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Local consequences of national policies - A spatial analysis of preferences for forest access reduction

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ABSTRACT

Stated preference studies eliciting welfare economic consequence of national policies, are often not considering the spatial variation in supply and demand. This spatial variation may however cause large distributional heterogeneity of policy changes. In this study, we use a choice experiment to test whether peoples' preferences for restrictions in forest access is influenced by spatial heterogeneity in local forest presence and quality conditions. Combining survey data with GIS information we assess the size of local forest cover, distance to nearest forest and forest quality indicators in a radius of 2.5 km from respondent's residence. We demonstrate that a nationally framed policy implementing access reductions to protect wildlife may have heterogeneous welfare consequences which can be described by a general disutility for access reductions and dependency on local forest attributes. Further, geo referencing the residence of all invited respondents allows us to test whether forest cover, distance and other forest attributes are different between respondents and non-respondents. No evidence of self-selection is identified.

1. Introduction

Ecosystem service (ES) values are heterogeneously distributed across the landscape as a consequence of spatial variation in both supply and demand. Spatial variation in supply of ES may be caused by locational differences in the abundance and quality of ecosystems, and spatial variation in demand may be caused by heterogeneity in individuals' preferences of ES. This, in turn, may also influence their choice of residential location. Large spatial variation in ES increases the need for understanding the sources of spatial value heterogeneity, to design spatially explicit policies that target efforts toward locations that maximize human welfare. This is increasingly recognized in the environmental economic literature (Broch et al., 2013; Campbell et al., 2009; Czajkowski et al., 2016).

One area where this spatial component becomes particular important is when analysing the distributional consequences of national, or even international agreements. While such policies typically emerge from overall political goals, they may have uneven consequences when implemented at a local scale. Likewise, people's preferences for national policies may be highly shaped by local conditions. Consequently, the issue that we address in the current paper is to what extend people's local surroundings affects their stated preferences for a national policy. We do so by looking at a Danish case of reducing access to forests with the aim of conserving wildlife. Thus while people obtain a utility of increased wildlife, they at the same time bear the cost of less access. We hypothesize that both quantitative and qualitative spatial characteristics in a respondent's surrounding affect the utility of avoiding access reduction, i.e. the distance and amount of forest cover and the quality in terms of forest species.

The importance of local surroundings is extensively studied in the revealed preference literature (e.g. Jensen et al., 2014; Zandersen et al., 2007a). Often the geographical scope of such analyses is rather limited. Within the stated preference literature considerations of spatial heterogeneity have mainly focused on including distance-decay effects and substitution (Bateman et al., 2006; Hanley et al., 2003; Jorgensen et al., 2013; Loomis, 2000; Moore et al., 2011), geopolitical thresholds (Bakhtiari et al., 2014a; Johnston and Duke, 2009), an a recent study by Czajkowski et al. (2016) analyses forest management decisions. A few studies have explicitly included site/choice-specific maps in the survey information (Johnston et al., 2002; Schaafsma et al., 2013), and Johnston and Ramachandran (2014) has addressed spatially explicit hotspot areas. Our study contributes to the existing literature by first of all, analysing spatial dependency of an environmental good which is widespread throughout a country, and not related to single sites. This is of particular importance for an environmental good like forests. We combine detailed spatial data with data from a choice experiment (full study described in Jacobsen et al., 2012) and are thus able to test the influence of the quantitative and qualitative characteristics.

In the following we will start by describing and motivate for the hypotheses addressed, followed by a method and a data section. After

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a result section, the results are discussed in which we also address the limitations and pitfalls that working with spatial data may have.

1.1. Hypotheses

In this paper we test two different sets of hypotheses. First, we hypothesize that peoples' utility is influenced by how close they live to forest and the quantity of local forest cover. Restricting access reduces the local recreational opportunities, but at varying degrees depending on the local quantity and quality of forests. Danish forest are scattered across the country, and recreation is an important component of the forest ecosystem value. About 70 million adults visit the approximately half million hectares of forest every year (Jensen, 2012). More than half of the recreational visits are within 3 km of distance from people's residence (DØRS, 2014), and the importance of the recreation opportunities in local forests is further supported by several studies pointing at the significance of distance for frequency of visits ((Degenhardt et al., 2011; Jensen and Koch, 2004; Tyrväinen, 2001). With this in mind we would therefore expect that policies reducing access will have a larger impact on utility for people living close to forests relative to people who live far away from forests. This distance-decay is a well-known finding also in the valuation literature from both the stated and revealed preference literature (Bateman et al., 2006; Bateman, 2009; Brouwer et al., 2010; Hanley et al., 2003; Hanley et al., 2003; Johnston et al., 2002; Moore et al., 2011; Panduro and Thorsen, 2014; Pellegrini and Fotheringham, 2002; Termansen et al., 2013). We would also expect the availability of substitutes (e.g. expressed by the quantity of forest in an area) to matter for the value of a recreation site which is confirmed by more studies (Jorgensen et al., 2013; Schaafsma et al., 2012; Schaafsma et al., 2013). The magnitude of the utility loss of access restrictions may therefore also depend on the total area available for recreation to the respondent, implying that there is a higher utility loss for larger areas, but at a diminishing rate as the supply of forest cover saturates individual recreational preferences and an increasing amount of forest substitution opportunities arise.

Second, we hypothesize that the quality of local forests impacts the disutility of an access reduction. The underlying reason is that some areas are more important than others due to their characteristics as also investigated by Johnston and Ramachandran (2014) in terms of hotspots. For forest recreation, several studies indicate that people prefer broadleaved forests over coniferous forests for recreation purposes (Jensen and Koch, 1997; Nielsen et al., 2007; Termansen et al., 2013) while others find no difference (Edwards et al., 2012; Zandersen et al., 2007a). The possibility to observe wildlife in forests is another parameter which we expect will increase the quality of the recreational experience and thus utility (Jacobsen et al., 2012). Also the extent of access rights (e.g. entry times, extent of where to walk, allowed activities, etc.) influence the recreational opportunities and mobility, and is in Denmark mainly framed by forest ownership (public vs. private) (Campbell et al., 2014). In public forests access opportunities are larger than in private (cf. description in (Campbell et al., 2014), and consequently access restrictions here may imply a larger utility loss than in private forests. Finally, in densely populated areas, recreational use of the forest may become partially rival as crowding effects may appear (Vedel et al., 2009). Bakhtiari et al. (2014b) find that people are willing to increase travel distances to recreational sites to avoid crowding, and therefore we would expect increased crowding potential to be associated with higher utility loss.

The provision of environmental amenities such as recreational opportunities also influences the residential choice of individuals. Spatial sorting makes it more likely that people who are keen users of outdoor recreation sites of good quality will chose to live closer to areas where the provision level of recreational opportunities is high (Baerenklau, 2010; Klaiber and Phaneuf, 2010; Kuminoff et al., 2013). Both the direct effect from access reductions on individual utility and the indirect from the possibility of spatial sorting is expected to lead to larger utility losses of reduced access rights in areas with high recreational quality and opportunities.

By testing these two sets of hypotheses in a stated preference (SP) context we examine the spatial patterns of local forest recreational experience similar to those employed in the travel-cost and hedonic pricing literature (e.g. distance to forest, broadleaved forest cover). Further, compared to earlier inclusion of spatial factors in SP models, we incorporate space through the respondent's actual residential location and local environment. Only a few SP studies have used the exact spatial residence of a respondent. Instead they are often based on more crude measures such as respondents indicating their residential location on a map in using internet questionnaires (Abildtrup et al., 2013; Jorgensen et al., 2013) or are relying on larger geographical units, e.g. postal code level or county level (e.g. Broch et al., 2013).

Finally, the possibility of spatial sorting might generate a potential self-selection bias in the participation of questionnaires asking for preferences for nature. Individuals that value recreation relatively more and therefore have located themselves in forest rich areas may be more likely to respond to a valuation questionnaire about forest and wildlife (Bateman et al., 2006). We test this by comparing participation rates in areas with different forest cover and local forest characteristics.

In the next section we first describe the estimation method and data followed by a section where we present and discuss results.

2. Methods

The empirical basis for the study is a choice experiment (CE) valuing different attributes related to improving conditions for wildlife, including access reduction. This is described in detail in Jacobsen et al. (2012). In addition to the responses from the CE, we include a set of spatial variables characterising the location of each respondents' residence.

Based on McFadden's random utility model (McFadden, 1973; McFadden, 1974), we describe the utility (U) which individual i derives from alternative j by a deterministic term V_{ij} and a stochastic term ε_{ij} where the latter cannot be observed by the analyst. Letting x_j describe a vector of attributes of alternative j, and β a vector of corresponding parameters, the deterministic part of the utility function

V_{ij} can be formulated as

$$U_{ij} = \beta' x_j - \beta_p \, cost_j \quad (1)$$

The attributes in x_j are given in Tables 1 and 2. It consists of *wildlife*, *acc* and *cost* which are the evaluated main attributes in the choice experiment. *Wildlife* represents improvements for both general and endangered wildlife but these are not in focus of the present study and for further information on these attributes we refer to Jacobsen et al. (2012). The *acc* represents reductions in access (in two levels; full year or half year) and *cost* is an annual tax increase for the household of the respondent.

x_j also consists of a set variables which are included as interactions with the main attributes as motivated in Section 1.1 to analyse how they affect these attributes. A variable *forest* is representing the quantity of forest in the vicinity of the respondents and represents the availability of substitutes. By taking the natural logarithm to *forest* we capture the diminishing marginal utility. The distance decay function, taking into account that a policy on reducing access will have larger impact for on the utility of those living close to forests, is represented by the variable (*dist*). We need to allow for non-zero intercept, and therefore we include both a linear and a log effect. The quality parameters enter the equation linearly.

We assume that an individual will choose the alternative k over another alternative j, if $Uk > U_{ij}$. We follow a standard random parameter logit approach (see e.g. Train, 2003, p. 138), allowing estimation of repeated choices for the individual. All main attributes are estimated as random parameters with an assumed normal distribution except