# Forest owners' willingness to accept compensation for voluntary conservation: A contingent valuation approach

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**Abstract**

To avoid conflicts often associated with mandatory regulations, it is crucial to motivate and incentivize forest owners to participate in voluntary conservation programs. To investigate forest owner preferences and willingness to accept compensation (WTA) to participate, we conduct a contingent valuation survey of non-industrial private forest owners in Norway. We find that WTA is negatively related to the size of the forest holding and absentee ownership, and positively related to the share of the forest classified as productive. The overall mean WTA per year per hectare is estimated at NOK 1800. Costs of reaching conservation goals can be saved by targeting small and relatively less productive forests and absentee owners first, before considering increasingly expensive forest areas. However, this recommendation only holds if desirable biological characteristics are not substantially less likely to be found in such areas. Results are potentially important both for our understanding of forest owner preferences and the costs of voluntary forest conservation schemes currently in use in many countries.

**Keywords:** forest, voluntary conservation, biodiversity, compensation, willingness to accept, contingent valuation.

**JEL codes:** Q23, Q28, Q51

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## Introduction

There is growing concern in the environmental economics literature that public benefits from forests are underprovided in current forest management regimes and need to be increased through policy measures that stimulate conservation. Forest economists, on the other hand, have traditionally been more concerned about understanding harvesting decisions in light of the (perceived) shortages of timber and the decline of traditional family forestry in the western world (Voukun et al., 2006), hence proposing various government support programs to increase forestry activity (Fischer et al., 2010). The non-industrial private forest (NIPF) owners are in the midst of these partly opposing foci of forest and environmental economics. They have always been important for forestry and provision of non-timber benefits in the Scandinavian countries as well as in the USA and are at the receiving end of a number of environmental and forestry motivated programs (see e.g. forest economics reviews by Amacher, 2003; Beach et al., 2005).

While increased conservation on private lands were originally done through mandatory regulation, i.e. land restrictions or relinquishment of property and user rights, large conflicts erupted between NIPF owners and the government over this approach in many countries. Instead, more emphasis is now put on voluntary programs to incentivize forest owners either to set aside land as reserves or to promote more environmentally sensitive forestry, i.e. various forms of payment for ecosystem service (PES) schemes. There is a growing literature that analyzes what motivates forest owners to participate in such programs, based on either hypothetical survey (contingent participation) data or on actual enrollment data (see e.g. Suter et al., 2008 and Langpap, 2004 for overviews). More recently, both strands of enviromental and forest economics have adopted the stated preference techniques of contingent valuation (CV) and choice experiments (CE) to analyze forest owners' minimum willingness to accept (WTA) compensation to participate in various programs.

As NIPF owners[1] typically have broader motivations than maximizing profits and therefore would not require full compensation for lost income due to conservation activities (Raunikar and Buongiorno, 2006), knowledge about WTA is important in the cost-effective targeting of conservation programs. Authorities with knowledge of the factors that determine WTA can utilize this to conserve more or biologically better forest land for the same, scarce conservation budget. Knowledge of mean WTA per hectare is also useful as a basis for deriving ballpark measures of the costs of various conservation targets (e.g. percentage conserved), which in turn can be compared with willingness to pay for conservation benefits.

The aim of this paper is to contribute to this emerging literature by investigating NIPF owners' WTA for participating in the nationwide voluntary conservation program in Norway, using a CV approach. Related studies using CV include Bateman et al. (1996) and Buckley et al. (2009) who investigate landowners' WTA to establish recreational woodlands or provide public access in England and Ireland, respectively, Amigues et al.'s (2002) and Kline et al.'s (2000) studies of landowners' WTA for protection of riparian habitat in France and the USA, respectively, and finally, Kilgore et al's (2008) and Sullivan et al.'s (2005) investigation of WTA and enrollment in forest stewardship and banking programs in the USA.[2] In Scandinavia, the only study we are aware of is Layton and Siikimäki's (2009) analysis of forest owner enrollment in a Finnish conservation program.[3] Compared to these studies, we attempt to link WTA more directly to welfare measurement in environmental economics, include a richer set of variables in our empirical analysis, and make a novel contribution to the analysis of Scandinavian NIPF owners' preferences and WTA for conservation. In the next

[1] A closely related literature investigates the motivations of farmers beyond profit maximisation, starting with the pioneering work by Gasson (1973).

[2] A few recent papers have used CE instead of CV to investigate forest owner preferences and WTA for different forest conservation programs (see e.g. Horne, 2006; Matta et al., 2009; Sorice et al., 2011).

[3] Another Finnish study by Mäntymaa et al. (2009) investigates factors influencing actual compensation claims, combined with some information, other than WTA, from survey data.

section we give a brief explanation of the voluntary forest conservation program, before clarifying theoretically how WTA can be defined. We then report the analysis and results of a CV survey of NIPF owners in the 10 counties of the Southern part of Norway, the main area of future expansion of forest conservation. In the final section we offer some conclusions.

**The voluntary forest conservation program in Norway**

Currently, around 2.5 percent of Norwegian productive forests are conserved in strict forest reserves, where no forestry is allowed. Hunting, fishing, sustainable harvesting of berries, mushrooms etc. and recreation are generally still permitted. According to an authoritative biological assessment, at least 4.6 percent of the productive forest area should be protected to satisfy public policy goals (Framstad et al., 2002). Due to the high conflict levels in the 1990s, the national forest owner association proposed in 2000 a new voluntary conservation program instead, where forest owners first take the initiative to report areas available for protection to the county government. The next step is a negotiation process, where compensation (usually in the form of a one-time payment), specific area and terms for the reserve are agreed. The ownership of the reserve remains with the forest owner, but he relinquishes all rights to extractive activities for perpetuity. The rules of compensation are quite similar between the old mandatory scheme and the new voluntary approach.[4] However, the main difference seems to lie in the process and the voluntariness. Enrolling sufficient NIPF owners in the scheme will be crucial to achieving conservation objectives.

**Analytical framework for WTA**

A NIPF owner, who derives utility from both non-timber amenities and all other goods (including timber values), is assumed to have the following indirect utility function:

(1) $V( P, I(F), Q(F), X )$,

[4] The information about the compensation amounts paid is currently not public.

where F is the owner's forest stock in his possession, P is the prices of goods, I(F) is his income including monetary benefits from the forest stock F, Q(F) is the non-timber, non-market quality level from the stock F, X is a vector of owner's characteristics that may influence his utility.[5] The literature suggests that the hectares enrolled in the program are not perfect substitutes in utility terms with the hectares not enrolled (Sullivan et al., 2005). For example, the forest owner can enjoy both the amenity benefits of his remaining stand and the enrolled stand. To this end, we modify our model as $F = (F_{IH}, F_C)$, where $F_{IH}$ is the owner's stocks in hand and $F_C$ is the stocks enrolled in the program. A few points can be noted from our model. I(F) captures the owner's monetary benefits from his forest stock through any kind of market activities, including timber production, sales of hunting rights, and investment activities. Q(F) provides the owner non-monetary benefits from the stock through any kind of non-market activities, including enjoying amenities and preferences for the exisistence of the forest stock (e.g. related to his own use and enjoyment of the forest). Note that I(F) is already measured in monetary terms while Q(F) is not. This modeling assumes that the owner enjoys only his private forest stock but not other forests, including neighbors'. This implies that the model ignores the public goods perspective of the forest though the effect of Q(F) on the owner's utility could capture his preference for conserving his forest for the public benefits. We consider a (discrete) change in the owner's forest stock from its present stock level $F_0 = (F, 0)$ to a level with a program enrollment $F_1 = (F - F_C, F_C)$, where $F_C$ is five dekar[6] in our survey. We can define NIPF owner's compensation claim (WTA) to enroll $F_C$ (five dekar) of his forest F as the compensating welfare measure using the indirect utility function (1)[7]:

(2) $V( P, I(F_0), Q(F_0), X ) = V( P, I(F_1) + WTA, Q(F_1), X )$,

[5] We do not specify I(F) and Q(F) here for simplicity and generality although I(F) and Q(F) can be functions of a vector of owner characteristics and his forest characteristics. Instead, we assume that X is a set of variables, which directly shift his utility, but not through I(F) and Q(F). We will discuss this later in this section.

[6] "Dekar" is a common area unit for forestry in Norway, corresponding to 0.1 hectares.

[7] We assume for simplicity that transaction costs and other costs not related to loss of timber values from enrolling are zero.

(3) $WTA = CS_Q + \Delta I$,

where $CS_Q$ is the compensating surplus for a change in the non-market component of the forest, defined as $V( P, I(F_0), Q(F_0), X ) = V( P, I(F_0) + CS_Q, Q(F_1), X )$, and $\Delta I = I(F_0) - I(F_1) \geq 0$ is the income loss from giving up forestry activities.

*Table 1 The sign of WTA to enroll in a program*

| | $I(F_0) > I(F_1)$ | $I(F_0) = I(F_1)$ | WTA vs. $\Delta I$ |
|---|---|---|---|
| $Q(F_0) > Q(F_1)$ | $CS_Q + \Delta I > 0$ | $CS_Q > 0$ | $WTA > \Delta I$ |
| $Q(F_0) = Q(F_1)$ | $\Delta I > 0$ | 0 | $WTA = \Delta I$ |
| $Q(F_0) < Q(F_1)$ | $CS_Q + \Delta I >/=/< 0$ | $CS_Q$ (=WTP) $< 0$ | $WTA < \Delta I$ |

As summarized in Table 1, our model suggests that the size and sign of WTA to enroll in the program depend both on the market, timber component $\Delta I$ (i.e. income loss due to restrictions on the enrolled forest) and the non-market, non-timber component $CS_Q$ (i.e. this is a standard non-market value in environmental economics). The market component $\Delta I$ is in the typical case positive (i.e. income loss), especially if there are timber production activities in the forest $F_C$. However, $\Delta I$ can also be zero if the forest $F_C$ is located in a remote and steep location too costly to harvest at current prices.[8] The size and sign of the non-market component $CS_Q$ depend on the relationship between amenity values without the program enrollment $Q(F, 0)$ and with the enrollment $Q(F - F_C, F_C)$. In the case where certain forest amenities or non-timber benefits as experienced by the forest owner are reduced with $F_C$ (e.g. if some valued acticities, such as wood collection, are banned), i.e. $Q(F_0) > Q(F_1)$, then the WTA will be higher than the loss in timber revenue $\Delta I$. Hence, extra compensation over and above the loss in timber revenues is required. If the conservation program significantly increases the forest quality of $F_C$, the more likely case, the owner can be willing to pay for the improvement, i.e. $Q(F_0) < Q(F_1)$. In this case, the owner will demand a compensation which is lower than the reduction in timber income. As noted, in some cases, the forest owner may not experience

[8] Even in this case $\Delta I$ may still be positive, if owners evaluate the loss of future income opportunity, i.e. loss of option value.

income loss from conservation. Likewise, the forest may currently be conserved in practice without compensation, i.e. forest amenities may not change if the forest is formally protected. In this case WTA (the compensation claim) would effectively be zero. Equation (2) is a simplification to clarify the main trade-off the forest owner needs to make and to bring out the similarity with standard environmental valuation approaches, that typically define willingness to pay (WTP) for an environmental improvement by the general public using the indirect utility function.[9] Note that our current model does not explicitly incorporate uncertainty, the irreversibility, and/or the time dimension of the decision to enroll land in a permanent conservation program.[10] By rearranging equation (2), WTA can be defined as a function of the other variables in the model. The bid function, b, can be written in general form as:

(4) $WTA = b( Q(F_0), Q(F_1), I(F_0), I(F_1), P, X )$.

Equations (3) and (4) provide the basic theoretical framework for analysis of our data. The non-market component $CS_Q$ (which is a function of Q and X) suggests that the owner's WTA can be correlated with a subset of owner characteristics (e.g. demographic characteristic such as age, gender, and income and subjective attitudinal factors) and plot/resource conditions (e.g. the presence of endangered species). The market component $\Delta I$ suggests that WTA can be correlated with a subset of market drivers (e.g. subjective economic importance of timber sale) and plot/resource conditions (e.g. the timber stocks). Also, WTA can be shifted directly by some owner characteristics and policy variables (e.g. the design characteristics of the program other than the compensation level). To sum up, we re-organize variables in equation (4) into four main sets[11], leading to an empirical specification of the WTA function:

[9] Note that WTA a negative change (in the eyes of the forest owners) is the correct approach, rather than WTP to avoid the change, since the rights to the status quo situation reside by tradition with the forest owner.

[10] See e.g. Gadaud and Rambonilaza (2010) for a discussion about WTA and option price.

[11] These categories are consistent with those from Beach et al. (2005) and Conway et al. (2004). Note that Conway et. al. (2004) and Vokun et al. (2006) study the opposite problem: forest owners' WTA (reservation prices) to harvest timber. It is likely that the WTA to harvest can be explained by many of the same variables, except with the opposite signs.

(5) $WTA = g(PR, OC, PV, MD, e_{WTA})$,

where PR is a vector of plot/resource conditions, OC a vector of owner characteristics, PV is a vector of policy variables, MD is a vector of market drivers, and the error term $e_{WTA}$ is a part of WTA that is unobservable by researchers.

**Survey design and administration**

A 10-page CV questionnaire was developed consisting of four main sections, three of which were utilized for this paper. The first section contained questions about the forest property and ownership, and the economic importance of various income-generating activities. The second part consisted of questions related to voluntary conservation and WTA. There was first a brief description of the voluntary program, where we did not specify how exactly compensations are calculated to avoid respondents anchoring on this information. A subsample received a slightly different wording of the information and the WTA question, suggesting a public tendering process (auction) instead of the standard voluntary conservation process.[12] This was included to test forest owners' preferences for the program design. Immediately following this was a question about whether the forest owner would consider enrolling the whole or parts of the forest given sufficient compensation. If so, there were questions about approximate share of the total forest property to enrol and questions zooming in on the characteristics of that parcel in terms of harvesting costs, richness in timber and presence of 10 key biological characteristics.[13] The respondents indicated whether or not they knew of the presence any of the 10 characteristics. We have comparatively more information about forest characteristics than previous studies (e.g. Kline et al. 2000).

[12] The two versions of the full survey are available from the authors upon request.

[13] These were: Old trees/tree clusters; rough terrain unharvested over the last 120 years; river canyons; more dead wood than usual in similar forest type; known redlist species; higher presence of deciduous trees than usual; presence of fields and old agricultural landscapes; places where large birds commonly mate; nesting birds of prey; and cultural heritage.

Following these questions, was an open-ended WTA question (see appendix), aided by a payment card[14], asking about the minimum compensation per five dekar as an annual payment for eternity to set aside the forest for reserve. The annual payment was chosen over one-time payment (as is the common form of compensation in practice) to make it easier for the forest owner to come up with a WTA response.[15] The respondent was prompted to consider what he would have been willing to pay for an equivalent property to help the thought process. It was also made clear that the answer would not be used to estimate compensation for this forest in particular, to remove any worries about our intentions and breach of anonymity. A payment card WTA question was chosen over the dichotomous choice format to preserve data efficiency. For the valuation question, there is one notable difference compared to standard CV in environmental valuation. Normally, the environmental change is identical for all respondents. In our survey, on the other hand, repondents are considering their own property in particular, which may vary between owners along many different dimensions. Hence, it is impossible to know whether WTA vary due to differences in preferences or in important underlying characteristics of the forest land. As a solution to this problen, we chose to ask questions giving us information about characteristics of the forest, so that these could to some extent be controlled for.[16] In addition, our survey data were merged with forest tax records that contained some basic information (see below). The WTA section closed with questions about how respondents came up with the WTA response, why/why not they were willing to participate in the program and attitude and opinion questions about voluntary conservation and alternative instruments. The final section contained background information about the

[14] Amounts ranging from NOK 0 to 2000 (inlcuding "don't know" at the end and an option to state more than 2000) on a non-linear scale were chosen in consultation with forestry experts to cover typical rents from timber. 8 NOK equal ca 1 Euro.

[15] When the one-time compensation is calculated in voluntary forest conservation, the amount is also based on a discounted stream of lost timber revneues into the future.

[16] Another solution, that may be more problematic in our view, is to phrase the WTA question in such a way that the forest characteristics are standardized to some extent, e.g. "suppose that you had mature hardwood forests right now on your property.." (as in Voukun et al., 2006:242).

forest owners and their households. Early versions of the survey instrument was tested in two video-taped focus groups and pilot tested by the survey firm TNS Gallup. Only small changes were required to make the questionnaire fully suitable for use.

The sample frame was an official list with names and contact information of all forest owners obtained from the government forest tax records. All forest properties located in the ten counties in southern, middle and eastern Norway larger than 25 hectares were selected, and connected to a total of 24,897 NIPF forest owners with mail addresses. 2007 forest owners were then randomly drawn from this adjusted list and questionnaire and a cover letter mailed in November 2007. After eliminating the unusable questionnaires, the overall adjusted response rate was 38.5 percent. This is a bit low, but comparable to other WTA surveys (e.g. the ca 30 percent in Amigues et al., 2002 and Sullivan et al., 2005). An analysis of non-response bias was conducted. As reported in Nybakk et al. (2009), which utilized another part of the data from the questionnaire, the final sample did not differ significantly along the dimensions of municipality location, type of land owned (agricultural, forest and other) or size of the forest land.[17] Analysis of a telephone survey of 962 non-respondents showed signs of higher education and lower age among respondents compared to non-respondents. For simplicity and in line with Nybakk et al. (2009) we decided not to weight the data.

## Analysis and results

### *Econometric modelling approach*

Based on the theoretical framework outlined above, we assume that a representative NIPF owner *i* has his true compensation claim (i.e. WTA) $wta_i$ for enrolling in the program, which is influenced by a vector of explanatory variables $x_i$ suggested in equation (5). We assume a normal distribution for WTA, i.e. $wta_i = x_i'\beta + \varepsilon_i$, where $\beta$ is a vector of parameters and $\varepsilon_i$ is

[17] This was information we had for all owners in the sample frame.

an independently and normally distributed error term with mean zero and standard deviation $\sigma$. Since our payment card data presumably reflects an interval within which the true WTA value lies, we employ an interval regression approach to estimate the true underlying value (Cameron and Huppert, 1989). When $wta_i$ is found in the interval between the lower limit $lwta_i$ and the upper limit $uwta_i$ given by the adjacent payment card values, the probability that the WTA value falls within the reported interval is given by: $\Pr( lwta_i < wta_i < uwta_i ) = \Pr ( L_i < z_i < U_i ) = \Phi(U_i) - \Phi(L_i)$, where $z_i$ is the standard normal random variable, $L_i = ( lwta_i - x_i'\beta ) / \sigma$, $U_i = ( uwta_i - x_i'\beta ) / \sigma$, $\Phi$ is the cumulative standard normal density function. The maximum likelihood estimation is employed to estimate the parameters $\beta$ and $\sigma$. The estimated mean and median WTA is computed as $x_i'\beta$.

*Variables and descriptive statistics*

Table 2 presents the main variables used for empirical analysis, their definition, and mean and standard deviation. The PR variables include the total size of the forest (which is different from the enrolled size, "Enrollsize"), estimated share of productive forest, and two indicators of whether there are registered biodiversity hotspots and significant amounts of deadwood compared to similar forest types.[18] Owner characteristics include similar types of variables to standard CV studies. We include a variable that specifies whether the owner is located in the local area or is an absentee owner. We also have dummies specifying membership in various organizations that indicate specific preferences. The three PC variables include whether or not the program is framed as an auction and whether there are expectations that owners will benefit (beyond compensation), e.g. through activities in the buffer zone of the reserve. The enrolled forest size is also included in this category. Of MD variables, we have rated

[18] As noted, we had a 10 different special features forest owners were asked to indicate. There was some item-non response and don't know answers to these questions (average " don't know" ca 14 percent). The share of "don't know" was higher for presence of red list species and nesting birds of prey. Since deadwood is an important biodiversity indicator and there was relatively low item-non-response and "don't know" for this feature, we included this in the further analysis.

importance of timber and recreational income-generation activities.[19] 48 percent answered that they did not want to participate, even if given adequate compensation. 373 subsequently answered the WTA question of which 35 percent answered "don't know" and were therefore removed from further analysis.[20] For comparison, in Amigues et al. (2002), 40 percent agreed to participate in habitat preservation, while only 18-19 percent had a non-zero WTA.

*Table 2 Definition of explanatory variables and descriptive statistics*[#]

| Variable | Description | Mean | Std. Dev. |
|---|---|---|---|
| ***DV: Dependent Variables*** | | | |
| WTA | WTA to enrol (the mid interval) | 874.8 | 1090.8 |
| uWTA | The upper limits of WTA | 902.4 | 704.8 |
| lWTA | The lower limits of WTA | 728.0 | 627.3 |
| ***PR: Plot/Resource Conditions*** | | | |
| Size | Registered forest size in dekar (=0.1 hectares) | 1365 | 2627 |
| Productive | Percentage of productive forest | 73,6 | 22.1 |
| Biodiversity | Dummy: existence of key habitats or hot spots | 0,47 | 0.50 |
| Deadwoods | Dummy: more dead woods than normal | 0,27 | 0.44 |
| ***OC: Owner Charateristics*** | | | |
| Residence | Dummy: resident in the same municipality of forest | 0.82 | 0.38 |
| Male | Dummy: male = 1 | 0.93 | 0.25 |
| Age | Age of owner | 51.4 | 11.0 |
| Edu1 | Dummy: education (university/college) | 0.30 | 0.46 |
| Edu2 | Dummy: education (more than 4 years in university) | 0.22 | 0.41 |
| Lowincome | Dummy: low individual income (below NOK 250,000) | 0.24 | 0.43 |
| Ogforest | Dummy: member of Norwegian forest owners' association | 0.87 | 0.34 |
| Ogrec | Dummy: member of hunting and fishing organization | 0.29 | 0.45 |
| Ogfarm | Dummy: member of Norwegian farmers' union | 0.59 | 0.49 |
| Ogenv | Dummy: member of environmental organization | 0.05 | 0.23 |
| Ogtour | Dummy: member of hiking association (DNT) | 0.18 | 0.39 |
| ***PV: Policy Variables*** | | | |
| Expectation | Dummy: expectation of economic benefit from the program | 0.25 | 0.43 |
| Auction | Dummy: auction was employed in the scenario | 0.45 | 0.50 |
| Enrollsize* | Dekars owner willing to enrol given compensation | 419 | 680 |
| ***MD: Market Drivers*** | | | |
| Timsale | Economic importance of timber sale last 5 years (1-7: very significant) | 1.92 | 1.30 |
| Recincome | Future economic importance of commercial recreational activities | 3.87 | 1.41 |

[#]Mean and standard deviation are for overview purposes and sake of brevity given only for the sample used for estimation of Model 1 in the next section (n=184).
* This variable equals "Size" times indicated ca. share of forest enrolled (categories 0-9%, 10-19, .., 90-100%).

[19] Another variable, timber prices, is not included as it would not vary across forest owners at one point in time. We did not include questions about timber price expectations, though this could have been an option. Higher prices (or price expectations) would imply higher WTA.

[20] The analysis of the participation decision of forest owners is a topic of ongoing research. The further drop in observations to the sample of 184 in Table 2 is due to item-non response for the variables included in the analysis).

As can be seen from the table, the average size of forest plots is 1365 dekar (136.5 hectares), while the mean size of forests enrolled is 419 dekar (a mean share of 31 percent). The respondents are predominantly male (93 percent), the mean age is 51, and 82 percent live in the same municipality where their forest(s) is located.

**Modelling results and discussion**

*Regression results*

We present two regression models in Table 3. Model 1 is a reduced model, where only forest/plot and forest owner characteristics are included. Model 2 is the full model including all explanatory variables from Table 2.[21] The motivation for this division is that Model 1 could be seen as a starting point for targeting the program based on information about key plot and owner characteristics only. This is information that should be relatively easily available. Both models show a reasonable fit to the data. Model 2 has a slightly lower number of observations so the two models are not strictly comparable. Forest owners who indicate a higher share of productive forest on their land demand a higher WTA to enroll in the program, as expected from the theoretical framework. One would also expect that other variables that reflect income reductions from timber or non-timber activities due to the imposed restrictions from conservation in Model 2 (i.e. the "Timsale" and "Recincome" variables), would be positive and significant, but for some reason we do not find that here.

*Table 3 Regression results for Model 1 (redcuced model) and Model 2 (full model).*

| | **Model 1 (N=184)** | | | **Model 2 (N=165)** | | |
|---|---|---|---|---|---|---|
| | Est. | Std. Err. | | Est. | Std. Err. | |
| Constant | 433.86 | 368.20 | | 72.08 | 410,38 | |
| Size | -0.02 | 0.01 | ** | -0.02 | 0,0138 | * |
| Productive | 4.57 | 2.13 | ** | 4.12 | 2,286 | * |
| Biodiversity | 132,06 | 103.28 | | 155.56 | 119,69 | |
| Deadwoods | -57.08 | 117.78 | | -11.32 | 118,14 | |
| Residence | 376.73 | 147.29 | ** | 400.90 | 151,84 | *** |

[21] A double log model was also tried, but the performance of this specification was not significantly better.

| | | | | | |
|---|---|---|---|---|---|
| Male | -211.94 | 234.55 | | -162.55 | 231,32 |
| Age | -0.77 | 4.30 | | 2.83 | 4,6967 |
| Edu1 | -21.67 | 127.59 | | 48.96 | 133,36 |
| Edu2 | -151.71 | 125.00 | | -101.83 | 137,91 |
| Lowincome | -91.94 | 123.22 | | -48.55 | 128,97 |
| Ogforest | 157.06 | 137.14 | | 223.27 | 147,40 |
| Ogrec | 50.70 | 104.14 | | -45.10 | 126,10 |
| Ogfarm | -135.15 | 123.64 | | -43.87 | 132,27 |
| Ogenv | -200.82 | 268.24 | | -350.83 | 245,78 |
| Ogtour | -68.24 | 124.53 | | -29.39 | 132,28 |
| Expectation | | | | 75.71 | 129,54 |
| Auction | | | | -161.62 | 109,44 |
| Timsale | | | | -30.11 | 47,69 |
| Recincome | | | | 36.50 | 41,85 |
| Sigma | 6.47 | 0.05 | *** | 6.46 | 0.05 *** |
| E(WTA) | 883.5 | 211.3 | | 907.0 | 229.3 |

*** p<0.01, ** p<0.05, * p<0.1. Note: Dependent variable is interval WTA amounts.

Both models show a weak, negative and significant relationship with the total size of the forest, i.e. larger forest areas give lower WTA. Kilgore et al. (2008) and Bateman et al. (1996) both find similar results. It is ambiguous from theory how size would affect WTA. One potential reason for the sign in our setup, is that larger owners potentially would be able to enroll parts of their land that have lower opportunity costs and therefore can accept somewhat lower compensation. The deadwood variable and indication of hotspot area on the land ("Biodiversity") are not significant. This, and preliminary analysis on smaller subsets of the data utilizing other combinations of the questions regarding environmental characteristics, demonstrate that the stated presence of such features in the enrolled forest do not significantly affect WTA. Though there are weaknesses related to asking forest owners to evaluate environmental features, the insignificant results suggest that the authorities may be able to enrol forests with such features without having to pay a "premium". There are indications from some model runs that membership in the national forestry association yields higher WTA, as expected, though in final models shown here, this variable is not significant. If the forest owner is not an absentee owner, he tends to demand higher WTA (variable “Residence”). This is as expected from studies of harvesting behaviour, which show that such

owners also are more likely to engage in harvesting and timber market activities and therefore stand more to loose financially (or are more aware of the loss) associated with conservation (see e.g. Amacher et al. 2003). The other forest owner characteristics are not significant, and there are also no clear theoretical predictions (similar to standard CV studies of the general public). Some studies find, for example, that non-timber forest values are held more frequently among more wealthy forest owners (e.g. Kuuluvainen et al., 1996). However, we find, as do e.g. Kline et al (2000), that WTA for forest conservation is fairly consistent across income categories, i.e. different configurations of the income variable yield no statistically significant influence on WTA ("Lowincome" is not significant). We do not have other indicators from the survey, than the membership variables that are not significant, that can be used to say something about the value the NIPF owners place on non-market, non-timber activities and amenities, i.e. the function Q(.). Further, forest owners do not state significantly different WTA when faced with a public auction format.

Generally, we find few significant variables, as is the case in many of the WTA studies in this area. One potential reason for this is, as also noted by Bateman et al. (1996), that land owners face a fairly difficult task to come up with a WTA amount, especially as many of the forest owners may not be experienced thinking in these terms.[22] It can be considered harder for forest owners to answer the WTA question than the typical WTP (or WTA) question from standard CV surveys of the general public. That is because forest owners not only have to think about the effect in utility terms on non-timber and amenity values (i.e. the $CS_Q$ measure) but the timber loss, which in principle can be calculated, but is hard in a survey situation.

[22] To the question on how they came up with an answer to the WTA question, 46 percent of the respondents answered "own calculations based on many factors", 26 percent "based on timber values minus harvesting costs", 6.5 percent "mainly based on property values" and 19 percent "pure guesswork" (remaining 2.7 percent "don't know"). It is comforting that around 80 percent derived their WTA from some sort of trustworthy calculation/estimation, though the 19 percent "guessing" is higher than would be desirable. We find no clear pattern when investigating the correlation between size of the forest and degree to which forest owners answer that they "guessed" when coming up with the WTA response.

*Mean WTA and ballpark measures of conservation costs*

In order to get a ballpark estimate of how much it would cost to reach different protection targets, we first calculate and report the mean WTA from the two models (E(WTA) in Table 3). Mean WTA from Model 1 is NOK 883.50 per year per five dekar, while from Model 2 it is slightly higher at NOK 907. The current protection level is as mentioned around 2.5 percent of total productive forest area, which is around 74 million dekar in 2011 (somewhat more than half of all forest land is classified as productive). Reaching almost a doubling at 4.6 percent (biologists' recommended minimum) or 10 percent (a potential longer term goal) would imply an enrollment increase of 1.55 and 5.55 million dekar, respectively. Assuming for simplicity that biologically important features are homogenously distributed, that new forests will come from the 10 central counties of Southern Norway, and taking NOK 900 per year per 5 dekar as the WTA estimate (ignoring for now that not all forests included in our survey are productive), would yield an annual cost of NOK 279 million and 999 million, to reach the two targets. For comparison, the government budget for forest conservation in 2011 was NOK 135 million, which is generally used as one-time payments for conservation areas.

*Supply curves for conservation areas*

However, these fairly high cost estimates imply that the government does not target the program by utilizing "price discrimination", i.e. offer different levels of compensation targeted to different forest owners to enroll the cheapest land first. This is the actual situation. What can our results say about sensible targeting? Based on our reduced Model 1 data we have derived two conceptual "supply curves" in Figures 2a and 2b for our sample. The cumulative enrolled forest area is generally strictly increasing in WTA, since more forest owners are willing to enroll land at high compensation than at low compensation levels. It is also true that enrolling additional forest land becomes increasingly expensive on the margin, as also demonstrated by Siikimaki and Layton (2007). Figure 2a shows, in addition, that there

is a price difference between those forest owners that have indicated a high productive forest share and those that have a low share (light-shaded curve is higher up in the diagram than the dark-shaded curve). If biologically valuable features are homogenously distributed over such areas[23], it would be best to target forest owners that have low productive forest shares. If the biological features of interest, on the other hand, are over-represented in productive areas, it may still be possible to target pockets contained in forests otherwise largely unproductive.

*Figure 2 & b: WTA and expected cumulative enrolled forest area for forests indicated as having low and high productive forest shares (2a), and WTA and expected cumulative enrolled forest area for absentee owners and owners residing locally.*

*Figure 2a*

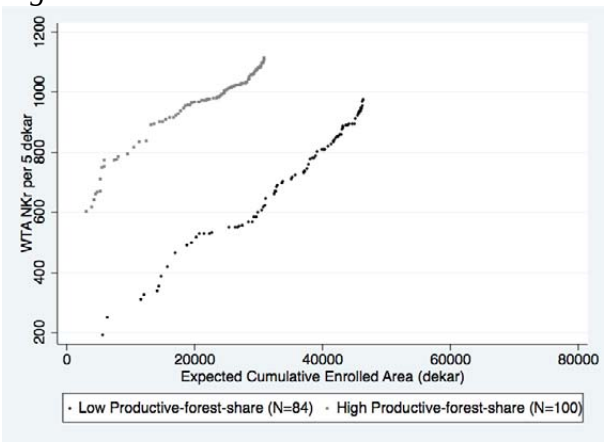
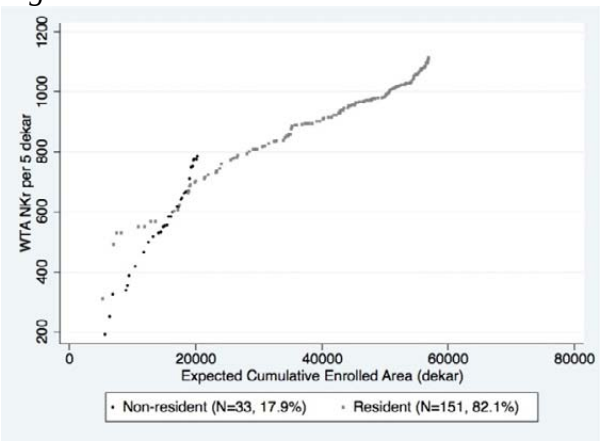



*Figure 2b*




Note for figure 2a: The cut-off point for high and low was set at 80 percent, which is the median of the sample.

Our regression results also showed that absentee owners have a lower WTA than those who reside in the same municipality as their forest is located. Targeting absentee onwers first, again assuming homogenous distribution of the biologically valuable features, yield a significant cost saving (see Figure 2b). However, since there are relatively fewer such forest areas, further enrollment requires paying a higher compensation to forest owners residing locally. This kind of "price discrimination" may be generally acceptable as it is in the spirit of of rural development policies. An additional potential benefit of this approach may be to

[23] This may be the case for some features, while others are positively correlated with productive areas.

reduce conflict levels locally, as not all forest owners are content with the current voluntary conservation approach. The two curves are for illustration purposes only and cannot be used to scale up to the whole population of NIPF owners.[24] Since our results also indicate that WTA is lower for the owners with the smaller holdings, it would also be efficient to target them. This is again assuming biodiversity is homogenously distributed, which may potentially be a more problematic assumption for different forest sizes. In any case, it is likely that the government have to move up along the supply curve to enroll increasingly expensive forest areas to reach the conservation targets.

## Conclusions

This paper has made a novel contribution to the analysis of Norwegian non-industrial private forest owners' preferences and WTA compensation for enrolling forests in a voluntary conservation program. We have derived from theory that their WTA can be defined as a sum of compensation for lost timber income and a non-market welfare measure depending on his preferences for amenities. The theoretical approach is developed to link our CV approach more thoroughly than previous studies with the standard valuation literature. We then conducted a representative CV survey of NIPF owners analysing the factors determining WTA, and deriving mean WTA and conceptual supply curves relating cumulative enrolled area to WTA levels. We find that WTA is negatively related to the size of the forest holding and absentee ownership, and positively related to the share of the forest classified as productive. The overall mean WTA per year per dekar is estimated at NOK 180, yielding annual costs for the government to reach 4.6 percent and 10 percent of productive forests conserved of NOK 279 and 999 million, respectively. The government may, however, save substantial costs by targeting small and relatively less productive forests and absentee owners

[24] This is because these curves are drawn based on our sample. To scale up, we need the distribution of enrolled size in the population (we have the data of size but not expected enrolled size).

first, which may also help dampen conflict levels, still a problem in some counties. This kind of “price discrimination” may be acceptable in a rural policy perspective. However, this recommendation only holds for forests that contain desirable biological characteristics that are not negatively correlated with these three dimensions (which may be the case for some features, but not for others).

Methodologically, it was challenging to ask landowners their WTA in the CV format we used. One problem we have discussed is the difficulty forest owners likely had in conceptually combining both a rough estimate of timber loss and their own preferences for amenities, yielding potential uncertainty in WTA responses. Kurttila et al., (2006) demonstrate the complexity of this task, if done accurately. Another challenge, sometimes raised in the CV literature, is potential strategic bias. Although we explicitly stated that the answers would not be used to calculate actual compensations, we cannot rule out that some forest owners may have answered strategically by inflating WTA responses. However, this problem is likely to be smaller than the case where the general public is asked WTA for a negative environmental change, since the rights of the status quo is to a larger degree contested. We can also not rule out that some forest owners had previous knowledge of the compensation formula of the program, biasing their responses away from the true welfare measure we are interested in. Finally, we were not as successful as we hoped at deriving information from forest owners about the presence of biological features on their land that could influence their WTA. Although it is not obvious how WTA would be affected, information about such features could potentially be important. There is a trade-off between the desire to collect very detailed information using more elaborate questions than ours and the potentially limited knowledge that some forest owners may have about biology. One option could have been to ask more about proxy features (such as age of stands, presence of rough terrain etc) that are correlated with biological features, and that forest owners may be more familiar with. These are all

difficult challenges, with few real solutions within the use of stated preference literature. If the aim is to reveal real (rather than stated, hypothetical) WTA performing actual auctions may be the only real solution. Our analysis is also based on a subset of a larger dataset, reduced by preceding questions regarding participation intentions, by difficulties in answering the WTA question and through item-nonresponse to certain important questions. Hence, due to these sample selection issues, results cannot be directly extended to the whole non-industrial forest owner population. Even if the challenges we encountered are real, their stated responses did also indicate that a large share of the forest owners did consider the WTA question carefully, yielding WTA responses that at least did conform with some important predictions, were such are found in the literature. Overall, despite the above caveats, our application demonstrates that CV may be used sucessfully to analyse land owner preferences and to yield measures of expected compensation claims for increased biodiversity conservation. Western governments are far behind on their comittments to the UN Convention on Biological Diversity, and are increasingly seeking voluntary economic instruments to reach conservation targets. To achieve this ambition, estimating reliable measures of potential compensation claims and overall opportunity costs will only become more important.

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**Appendix: WTA question**

"Assume that you were offered compensation as an annual payment specified per 5 **dekar**, index regulated by general price increases, for the part of the forest your are willing to set

aside for conservation. Indicate by a cross in the table below the **annual** payment you at least would need in compensation **per 5 dekar net of taxes** (5 dekar is around the same size as a football field). When you decide an amount, also think about what you would be willing to pay for a similar forest. The amount you state will not be used to decide compensation for your forest, but will give a an idea about how much conservation would cost in total."

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