTURE,PAST,TRIPS,BIDAMT,RBID,SHODNOT,OBJECT $
SAMPLE ; ALL $

READ ; NVAR=8 ; FILE=C:\DYLAN\SURV5.TXT ;
NAMES=AGE,SEX,PEOPLE,EDUC,MEMBER,DONATE,HOURS,DOLLARS $
SAMPLE ; ALL $

READ ; NVAR=8 ; FILE=C:\DYLAN\SURV6.TXT ;
NAMES=VOLMIN,VOLMAX,A5000,A12500,A22500,A37500,A52500,A67500 $
SAMPLE ; ALL $

READ ; NVAR=6 ; FILE=C:\DYLAN\SURV7.TXT ;
NAMES=A82500,A97500,
A112500,A127500,PROINDX,VERSION $
SAMPLE ; ALL $

OPEN ; OUTPUT = C:\DYLAN\JAYBASE.OUT $

? CREATE INCOME TRANSFORMATIONS ?

CREATE ; IF (A5000=1) INC1=5000 ; (ELSE) INC1=0 $
CREATE ; IF (A12500=1) INC2=12500 ; (ELSE) INC2=0 $
CREATE ; IF (A22500=1) INC3=22500 ; (ELSE) INC3=0 $
```

```
CREATE ; IF (A37500=1) INC4=37500 ; (ELSE) INC4=0 $
CREATE ; IF (A52500=1) INC5=52500 ; (ELSE) INC5=0 $
CREATE ; IF (A67500=1) INC6=67500 ; (ELSE) INC6=0 $
CREATE ; IF (A82500=1) INC7=82500 ; (ELSE) INC7=0 $
CREATE ; IF (A97500=1) INC8=97500 ; (ELSE) INC8=0 $
CREATE ; IF (A112500=1) INC9=112500 ; (ELSE) INC9=0 $
CREATE ; IF (A127500=1) INC10=127500 ; (ELSE) INC10=0 $

CREATE ; INC = (INC1 + INC2 + INC3 + INC4 + INC5 + INC6 +
INC7 + INC8 + INC9 + INC10) $

CREATE ; LINC = LOG(INC) $

CREATE ; IF (A5000=1 + A12500=1) INCDUM=0 ; (ELSE) INCDUM=1 $


? CREATE 'REASONS FOR VALUING FOREST PROTECTION' DUMMIES ?

CREATE ; IF (HABITAT = 2) HABDUM = 1 ; (ELSE) HABDUM = 0 $
CREATE ; IF (SCENIC = 2) SCENEDUM = 1 ; (ELSE) SCENEDUM = 0 $
CREATE ; IF (RECREATE = 2) RECDUM = 1 ; (ELSE) RECDUM = 0 $
CREATE ; IF (RARESPP = 2) RAREDUM = 1 ; (ELSE) RAREDUM = 0 $
CREATE ; IF (EXIST = 2) EXISTDUM = 1 ; (ELSE) EXISTDUM = 0 $
CREATE ; IF (SCISTUD = 2) SCIDUM = 1 ; (ELSE) SCIDUM = 0 $
CREATE ; IF (PRODUCT = 2) PRODUM = 1 ; (ELSE) PRODUM = 0 $
CREATE ; IF (EROSION = 2) ERODUM = 1 ; (ELSE) ERODUM = 0 $
CREATE ; IF (CHILDREN = 2) CHILDUM = 1 ; (ELSE) CHILDUM = 0 $


? CREATE OTHER CONTINUOUS VARIABLE LOGS ?

CREATE ; IF (RECDAYS=0) GRECDAYS=.001 ; (ELSE) GRECDAYS=RECDAYS$
CREATE ; LRECDAYS = LOG(GRECDAYS) $

CREATE ; IF (TRIPS=0) GTRIPS=.001 ; (ELSE) GTRIPS=TRIPS $
CREATE ; LTRIPS = LOG(GTRIPS) $

CREATE ; LAGE = LOG(AGE) $

CREATE ; LPEOPLE = LOG(PEOPLE) $

CREATE ; LEDUC = LOG(EDUC) $

CREATE ; LBIDAMT = LOG(BIDAMT) $
```

```
CREATE ; IF (VOLMAX=0) GVOLMAX=.001 ; (ELSE) GVOLMAX=VOLMAX $
CREATE ; LVOLMAX = LOG(GVOLMAX) $

CREATE ; IF (PROINDX=0) GPROINDX=.001 ; (ELSE) GPROINDX=PROINDX $
CREATE ; LPROINDX = LOG(GPROINDX) $


? REGRESSION FOR VERSION B (HIGHER DEGRADATION) ?

SAMPLE ; 1-124 $

REJECT ; SHODNOT=1 + OBJECT=1 $

DSTAT ; RHS = TRIPS,BIDAMT,INC ; OUTPUT = 2 $
DSTAT ; RHS = INC ; OUTPUT = 2 $

LOGIT ; LHS = RBID ;
RHS = ONE,TRIPS,BIDAMT,INC $


? REGRESSION FOR VERSION A (LOWER DEGRADATION) ?

SAMPLE ; ALL $
SAMPLE ; 125-276 $

REJECT ; SHODNOT=1 + OBJECT=1 $

DSTAT ; RHS = TRIPS,BIDAMT,INC ; OUTPUT = 2 $
DSTAT ; RHS = INC ; OUTPUT = 2 $

LOGIT ; LHS = RBID ;
RHS = ONE,TRIPS,BIDAMT,INC $


? REGRESSION FOR BOTH VERSIONS COMBINED ?

SAMPLE ; ALL $

REJECT ; SHODNOT=1 + OBJECT=1 $

DSTAT ; RHS = TRIPS,BIDAMT,INC ; OUTPUT = 2 $
DSTAT ; RHS = INC ; OUTPUT = 2 $

LOGIT ; LHS = RBID ;
RHS = ONE,TRIPS,BIDAMT,INC $
```

APPENDIX 7
Data Output File for Chapter 2 Models

```
*-* LIMDEP *-* File created 02/22/96 / 04:26:42


MODEL COMMAND:
DSTAT;RHS=TRIPS,BIDAMT,INC;OUTPUT=2$
Descriptive Statistics
Variable     Mean     Std. Dev.      Skew.   Kurt.   Minimum     Maximum    Cases
TRIPS     4.4653        6.1377       3.525  21.064   0.0000       45.00       101
BIDAMT    79.812        125.50       1.777   4.798    1.000       400.0       101
INC       50817.        32959.       0.786   2.907    5000.     0.1275E+06    101


Correlation Matrix

               1-TRIPS      2-BIDAMT     3-INC

   1-TRIPS       1.0000
   2-BIDAMT    -0.52098E-01   1.0000
   3-INC        0.63108E-01  0.46279E-01   1.0000


MODEL COMMAND:
DSTAT;RHS=INC;OUTPUT=2$
Descriptive Statistics
Variable     Mean     Std. Dev.      Skew.   Kurt.   Minimum     Maximum    Cases
INC       50817.        32959.       0.786   2.907    5000.     0.1275E+06    101

MODEL COMMAND:
LOGIT;LHS=RBID;RHS=ONE,TRIPS,BIDAMT,INC$
Multinomial Logit Model
2 Outcomes: RBID=0   RBID=1
Coefficients for RBID=0   set to ZERO.
Least squares starting values:
Dep. Var. is binary: RBID=1
Variable  Coefficient  Std. Error   t-ratio Prob|t|≥x   Mean of X  Std.Dev.of X
-------------------------------------------------------------------------------
Constant  0.62711       0.8660E-01    7.242  0.00000
TRIPS     0.12187E-01   0.6969E-02    1.749  0.08034   4.4653        6.1377
BIDAMT   -0.17462E-02   0.3405E-03   -5.128  0.00000   79.812        125.50
INC       0.18006E-05   0.1297E-05    1.388  0.16522   50817.        32959.

******************************************************************************

                         Method=NEWTON; Maximum iterations= 25
   Convergence criteria: Gradient=    0.1000000E-03
                         Function  =    0.1000000E-03
                         Parameters=    0.1000000E-03
   Starting values:   0.6271       0.1219E-01 -0.1746E-02  0.1801E-05

==> NEWTON Iterations

 Iteration:   1 Fn=   61.29092
 Param    0.627      0.122E-01-0.175E-02 0.180E-05
 Gradnt   1.81       -35.4       0.226E+04-0.467E+05

 Iteration:   2 Fn=   52.99918
 Param   0.485      0.625E-01-0.728E-02 0.820E-05
 Gradnt  0.318E-01 -15.0       370.     -0.248E+05
```

```
 Iteration:   3 Fn=   52.22511
 Param   0.360     0.107    -0.904E-02 0.100E-04
 Gradnt -0.418E-01 -3.28      57.7    -0.472E+04

 Iteration:   4 Fn=   52.18794
 Param   0.330     0.121    -0.948E-02 0.103E-04
 Gradnt -0.604E-02-0.187      2.62     -382.

 Iteration:   5 Fn=   52.18784
 Param   0.328     0.122    -0.951E-02 0.103E-04
 Gradnt -0.249E-04-0.600E-03 0.704E-02 -1.44
** Gradient has converged.
** B-vector has converged.

*******************************************************************************

Multinomial Logit Model
Maximum Likelihood Estimates
Log-Likelihood.............     -52.18784
Restricted (Slopes=0) Log-L.    -66.35469
Chi-Squared ( 3)...........      28.33371
Significance Level..........    0.3090228E-05
Variable  Coefficient  Std. Error   t-ratio Prob|t|≥x   Mean of X  Std.Dev.of X
-------------------------------------------------------------------------------
Constant  0.32845       0.4799        0.684  0.49368
TRIPS     0.12224       0.6654E-01    1.837  0.06619   4.4653        6.1377
BIDAMT   -0.95054E-02   0.2506E-02   -3.794  0.00015   79.812        125.50
INC       0.10313E-04   0.7761E-05    1.329  0.18390   50817.        32959.

Frequencies of actual & predicted outcomes
Predicted outcome has maximum probability.

            Predicted

Actual       0      1        TOTAL

  0         18     19          37
  1          3     61          64

TOTAL       21     80         101



MODEL COMMAND:
DSTAT;RHS=TRIPS,BIDAMT,INC;OUTPUT=2$
Descriptive Statistics
Variable     Mean      Std. Dev.      Skew.    Kurt.    Minimum     Maximum    Cases
TRIPS      4.9924       9.5704        3.723   18.126    0.0000      60.00        131
BIDAMT     74.031       113.24        1.868    5.536     1.000      400.0        131
INC        43989.       29335.        0.912    3.352    5000.     0.1275E+06     131


Correlation Matrix

                1-TRIPS      2-BIDAMT     3-INC

   1-TRIPS       1.0000
   2-BIDAMT     -0.81364E-01   1.0000
   3-INC        -0.71951E-01 -0.82167E-01   1.0000
```

```
MODEL COMMAND:
DSTAT;RHS=INC;OUTPUT=2$
Descriptive Statistics
Variable     Mean     Std. Dev.      Skew.    Kurt.    Minimum      Maximum    Cases
INC       43989.       29335.       0.912    3.352     5000.     0.1275E+06    131


MODEL COMMAND:
LOGIT;LHS=RBID;RHS=ONE,TRIPS,BIDAMT,INC$
Multinomial Logit Model
2 Outcomes: RBID=0   RBID=1
Coefficients for RBID=0   set to ZERO.
Least squares starting values:
Dep. Var. is binary: RBID=1
Variable  Coefficient  Std. Error   t-ratio Prob|t|≥x   Mean of X  Std.Dev.of X
-------------------------------------------------------------------------------
Constant  0.60403       0.7867E-01    7.679  0.00000
TRIPS    -0.13250E-02   0.3970E-02   -0.334  0.73858   4.9924        9.5704
BIDAMT   -0.18712E-02   0.3358E-03   -5.572  0.00000   74.031        113.24
INC       0.34507E-05   0.1295E-05    2.664  0.00772   43989.        29335.

*******************************************************************************

                         Method=NEWTON; Maximum iterations= 25
   Convergence criteria: Gradient=   0.1000000E-03
                         Function  =   0.1000000E-03
                         Parameters=   0.1000000E-03
   Starting values:   0.6040     -0.1325E-02 -0.1871E-02  0.3451E-05

==> NEWTON Iterations

 Iteration:   1 Fn=   81.23316
 Param    0.604     -0.132E-02-0.187E-02 0.345E-05
 Gradnt   4.69       26.4      0.281E+04-0.148E+06

 Iteration:   2 Fn=   70.27881
 Param    0.394     -0.598E-02-0.775E-02 0.160E-04
 Gradnt   0.511      -2.53       581.    -0.500E+05

 Iteration:   3 Fn=   69.29355
 Param    0.338     -0.422E-02-0.103E-01 0.208E-04
 Gradnt   0.164     -0.117E-01  110.    -0.287E+04

 Iteration:   4 Fn=   69.25279
 Param    0.332     -0.384E-02-0.110E-01 0.218E-04
 Gradnt   0.110E-01 0.168E-01  5.47      103.

 Iteration:   5 Fn=   69.25270
 Param    0.331     -0.382E-02-0.110E-01 0.218E-04
 Gradnt   0.327E-04 0.659E-04 0.141E-01 0.659
** Gradient has converged.
** Function has converged.
** B-vector has converged.

*******************************************************************************


Multinomial Logit Model
Maximum Likelihood Estimates
Log-Likelihood.............     -69.25270
Restricted (Slopes=0) Log-L.    -87.56561
Chi-Squared ( 3)...........      36.62583
Significance Level..........    0.5448222E-07
```

Variable	Coefficient	Std. Error	t-ratio	Prob¦t¦≥x	Mean of X	Std.Dev.of X
Constant	0.33145	0.4133	0.802	0.42260		
TRIPS	-0.38182E-02	0.1954E-01	-0.195	0.84509	4.9924	9.5704
BIDAMT	-0.11025E-01	0.2679E-02	-4.115	0.00004	74.031	113.24
INC	0.21832E-04	0.8383E-05	2.604	0.00921	43989.	29335.

Frequencies of actual & predicted outcomes
Predicted outcome has maximum probability.

	Predicted		
Actual	0	1	TOTAL
0	27	24	51
1	8	72	80
TOTAL	35	96	131

MODEL COMMAND:
DSTAT;RHS=TRIPS,BIDAMT,INC;OUTPUT=2$
Descriptive Statistics

Variable	Mean	Std. Dev.	Skew.	Kurt.	Minimum	Maximum	Cases
TRIPS	4.7629	8.2415	3.949	21.634	0.0000	60.00	232
BIDAMT	76.547	118.50	1.838	5.237	1.000	400.0	232
INC	46961.	31081.	0.875	3.197	5000.	0.1275E+06	232

Correlation Matrix

	1-TRIPS	2-BIDAMT	3-INC
1-TRIPS	1.0000		
2-BIDAMT	-0.69368E-01	1.0000	
3-INC	-0.26273E-01	-0.16559E-01	1.0000

MODEL COMMAND:
DSTAT;RHS=INC;OUTPUT=2$
Descriptive Statistics

Variable	Mean	Std. Dev.	Skew.	Kurt.	Minimum	Maximum	Cases
INC	46961.	31081.	0.875	3.197	5000.	0.1275E+06	232

MODEL COMMAND:
LOGIT;LHS=RBID;RHS=ONE,TRIPS,BIDAMT,INC$
Multinomial Logit Model
2 Outcomes: RBID=0 RBID=1
Coefficients for RBID=0 set to ZERO.
Least squares starting values:
Dep. Var. is binary: RBID=1

Variable	Coefficient	Std. Error	t-ratio	Prob¦t¦≥x	Mean of X	Std.Dev.of X
Constant	0.62179	0.5757E-01	10.800	0.00000		
TRIPS	0.17148E-02	0.3429E-02	0.500	0.61704	4.7629	8.2415
BIDAMT	-0.18242E-02	0.2384E-03	-7.651	0.00000	76.547	118.50
INC	0.27763E-05	0.9072E-06	3.060	0.00221	46961.	31081.

****

```
                         Method=NEWTON; Maximum iterations= 25
   Convergence criteria: Gradient=   0.1000000E-03
                         Function  =   0.1000000E-03
                         Parameters=   0.1000000E-03
   Starting values:   0.6218      0.1715E-02 -0.1824E-02  0.2776E-05

==> NEWTON Iterations

 Iteration:   1 Fn=   143.1299
 Param   0.622      0.171E-02-0.182E-02 0.278E-05
 Gradnt   6.52      -8.01       0.507E+04-0.194E+06

 Iteration:   2 Fn=   125.3571
 Param   0.480      0.732E-02-0.757E-02 0.128E-04
 Gradnt  0.911      -3.44        942.    -0.559E+05

 Iteration:   3 Fn=   124.1844
 Param   0.441      0.939E-02-0.960E-02 0.162E-04
 Gradnt  0.243      0.153        148.     0.167E+04

 Iteration:   4 Fn=   124.1535
 Param   0.439      0.973E-02-0.100E-01 0.167E-04
 Gradnt  0.111E-01 0.231E-01  5.08       363.

 Iteration:   5 Fn=   124.1535
 Param   0.440      0.974E-02-0.100E-01 0.167E-04
 Gradnt  0.152E-04 0.385E-04 0.614E-02 0.651
** Gradient has converged.
** Function has converged.
** B-vector has converged.

*******************************************************************************


Multinomial Logit Model
Maximum Likelihood Estimates
Log-Likelihood..............    -124.1535
Restricted (Slopes=0) Log-L.   -153.9843
Chi-Squared ( 3)............    59.66173
Significance Level..........   0.1000000E-06
Variable  Coefficient  Std. Error   t-ratio Prob|t|≥x   Mean of X  Std.Dev.of X
--------------------------------------------------------------------------------
Constant  0.43955      0.3042        1.445  0.14842
TRIPS     0.97397E-02  0.1831E-01    0.532  0.59472   4.7629        8.2415
BIDAMT   -0.10023E-01  0.1792E-02   -5.594  0.00000   76.547        118.50
INC       0.16669E-04  0.5646E-05    2.952  0.00315   46961.        31081.

Frequencies of actual & predicted outcomes
Predicted outcome has maximum probability.

            Predicted

Actual       0      1        TOTAL

  0         42     46          88
  1         12    132         144

TOTAL       54    178         232
```

APPENDIX 8
Sample Data Output File for Chapter 3 Models
(Output File for Camper Models)

```
*-* LIMDEP *-* File created 02/22/96 / 04:39:46


MODEL COMMAND:
DSTAT;RHS=TRIPS,BIDAMT,INC;OUTPUT=2$
Descriptive Statistics
Variable      Mean     Std. Dev.      Skew.   Kurt.   Minimum      Maximum    Cases
TRIPS     6.2750       8.2400         3.185  14.982   0.0000       50.00         80
BIDAMT    69.500       106.39         1.987   6.226    1.000       400.0         80
INC       44656.       28076.         1.244   4.426    5000.     0.1275E+06      80


Correlation Matrix

                1-TRIPS      2-BIDAMT     3-INC

   1-TRIPS       1.0000
   2-BIDAMT     0.29730E-01   1.0000
   3-INC        0.17923E-01 -0.98139E-01   1.0000


MODEL COMMAND:
DSTAT;RHS=INC;OUTPUT=2$
Descriptive Statistics
Variable      Mean     Std. Dev.      Skew.   Kurt.   Minimum      Maximum    Cases
INC       44656.       28076.         1.244   4.426    5000.     0.1275E+06      80

MODEL COMMAND:
LOGIT;LHS=RBID;RHS=ONE,TRIPS,BIDAMT,INC$
Multinomial Logit Model
2 Outcomes: RBID=0   RBID=1
Coefficients for RBID=0   set to ZERO.
Least squares starting values:
Dep. Var. is binary: RBID=1
Variable  Coefficient  Std. Error   t-ratio Prob|t|≥x   Mean of X  Std.Dev.of X
--------------------------------------------------------------------------------
Constant  0.73080       0.9669E-01    7.558  0.00000
TRIPS    -0.39689E-02   0.5428E-02   -0.731  0.46466   6.2750        8.2400
BIDAMT   -0.18080E-02   0.4224E-03   -4.281  0.00002   69.500        106.39
INC       0.32417E-05   0.1600E-05    2.026  0.04277   44656.        28076.

*******************************************************************************

                         Method=NEWTON; Maximum iterations= 25
   Convergence criteria: Gradient=    0.1000000E-03
                         Function  =    0.1000000E-03
                         Parameters=    0.1000000E-03
   Starting values:    0.7308      -0.3969E-02 -0.1808E-02  0.3242E-05

==> NEWTON Iterations

 Iteration:    1 Fn=    44.03599
 Param    0.731     -0.397E-02-0.181E-02 0.324E-05
 Gradnt  -4.24      -7.95      0.101E+04-0.381E+06
```

```
 Iteration:   2 Fn=   37.32600
 Param   0.927     -0.186E-01-0.777E-02 0.168E-04
 Gradnt  -1.43      -7.24       78.7    -0.126E+06

 Iteration:   3 Fn=   36.64949
 Param   0.749     -0.221E-01-0.906E-02 0.276E-04
 Gradnt -0.322      -1.85      -0.680   -0.278E+05

 Iteration:   4 Fn=   36.60856
 Param   0.672     -0.230E-01-0.932E-02 0.314E-04
 Gradnt -0.256E-01-0.157      -0.441    -0.199E+04

 Iteration:   5 Fn=   36.60836
 Param   0.666     -0.231E-01-0.934E-02 0.317E-04
 Gradnt -0.142E-03-0.892E-03-0.268E-02 -10.7
** B-vector has converged.

********************************************************************************

Multinomial Logit Model
Maximum Likelihood Estimates
Log-Likelihood..............   -36.60836
Restricted (Slopes=0) Log-L.   -47.05350
Chi-Squared ( 3)............    20.89029
Significance Level..........   0.1109452E-03
Variable  Coefficient  Std. Error   t-ratio Prob|t|≥x   Mean of X  Std.Dev.of X
--------------------------------------------------------------------------------
Constant  0.66617       0.6452       1.032  0.30187
TRIPS    -0.23108E-01   0.3064E-01  -0.754  0.45077   6.2750        8.2400
BIDAMT   -0.93387E-02   0.2802E-02  -3.333  0.00086   69.500        106.39
INC       0.31679E-04   0.1578E-04   2.007  0.04471   44656.        28076.

Frequencies of actual & predicted outcomes
Predicted outcome has maximum probability.

            Predicted

Actual       0     1         TOTAL

  0         10    12           22
  1          3    55           58

TOTAL       13    67           80


MODEL COMMAND:
DSTAT;RHS=TRIPS,BIDAMT,INC;OUTPUT=2$
Descriptive Statistics
Variable     Mean     Std. Dev.      Skew.   Kurt.   Minimum      Maximum   Cases
TRIPS     3.9671       8.1569        4.506  26.643   0.0000       60.00       152
BIDAMT    80.257       124.58        1.748   4.752    1.000       400.0       152
INC       48174.       32576.        0.717   2.767    5000.     0.1275E+06    152


Correlation Matrix

                1-TRIPS       2-BIDAMT      3-INC

   1-TRIPS       1.0000
   2-BIDAMT     -0.10693       1.0000
   3-INC        -0.36304E-01  0.11563E-01   1.0000
```

```
MODEL COMMAND:
DSTAT;RHS=INC;OUTPUT=2$
Descriptive Statistics
Variable      Mean      Std. Dev.      Skew.   Kurt.   Minimum     Maximum   Cases
INC        48174.       32576.        0.717   2.767    5000.     0.1275E+06   152


MODEL COMMAND:
LOGIT;LHS=RBID;RHS=ONE,TRIPS,BIDAMT,INC$
Multinomial Logit Model
2 Outcomes: RBID=0   RBID=1
Coefficients for RBID=0   set to ZERO.
Least squares starting values:
Dep. Var. is binary: RBID=1
Variable  Coefficient  Std. Error   t-ratio Prob|t|≥x   Mean of X  Std.Dev.of X
--------------------------------------------------------------------------------
Constant  0.56197       0.7097E-01    7.918  0.00000
TRIPS     0.30597E-02   0.4408E-02    0.694  0.48759   3.9671        8.1569
BIDAMT   -0.17765E-02   0.2884E-03   -6.159  0.00000   80.257        124.58
INC       0.27868E-05   0.1097E-05    2.539  0.01111   48174.        32576.

********************************************************************************

                         Method=NEWTON; Maximum iterations= 25
   Convergence criteria: Gradient=   0.1000000E-03
                         Function  =   0.1000000E-03
                         Parameters=   0.1000000E-03
   Starting values:   0.5620      0.3060E-02 -0.1777E-02  0.2787E-05

==> NEWTON Iterations

 Iteration:   1 Fn=   97.92539
 Param   0.562     0.306E-02-0.178E-02 0.279E-05
 Gradnt   10.7    -0.226      0.405E+04 0.184E+06

 Iteration:   2 Fn=   84.37498
 Param   0.230     0.133E-01-0.728E-02 0.123E-04
 Gradnt   1.68    -0.707       878.     0.201E+05

 Iteration:   3 Fn=   83.04538
 Param   0.183     0.155E-01-0.992E-02 0.157E-04
 Gradnt  0.424     0.329       188.     0.140E+05

 Iteration:   4 Fn=   82.96418
 Param   0.182     0.160E-01-0.108E-01 0.164E-04
 Gradnt  0.359E-01 0.443E-01  14.1      0.165E+04

 Iteration:   5 Fn=   82.96371
 Param   0.182     0.161E-01-0.109E-01 0.164E-04
 Gradnt  0.243E-03 0.342E-03 0.891E-01  12.5
** B-vector has converged.

********************************************************************************


Multinomial Logit Model
Maximum Likelihood Estimates
Log-Likelihood..............   -82.96371
Restricted (Slopes=0) Log-L.   -104.0388
Chi-Squared ( 3)............    42.15010
Significance Level..........   0.2997504E-08
```

```
Variable  Coefficient  Std. Error   t-ratio Prob|t|≥x   Mean of X  Std.Dev.of X
-------------------------------------------------------------------------------
Constant  0.18227      0.3589         0.508  0.61154
TRIPS     0.16076E-01  0.2302E-01     0.698  0.48501   3.9671        8.1569
BIDAMT   -0.10869E-01  0.2463E-02    -4.413  0.00001   80.257        124.58
INC       0.16431E-04  0.6457E-05     2.545  0.01093   48174.        32576.

Frequencies of actual & predicted outcomes
Predicted outcome has maximum probability.

            Predicted

Actual        0     1        TOTAL

  0          37    29          66
  1           7    79          86

TOTAL        44   108         152


MODEL COMMAND:
DSTAT;RHS=TRIPS,BIDAMT,INC;OUTPUT=2$
Descriptive Statistics
Variable     Mean     Std. Dev.      Skew.   Kurt.   Minimum     Maximum    Cases
TRIPS     4.7629       8.2415        3.949  21.634   0.0000      60.00        232
BIDAMT    76.547       118.50        1.838   5.237    1.000      400.0        232
INC       46961.       31081.        0.875   3.197    5000.    0.1275E+06     232

 Correlation Matrix

                1-TRIPS       2-BIDAMT     3-INC


   1-TRIPS       1.0000
   2-BIDAMT    -0.69368E-01   1.0000
   3-INC       -0.26273E-01 -0.16559E-01    1.0000



MODEL COMMAND:
DSTAT;RHS=INC,CAMP;OUTPUT=2$
Descriptive Statistics
Variable     Mean     Std. Dev.      Skew.   Kurt.   Minimum     Maximum    Cases
INC        46961.      31081.        0.875   3.197    5000.    0.1275E+06     232
CAMP     0.34483      0.47634        0.652   1.420   0.0000       1.000       232

Correlation Matrix

                1-INC         2-CAMP

   1-INC         1.0000
   2-CAMP      -0.53917E-01   1.0000

MODEL COMMAND:
LOGIT;LHS=RBID;RHS=ONE,TRIPS,BIDAMT,INC$
Multinomial Logit Model
2 Outcomes: RBID=0   RBID=1
Coefficients for RBID=0   set to ZERO.
Least squares starting values:
Dep. Var. is binary: RBID=1
```

```
Variable  Coefficient  Std. Error   t-ratio Prob|t|≥x   Mean of X  Std.Dev.of X
-------------------------------------------------------------------------------
Constant  0.62179       0.5757E-01   10.800  0.00000
TRIPS     0.17148E-02   0.3429E-02    0.500  0.61704   4.7629        8.2415
BIDAMT   -0.18242E-02   0.2384E-03   -7.651  0.00000   76.547        118.50
INC       0.27763E-05   0.9072E-06    3.060  0.00221   46961.        31081.

******************************************************************************

                         Method=NEWTON; Maximum iterations= 25
   Convergence criteria: Gradient=    0.1000000E-03
                         Function  =    0.1000000E-03
                         Parameters=    0.1000000E-03
   Starting values:    0.6218      0.1715E-02 -0.1824E-02  0.2776E-05

==> NEWTON Iterations

 Iteration:    1 Fn=    143.1299
 Param    0.622      0.171E-02-0.182E-02 0.278E-05
 Gradnt   6.52      -8.01       0.507E+04-0.194E+06


 Iteration:    2 Fn=    125.3571
 Param    0.480      0.732E-02-0.757E-02 0.128E-04
 Gradnt  0.911      -3.44        942.     -0.559E+05

 Iteration:    3 Fn=    124.1844
 Param    0.441      0.939E-02-0.960E-02 0.162E-04
 Gradnt  0.243       0.153       148.      0.167E+04

 Iteration:    4 Fn=    124.1535
 Param    0.439      0.973E-02-0.100E-01 0.167E-04
 Gradnt  0.111E-01 0.231E-01  5.08       363.

 Iteration:    5 Fn=    124.1535
 Param    0.440      0.974E-02-0.100E-01 0.167E-04
 Gradnt  0.152E-04 0.385E-04 0.614E-02 0.651
** Gradient has converged.
** Function has converged.
** B-vector has converged.

******************************************************************************

Multinomial Logit Model
Maximum Likelihood Estimates
Log-Likelihood.............     -124.1535
Restricted (Slopes=0) Log-L.    -153.9843
Chi-Squared ( 3)...........      59.66173
Significance Level..........    0.1000000E-06
Variable  Coefficient  Std. Error   t-ratio Prob|t|≥x   Mean of X  Std.Dev.of X
-------------------------------------------------------------------------------
Constant  0.43955       0.3042        1.445  0.14842
TRIPS     0.97397E-02   0.1831E-01    0.532  0.59472   4.7629        8.2415
BIDAMT   -0.10023E-01   0.1792E-02   -5.594  0.00000   76.547        118.50
INC       0.16669E-04   0.5646E-05    2.952  0.00315   46961.        31081.

Frequencies of actual & predicted outcomes
Predicted outcome has maximum probability.

            Predicted

Actual        0     1        TOTAL

  0          42    46          88
  1          12   132         144
```

```
TOTAL        54   178          232

MODEL COMMAND:
DSTAT;RHS=TRIPS,BIDAMT,INC;OUTPUT=2$
Descriptive Statistics
Variable      Mean      Std. Dev.      Skew.    Kurt.    Minimum     Maximum    Cases
TRIPS     6.0313        5.0256         1.647    7.050    0.0000      25.00         32
BIDAMT    78.094        120.45         1.829    5.109     1.000      400.0         32
INC       45391.        28787.         1.128    3.927     5000.     0.1275E+06     32


 Correlation Matrix

                1-TRIPS       2-BIDAMT     3-INC

   1-TRIPS       1.0000
   2-BIDAMT    -0.40017E-02   1.0000
   3-INC        0.19502      -0.81903E-01   1.0000


MODEL COMMAND:
DSTAT;RHS=INC;OUTPUT=2$
Descriptive Statistics
Variable      Mean      Std. Dev.      Skew.    Kurt.    Minimum     Maximum    Cases
INC       45391.        28787.         1.128    3.927     5000.     0.1275E+06    32


MODEL COMMAND:
LOGIT;LHS=RBID;RHS=ONE,TRIPS,BIDAMT,INC$
Multinomial Logit Model
2 Outcomes: RBID=0   RBID=1
Coefficients for RBID=0   set to ZERO.
Least squares starting values:
Dep. Var. is binary: RBID=1
Variable  Coefficient  Std. Error   t-ratio Prob¦t¦≥x   Mean of X  Std.Dev.of X
--------------------------------------------------------------------------------
Constant  0.66964       0.1478        4.531  0.00001
TRIPS     0.13665E-02   0.1358E-01    0.101  0.91986   6.0313        5.0256
BIDAMT   -0.17663E-02   0.5577E-03   -3.167  0.00154   78.094        120.45
INC       0.46277E-05   0.2379E-05    1.945  0.05177   45391.        28787.

*******************************************************************************

                         Method=NEWTON; Maximum iterations= 25
   Convergence criteria: Gradient=    0.1000000E-03
                         Function  =    0.1000000E-03
                         Parameters=    0.1000000E-03
   Starting values:    0.6696       0.1367E-02 -0.1766E-02  0.4628E-05

==> NEWTON Iterations

 Iteration:    1 Fn=    16.50234
 Param   0.670      0.137E-02-0.177E-02 0.463E-05
 Gradnt  -2.34      -18.3        462.     -0.214E+06

 Iteration:    2 Fn=    12.27630
 Param   0.599      0.547E-02-0.774E-02 0.251E-04
 Gradnt  -1.05      -8.20        22.2     -0.950E+05

 Iteration:    3 Fn=    10.86491
 Param  -0.298E-01 0.583E-02-0.100E-01 0.547E-04
 Gradnt -0.524      -4.11       -7.04     -0.400E+05
```

```
Iteration:   4 Fn=    10.35075
Param  -0.624      0.224E-01-0.122E-01 0.826E-04
Gradnt -0.200      -1.59      -2.81     -0.119E+05

Iteration:   5 Fn=    10.28246
Param  -0.896      0.393E-01-0.135E-01 0.958E-04
Gradnt -0.313E-01-0.236      -0.374     -0.159E+04

Iteration:   6 Fn=    10.28109
Param  -0.936      0.423E-01-0.137E-01 0.979E-04
Gradnt -0.748E-03-0.533E-02-0.936E-02 -35.0

Iteration:   7 Fn=    10.28109
Param  -0.937      0.424E-01-0.137E-01 0.980E-04
Gradnt -0.376E-06-0.258E-05-0.554E-05-0.171E-01
** Gradient has converged.
** Function has converged.
** B-vector has converged.

*******************************************************************************
```

```
Multinomial Logit Model
Maximum Likelihood Estimates
Log-Likelihood..............   -10.28109
Restricted (Slopes=0) Log-L.   -17.99472
Chi-Squared ( 3)............    15.42727
Significance Level..........   0.1485639E-02
```

Variable	Coefficient	Std. Error	t-ratio	Prob¦t¦≥x	Mean of X	Std.Dev.of X
Constant	-0.93670	1.480	-0.633	0.52686		
TRIPS	0.42359E-01	0.1776	0.239	0.81149	6.0313	5.0256
BIDAMT	-0.13703E-01	0.5510E-02	-2.487	0.01289	78.094	120.45
INC	0.97969E-04	0.4746E-04	2.064	0.03898	45391.	28787.

Frequencies of actual & predicted outcomes
Predicted outcome has maximum probability.

	Predicted		
Actual	0	1	TOTAL
0	6	2	8
1	1	23	24
TOTAL	7	25	32

MODEL COMMAND:
DSTAT;RHS=TRIPS,BIDAMT,INC;OUTPUT=2$
Descriptive Statistics

Variable	Mean	Std. Dev.	Skew.	Kurt.	Minimum	Maximum	Cases
TRIPS	6.4375	9.8692	2.936	11.744	0.0000	50.00	48
BIDAMT	63.771	96.815	2.016	6.772	1.000	400.0	48
INC	44167.	27888.	1.313	4.703	5000.	0.1275E+06	48

```
 Correlation Matrix

              1-TRIPS      2-BIDAMT     3-INC

   1-TRIPS      1.0000
   2-BIDAMT     0.50010E-01   1.0000
   3-INC       -0.41551E-01 -0.11577       1.0000


MODEL COMMAND:
DSTAT;RHS=INC;OUTPUT=2$
Descriptive Statistics
Variable     Mean      Std. Dev.      Skew.   Kurt.   Minimum    Maximum    Cases
INC        44167.       27888.        1.313   4.703    5000.    0.1275E+06    48


MODEL COMMAND:
LOGIT;LHS=RBID;RHS=ONE,TRIPS,BIDAMT,INC$
Multinomial Logit Model
2 Outcomes: RBID=0   RBID=1
Coefficients for RBID=0   set to ZERO.
Least squares starting values:
Dep. Var. is binary: RBID=1
Variable  Coefficient  Std. Error   t-ratio Prob|t|≥x   Mean of X  Std.Dev.of X
-------------------------------------------------------------------------------
Constant  0.77128       0.1335        5.778  0.00000
TRIPS    -0.51367E-02   0.6271E-02   -0.819  0.41272   6.4375       9.8692
BIDAMT   -0.18941E-02   0.6430E-03   -2.946  0.00322   63.771       96.815
INC       0.20584E-05   0.2231E-05    0.922  0.35628   44167.       27888.

*******************************************************************************

                        Method=NEWTON; Maximum iterations= 25
   Convergence criteria: Gradient=   0.1000000E-03
                        Function  =   0.1000000E-03
                        Parameters=   0.1000000E-03
   Starting values:   0.7713     -0.5137E-02 -0.1894E-02  0.2058E-05

==> NEWTON Iterations

 Iteration:   1 Fn=   27.34112
 Param   0.771    -0.514E-02-0.189E-02 0.206E-05
 Gradnt  -1.91      10.1       552.    -0.167E+06

 Iteration:   2 Fn=   24.25187
 Param    1.14    -0.230E-01-0.810E-02 0.103E-04
 Gradnt -0.527     -2.29      51.2     -0.427E+05

 Iteration:   3 Fn=   24.13156
 Param    1.12    -0.240E-01-0.924E-02 0.145E-04
 Gradnt -0.486E-01-0.201       2.49    -0.449E+04

 Iteration:   4 Fn=   24.13028
 Param    1.11    -0.242E-01-0.932E-02 0.152E-04
 Gradnt -0.767E-03-0.328E-02-0.139E-02 -70.0

 Iteration:   5 Fn=   24.13028
 Param    1.11    -0.242E-01-0.932E-02 0.152E-04
 Gradnt -0.181E-06-0.809E-06-0.296E-05-0.163E-01
** Gradient has converged.
** Function has converged.
** B-vector has converged.

*******************************************************************************
```

```
Multinomial Logit Model
Maximum Likelihood Estimates
Log-Likelihood..............   -24.13028
Restricted (Slopes=0) Log-L.   -28.97459
Chi-Squared ( 3)............    9.688622
Significance Level..........   0.2140713E-01
Variable  Coefficient  Std. Error   t-ratio Prob|t|≥x   Mean of X  Std.Dev.of X
-------------------------------------------------------------------------------
Constant   1.1111       0.8008        1.387  0.16531
TRIPS     -0.24203E-01  0.3160E-01   -0.766  0.44367   6.4375        9.8692
BIDAMT    -0.93206E-02  0.3953E-02   -2.358  0.01837   63.771        96.815
INC        0.15170E-04  0.1607E-04    0.944  0.34518   44167.        27888.

Frequencies of actual & predicted outcomes
Predicted outcome has maximum probability.

            Predicted

Actual       0     1        TOTAL

  0          6     8           14
  1          2    32           34

TOTAL        8    40           48




MODEL COMMAND:
DSTAT;RHS=TRIPS,BIDAMT,INC;OUTPUT=2$
Descriptive Statistics
Variable      Mean      Std. Dev.      Skew.   Kurt.   Minimum      Maximum   Cases
TRIPS     3.7391        6.4958      4.158  24.891   0.0000       45.00        69
BIDAMT    80.609        128.64      1.740   4.596    1.000       400.0        69
INC       53333.        34632.      0.632   2.575    5000.     0.1275E+06     69

Correlation Matrix

               1-TRIPS       2-BIDAMT     3-INC

   1-TRIPS      1.0000
   2-BIDAMT   -0.67089E-01   1.0000
   3-INC       0.52296E-01  0.90811E-01   1.0000

MODEL COMMAND:
DSTAT;RHS=INC;OUTPUT=2$
Descriptive Statistics
Variable      Mean      Std. Dev.      Skew.   Kurt.   Minimum      Maximum   Cases
INC       53333.        34632.      0.632   2.575    5000.     0.1275E+06     69

MODEL COMMAND:
LOGIT;LHS=RBID;RHS=ONE,TRIPS,BIDAMT,INC$
Multinomial Logit Model
2 Outcomes: RBID=0   RBID=1
Coefficients for RBID=0   set to ZERO.
Least squares starting values:
Dep. Var. is binary: RBID=1
```

Variable	Coefficient	Std. Error	t-ratio	Prob¦t¦≥x	Mean of X	Std.Dev.of X
Constant	0.60127	0.1067	5.637	0.00000		
TRIPS	0.11811E-01	0.8370E-02	1.411	0.15824	3.7391	6.4958
BIDAMT	-0.16993E-02	0.4239E-03	-4.009	0.00006	80.609	128.64
INC	0.13360E-05	0.1573E-05	0.849	0.39567	53333.	34632.

****

```
                         Method=NEWTON; Maximum iterations= 25
   Convergence criteria: Gradient=    0.1000000E-03
                         Function  =   0.1000000E-03
                         Parameters=   0.1000000E-03
   Starting values:   0.6013       0.1181E-01 -0.1699E-02  0.1336E-05

==> NEWTON Iterations

 Iteration:    1 Fn=    44.09976
 Param    0.601      0.118E-01-0.170E-02 0.134E-05
 Gradnt   4.12      -17.0       0.180E+04 0.164E+06

 Iteration:    2 Fn=    38.27961
 Param    0.388      0.592E-01-0.695E-02 0.577E-05
 Gradnt   0.517     -8.01       334.      0.207E+05

 Iteration:    3 Fn=    37.72419
 Param    0.320      0.957E-01-0.897E-02 0.673E-05
 Gradnt   0.917E-01 -1.65       63.1      0.494E+04

 Iteration:    4 Fn=    37.69494
 Param    0.307      0.107     -0.955E-02 0.687E-05
 Gradnt   0.560E-02-0.813E-01  3.89       344.

 Iteration:    5 Fn=    37.69483
 Param    0.306      0.108     -0.959E-02 0.687E-05
 Gradnt   0.306E-04-0.205E-03 0.169E-01  1.92
** Gradient has converged.
** B-vector has converged.
```

****

Multinomial Logit Model
Maximum Likelihood Estimates
Log-Likelihood.............. -37.69483
Restricted (Slopes=0) Log-L. -46.94659
Chi-Squared (3)............ 18.50352
Significance Level.......... 0.3462485E-03

Variable	Coefficient	Std. Error	t-ratio	Prob¦t¦≥x	Mean of X	Std.Dev.of X
Constant	0.30614	0.5435	0.563	0.57326		
TRIPS	0.10768	0.7638E-01	1.410	0.15856	3.7391	6.4958
BIDAMT	-0.95939E-02	0.3257E-02	-2.945	0.00323	80.609	128.64
INC	0.68725E-05	0.8430E-05	0.815	0.41496	53333.	34632.

Frequencies of actual & predicted outcomes
Predicted outcome has maximum probability.

	Predicted		
Actual	0	1	TOTAL
0	16	13	29
1	2	38	40
TOTAL	18	51	69

```
MODEL COMMAND:
DSTAT;RHS=TRIPS,BIDAMT,INC;OUTPUT=2$
Descriptive Statistics
Variable      Mean      Std. Dev.        Skew.    Kurt.    Minimum      Maximum    Cases
TRIPS      4.1566        9.3515         4.319   23.354    0.0000       60.00          83
BIDAMT     79.964        121.90         1.741    4.818     1.000       400.0          83
INC        43886.        30306.         0.727    2.728     5000.     0.1275E+06       83


 Correlation Matrix

                1-TRIPS       2-BIDAMT      3-INC

   1-TRIPS       1.0000
   2-BIDAMT     -0.13464       1.0000
   3-INC        -0.90707E-01 -0.68177E-01   1.0000


MODEL COMMAND:
DSTAT;RHS=INC;OUTPUT=2$
Descriptive Statistics
Variable      Mean      Std. Dev.        Skew.    Kurt.    Minimum      Maximum    Cases
INC        43886.        30306.         0.727    2.728     5000.     0.1275E+06     83


MODEL COMMAND:
LOGIT;LHS=RBID;RHS=ONE,TRIPS,BIDAMT,INC$
Multinomial Logit Model
2 Outcomes: RBID=0   RBID=1
Coefficients for RBID=0   set to ZERO.
Least squares starting values:
Dep. Var. is binary: RBID=1
Variable  Coefficient  Std. Error   t-ratio Prob|t|≥x   Mean of X  Std.Dev.of X
--------------------------------------------------------------------------------
Constant  0.51543       0.9779E-01    5.271  0.00000
TRIPS     0.13052E-03   0.5216E-02    0.025  0.98004   4.1566        9.3515
BIDAMT   -0.17950E-02   0.3994E-03   -4.494  0.00001   79.964        121.90
INC       0.41421E-05   0.1598E-05    2.591  0.00956   43886.        30306.

********************************************************************************

                         Method=NEWTON; Maximum iterations= 25
   Convergence criteria: Gradient=   0.1000000E-03
                         Function  =    0.1000000E-03
                         Parameters=    0.1000000E-03
   Starting values:   0.5154      0.1305E-03 -0.1795E-02  0.4142E-05

==> NEWTON Iterations

 Iteration:   1 Fn=   53.30624
 Param   0.515     0.131E-03-0.179E-02 0.414E-05
 Gradnt   6.57      16.2      0.226E+04 0.189E+05

 Iteration:   2 Fn=   44.40755
 Param   0.212E-01 0.510E-03-0.736E-02 0.186E-04
 Gradnt  0.933     -1.57       567.    -0.122E+05

 Iteration:   3 Fn=   43.08584
 Param  -0.570E-01 0.263E-02-0.110E-01 0.245E-04
 Gradnt  0.307     -0.197      155.     0.275E+04

 Iteration:   4 Fn=   42.93716
 Param  -0.793E-01 0.356E-02-0.128E-01 0.269E-04
 Gradnt  0.404E-01-0.235E-01  18.0      723.
```

```
 Iteration:   5 Fn=   42.93488
 Param  -0.822E-01 0.371E-02-0.131E-01 0.272E-04
 Gradnt  0.699E-03-0.384E-03 0.287      15.2

 Iteration:   6 Fn=   42.93488
 Param  -0.822E-01 0.371E-02-0.131E-01 0.272E-04
 Gradnt  0.186E-06-0.870E-07 0.733E-04 0.442E-02
** Gradient has converged.
** Function has converged.
** B-vector has converged.

****************************************************************************

Multinomial Logit Model
Maximum Likelihood Estimates
Log-Likelihood..............   -42.93488
Restricted (Slopes=0) Log-L.   -57.04230
Chi-Squared ( 3)............    28.21485
Significance Level..........   0.3273041E-05
Variable  Coefficient  Std. Error   t-ratio Prob|t|≥x   Mean of X  Std.Dev.of X
-------------------------------------------------------------------------------
Constant -0.82198E-01   0.5012       -0.164  0.86973
TRIPS     0.37076E-02   0.2529E-01    0.147  0.88346    4.1566        9.3515
BIDAMT   -0.13076E-01   0.3984E-02   -3.282  0.00103    79.964        121.90
INC       0.27185E-04   0.1058E-04    2.570  0.01017    43886.        30306.

Frequencies of actual & predicted outcomes
Predicted outcome has maximum probability.

            Predicted

Actual        0     1       TOTAL

  0          25    12         37
  1           4    42         46

TOTAL        29    54         83
```

VITA

Dylan Henry Jenkins was born on October 22, 1969 in Lancaster, Pennsylvania to Kay Elaine Shenk and Stanley Robert Jenkins. He earned his bachelor of science in Forest Resource Management in 1993 from Clemson University and his master of science in Forest Management and Economics in 1996 from Virginia Tech. He is engaged to Margaret Elizabeth Sternfels of Edgewater, Maryland.