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Production of Wind Energy and Agricultural Land Values: Evidence from Pennsylvania

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Abstract

Given the push toward renewable and alternative energy, a new energy mix is emerging. Wind is the fastest growing source of renewable electricity in the United States. The siting of wind turbines has proven controversial with multiple operations facing local resistance. Opponents cite issues such as noise, bird deaths, and aesthetics. Given that farmer portfolios are heavily comprised of land assets, the possibility that surrounding wind energy operations may reduce agricultural land value is of concern. This study examines that possibility using a hedonic regression analysis comparing per acre land value to a series of land characteristics and distance variables for Somerset County, PA. Results indicate no significant relationship between the presence of wind turbines and the value of agricultural land. This confirms the findings of similar studies which have examined the same relationship.

Keywords: wind energy, hedonic regression, agricultural economics

JEL Codes: Q14, Q15, Q18, Q420, Q43

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1 Introduction

Renewable energy sources have become more common in the United States in recent years, driven by innovation in the energy sector and the desire among policymakers and the general public to diversify the energy supply of the U.S. and reduce the country's dependence on foreign oil (Velasco, 2008). Emerging sources of renewable energy include biofuels, solar, and wind, with wind being the fastest growing source of electricity in the United States (Bohn and Lant, 2009). While wind energy has been harnessed through windmills for much of recorded history, turbines for electricity were first developed for commercial use in Vermont in 1941 (Pralle and Boscarino, 2011) and really took off in 1992 when the federal government provided a production tax credit for renewable energy (Peek, 2014). According to Peek (2014), the tax credit led to the number of U.S. turbines increasing seven-fold over the next two decades. In addition to the incentive provided by tax credits and physical wind energy potential, Bohn and Lant (2009) argue that the development of wind energy is determined by factors dependent on human beliefs and actions, such as population size, public policies, renewable portfolio standards, and procedures and regulations for the siting and permitting of wind farms.

The role that human beliefs and actions play is important to highlight because wind turbines bring forth an array of positive and negative impacts. Benefits include very low cost energy after installation, income to rural areas, reduction in greenhouse gases and increased energy independence. Wind energy can provide clean energy which does not contribute to air or groundwater pollution, especially relative to conventional generation, and therefore can be really important to regional environmental efforts. Siler Evans (2013), for example, finds that a wind turbine in West Virginia displaces twice as much carbon dioxide as the same turbine in California.

Opponents to wind-energy development have concerns both aesthetic and practical. A frequent concern that has been discussed in the ecological and environmental literature is that wind turbines ruin the natural beauty of a landscape (Brisman, 2005; Good, 2006). Other concerns revolve around turbine noise, shadow flicker and bird deaths (Pralle and Boscarino, 2011). Coleby et al. (2009) found using a survey-based approach that aesthetic impact remains the root cause of objection, at least at the local level. These objections mean that wind turbine operations are often subject to significant local resistance (Heintzelman and Tuttle, 2012). A short, but by no means exhaustive list of prominent communities that have seen resistance to wind energy operations include Glebe Mountain, VT; Hoosac, ME; Redington, ME; and most notably, Cape Wind, MA (Bohn and Lant, 2009).

As first noted by Devine-Wright (2005), the literature on public perceptions about renewable energy sources such as wind shows a strong degree of “Not In My Back Yard” (NIMBY) attitude. Individuals are very much in favor of wind energy generally (Swofford and Slattery, 2010), but not when the proposed siting is near their home. As argued by Fischel (2001), NIMBYs are often homeowners who cannot adequately insure their home value against decline from neighborhood effects, such as noise from a wind farm. This concern is not unfounded, given that proximity to wind facilities has been shown in some cases to reduce home values (Heintzelman and Tuttle, 2012), although other recent papers find no significant effect (Sims, Dent, and Oskrochi (2008); Sims and Dent (2007)).

In this paper we examine whether the presence of wind turbines has affected the value of nearby agricultural land in Somerset County, Pennsylvania. In doing so we build off an important recent paper by Vyn and McCullough (2014). While the literature on wind turbines has focused primarily on residential home sales, Vyn and McCullough (2014) also look at farmland sales and find no effect of wind turbine proximity on the value of farmland. Our paper adds to their contribution in two ways. First, to our knowledge we are the first to look at the effect of wind turbines on agricultural land in the United States, a country with a very different housing and mortgage market. Second, our focus area is primarily rural and agricultural, with a population density of fewer than 80 people per square mile.

Having a better understanding of the relationship between wind facilities and agricultural land in areas like Somerset County is important for two reasons. First, if wind power facilities continue to emerge in the United States they will likely be located in agricultural and rural areas in order to overcome the most stringent of NIMBY opposition. Second, if wind power facilities reduce the value of agricultural land, the impacts on the financial portfolio of farmers could be severe since farm real estate make up over 80 percent of farm assets in the United States (Bloomendahl et al., 2011).

2 Methods

Somerset County is located in southwestern Pennsylvania in the Laurel Highlands region. It is the seventh largest county in the state with a land area of just over 1,000 square miles. The county is settled mostly by farmers and includes 25 townships, 25 boroughs, and only 72.4 persons per square mile compared to the state average of 283.9 (U.S. Census Bureau, 2014). Tourism, manufacturing, coal mining, and agriculture are the major economic forces in the county. The 2013 population estimate is 76,520, which is a 1.6 percent decline since 2010.

Agricultural land makes up roughly 312.5 square miles (or about 29%) of the county land area. Somerset County also has a high concentration of wind energy operations. The area currently has 221 wind energy turbines owned by multiple companies. Figure 1 shows an overview of the spatial relationships between agricultural land and wind turbines in Somerset County. The majority of the wind turbines in the county are monopole and range from 90 to 150 feet high. Somerset County has received significant investment and activity in wind energy operations. The amount of electricity generated by Somerset County windmills has more than doubled since it began in 2000 (Stouffer, 2010). The first windmill in southwest PA began generating power in 2000 and wind energy has been growing in Pennsylvania ever since. In 2009, electricity generated by windmills in Pennsylvania more than doubled, adding more than 387 MW of wind power capacity (Stouffer, 2010).

Wind turbine data for the area was obtained through the United States Geological Survey (Diffendorfer et al., 2014), which provides a shape file mapping every documented wind turbine in the United States. This data set was created using the Federal Aviation Administration Digital Obstacle File and ArcGIS Desktop by the Geosciences and Environmental Change Science Center of the United States Geological Survey. This data represents all wind turbines in the area as of July 2013. In the fall of 2014, current assessed values for every agricultural land parcel in Somerset County were obtained through the Somerset County Government website. Descriptive statistics for all non-binary variables in our data set are presented in Table 1. Assessed values were used as very few agricultural parcels in the county have changed owners in the past decade and those that have are not arms-length sales but instead sales between family members. Given the lack of arms-length farm sales, assessed value is the best measure for the value of agricultural land given that assessors attempt to approximate market value.

In addition to data on parcel size in acres and assessed value, the only additional data in the file from the Somerset County government are land use codes. For Somerset County there are six different land use codes that are used: AAB (with buildings, tillable and no-till soil, AAO (with buildings, no-till soil), AAT (with buildings, tillable soil), VVB (no buildings, tillable and no-till soil), VVO (no buildings and no-till soil, and VVT (no buildings and tillable soil). As can be seen, the primary distinctions are whether the parcel has buildings and tillable land. These determinations are made as part of the property assessment process, which occurs on an as-needed basis by a professional assessor. The assessor makes observations regarding the specific property characteristics, noting features such as buildings, acreage, topography, soil quality, location, and many more. Neighboring properties are also taken into consideration when determining the value of a land parcel. Assessed value is calculated as one-half of market value, which is defined by the assessor based on property characteristics and the examination of similar sales.

An additional factor that impacts assessed value in Somerset County, Pennsylvania is the Clean and Green program, a state law which allows qualifying agricultural and forest land to be assessed at a value for that use rather than fair market value (Rizzo and Maust, 2001). The purpose of the law (Pennsylvania Farmland and Forest Land Assessment Act, Act 319-amended by Act 156 in 1998 and Act 235 in 2004) is “to encourage property owners to retain their land in agricultural, open space, or forestland use, by providing some real estate tax relief.” In our data set this is coded as zero if the property is not part of the Clean and Green program and 1 if it qualifies. Distance variables were computed using ESRI ArcMap.

Based on general hedonic theory, the model relates the assessed value of a particular parcel to a vector of land characteristics, the distance in miles to the nearest turbine, and a radius variable describing how many turbines exist within one mile of any given property. The inclusion of the radius variable serves as a robustness check, as the estimation of local effects often requires controlling for more than simple linear distance to a landmark (Ross et al., 2011).

$$(1) Assessed = \alpha Acres + \beta LandUse + \chi CleanGreen + \delta Miles + \gamma Radius + \epsilon$$

The availability of more extensive data would likely increase the accuracy of this model. However, this paper is concerned with the coefficients for each distance variable, not in predicting the determinants of assessment values. It should be noted that this model is not meant to be predictive, but rather, to explain the relationship between the distance variables and the per acre land value.

3 Results & Discussion

For robustness, three specifications were examined (as shown in Table 2). The first column is a parsimonious regression which includes only the distance variables. The second column is the full specification as described in equation (1) above. The third column is the same specification as estimated in column 2 but using generalized least squares to deal with heteroskedasticity related to different categories of properties have different variabilities. While the parsimonious regression shows no relationship between assessed value of agricultural land and distance variables, both full specifications display positive and statistical significant relationships between the mileage variable and assessed value. While statistically significant at the 10 percent level, this relationship is not economically meaningful. Calculated at the mean assessed value, a parcel moved one mile closer to a turbine can be expected to have their assessed valuation decline by $443, or just over one percent of a standard deviation in assessed value.

It is important to note that our data does not allow us to address causality. If turbines are more likely to be sited away from high-quality agricultural land than our results might be picking up that selection effect. This selection effect, however, means that our results are upward estimates. Given how small in economic magnitude the relationship is between the assessed value of agricultural property and distance from wind turbines, policymakers and citizens should be more confident in the results of Vyn and McCullogh (2014).

4 Conclusions and Policy Implications

While Heintzelman and Tuttle (2012) did find that wind facilities reduce the value of surrounding land, their study consisted of primarily residential properties. This study, with its sole focus on agricultural land, finds no significant relationship between wind energy operations and the value of surrounding agricultural land. This is in agreement with the studies conducted by Sims and Dent (2007) and Sims et al. (2008) which also looked at only residential land, but found no significant relationship. This study also confirms the findings of Vyn and McCullough (2014) which is the only study containing a significant amount of agricultural property in the hedonic regression. Based on the results of this study, it is not likely that policy makers should be concerned with the impact of wind turbines on surrounding agricultural land. The same cannot be said about the relationship between wind turbines and residential property, as studies have shown mixed results.

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Figure 1
Agricultural Land and Wind Turbines in Somerset County, PA

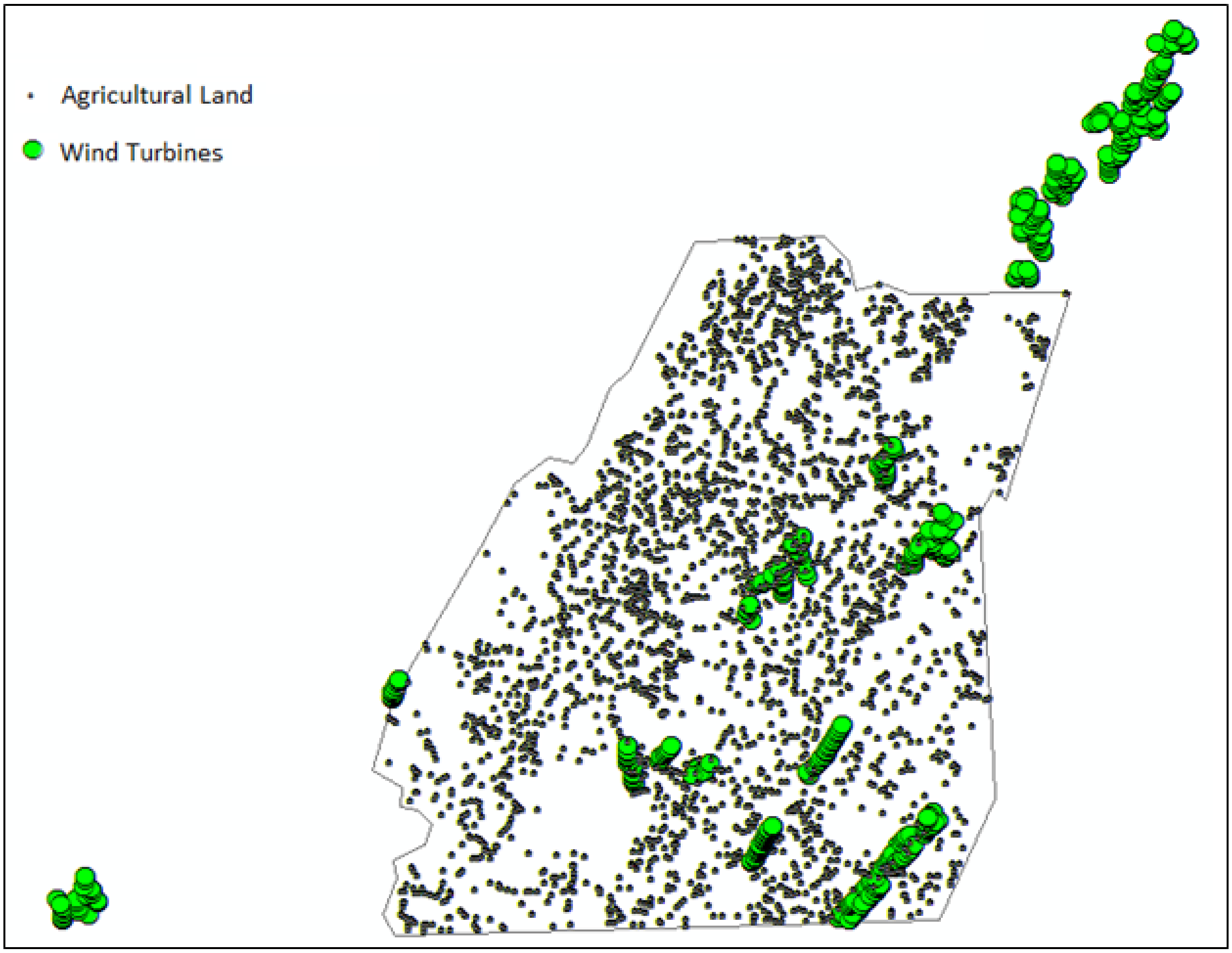

Table 1
Descriptive Statistics for Non-Binary Variables

Variable	Mean	Standard Deviation	Minimum	Maximum
Assessed	52,961	35,104	280	359,860
Acres	68.8	81.9	0.6	148.7
Miles	5.26	3.43	0.03	14.55
Radius	0.45	1.83	0	15
Land Use Codes (Factor)	n/a	n/a	n/a	n/a

Number of observations is equal to 2912.

Table 2
Regression Results
Dependent Variable: Assessed Value

Variable	(1)		(2)		(3)	
Acres			137.84 (1614.74)	***	137.84 (7.8)	***
CleanGreen			-16341.52 (1274.48)	***	-16341.76 (1274.45)	***
Miles	164.9 (202.0)		443.52 (1395.44)	*	443.53 (186.87)	*
Radius	-460.2 (379.0)		-400.94 (348.64)		-400.94 (348.64)	
AAO (with buildings; no-till soil)			-6631.54 (1395.44)	***	-6631.54 (1395.44)	***
AAT (with buildings; tillable soil)			220.68 (2319.03)		220.68 (2319.03)	
VVB (no buildings; tillable & no-till soil)			-37332.09 (6642.12)	***	-37332.09 (6642.11)	***
VVO (no buildings; no-till soil)			-45324.7 (5950.59)	***	-45324.7 (5950.6)	***
VVT (no buildings; tillable soil)			-41343.99 (14469.42)	**	-41343.99 (14469.4)	**
Constant	52298.8 (1305.0)	***	54010.56 (1614.74)	***	54010.56 (1614.7)	***
Observations	2912		2912		2912	
R-squared	0.001095		0.1573		n/a	

Notes: Columns (1) and (2) estimated by Ordinary Least Squares. Column (3) is estimated by Generalized Least Squares. Standard errors in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level respectively.