Spatial Analysis of the Effects of the Deployment and Dismantling of Wind Turbines in Germany

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Motivation

Macroeconomic impacts linked with the construction and use of photovoltaic cells and wind power plants have been emphasized in many studies [e.g., 1, 2, 3]. Regarding impacts related to the end-of-life (EOL) of these technologies, most studies currently focus on waste forecasts or impact analysis of investments and not on employment or changes in value added. [e.g., 4, 5].

The increased deployment of renewable energy is linked to the rising volume of construction elements that cannot be reused at other locations. We investigate the possible regional impacts of the investment and recycling of wind turbine construction elements.

Methods

Using spatial econometric modeling, we investigate the effects of wind turbine investments in Germany on employment in regions on NUTS-3 level. Our sample consists of 401 German regions on NUTS-3 level across 2009-2019. We investigate whether spatial linkages between regions affect other neighboring districts. After testing for spatial dependence, we execute a spatial Durbin model (SDM) to account for spatial autocorrelation, which can detect spillover effects of the regional shift arising from the investment dismantling of wind turbines. The SDM incorporates spatial lags of the dependent and the explanatory variables by including a spatial weight matrix based on distance-related neighborhood effects [6]. For the impact of wind turbine deployment, we use data provided by the German Bundesnetzagentur [7]. We multiply the aggregated number of turbines in a region with the cost of investment and the estimated costs of dismantling, accounting for the net wind turbine stock. To control for the economic structure in a region, we include, e.g., gross value added of the industry sector to account for productivity in a region. [8, 9]. Additionally, we include a variable indicating the presence of manufacturers of wind turbines in a region.

Results and Conclusions

Our model shows that the effects of turbine dismantling on employment can not be attributed to the region where dismantling happens but to neighboring regions. Still, the investment and dismantling effects are marginal. However, the results from the SDM indicate that the spatial coefficient ρ is highly significant and positive, meaning that impacts of neigboring regions influence a region with a multiplier of $\rho = 0.21$. Additionally, a positive effect of 0.3 percent can be attributed to regions of wind turbine manufacturers, which supports the notion of a particular labor force and capital needed in the wind turbine construction/dismantling sector.

As the peak of the EOL of wind turbines will occur 20 years from now [10], regional employment's effects are local and global and spill over to all regions [11]. Building a circular economic structure for implementing recycled glass fiber-based products in the chemical and cement industries could magnify these effects. With the increasing replacement of raw materials, a shift between industrial processes and resources is expected. With our model, we can emphasize the change of implementing recycling on the economy, disentangling regional effects beyond the direct impact of the shift of material flows.

Literature

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