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

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Abstract

While the non-market benefits of forests have been well-documented in the literature, forest owners' preferences and willingness to accept (WTA) compensation to supply such benefits have been much less studied. 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 WTA, 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 dekar is estimated at NOK 180. Costs of reaching conservation goals can be saved by targeting small and relatively less productive forests and absentee owners first, before taking on increasingly expensive forest 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.

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1. Introduction

A large and growing literature in environmental economics have assessed and valued the public benefits of forest conservation or multiple use forestry, using conventional stated or revealed preference methods. This literature has generally found that forests have the potential to provide substantial public, non-market benefits in terms of ecosystem services and biodiversity (Kramer et al., 2003; Lindhjem, 2007; this special issue). There is growing concern among environmental economists (and ecologists) that these benefits are substantially underprovided in current forest management regimes and need to be increased through policy measures and programs that stimulate conservation (Chiabai et al., 2011). 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 arguing for various government support programs to increase forestry activity (Fischer et al., 2010). While some of these efficiency-wise dubious programs are still in place in many countries (e.g. support for forest road building and harvesting in steep terrain), more recent forestry programs have been targeted towards stewardship objectives (e.g. Arano et al., 2004; Church and Ravenscroft, 2008; Gruchy et al., 2012).

The non-industrial private forest (NIPF) owners[1] are in the midst of these partly opposing paradigms 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 programs

[1] "Small-scale forest owners" is sometimes used instead of "NIPF owners" in the literature, because it defines this group by what they are instead of what they are not (Fischer et al., 2010).

advocated by both camps (see e.g. forestry economics reviews by Amacher, 2003; Beach et al., 2005). While the push for increased conservation and stewardship on private lands originally were controlled under mandatory regulation, i.e. land restrictions or relinquishment of property rights, large conflicts erupted between NIPF owners and the government over this approach in Scandinavia (Bergseng and Vatn, 2009) and the USA (Shogren and Tschirhart, 2001). Instead, much 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 (or in the timber market[2]).

As NIPF owners typically have broader motivations than maximizing profits (Raunikar and Buongiorno, 2006), knowledge about WTA is important in the cost-effective targeting of conservation programs. Authorities equipped with detailed knowledge of the factors that determine likely compensation claims, 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

[2] Vokun et al. (2006) and Conway (2002), for example, use the CV approach to estimate NIPF owners' stated minimum price offers (reservation prices) to harvest and enter the timber market. This is in some way the "opposite" to WTA for conservation, as we return to in Section 3.

costs of various conservation targets (e.g. percentage of forests conserved), which in turn can be compared with willingness to pay (WTP) estimates to obtain conservation benefits.

The aim of this paper is to build on the small and growing literature on land owners' WTA and analyze NIPF owners' WTA for participating in the dominating nationwide voluntary conservation program in Norway. We first clarify theoretically how WTA can be defined and how WTA consists of compensation for lost timber income and a non-market welfare measure depending on his/her preferences for amenities. We then conduct a representative CV survey of NIPF owners in the 10 counties of the Southern part of Norway, the main area of future expansion of forest conservation. We analyze the key factors determining WTA, estimate mean WTA, and derive conceptual supply curves for conservation relating stated WTA to cumulative enrolled forest areas.

Related studies using open-ended or dichotomous choice CV approaches 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 (2000a; 2000b) studies of landowners' WTA for protection of riparian habitat in France and the USA, respectively, and finally, Kilgore et al's (2008a; 2008b) and Sullivan et al.'s (2005) investigation of WTA and enrollment in forest stewardship and banking programs in the USA. In Scandinavia, the only study we are aware of is Layton and Siikimäki's (2009) dichotomous choice analysis of forest owner enrollment in a Finnish conservation program.[3] In addition to these studies, a few recent articles have used CE instead of CV

[3] Results from the same survey are also analyzed in Siikimäki and Layton (2007). Another Finnish study by Mäntymaa et al. (2009) investigates factors influencing actual compensation claims, combined with some information, other than WTA, from survey data.

to investigate forest owner preferences and WTA for different forest conservation programs (Horne, 2006; Matta et al., 2009; Gadaud and Rambonilaza, 2010; Sorice et al., 2011). 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, catagorized according to Beach et al. (2005), and make a rare contribution to the analysis of Scandinavian NIPF owners' preferences and WTA for conservation.

The paper is organized as follows. The next section gives a brief overview of the Norwegian study context, related to the current state of forest conservation and the content of the voluntary conservation program. Section 3 develops the analytical framework formally defining WTA and relating it to key categories of explanatory variables that will be investigated empirically. Section 4 outlines the survey design and content and motivates and explains the choice of variables for empirical analysis. Section 5 presents the econometric approach to the data and the main results. In Section 6 we offer some conclusions and discuss policy and research implications.

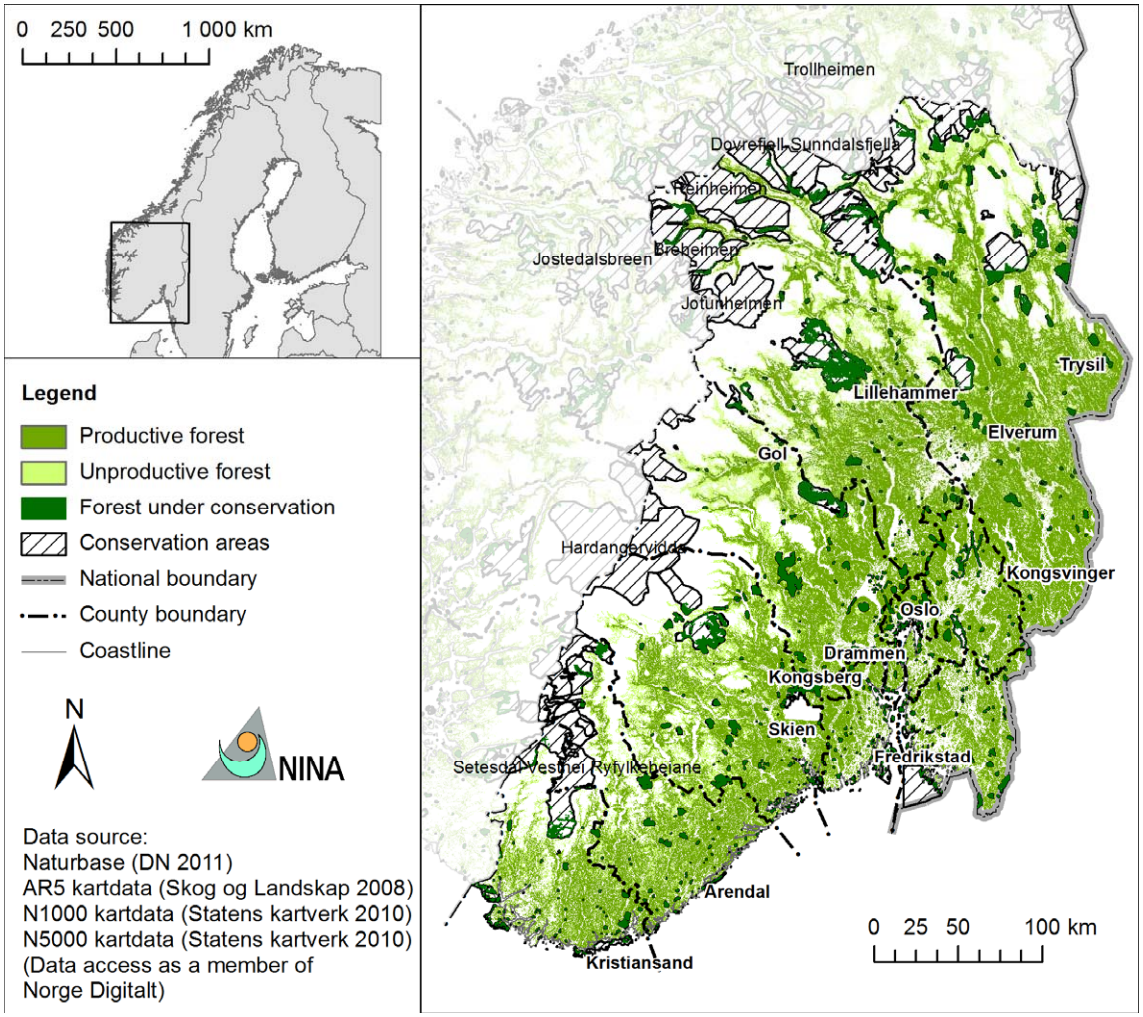
2. The voluntary forest conservation approach in Norway

Currently, around 2.3 percent of Norwegian productive forests are conserved in strict forest reserves, where no forestry, hunting or extractive activities are allowed (Skog og Landskap, 2011).[4] Other recreational activities are generally allowed, though many of the reserves are remote, inaccessible and not much used by the average recreationists who rather prefer more actively managed and open forests (Gundersen and Stange, 2011). Hence, conservation of this kind can be assumed to largely provide non-use values related to biodiversity and habitat protection (Lindhjem and Navrud, 2009).

[4] This percentage is much lower than, for example, in Sweden and Finland.

According to an authoritative biological assessment, at least 4.6 percent of the productive forest area in Norway should be protected to satisfy public policy goals (Framstad et al., 2002). A more recent assessment concludes that especially low lying, productive forests and endangered species and habitat types in Southern Norway, the area of our analysis, are still highly underrepresented in the protected area network (Framstad et al., 2010). OECD (2011) also recommends increased forest conservation in Norway. Figure 1 depicts the survey area, which includes the ten most important forest counties for conservation, the productive and unproductive forest cover, and the current protected area network (including forest areas both under voluntary and previously mandatory schemes).

Figure 1 Study area, forest cover and protected area network in Southern Norway



Note: “Conservation areas” are the total areas, while “forest under conservation” is the part that is forest.

Traditionally, the main regulatory instrument for conservation in Norway, in addition to the forest law and forest certification schemes, has been the state’s appropriation of private forest land for forest reserves against compensation based on the value of the standing timber. This was the source of serious conflicts between forest owners, the state, and environmental NGOs in the 1990s. In 2000, the national forest owner association proposed a new voluntary conservation approach, 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 area are agreed. The ownership of the reserve remains with the forest owner, but he/she relinquishes all rights to extractive activities for perpetuity. This is different from the Finnish scheme “Trading in Natural Values,” for example, where contracts are time limited, 10 years in the pilot program (Mäntymaa et al. 2009). The rules of compensation are quite similar between the mandatory and the new voluntary approach though there seems to be some more room for negotiation (Skjeggedal et al., 2010).[5] However, the main difference compared to mandatory conservation seems to lie in the process steps and the central element of voluntariness. Since 2003, nearly all new conservation processes have been in the voluntary form (with one important exception[6]), and there is general political agreement only to pursue the voluntary approach in the foreseeable future.

Enrolling sufficient NIPF owners in the scheme will be crucial to achieving conservation objectives. Around 75 percent of the Norwegian forest area is owned by ca.120 000 private forest owners. A handful of them own large areas, while the majority

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

[6] Trillemarka, the largest forest reserve in Norway (147 km^2), established in 2009.

of the holdings are small and owned by the NIPF category. In the next section we present the analytical framework of NIPF owner's WTA to enrol.

3. Analytical framework for WTA

Several theoretical models have been suggested to explain the behavior of NIPF owners, generally relying on many of the same factors expected to influence decisions related to the forest stock in their possession (see e.g. Amacher, 2003; Conway et al., 2003; Pattanayak et al., 2003; Beach et al., 2005; Voukun et al., 2006). In the following we develop a simple framework, inspired by Sullivan et al. (2005) and Beach et al. (2005), defining forest owners' required compensation level (WTA) to set aside a part of their forest as a conservation reserve.

A representative NIPF owner, who derives utility from both non-timber amenities and all other goods, measured by the present value of income derived from both timber and non-timber sources, is assumed to have the following indirect utility function:

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

where F is the owner's forest stock in his/her possession, P is the prices of goods, I(F) is his/her income including benefits from the forest stock F, Q(F) is his/her non-timber, non-market benefits from the stock F, X is a vector of owner's characteristics that may influence his/her utility. The literature suggests that the hectares enrolled in the program are not perfect subsitutes in utility terms with the hectares not enrolled: The forest owner can enjoy both the amenity benefits of his/her remaining stand and the enrolled stand (Sullivan et al., 2005). To this end, we modify our model as $F = (F_{IH}, F_{EN})$, where F_{IH} is owner's stocks in hand and F_{EN} is the stocks enrolled in the program.

A few points can be noted from our model. I(F) captures owner's monetary benefits from his/her forest stock through any kind of market activities, including timber production, sales of hunting rights, and investment activities. Q(F) captures 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. Note that I(F) is already measured in monetary terms while Q(F) is not. This modeling assumes that the owner enjoys only his/her private forest stock but not others' forests, including neighbors'. This implies that the model ignores a public goods perspective of the forest though Q(F) could capture owner's preference for conserving his/her forest for the public benefits. Also note that, though we do not specify I(F) and Q(F) for generality and simplicity, Sullivan et al. (2005) and Mantymaa et al (2009) go more into detail of the functions relating to the theory of forest economics. Their basic intuition is reflected in our simpler exposition.

We consider a (discrete) change in 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 indicates the forest stock enrolled in the program (5 dekar in our survey). We can define NIPF owner's compensation claim (WTA) to enroll F_C (5 dekar) of his/her forest F as the compensating welfare measure using indirect utility function (1).

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

(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 $V(P, I(F_0), Q(F_0), Z) = V(P, I(F_0) + CS_Q, Q(F_1), Z)$, 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

	$I(F_0) > I(F_1)$	$I(F_0) = I(F_1)$
$Q(F_0) > Q(F_1)$	$CS_Q + \Delta I > 0$	$CS_Q > 0$
$Q(F_0) = Q(F_1)$	$\Delta I > 0$	0
$Q(F_0) < Q(F_1)$	$CS_Q + \Delta I >/=/< 0$	CS_Q (=WTP) < 0

As summarized in Table 1, our model suggests that the amount and sign of WTA to enroll in the program depend both on the market, timber component ΔI (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 ΔI is in the typical case positive (i.e. income loss), especially if there are timber production activities in the forest F_C. However, ΔI can also be zero if the forest F_C is located in a remote and steep location too costly to harvest at current prices.[7]

The size and sign of 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 recreation acticities are banned), i.e. $Q(F_0) > Q(F_1)$, then the WTA will be higher than the loss in timber revenue ΔI. 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 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.

[7] Even in this case ΔI may still be positive, if owners evaluate the loss of future income opportunity, i.e. loss of option value.

In some cases, the forest owner may not experience income loss from conservation, as suggested above. Likewise, the forest may currently be conserved in practice without compensation, i.e. forest amenities may not change if the forest is formally protected. Hence, 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.[8] Our model does not explicitly incorporate uncertainty or the irreversibility of the decision to enroll land in a permanent conservation program. However, the intuition behind our model is not changed by introducing expected utility, interpreting WTA instead as an option price (see e.g. Gadaud and Rambonilaza (2010)). Finally, the time dimension could be incorporated in I(F) and Q(F), e.g. interpreting amenity benefits as a discounted stream of benefits from the forest stock at each point in time prior to the rotation age and timber income as the discounted timber revenue subtracted harvesting costs.[9]

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 follows:

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

Equation (4) provides the basic theoretical framework for analysis of our data. Re-organizing variables in equation (4) into categories according to Beach et al. (2005)

[8] 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.

[9] See e.g. equation 2 in Sullivan et al. (2005).

(equations 3-5), Conway et al. (2004) (equation 8)[10] and Vokun et al (2006) (equation 2), WTA can empirically be specified as a function of four main sets of variables and the error term e_{WTA}:

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

where PR is a vector of plot/resource conditions (including the timber stocks defined above and other characteristics such as the presence of endangered species etc), OC a vector of owner characteristics (e.g. both objective factors such as age, gender, income and education level and subjective attitudinal factors), PV is a vector of policy variables (e.g. the design characteristics of the program other than the compensation level), MD is a vector of market drivers (such as timber prices, costs of harvesting, interest rates etc.), and e_{WTA} is a part of WTA that is unobservable by researchers. We will return to these variables and the econometric estimation approach in Sections 5.1-5.2.

4. Survey design and administration

4.1 Survey development and testing

A 10-page CV questionnaire was developed consisting of four main sections, three of which were utilized for the analysis in this paper.[11] The first section contained eight questions about the forest property and ownership and a question about the economic importance of various income-generating activities related to forestry and other commercial activities.

[10] In contrast to our interest here, Conway et al (2004) and Vokoun et al (2006) study the completely opposite problem: forest owners' WTA (reservation prices) to harvest timber. It can be safely assumed that the WTA to harvest can be explained by many of the same variables as WTA to conserve, except with the opposite signs.

[11] One part contained seven questions related to innovativeness and alternative income generating activities, information which was used for another paper based on the survey data, see Nybakk et al. (2009).

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. However, some forest owners may have had prior knowledge about previous program compensation levels, which may have influenced their response to the WTA question. 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. 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 elements (such as dead trees, known red list species, significant presence of deciduous trees etc). We have comparatively more information about forest characteristics than previous studies (e.g Kline et al. 2000a;b).

Following these questions, was an open-ended WTA question, aided by a payment card[12], asking about the minimum compensation per 5 dekar[13] as an annual payment to set aside the forest for reserve. The respondent was prompted to consider what he/she 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

[12] Amounts ranging from NOK 0 to 2000 were chosen in consultation with forestry experts to cover the typical value range of rents from timber in a Norwegian forest. 8 NOK equal ca 1 Euro.

[13] A common area unit for forestry in Norway, corresponding to 0.5 hectares.

forest in particular, to remove any worries about our intentions and breach of anonymity.[14] A payment card WTA question was chosen over the dichotomous choice format (i.e. "yes" or "no" to a given compensation level) to preserve data efficiency for our given sample size, since dichotomous choice is generally not considered to be the superior format (e.g. Boyle, 2003). For those studies that apply CV, referred in the introduction, there is an even mix between the two types of formats. The exact wording of the WTA question (translated into English) and the visual representation of the payment card is given in the appendix.

For the valuation question, there is one notable difference compared to a standard CV approach in the environmental valuation literature. While in standard CV, the environmental change respondents are asked to value are identical for all respondents, the forest owners in our survey 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. One solution to this issue 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). Instead, we chose to ask questions giving us information about characteristics of the forest, so that these could to some extent be controlled for. In addition, our survey data were merged with forest tax records for the size and location of the forests. 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

[14] Anonymity was also guaranteed in the letter accompanying the questionnaire.

instruments. The final section contained background information about the forest owners and their households, much in the same way as in a standard CV survey.

Early versions of the survey instrument was tested in two video-taped focus groups conducted in two separate locations with a high number of NIPF owners (Fagernes and Lillehammer) by TNS Gallup, the professional survey company that undertook the survey. The survey also underwent pilot testing among forest owners and managers, before being finalised. Only small changes were required to make the questionnaire fully suitable for use.

4.2 Sampling and data collection

A complete and official list with the names and contact information of Norwegian forest owners obtained from the government forest tax records constituted the sample frame. All forest properties located in the ten counties in southern, middle and eastern Norway (covering the large majority of forests of potential interest for conservation) larger than 25 hectares were selected to an adjusted list, and connected to a total of 24,897 NIPF forest owners with mail addresses (see map in Figure 1).[15]

2007 forest owners were then randomly drawn from the adjusted list. The questionnaire and a cover letter explaining the objective and importance of the study were mailed to the forest owners in November 2007 by post following an approach modified from Dillman (2000). A self-addressed, stamped return envelope was also included to simplify the answering process. A second wave containing a reminder was mailed two weeks later. Two weeks after the reminder letter, a questionnaire packet similar to the

[15] The cut-off point of 25 ha was chosen because, from an ecological perspective, smaller properties would not contribute significantly to conservation purposes.

first wave was sent out to all non-respondents. Data collection ended in January 2008 and resulted in 809 returned questionnaires.

26 respondents reported that they were not forest owners and 18 respondents reported that they had less than 25 ha of forest, reducing the valid sample size to 1965. A total of 110 questionnaires contained significant numbers of missing values (item non-response) and were deleted from the final data. After eliminating the unusable questionnaires, we were left with 756 usable responses, resulting in an overall adjusted response rate of 38.5 percent. This is a bit low, but comparable to other WTA surveys (e.g. the 31 percent in Amigues et al. 2002 and 30 percent in Sullivan et al. 2005). The register the sample is drawn from include information about the location of the property's (municipality level) as well as type (agricultural, forest, other) and size. Comparing the final sample with the gross sample and the population along these dimensions, show only marginal differences. There were no indications of non-response bias related to number of respondents from different regions or property size in t-tests ($p<0.05$). To further investigate potential non-response bias, we also conducted a small telephone survey of 962 non-respondents, resulting in 105 completed questionnaires. As reported in Nybakk et al. (2009) results from this non-response bias analysis showed signs of significantly higher education and lower age among respondents compared to non-respondents (as is often the case for such surveys). In line with Nybakk et al. (2009) we decided not to weight the data, as additional bias may be introduced due to the low response rate of the telephone survey.

5. Analysis and results

5.1 Econometric modelling approach

Based on the theoretical framework we developed in Section 3, we assume that a representative NIPF owner *i* has his/her 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 β is a vector of parameters and ε_i is an independently and normally distributed error term with mean zero and standard deviation σ. 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, $L_i = (lwta_i - x_i'\beta) / \sigma$, $U_i = (uwta_i - x_i'\beta) / \sigma$, Φ is the cumulative standard normal density function. The maximum likelihood estimation is employed to estimate the parameters β and σ. The estimated mean and median WTA is computed as $x_i'\beta$.

5.2 Variables and descriptive statistics

Extensive preliminary analyses was conducted on the data to choose and code relevant explanatory variables in the four categories of equation (5), that may influence forest owners' stated WTA. Table 2 presents the main variables used for subsequent 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 biodiversity hotspots

registered on the land[16] and whether or not there are significant amounts of deadwood compared to similar forest types, an important feature of forest biodiversity in Norway.[17] Owner characteristics include similar types of variables to standard CV studies, perhaps with the exception of the variable that specifies whether the owner is located in the local area or an absentee owner. We also have dummies specifying memebership in various organizations that indicate preferences for conservation, recreation activities, farming or forestry.

The three PC variables includes whether or not the program is framed as an auction and whether there are expectations that owners will benefit 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 importance of timber and recreational income-generation activities on the land.[18] We return to the interpretation of the relationship of the variables with WTA in our discussion of estimation results in the next section.

Compared to the sample of 756 who responded to the participation question, 48 per cent did not want to participate, even if given adequate compensation. Of the remaining respondents, 373 subsequently answered the WTA question. 35 percent of these

[16] Forest owners can set aside areas of 'Complementary Hotspot Inventory' ("MiS" in Norwegian), with biodiversity hotspots covering at least 1% of the productive forest area in their property and receive a modest compensation. Recently, forest owners with large areas of MiS can propose the establishment of a nature reserve on their property as part of the voluntary conservation approach and receive full compensation if the forest area fulfills the criteria for protection as a nature reserve.

[17] We had originally a battery of 10 different special environmental features or characteristics forest owners were asked to indicate. For this, there was higher than average item non-response and hence only the deadwood indicator was chosen for analysis.

[18] 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 (e.g. as in Siikimaki and Layton 2007). Higher prices (or price expectations) would imply higher WTA.

answered “don’t know” to the WTA question and were therefore removed from further analysis.[19] For comparison, in Buckley et al. (2009), 51 percent of landowners did not want to provide access to their woodland. In Amigues et al. (2002), 40 per cent agreed to participate, 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
lWTA	The lower limits of WTA	902,4	704,8
uWTA	The upper 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 250,000NKr)	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 (1-7: very significant)	1,92	1,30
Recincome	Economic importance of recreational activity	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 * indicated ca. share of forest enrolled (categories 0-9%, 10-19, .., 90-100%).

[19] 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 1 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 per cent), the mean age is 51 and 82 percent live in the same municipality where their forest(s) is located.

5.3 Modelling results and discussion

Regression results

We present two regression models in Table 3. The first (Model 1) is a reduced model, where only forest/plot and forest owner characteristics are included. The second model is the full model including all explanatory variables from Table 2.[20] The motivation for this division, is that Model 1 could be seen as a starting point for targeting the program based on limited information only about key plot and owner characteristics. 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 due to the inclusion of all variables (some of which contain item non-response) 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 or indicate income reductions from timber or non-timber activities (e.g. hunting) 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.

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

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	-0,0201	0,0090	**	-0,0266	0,0138	*
Productive	4,574	2,138	**	4,125	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	***
Male	-211,94	234,55		-162,55	231,32	
Age	-0,7788	4,3094		2,8364	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	6,4702	0,0499	***	6,4639	0,0527	***
E(WTA)	883,5	211,3		907,0	229,3	

*** p<0.01, ** p<0.05, * p<0.1, (*) p<0.2. 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 ownership in the national forestry association yields higher WTA, as expected, though in final models shown here, this variable is not significant ($p<0.2$ in Model 2). If the forest owner is not an absentee owner, he/she tends to demand higher WTA (variable “residence”). This is as expected from forest economics 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. Hyberg and Holthausen, 1989; Kuuluvainen et al., 1996). However, we find, as do e.g. Kline et al (2000a), 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(.) from Section 3. Forest owners do not state significantly different WTA when faced with a public auction format, though the “Auction” variable is approaching significant p-levels in Model 2.

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), is

that land owners face a fairly difficult task to come up with a WTA amount, especially as they are not experienced thinking in these terms. This was also indicated in a question we included asking forest owners how they came up with an answer to the WTA question.[21] 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 in practice is hard, without spending considerable time. Results indicate that those owners that are more engaged in forestry (more aware or "sophisticated" in some sense) also demand higher WTA, when other characteristics are controlled for.

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 2.3 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).[22] Reaching a doubling at 4.6 percent (biologists' recommended minimum) or 10 percent (a potential longer term goal) would imply an enrollment increase of 1.7

[21] 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.

[22] http://www.skoginfo.no/?module=Articles;action=ArticleFolder.publicOpenFolder;ID=160

and 5.7 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 306 million and 1026 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.

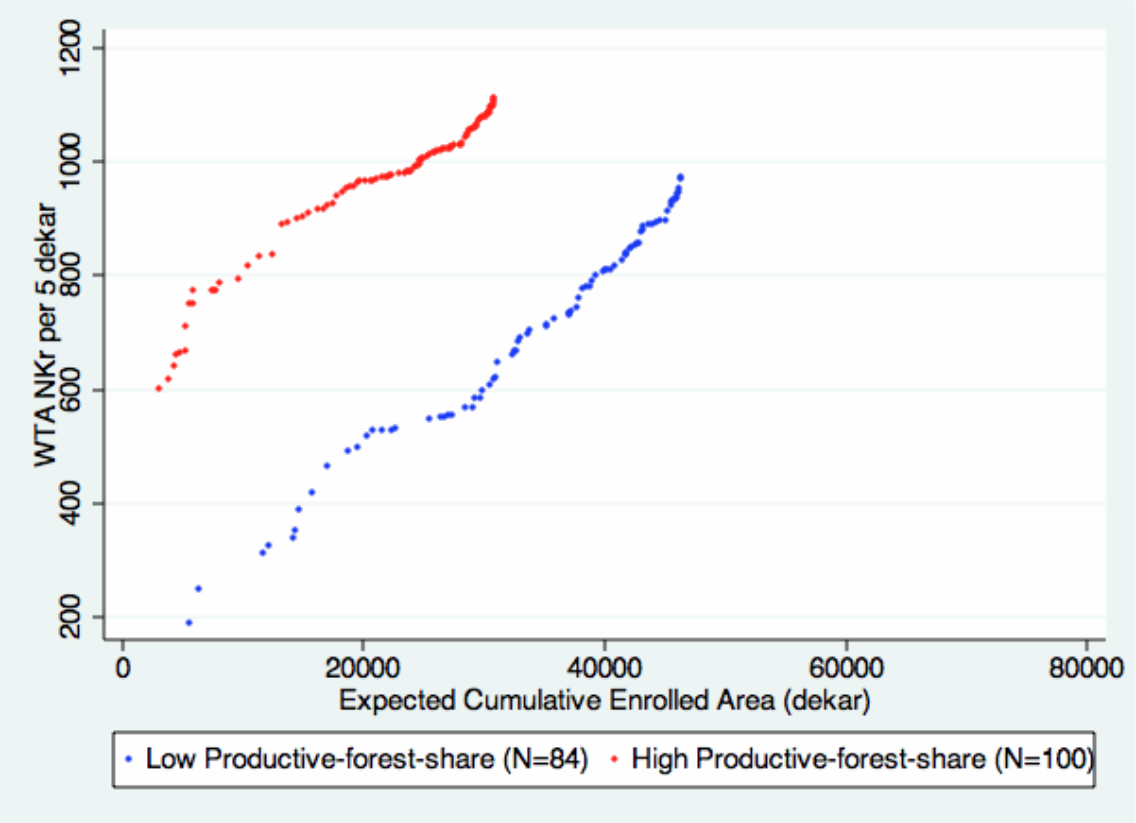
Supply curves for conservation areas

However, these fairly high cost estimates imply that the government do 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 2 and 3. 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 in Siikimaki and Layton (2007). Figure 2 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

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

the other hand, are over-represented in productive areas, it may still be possible to target such pockets contained in forest holdings otherwise largely unproductive.

Figure 2 WTA and expected cumulative enrolled forest area for areas contained in forests indicated as having low and high productive forest shares

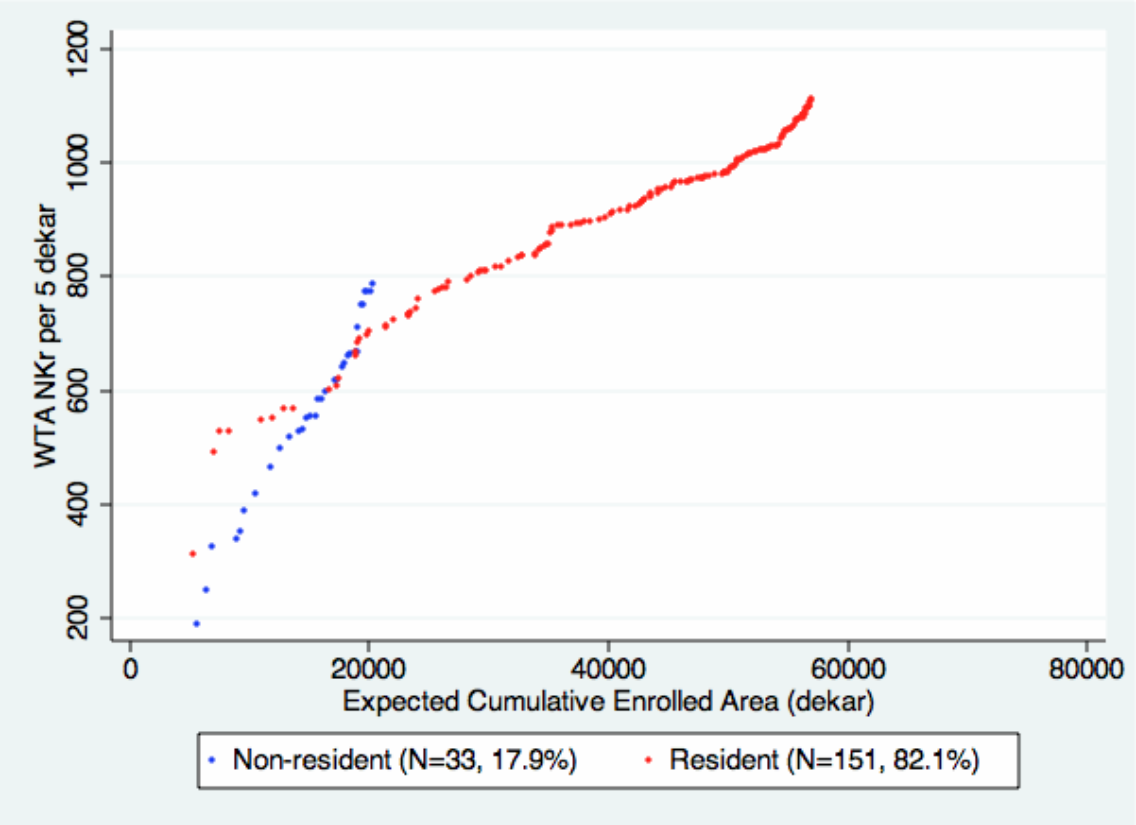


Note: The cut-off point between high and low was set at 80 percent, which is the median of the sample.

Our regression results also showed that absentee owners required a lower WTA than those who reside in the same municipality as their forest are located. Targeting absentee onwers first, again assuming homogenous distribution of the biologically valuable features, yield a significant cost saving up to around 20000 enrolled dekars (see Figure 3).[24] However, since there are relatively fewer such forest areas, further enrollment requires paying a higher compensation to forest owners residing locally.

[24] Note that the curve depends on the size of the sample.

Figure 3 WTA and expected cumulative enrolled forest area for absentee owners and owners residing in the municipality of their forests



These two curves are for illustration purposes only and cannot be used to scale up to the whole population of NIPF owners.[25] A final point can be made regarding policy implications. Since our results indicate that WTA is lower for the smallest forest owners, for absentee owners and for owners not organized in the national forest association, it would be efficient to offer them conservation contracts first. This is again assuming biodiversity is homogenously distributed. An additional potential benefit of this approach would also be to reduce conflict levels locally, as not all forest owners are

[25] 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). It is a topic of ongoing research to analyse the participation and WTA questions jointly, and attempt to estimate expected enrolled size to contruct a global supply curve for forest conservation.

content with the current voluntary forest conservation approach. In any case, it is likely that the government will have to move up the supply curve to enroll increasingly expensive forest areas to reach the biodiversity targets.

6. Conclusions

This paper has made a rare contribution to the analysis of Norwegian non-industrial forest owners' preferences and willingness to accept compensation for enrolling forests in a voluntary conservation program. We have shown how in principle their WTA can be defined as a sum of compensation for lost timber income and a non-market welfare measure depending on his/her preferences for amenities. The theoretical approach is developed to link the CV approach we use to analyse WTA, with the standard valuation literature. We then conducted a representative CV survey of NIPF owners in the 10 counties of the Southern part of Norway, analysing the factors determining WTA, and deriving mean WTA and conceptual supply curves relating cumulative enrolled area to WTA levels. Using a fairly rich dataset, 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. We also find indications that members of the national forest association demand higher compensation, and that overall more "sophisticated" forest owners who are more actively engaged in forestry activities (or more aware of potential losses) state higher WTA. The overall mean WTA per year per dekar is estimated at NOK 180, yielding annual costs for the government to reach 4.6 percent (doubling of the current level) and 10 percent conservation of NOK 306 million and 1026 million, respectively. For comparison, the government budget for forest conservation in 2011 was NOK 135 million. The government may, however, save substantial costs by targeting small and relatively less productive forests and absentee

owners first, which may also help dampen conflict levels, still a problem in some counties.

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. These are difficult challenges, with few real solutions within the use of stated preference literature. Performing actual pilot auctions making forest owners reveal true WTA is 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. Analysing these issues further, is topic of future research. Even if the challenges we encountered are real, there 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. Almost all western governments, including the Norwegian, are far behind on their comittments to the UN Convention on Biological Diversity and national constituents, 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 and payment card format

"Assume that you were offered compensation as **an annual payment specified per 5 dekar**[26], 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**

[26] 5 dekar = 0.5 hectares. The bold types were identically used in the text in the questionnaire.

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."

Note: Make just one cross

	Amount (kroner)
☐	0
☐	20
☐	40
☐	100
☐	150
☐	200
☐	250
☐	275
☐	300
☐	400
☐	500
☐	800
☐	1250
☐	2000
☐	More than 2000 - Specify amount _____
☐	Don't know

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