The value of Danish forest areas

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Abstract

Nature and recreation opportunities are requested by an urbanising society, and forestation and nature restoration projects can be socially desirable both in rural and urban areas. But recreation and nature values are not traded on a market, and the value of such projects cannot be compared with the value of other projects. However, the benefits of forestation and nature restoration projects can be assessed by monetary valuation methods. One of these methods is the hedonic price method, by which house price functions can be used to reveal how much people are willing to pay for amenity benefits in housing.

House owners’ willingness to pay for forest amenities in four forests and one afforestation area in Denmark is analysed by hedonic pricing. The results clearly indicate significant values of forests. House prices decline by 0.04% when the distance to the forest increases by 1%. Implicit prices of the differences between locations 100 to 500 m’s from a forest are estimated. In a forested area in Zealand the implicit price is estimated to approximately 370 000 DKK by 100 meters and 200,000 by 400 meters. In a forested area in South Jutland the price is estimated to be approximately 160,000 DKK at 100 meters, and approximately 70,000 DKK at 500 meters. Thus the results indicate major differences between the areas which can be explained by variance in house prices, as well as differences in forest characteristics. In a forestation area in the north of Jutland the price of an average house increased by up to 23% from the period before the tree planting to the period after the forestation was completed. In addition, some of the value of the forestation projects already showed up in the planting period.

The analysis has approved that the hedonic price method can be used to estimate the house owners’ use values of the forests. However, the analysis is
clearly underestimating the value, as other users values, including non-use-values, are not estimated.

1 Introduction

Non-market valuation can be used to estimate the benefits of forests and other environmental assets not being traded on a market. The results from such economic valuation studies can be used to prioritise projects or more aggregate policies, by providing answers to questions such as whether project A, policy B or programme C are socially worthwhile (Bateman et al. [1]). Consequently, valuation techniques can help revealing social values for environmental goods resulting from e.g. agri-environmental policies and land management programmes. One example where such techniques can be applied is on afforestation projects with the purpose to investigate whether and where afforestation projects are socially desirable.

During recent years forestation has received notable political attention in Denmark, both at national and local level. One fifth of the Danish municipalities plan to forest in the coming five-year period (Tvedt [2]). An increase in the forested area from 10 to 20% of the total land area in Denmark by afforestation is one of the prioritised political goals in Danish nature policy. Approximately 12% of the total Danish land area is presently forested, while approximately 65% of the land use is agricultural land (Bach et al. [3]). The political target on forestation is anticipated to be accomplished during a period of 80-100 years, being the time of a “tree generation”.

The benefits derived from forested areas are multiple: Cultural, social (serving mental and physical health factors), economic (timber), aesthetic (landscape variation and attractiveness), ecological (creating forest biotopes) and environmental (nutrient abatement) (Tyrväinen [4]). One of the main arguments for forestation in Denmark is not driven by market economic considerations, but by the need for more recreational opportunities for urban citizens, as well as the need for ground water protection and improvements of the landscape (Danish Forest and Nature Agency [5]). These benefits are not traded on a market, and therefore they have no price. Monetary values have to be estimated by valuation techniques.

A large international literature on such valuation exists (for some different examples, see e.g. van der Bergh [6]; Garrod & Willis [7]). When measuring the value of non-marketed environmental goods empirically, hypothetical valuation methods, such as the Contingent Valuation (CV) method, are the most commonly used method internationally, but hedonic pricing is also widely used (Palmquist [8]; Powe et al. [9]; Tyrväinen & Miettinen [10]). The difference between the methods is, amongst other things that the contingent valuation is used to directly elicit respondents’ willingness to pay for a project or a policy, and therefore the method provides hypothetical answers. Contrary, the hedonic price method is used to elicit values of a project by indirect analysis of a connected, marketed product – for example travel costs or house prices. While the CV method allows the researcher to ask the respondents to value all sorts of
goods – both use values as well as existing values (the value of knowing that an environmental asset exists), only use values can be estimated by the house price method. By using the house price method we estimate the use values of forests for a limited group of inhabitants because it is expected that the forests will provide a capital gain for the house owners in the area. But the method is strong because the valuation can be based on real and not postulated prices. Normally, the hedonic price method is used for valuation of existing attributes like forests. Forestation represents a change in environmental quality, and the literature contains few examples of valuation of changes in quality by the house price method (Bogart & Cromwell [11] is an exception). Consequently, this application of the hedonic pricing from a forestation area is a new contribution to the international literature.

In the following section the outline and methods are described, followed by the analyses and results. In the last section the results are discussed compared to similar studies described in the international literature.

2 Methods, areas and data

2.1 The house price method

As mentioned this analysis is based upon hedonic price analysis on house prices in forested areas in Denmark, as house prices have been used to reveal how much people are willing to pay for amenity benefits in housing. The hypothesis is that proximity to a forest is one characteristic that influences the price of the house.

Following Freeman [12] the characteristics of the house can be divided into groups, and the house price $P$ for house $i$ can be described as

$$P_i = P(S, N, Q)$$

(1)

where $S$ represents the structural characteristics of the house (number of rooms, size/quality/age of the house, etc.), $N$ represents the characteristics of the area (shops, schools, transport, motor ways etc.) and $Q$ represents the characteristics of the environment (view, recreational possibilities, air quality etc). The assumption behind this formula is that differences in house prices and rents can be explained by different housing characteristics, such as the structural characteristics of the house as well as environmental qualities.

Choice of variables for the house price estimation must of course be made with consideration of house buyers preferences, and what they focus on when they buy a house: Is it short proximity to forests, is it the distance in metres from the house to the edge of the forest, the distance on tracks and roads leading to the forests, the view of a forest etc.?

There is at least two ways to conduct such analyses which we have applied: The first one is to investigate how the distance from houses to a forest influences the prices on houses, measured as the distance from the house to the forest
border. The second is to investigate how house prices in an area are affected by forestation projects. The two possibilities are implemented here in two analyses:

1. An analysis of house prices in four forested areas in Denmark, and
2. An analysis of the house prices in a forestation area in Jutland, the Drastrup forest.

The use of the method implied econometric estimations of the house price functions to investigate how marginal changes, for example land use changes, influenced the house prices. Several econometric challenges occur in estimating the house price function, including choice of functional form and variables. Consequently, this study encompassed careful empirical testing of several models.

2.2. Data and areas

House data have been excellent in Denmark both regarding the time span of the data sets and the characteristics of the houses included in the data collected by the Central Register for Housing and Building. Data from the register are used for both parts of the analysis. For the analysis of the existing forest data from a 30-year period were sampled, but only data from the period 1985-2000 were used for the analysis. The time period is used because we found that there was a shift in the housing market about 1985. The house price data were deflated with a house price index to adjust the prices for the general increase in house prices in the period. After deflation the house price function was rather stable.

The four existing forest areas were located in Jutland (close to the town of Esbjerg) and on Zealand (close to the towns of Hillerød, Allerød and Haslev). The areas were chosen primarily because there were housing areas in close vicinity to these forests, the housing areas were relatively homogeneous, and there were no other dominant characteristics in the areas except for the forest, e.g. highways, railroads etc. House prices from approximately 1500 houses were collected in the four areas. The forests are mainly deciduous trees, but also some spruce. The areas were chosen to fulfil methodological purposes, and not for the purpose of serving knowledge in especially important areas regarding landscape values etc. The method requires that we choose areas with a comprehensible amount of houses, and house sales.

The forestation area was the village Frejlev close to Drastrup Forest southwest of Aalborg in the North of Jutland. The afforested area in Drastrup covered approximately 725 ha, and included forested land (mixed deciduous and spruce), extensive pasture areas as well as public tracks. A couple of small villages are located in the neighbourhood of the afforested area, the closest being the village of Frejlev. In this village nearly 400 one-family residences are located close to the forest. The afforestation project was initiated in 1991, and the first phase of
the tree planting was completed in 1995. Data from house sales were grouped in three categories: one period before the afforestation started from 1985-1990, the planning and planting period from 1991-1995, and finally the period from 1996 to 2000 after forestation took place. During the period from 1985 to 2000 142 houses were sold, and hence, the data set consists of these 142 houses and house prices. The house owners' willingness to pay for forestation in close vicinity to their living area was estimated by house price functions for each of the periods (1985-1990, 1991-1995 and 1996-2000).

While the afforestation study in Drastrup investigated the willingness to pay for the afforestation project by nearby house owners, the investigation of the existing forests estimated the value of proximity to the forests, i.e. how much house prices dropped when distance increased by 1%.

3 Analyses and results

In the house price study of the four forested areas in Jutland and on Zealand different house price functions were estimated for each of the areas as functions of the distance to the forest. In Hillerød a “distance parameter” was estimated indicating the value of being located closer to the edge of the forest. This parameter showed that the value of the distance to the forest from the houses was approximately 580 DKK per meter from the forest. If an average house in Hillerød was located 100 metres from the forest, the house price was therefore 232,000 DKK higher than a similar, average house being located 500 metres from the forest.

In two of the other areas (Allerød on Zealand and Esbjerg in South Jutland) the house prices decreased by 0.04% when the distance from the forests increased by 1%. This function can be used to estimate implicit prices for houses located 100 and 500 m from the forest. The difference in prices is apparent from Figure 1. In Allerød the price on an average house is 367,505 DKK more than an average house 500 m or more from the forest price, while the price of an house localised 300-400 m from the forest border was 197,454 DKK higher than an average house more than 500 m away from the forest border. In Esbjerg the house price was 158,124 DKK more for a house localised 100 m from the forest compared to an average house localised 5-600 m from the forest.

The reason for the difference between Esbjerg and Allerød is mainly that the average house prices are much lower in Esbjerg compared to Allerød. By multiplication of these values with the number of houses in each distance category we can obtain an aggregate value of each forest. However, this type of value aggregation will result in that a large forest with few living areas and houses in the neighbourhood will have a low social value (when assessed with the house price method). On the contrary, a forest surrounded by houses will have a larger value. Consequently, this type of aggregation is not correct.
However, the results indicate that house-owners in the three mentioned areas showed a significant willingness to pay for short proximity to forests. Only in the fourth area the results were not significant. This might be due to the poor accessibility of that specific forest.

As mentioned, the value of a forestation area was also estimated by the house price method. This analysis was different from the analysis of the existing forests in that a change in the environmental quality over time was investigated. This was done by firstly deflating house prices of sold houses in Frejlev by a local house price index, so that the prices were adjusted for the general increase in house prices in the period. Hereby, the price data for the houses sold in the period were represented in 2000-prices. The house price index was estimated from houses sold in the municipality of Aalborg to represent the changes in local house prices as opposed to using a general, national house price index.

It was also investigated if the changes in house prices could be assigned to the afforestation alone by investigation of other changes in the area in the period. A new road was built in the period, and this road moved some traffic away from a neighbourhood north of the village analysed in this study. This road might have had a synergic effect with the forestation, although the traffic was not moved away from the village and houses analysed. Consequently, we have chosen not to take this change in infrastructure into account.

House prices from 1985 to 2000 were divided into three periods; before forestation (1985-1990), during forestation (1991-1995) and after forestation (1996-2000), to investigate the marginal willingness to pay for change in environmental quality: i.e. the forestation of the area, including pasture areas and establishment of public tracks for recreation. The first hypothesis was that the house prices in the village Frejlev increased more than the house prices in the rest of the municipality of Aalborg, and that this marginal increase could be explained by forestation in the area. This hypothesis was investigated by using a dummy variable describing if the house was sold after the afforestation took place. A linear model was estimated, resulting in an increase on house prices for an average house in Frejlev of 170,000 DKK.
The second hypothesis was that the house prices within the Frejlev area increased already during the planning and planting period. A new dummy variable was introduced into the model. Houses sold in the planning and planting period (1991-1995) were sold 103,000 DKK above the sales price in the period from 1985-1990. The total extraordinary sales price after the afforestation was estimated to 230,000 DKK or 23% above the sales price from 1985-1990 (see Table 1). The results were highly significant.

This might be an overestimation by 8% because of a lack of an exact house price index (see Hasler et al. [13]).

<table>
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<tr>
<th>Table 1: The value of the forestation project in Drastrup.</th>
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<td>Estimated values</td>
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<td>Value added in the starting period (1991-95)</td>
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<td>Value added after the project (1996-2000)</td>
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<td>Estimated value for all house owners</td>
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The increase in house prices in the area was aggregated to obtain an estimate for the total benefits of afforestation on the house prices. The southern part of Frejlev has 395 houses close to Drastrup, and the aggregated result was 93 million DKK (see Table 1). This equals an average of 130,000 DKK per ha afforested land. Compared to the average costs paid by the Ministry of Environment and Energy on 66,000 DKK/ha, the estimated benefits exceeded the costs, even if lost income from agricultural production was included.

4 Comparisons with results from other analyses

The results are, after a re-estimation, directly comparable to the house price study of Tyrväinen & Miettinen [10]. To be able to compare the results we have estimated a semi-logarithmic model, so that an absolute increase in the distance in metres is followed by a relative change in value, in per cent. Tyrväinen and Miettinnen’s analysis [10] showed that a distance of 1 km gave a fall in house prices by 5.6%. The re-estimated model in this study shows house prices increasing by 8.5% when the distance to a forest increases by 1 km.

5 Conclusions

Application of the hedonic price method in a forestation area close to Aalborg in the northern part of Jutland, and in four forested areas in Jutland and on Zealand, showed that forestation yields significant increases in the house prices. House sales prices increased during the forestation project and the house price increased even more after the forestation project was completed. House prices of houses close to older, existing forests declined by 0.04% when the distance to the forest increased by 1%. The house price function resulted in a difference from 70,000
(Esbjerg) to 370,000 DKK (Allerød) in house prices when the distance from the house to the forest increased from 100 to 500 m.

Because the valuation includes no interviews and direct questions, no explanations can be given for the willingness to pay. Another drawback to the hedonic pricing is that only house owners’ use values are estimated. Thus, the values of the forests are underestimated as other use and non-use values are not included. The force of the method is, however, that the values are withdrawn from real market transactions, and not stated.

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References


