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Do turbines in the vicinity of respondents' residences influence choices among programmes for future wind power generation?

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ABSTRACT

This paper contributes to the literature on accounting for spatial characteristics in the analysis of stated choices. It is studied whether the present spatial allocation of turbines in a region affects choices on alternative programmes describing the future shape of wind power generation. Due to the present allocation turbines affect inhabitants of the study region differently. Using a Geographical Information System variables describing respondents' exposure to turbines are calculated, e.g. distance to the nearest turbine. Including them into multinomial and latent class logit models shows that exposure to turbines affects the propensity to choose the non-buy alternative and willingness to pay (WTP) values. Respondents who live further away from turbines are more likely to be the opponents of wind power generation and thus have a higher willingness to pay for moving turbines further away from residential areas. Tests for global and local spatial autocorrelation reveal that global spatial autocorrelation of the individual-specific WTP values is low. However, local clusters of similar WTP exist. Particularly in the biggest city of the study region clusters of respondents with low WTP values are present. Spatial analysis thus provides otherwise invisible pattern.

1. Introduction

Considering spatial characteristics and dimensions in the analysis of stated choice data is gaining more and more attention. Areas of research are, for example, the impact of spatial heterogeneity on stated choices and whether spatial clustering of willingness to pay (WTP) values takes place. So far, however, the majority of studies accounting for spatial dimensions investigated whether a distance-decay effect is present (Schaafsma, 2010). Generally, the distance-decay effect means that WTP values decline as respondents to survey are located further away from the environmental change in question.

This paper contributes twofold to the literature on the effect of spatial pattern on stated choices. Firstly, we investigate whether spatial heterogeneity affects choices regarding the future shape of wind power generation on a regional level. In the present case spatial heterogeneity is a result of the previous expansion of wind power generation, e.g., people live in different distances to turbines or have varying numbers of turbines in the surrounding of their place of residence. Due to this varying exposure people might have different propensities to opt for development alternatives constraining future wind power development. Secondly, we investigate whether people who live closer to each other state similar preferences. People living at the same location face similar exposure to turbines and thus might value programmes on future wind power development similarly.

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The data were derived in a choice experiment (CE) concerning wind power generation in Westsachsen, Germany. Respondents were asked to choose between three alternatives shaping future wind power generation. One alternative, the non-buy alternative, was defined as being more in favour of wind power generation as the buy alternatives that constrain development at least with respect to one choice attribute. For example, distance between turbines and residential areas is increased compared to the non-buy alternative. The analysis uses standard multinomial logit (MNL) and latent class (LC) logit models in order to account for unobserved taste heterogeneity. Exposure to turbines is determined using a Geographical Information System (GIS) calculating variables describing the relationship between respondents' place of residence and the turbines' locations.

The paper proceeds with a brief literature review concerning the consideration of spatial pattern in stated choice analysis and presents in Section 3 the study region and the design of the CE. Subsequently the econometric approach and the measures to determine global and local spatial autocorrelation are introduced. Section 5 presents the results from the estimations and spatial analysis before the paper concludes.

2. Spatial pattern in stated choice analysis

2.1. Current state of including spatial pattern

Keywords for describing the inclusion of spatial characteristics into the analysis of stated choice data are *distance decay*, *directional heterogeneity*, *spatial heterogeneity,* and *spatial autocorrelation*. While the following brief overview is confined to environmental valuation using stated chocies studies, spatial characteristics have also been considered in choice models regarding, for example, housing choices of residents (Bhat and Guo, 2004) or destinations choices of migrants (Pellegrini and Fotheringham, 2002). Another example is the study by Schnier and Felthoven (2011) who analysed the spatial decisions of fishermen taking into account spatial heterogeneity and autocorrelation. However, these studies all focused on destination choices and not on choices concerning changes in an area people are already living in.

According to the *distance decay effect* the distance between a site of interest and an individuals' home reflects the cost of use and thus should influence respondents willingness to pay for improving the quality of this site, i.e., willingness to pay is expected to decrease with distance to the environmental good in question (Bateman, 2009). Studies, both contingent valuation and choice experiments, explicitly investigating this relationship mainly reported a decay of the stated WTP values with increasing distances (Schaafsma, 2010). One of the first studies explicitly investigating the relationship between distance and willingness to pay in the context of a choice experiment was presented by Concu (2007). The attributes of this CE dealed with management policies for native vegetation in Australia. To capture the effect of distance a geographically balanced sample was used and various tests were applied to identify the specification of the distance–utility relationship. According to Concu disregarding the effects of distance in the welfare analysis would severely cause under-estimation of individual and aggregated benefits and losses. Another study, also from Australia, investigates the distance decay function for an iconic asset, the Great Barrier Reef (GBR) (Rolfe and Windle, 2012). The authors conducted CEs in six different locations ranging from a regional town within the GBR catchment to a place more than 4000 km away from the GBR. Rolfe and Windle argued that WTP values decay as a function of distance to the GBR but this function was not as clear as reported by other studies. For example, Australians living in Queensland and thus closer to the asset stated a higher willingness to pay. However, future use values were found to be very consistent for populations more than several hundred kilometres away from the GBR. Thus, the authors concluded, distance decay functions are likely to be limited in the case of iconic assets as the population base supporting the preservation of those assets is probably larger.

Liekens et al. (2013) investigated the amenity, recreation, and biodiversity values associated with land use changes from agricultural land to various types of nature. In their survey respondents were asked to choose between different nature development scenarios, described in terms of their ecological quality and a set of spatial characteristics such as size, accessibility, adjacent land use and distance to the respondents' residence. Both size and distance significantly influenced WTP values, i.e. they increased with the size of the area and decreased when nature areas were situated further away from the place of residence. The latter effect, however, was more significant. Schaafsma et al. (2012) not only explored the distance decay effect but also whether the direction in which the respondents' residences are located relative to the environmental asset influenced stated WTP values. They argued that simply including a distance parameter as an additional socio-demographic variable or distance as an attribute in a CE might only partially address the spatial heterogeneity in WTP values. Direction was accounted for by including dummy variables for different directions in site-specific utility functions. The authors found that accounting for the direction effect in distance decay lead to improved model fit and significant differences in WTP values. The spatial pattern in WTP values reflected the availability of substitute sites quite well.

Brouwer et al. (2010) analysed whether the place of residence in a river basin influences choices among water quality improvement alternatives. Due to *spatial heterogeneity* the authors expected respondents to value changes in environmental good provision differently depending on where the change takes place. They found that respondents have preferences for acceptable levels of water quality in the entire basin but are only willing to pay for good water quality in their own sub basin. The authors argued that aggregating WTP estimates from sub basins to the whole river basin without taking spatial dependence into account would underestimate the welfare effects of improved water quality. Garrod et al. (2012), estimating the wildlife and landscape benefits of environmental stewardship, found that respondents were more likely to prefer environmental stewardship benefits in the landscapes where they lived. This is in line with the results presented by