THE EFFECT OF ELECTRICITY TRANSMISSION INFRASTRUCTURE ON HOUSEHOLDS' WELLBEING

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Overview

Expanding the supply of electric power from renewable sources has been and will continue to be an important part of current European agenda on energy policy. A closely related issue is the topic of grid expansion. In Germany, in particular, the expansion of renewable energy has been especially ambitious. As a consequence, there has been a vigorous debate on the optimal amount of grid expansion, including associated infrastructure such as transmission towers and lines. To increase the complexity of the debate, benefits of expansion are in the form of grid stability and system flexibility are dispersed across the system, while costs in terms of aesthetics, health effects, and loss in property values primarily affect households located in the vicinity of infrastructure installations. These costs are currently not fully priced when considering the benefits and costs of grid expansion, so that they constitute a negative externality of network infrastructure. This paper provides an important contribution to the debate on grid expansion by evaluating the welfare cost of transmission infrastructure for local households. We therefore contribute to providing a fuller assessment of the cost side of network expansion.

Welfare effects of environmental externalities have been a prominent area of research for environmental economists. While some relevant literature exists already, evidence on the effects of transmission infrastructure on households and individuals, such as health and property values, is inconclusive (Jackson and Pitts 2010, Porsius et al. 2014). Economists have estimated the effect of transmission infrastructure on property values (Kinnard 1967, Brown 1976, Jackson and Pitts 2010) and analysed health effects of electromagnetic fields (Ahlbom 2001, Draper 2005, Porsius et al. 2014). We contribute to this debate by applying causal methods to a unique combination of representative household level data for Germany capturing subjective life satisfaction with detailed data on transmission infrastructure. This allows us to assess the effects of power infrastructure on subjective wellbeing. In this manner we shed light on the externalities caused by infrastructure on the communities located close to it, and thus provide key insights informing further grid-expansion projects.

We make use of the life satisfaction approach to quantify the economic value of proximity to electric transmission towers on households living in a pre-established radius around them. By exploiting spatial and temporal variation in households and pylons, we identify causal impacts with respect to self-reported wellbeing through appropriate causal methods, focusing on a difference-in-differences research design. Our work builds on previous work used to measure the effects of environmental externalities on households (Krekel and Zerrahn 2017, Maddison and Rehdanz 2011).

Methods

We determine the causal effect of the proximity of transmission towers on households' self-rated wellbeing by using a life satisfaction approach and suitable econometric techniques. In our case, we use data from the German Socio-Economic Panel Study (SOEP), where the dependent variable "satisfaction with life" is obtained from an eleven point Likert scale and the treatment indicator "Proximity to transmission towers" is obtained from a newly constructed dataset of transmission towers in Germany. Using this method, the causal effect of the proximity of transmission towers on our dependent variable can be assessed, and by measuring the relation between the marginal utility of income and the marginal disutility of proximity to towers, it is possible to estimate an average monetary valuation of the welfare consequences of living in proximity to transmission towers. The life satisfaction approach is not only useful for the monetary valuation of externalities, it is also useful because reported wellbeing avoids information asymmetries, sorting bias, framing, and can account for consequences of proximity to transmission lines not clearly discernible to the household.

Causal empirical methods require observations in the sample to be assigned to treatment and control groups. As reported effects of proximity to transmission lines on health (Porsius et al 2015) and income (Colwell and Foley 1979, Des Rosiers 1998) have been observed to decrease with distance, households located within a specific radius from where the transmission tower has been built are assigned to the treatment group, while households further away, form the control group. In our estimations we control for time-varying and time-invariant unobserved heterogeneity by including household fixed effects, time fixed effects, and household level trends in the difference-in-differences

estimation. We also explicitly control for a broad range of observable household characteristics such as income and educational level by including the relevant survey data from SOEP. Furthermore, to prevent bias from endogenous assignment into the treatment or control group, we exclude households which moved during the observation period or enter the panel while a transmission tower is already present. To ensure comparability and common-trend behaviour we use propensity-score matching, and in order to cross-validate the assignment to the treatment and the control group, spatial matching is applied. Both matching techniques allow us to compare households that are similar in terms of geographic location and economic characteristics.

Results

Preliminary results suggest a significant negative causal link between households' subjective wellbeing and the presence of transmission towers. This effect appears to be spatially and temporally limited, as the wellbeing of households is less affected by transmission towers located further away. Moreover, we find some degree of adaptation over time. A full analysis, including sensitivity and robustness tests, is currently underway.

Conclusions

Our analysis sheds light on the causal effects of the proximity of transmission towers on reported wellbeing. Our research strategy exploits spatial and temporal information on transmission towers and surveyed households to identify the causal effect. We estimate by using a difference-in-differences research design.

Overall, we find that transmission towers have a negative causal effect on self-rated wellbeing on the representative set of German households captured by the German Socio-Economic Panel Study (SOEP). Our analysis thus contributes to the salient topic of the welfare effects of transmission towers on households.

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