Local Impacts of Wind Farms on Property Values: A Spatial Difference-In-Differences Analysis

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Introduction

Over the last two decades, fostered by strong financial incentives, wind power in Germany has seen a rapid market diffusion. The promotion policy in the form of guaranteed feed-in tariffs for renewable energies such as wind power often rewarded investors in these technologies with extraordinary economic returns. However, today's investment decisions in large-scale onshore wind power projects in Germany are no longer determined only by the investment's economic benefit, but also by the mitigation of public concerns and thereby the increase of social acceptance. Despite a mostly positive attitude towards the expansion of wind power, local public concerns refer to the common assumption that the proximity to large-scale wind farms devalues property prices in the surroundings. In addition, the average hub height and rotor diameter of newly constructed wind turbines have increased tremendously over the last years, causing a substantial change in the landscape of the affected regions. In turn, the change in the landscape can be supposed to have an impact on the view of those properties that are affected by the construction of a wind farm in their proximity, and thus exert a negative impact on the properties' value.

The aim of this study is to investigate local visibility impacts of wind farms on the development of property prices. Overall, four wind farm sites located in the federal state of North Rhine-Westphalia, Germany, are investigated.

Spatial Difference-In-Differences

To examine the potential devaluation of properties close to wind farm sites, we use a quasi-experimental technique and apply a spatial difference-in-differences (DID) approach. A spatial DID analysis allows for a comparison of the observed changes in the values of the treated properties against the values of a control group (Parmeter and Pope, 2013; Heckert and Mennis, 2012).

In our model, the treated properties (treatment group) are defined as those with a direct view on the wind farm, while the properties which experienced no treatment (control group) are those without a view on the constructed wind farm. By applying viewshed analyses in ArcGIS, we were able to infer the view of those individual properties that were directly affected by the newly constructed wind farm. The treatment and control groups are determined by an interaction term that indicates the degree of visibility and the time of construction of the wind farm.

In contrast, most studies adopt simple distance measures as proxies for visibility (Heintzelman and Tuttle, 2011; Hoen et al., 2013). In order to make a comparison between the two measures, we perform the same analysis in a second model, where we use distance measures as indicators for visibility. In this case, the treatment group comprises properties in the range of 1 to 3 km around the wind farm sites. Through differentiation between simple distance measures and visibility, we tried to draw a more distinct picture of the potential local impacts in order to better understand the obtained 'wind farm treatment'.

Results

For the region around the considered wind farm sites, our dataset includes 2,141 property transactions in the period from 1992 to 2010. The four wind farms were put into operation between April 2001 and July 2002, determining the exogenous change of the environmental attribute 'visibility', which is supposed to be reflected in the property prices. By applying viewshed analyses in ArcGIS on the basis of a high resolution 3D digital surface model, it was possible to establish that 608 properties have a direct view of at least one wind turbine. Figure 1 gives an overview of the study area and the affected properties. The extent of the turbine visibility for the different properties varies between one and 25 turbines. We distinguish three classes of visibility treatment: low visibility (view on 1 to 3 turbines, which pertains to 262 properties), medium visibility (view on 4 to 8 turbines, which pertains to 228 properties), and high visibility (view on more than 8 turbines, which pertains to 118 properties). In reference to the second model specification using distance measures, 28 properties are found to be in the range of 1 km, 120 properties are in the range of 2 km, and 469 properties are located in the range of 3 km around the wind farms.

According to overall performance of the models, we find that all model speci-

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fications perform very well with respect to the adjusted R² obtained (0.866 - 0.867). Moreover, both models are consistent regarding the expected signs and significance levels of the coefficients with respect to the structural, neighborhood, and spatial variables considered. However, we do find significant differences between visibility and distance variables regarding their ability to capture local wind farm impacts on property prices.

Using distance variables, we find a negative impact of about -9% (at the 10% significance level) for properties within the range of 1 km. Unexpectedly, the 2 km distance variable is found to be statistically not significant. The variable capturing the properties within the 3 km range indicates a negative impact of about -11% (at the 1% significance level) after the treatment. Certainly, the results obtained from the three distance measures depend on the number of transactions in each range. In particular, the low number of transactions within 1 km may affect the interpretability of the results, as one expects the strongest negative impacts in the close vicinity.

On the contrary, a general wind turbine visibility (irrespective of the extent of visibility) only has a moderate negative impact on property prices of about -3% (at the 10% significance level). While low and medium visibility have no statistically significant impact on property prices, high visibility depresses prices by about -8% (at the 1% significance level). According to our results, it is not the visibility per se that leads to decreasing property prices, but rather the extent of visibility.

Overall, we find a negative impact on the development of property values due to the 'wind farm treatment'. Yet, the two alternative measures which are often used to capture similar local effects lead to widely differing results.
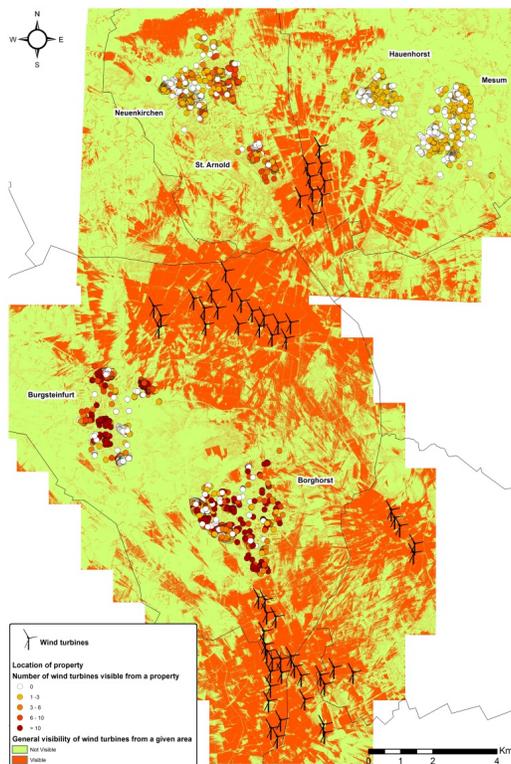

Figure 1: Wind farm visibility (Source, Own illustration)

Conclusions

In order to analyze the local impacts of wind farm proximity and, in particular, wind farm visibility, we apply a spatial DID approach to four wind farm sites in Germany. By isolating the treatment effect caused by the construction of the wind farm, we investigated the differences in property value changes between the treatment group and the control group.

The results obtained indicate that the two most commonly used measures to estimate the impact of wind farms on property prices have significantly different results. Further analyses are necessary to estimate which of these two instruments might better capture the effects considered, as they possess rather different characteristics. According to our results, visibility seems to be a more specific indicator, which enables to single-out a distinct component in the price valuation of a property. Distance variables, on the other hand, are relatively generic means to approximate the local impacts of wind farms, which, according to our findings, remain ambiguous regarding their interpretability.

References

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