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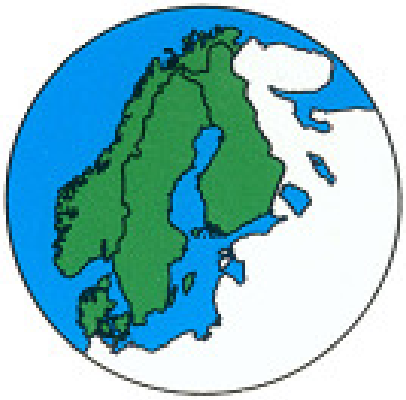

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A Hedonic Pricing Model for Hunting in Denmark

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Abstract

This paper examines attributes that influence the price on hunting leases in Denmark. Landowners have the right to hunt on their land and the possibility to lease out this hunting right. The lease of hunting rights contributes to the landowners' income and in order to optimize total income it is essential to understand hunters' preferences for leasing an area for hunting.

The analysis utilizes detailed information obtained from 751 hunting contract leaseholders. The hedonic pricing method was used to find significant determinants that influence the market value of a hunting lease. Among other things we find positive influence from the bag rate of deer on the lease price, it is however relatively small. Furthermore, leasing out to consortiums rather than individuals seems to push the price upwards. Not surprisingly we find a significant reduction on the hunting price when the lease is between relatives.

Keywords: Hunting, hedonic pricing, recreation, natural resource management

1. Introduction

During the last decades the fluctuating, and mostly decreasing, timber prices have made forest owners aware of other sources of income from forest. One of these non-timber forest income possibilities is the revenue from leasing out land for hunting. In Denmark the hunting right belongs to the landowner and if the area is larger than 5 hectares, the landowner is allowed to transfer the hunting right for that specific area to a leaseholder or a consortium and thus be able to benefit financially from the wildlife resource. Management decisions aiming at maximizing net revenue of land is, however, often restricted by lack of information concerning what actually contributes to the value or the price of a hunting lease. An example could be large populations of deer that might result in crop damage due to deer browsing. Here it would be useful to know how much population sizes contribute to the price of a hunting lease in order to compare to the

economic consequences of crop damage. Another example could be the importance of biotope improvement on the hunting prices. The cost as well as opportunity cost of land can then be compared to potential increase in hunting income. The economy of hunting is of considerable size. Thorsen and Strange (2000) report the total market value of hunting leases in Danish forests to presumably exceeding 13 million Euro per year. At present there is no study of the gross value of hunting in Denmark, but a recent Swedish study reports the gross value of hunting in Sweden to be around 335 million Euro per year (Mattsson et al., 2008).

Thus, the aim with the present study is to analyse this considerable market by identifying determinants of hunting prices in Denmark. We do that by asking hunters how much they pay for contracts and details about the area.

1.1 Literature

The economic value of hunting has been subject to a number of studies. Many studies operate within a stated preference framework using either contingent valuation (see e.g. Goodwin et al., 1993; Hussain et al., 2004; Fix et al., 2005, Mattsson 1989, Mattsson et al., 2008) or some kind of choice modelling (e.g. Boxall and McNab, 2000; Hunt et al., 2005). In the area of revealed preferences some studies using the travel cost method has been made (see e.g. Knoche & Lupe, 2006; Nguyen, 2007). Hedonic pricing is also frequently used (Livengood, 1983;Pope & Stoll, 1985; Messonnier & Luzar, 1990; Meilby et al.,2006; Zhang et al., 2006).

Common for all these studies, except Meilby et al. (2006), Mattsson (1989) and Mattsson et al. (2008), is that they are American or Canadian. Mattson (1989) and Mattsson et al. (2008) use CVM in Sweden. Meilby et al. is like the present study an examination of Danish hunting determinants. However, where Meilby et al. (2006) covered hunting leases at major Danish forest estates, the present study work with a larger, more widespread and probably more representative sample of Danish hunting leases. Furthermore, Meilby et al. collected data from estate owners, whereas we collect it from hunters.

Thus the study is novel in its empirical context of exploring an existing market for nature-based recreational goods. This is an important knowledge to gain, e.g. in order to optimise land management with multiple uses. In the following we will start describing the hedonic method used and the theory behind. Following the data collection and the results will be presented and we will finish by discussing the main findings. Some of the important results we find are that price per hectare increases by area and that the price increases considerably when a consortium is created.

2. Method

A hunting lease can be regarded as a composite good. Following Lancaster (1966) we will assume that a consumer derives utility from the attributes that goods possess rather than goods themselves. In this context it implies that hunters do not derive utility from the hunting contract *per se* but from the range of attributes or characteristics that are embodied in the hunting lease and the observed price

In economics, the hedonic demand theory (Rosen, 1974) is used to decompose values of composite goods into its attributes. It is often used to derive values of environmental goods or services that are not directly traded in the market by analysing prices of goods in related markets, e.g. houses who's price may reflect environmental attributes. Hunting rights are likewise traded on a market and we are able to apply the hedonic framework to identify attributes that significantly contribute to the price of a hunting lease. Among other things, the method assumes a large number of buyers and sellers, making the individual hunter as well as the land owner price takers.

Because of the large variation in hunting contracts, it is difficult to estimate the demand for generic hunting contract attributes. Following Lancaster (1966) we therefore assumed that a hunting lease can be reduced to its constituents parts and decomposed into attributes such as area size, land type, bag rate etc. We also assume that the market (the land owners and the lessees) value those constituent parts.

In this study, we develop a model to describe the price of hunting leases in line with other hedonic studies of hunting leases. The model consists of a number of vectors that are likely to affect the price of hunting leases. The first is a vector of predetermined characteristics of the area, which we call location variables. These include characteristics that the land owners are very unlikely to change. The second vector we denote area quality. This includes variables, which the owner to a certain degree will be able change such as the share of forest, the number of small biotopes etc. The third vector contains personal characteristics of the leaser/lessee, and finally a vector with variables that do not fall under any of the three above mentioned categories. The lease price per hectare *P* for a hunting contract, *i*, can thus formally be described as:

$$P_i = f(Location_i, Area_i, Personal_i, Other_i, \varepsilon_i) \qquad (1)$$

The model includes an error term ε_i, representing the effect of factors not observed and captured by the model. The specific attributes contained in the mentioned vectors can be seen in the first and last column of Table 1. From a landowner perspective especially the area vector is

worthy of note because here he/she can affect lease price by management decisions.

An implicit price function is obtained by regressing the price of a hunting lease on attributes that are hypothesized to affect the price. To find the marginal implicit price (or willingness to pay) for one additional unit of a specific attribute, one needs to undertake the second stage of a hedonic price model. This implies taking partial derivatives of the implicit price function with respect to an attribute. In the present paper we do not undertake this second stage of the model.

3. Data

Members of the major Danish hunting organisation were in 2006/2007 through magazine articles invited to answer a questionnaire either at a specific site at the Internet or by requesting a postal questionnaire. The questionnaire was designed on the basis of discussions and interviews with hunters and tested in a focus group and elicited information regarding number of leases, attributes of the hunting area, price, terms of lease, etc. The respondents were also asked to state approximated game population and bag rates. Furthermore, questions about hunting preferences and socioeconomic characteristics were included.

A total of 1246 hunters answered the questionnaire. Because hunters were invited through articles and e-mails and not contacted directly we cannot calculate a response rate as such. Every respondent were compared to the hunting organisation's member register in order to ensure answers from hunters only and avoid doublets. This control removed 195 answers from the sample. A further 12 respondents had left blank answers at essential questions e.g. hunting price or area size and were thus also removed. Of the remaining 1039 respondents a total of 288 hunters were not holding a hunting lease and are therefore irrelevant for the following analysis.

4. Results

In Table 1 we present some descriptive statistics of the data. We see that the average area size for the 751 leases was 160 hectares and the average annual lease price per hectare was almost 300 DKK[4].

[4] 1 Euro is approx. 7.5 DKK. In the following DKK will be used.

Table 1. Variable description. The prefix d_ indicates dummy variables.

Name	Min	Max	Median	Mean	Std error	Description
Location Variables						
areasize	5	2000	97	159.67	200.83	Hectare per lease
price_hectare	13.33	2000	239.69	298.75	236.81	Price in DKK per hectare
ln_areasize	1.61	7.60	4.57	4.57	1.01	Log of area in hectares
ln_price_hectare	2.59	7.60	5.48	5.39	0.84	Log of price in DKK
west_x_reddeer	0	8	0	0.11	0.71	Bag rate of red deer crossed with region of western part of Denmark
D_Fyn	0	1	0	0.10	0.30	Region dummy
d_Sjaelland	0	1	0	0.16	0.36	Region dummy
d_nearcity	0	1	0	0.13	0.34	1 indicates that the hunting area is close to a city
d_estatehunt	0	1	0	0.29	0.45	1 if the lease is at an estate or similar
Area quality Variables						
forest_share	1	21	3	6.01	6.51	Share of forest on the area in intervals of 5%
farmland_share	1	21	13	11.21	6.73	Share of farmland on the are in intervals of 5%
bagrate_deer	0	70	4	7.50	9.39	The bag rate of deer
activity	0	300	30	34.13	26.34	Number of hunting days for the lessee
d_oldforest	0	1	0	0.26	0.44	1 if there is old forest present
d_cabin	0	1	0	0.45	0.50	1 indicates the presence of a hunting cabin
biotope	0	41	4	4.93	5.24	The number of biotopes on the area
Personal Variables						
Income	0	10	5	5.22	1.63	Income of hunter measured in 10 categories
d_careful	0	1	0	0.01	0.12	Indicating self reported carefulness
d_plus	0	1	0	0.04	0.21	Self reported issues that affect price upwards
d_minus	0	1	0	0.07	0.25	Self reported issues that affect price downwards
D_relative	0	1	0	0.15	0.36	1 if the leaser and lessee is relatives, friends or similar
Other Variables						
d_consortium	0	1	1	0.82	0.38	1 if lessee is a consortium
contractlength	1	99	1	3.30	4.54	Length in years of the lease
d_contract	0	1	0	0.31	0.46	1 indicates a formal contract compared to a verbal agreement

Results of the estimations based on an ordinary least square regression are presented in Table 2. When developing a hedonic model there is no theoretical argument for choosing a specific functional form. Therefore we have been testing a range of different functional forms, including performing a Box-Cox specification test that yielded no guidance for the choice of functional form in relation to statistical properties. Based on statistical performance (highest r-square) we chose a log-log lease equation model where the dependent variable 'price per hectare' and the explanatory variable 'area size' are in natural logarithm.

Table 2. Estimated coefficients for hedonic model of hunting lease price. Dependent variable is ln price per hectare.

Variable	Coefficient	Std. error	t-value	Pr > t	95% Confidence interval	
Intercept	5.912	0.151	39.20	0.00	5.604	6.187
Location Variables						
ln_areasize	-0.354	0.032	-11.15	0.00	-0.417	-0.292
d_Fyn	0.423	0.073	5.78	0.00	0.280	0.568
d_Sjaelland	0.346	0.063	5.45	0.00	0.221	0.470
d_estatehunt	0.189	0.056	3.39	0.00	0.079	0.299
d_nearcity	0.143	0.064	2.24	0.03	0.018	0.270
west_x_reddeer	0.075	0.031	2.42	0.02	0.013	0.135
Area Quality Variables						
Forestshare	0.010	0.005	1.91	0.05	0.000	0.020
farmlandshare	-0.025	0.005	-5.16	0.00	-0.033	-0.015
d_oldforest	0.141	0.049	2.88	0.00	0.045	0.237
d_biotope	0.007	0.005	1.61	0.10	-0.001	0.016
bagrate_deer	0.020	0.003	6.21	0.00	0.014	0.027
d_cabin	0.365	0.052	7.08	0.00	0.264	0.467
Personal Variables						
Activity	0.002	0.001	2.29	0.02	0.000	0.003
d_relative	-0.285	0.062	-4.58	0.00	-0.406	-0.161
Income	0.048	0.013	3.56	0.00	0.022	0.074
Careful	-0.443	0.178	-2.49	0.01	-0.792	-0.094
d_plus	0.303	0.104	2.92	0.00	0.099	0.507
D_minus	-0.183	0.085	-2.15	0.03	-0.352	-0.018
Other Variables						
contractlength	0.012	0.005	2.43	0.02	0.002	0.021
d_contract	0.226	0.052	4.36	0.00	0.124	0.327
d_consortium	0.447	0.060	7.44	0.00	0.331	0.567
N	751					
Adj R-Square	0.5335					

Among several variables that were hypothesized to contribute to lease value we only included those with a significance level of 10 percent or better in the model. The variables with the greatest impact on hunting price will be described here.

Among attributes that contribute positively to the hunting price we see the region dummies for Sjaelland and Fyn. Furthermore, hunting areas leased to a consortium seem be priced some 45% higher than areas typically leased to individual hunters. Also, hunting leases based on a written contract compared to a verbal agreement seem to have on 20 per cent higher price per hectare. If a hunting area is equipped with hunting cabin, the lease price in the present sample will increase with almost 37 per cent.

Only a small number of the attributes investigated seem to negatively affect the price of a hunting lease (apart from the obvious negations, e.g. 'No cabin', 'No written contract'). First we see the negative coefficient of the variable ln_areasize, which suggests that the price per hectare is decreasing with increases in area size. If the landowner and the lessee are related there is a significantly reduction of the price at almost 30 per cent. In the end of the questionnaire we asked the respondents whether the hunting price was affected by something we did not cover in the questionnaire. A small part (see Table 1) replied that they were regarded as 'careful' hunters by the land owner, and they believed that for that reason they enjoyed a a sort of discount on the price. This discount is indeed found and is estimated to be around 45 per cent of the price. Further answers to the above mentioned questioned were categorized in price increases (plus) and decreases (minus) and shows the expected sign.

4. Discussion

First of all we see from the study that we have been able to explain about half of the observed variation by the chosen variables. And most of them behave as we would have expected. Compared to an earlier study (Meilby et al., 2006), the regional price difference is smaller. But it is not directly comparable as Meilby et al. only focused on forests. In the following we will start discussing the main findings and then briefly discuss the validity of the used method.

The analysis shows that a number of attributes affect the price of a hunting lease. Among these some of the location attributes contribute a great deal to the hunting lease. From a management point of view these attributes are not especially interesting as the owner is not able to easily change e.g. region or distance to a city. But obviously it is relevant for a hunting lessee, as he is able to travel. And it may be interesting e.g. in order to weight travel cost and hunting costs.

The bag rate of deer was found to positive influence the lease price which is in line with our prior expectation. However, the influence was estimated to be relatively small compared to some of the other area attributes, being 2% per deer in the bag (corresponding to some 8-10% for the median bag rate). The reason could be that hunters relatively easy can gain reasonable knowledge about location and area attributes such as forest share, distance to a city or the presence of a hunting cabin. However, they do not necessarily have any experience of hunting outcome in terms of bag rate. This is supported by the fact that the median hunting contract length is reported to be 1 year only. Some may renew the contract year after year, but it may indicate that some of the lessees perhaps had no experience or knowledge of potential bag rates at the time when they settled the terms of the lease including lease price. The number of biotopes at the hunting area also has a positive, but relatively small influence on the hunting price. We note that in our data, we only have access to information about the number of biotopes, not the size nor the quality. That two attributes, which in different ways are related to wildlife population do not contribute much to the hunting lease appears a bit surprising. One reason for this could maybe be found in the size of the hunting areas in the sample. The typical size (see Table 1) is around 97 hectares, which indicates that more landowners 'share' populations and thus the size of deer population is not only influenced by attributes on the hunting area examined but on neighbouring areas. In other words small hunting areas could lead to a sort of the classical 'Tragedy of the Commons' described by Hardin (1968).

We also se that consortium pays higher prices than individuals do. This may be due to the fact that consortiums are able to aggregate the willingness to pay for several hunters and hence outbid most individuals and secure the better hunting leases. It is straight forward that two or more hunters are able to pay more than one hunter. The fact that they seem also to be willing to pay more can either be because they pay for area qualities not covered by the other variables of the model, or because the land owner perceive the consortium to be a more costly lessee than an individual, e.g. the number of hunters present on hunting days may be much higher, and hence interference with other productions in the forest increase. Thus, it represents a supply side effect on the marginal cost of renting out the land. This also relates to the fact that there need not be rivalry between consortium members. E.g. if two members of the same consortium hunt on different days then the part of the utility related to the hunting or nature experience it self (and not the shooting) is not in conflict. Thus an argument could be that some part of the hunting lease is not a private good, but rather a club good (cf. nomenclature in Ostrom, 2003).

It is also worthy of note that the land owner's relatives or friends obtain discounts on the hunting lease. Interpreted combined with the

observation that hunters who state they get a discount due to being careful hunters, e.g. shooting relatively few deer we argue that trust is a key issue: When landowners transfer their hunting rights and thus the management of the wildlife resource it is of great importance that it is transferred to somebody trustworthy.

Regarding the validity a few topics are worth noticing. It is often rumoured that the income from hunting leases are part of a black economy. Whether this is true or not is not to be determined in this paper. However, to avoid potential self selection in the sample we decided to ask the lessees rather than the leasers as the incentive to give truthful answers were thought to be higher from lessees. We could speculate of strategic answers from lessees as well, but it is ambiguous whether they would tend to over or under state their payment if they believed they by their answer could influence the market.

By only addressing members of the Danish hunting organisation we have not reached a representative sample of the Danish hunters. However, out of 163.600 active hunters in 2006/7 (Miljøministeriet, 2008) the 93.736 were organised in the Danish hunting organisation by the end of 2007 (Danmarks Jægerforbund, 2008), so a relatively large proportion is targeted. Furthermore, the focus has been on the price per hectare, i.e. area related. And even with a representative sample of hunters we would not necessarily get a representative sample of areas. Thus we believe that the form of collecting data have given a sufficiently good proxy of the average hunting price in Denmark.

5. Concluding remarks

In this study we analyse which and how much attributes of a hunting lease contribute to the price of a hunting lease. The results can be used in order to make informed management decisions that affect wildlife and hunting lease prices. We find that location specific variables determine the prices considerably, whereas the area quality variables have a smaller influence. Apparently also the relationship between the owner and the lessee is quite determining for the price setting.

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