A Hedonic Analysis of the Disamenity Value of Wind Farm Development in Ireland

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Introduction:

The generation of renewable energy has in recent years become a very important policy goal for Governments around the world, with the industry's development being seen as a key step in the formulation of any climate change policy. Wind power is viewed as being the most developed and fastest growing form of renewable energy on a global scale. In the United States alone, the capacity and net generation of wind energy increased by more than 1,348% and 1,164%, respectively, between 2000 and 2009 (Heintzelman & Tuttle, 2011). While renewable energy sources provide environmental advantages to traditional fossil fuels, the idea that there might be a social cost to the generation of renewables has generally been ignored.

Critics of wind energy have tended to focus on the negative impacts that it has on surrounding areas and residents, with the most prevalent argument being that turbines have a negative aesthetic impact on an area. It is also argued that wind energy has a detrimental effect on local wildlife, especially bats and migratory birds while it is said to have a negative effect on human health with wind turbines being accused of causing health problems such as abnormal heartbeats, insomnia, headaches, nausea, and visual blurring (Heintzelman & Tuttle, 2011). Such negative effects would in theory led to negative impact on local property prices.

In this paper I will carry out an hedonic analysis of the impact of wind farms on property prices in Ireland. I will use a combination of housing characteristic variables (physical characteristics, type of dwelling), environmental variables (which will capture the distance from and number of nearby turbines for each house) and data on house prices to carry out this study.

Policy Background:

In March 2007, the EU launched its own ambitious plan for tackling climate change. The main elements of this plan were (i) to reduce emissions of greenhouse gases by 20% by 2020, (ii) to increase energy efficiency to save 20% of EU energy consumption by 2020, (iii) to reach 20% of renewable energy in the total energy consumption in the EU by 2020, and (iv) to reach 10% of biofuels in the total consumption of vehicles by 2020[1].

The European Council of 11 and 12 December 2008 definitively adopted the package with a target of 20% of all energy in the EU to come from renewable sources by 2020 being set. Ireland’s country specific target was set at 16% with Renewables contribution to gross electricity consumption being 40% by 2020. Onshore wind is to account for roughly 80% of our renewables contribution, which will result in an installed total of 6,000MW[2].

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[1] http://ec.europa.eu/energy/renewables/targets_en.htm
[2] www.seai.ie

Planned Wind Development:

Attempting to forecast the number of wind farms to satisfy this demand can be difficult as turbines can be built in different sizes and in locations with differing wind resources. However it is possible to draw estimates from the current installed wind capacity.

As of 04/12/12 there were 179 wind-farms online and operational in Ireland, with a total installed wind capacity of 2,146MW which will average 5,580,178MWh a year or a 31% load capacity factor[3]. We can see from this that in order to meet Ireland's 2020 targets that it will require roughly a tripling of the number of current wind turbines. While this may sound ambitious on its own, the Government has recently announced plans to export wind energy to the UK in order to help them meet their renewable targets. This plan will involve the construction of wind turbines in the midlands, namely counties Offaly and Laois, with the energy generated being exported to the UK via the recently opened East-West Interconnector.

In order to get a better understanding of this deal it is necessary to outline the policy that facilitated it's drafting. In June 2009, a new EU directive on the promotion of renewable energy sources (RES) entered into effect. The directive 2009/28/EC, provides for three cooperation mechanisms that will allow member states to achieve their national RES target in cooperation with other member states: statistical transfer, joint projects, and joint support schemes (briefly outlined below).

1. Statistical Transfers - one Member State with a renewable surplus sells its statistically to another Member State.
2. Joint Project - a new renewable project in one Member State can be co-financed by another Member State and the production shared statistically between the two.
3. Joint Support - where two or more Member States agree to cooperate on all or part of their support schemes for developing renewable energy and share the value between them.

The agreement signed between Ireland and the UK falls into category 2 of these agreements. The existence of this deal, coupled with the potential for future deals means that Ireland will be left with a situation where it will have to more than triple the number of wind-farms in operation in the country.

Social Acceptability Issues:

The development of wind farms brings with it a certain amount of acceptance concerns with scepticism attached to their ability to generate sufficient output and fear of their impact on home/land values. Wustenhagen (2007) suggests that there are three key dimensions to social acceptance of wind power projects:

1. Market acceptance concerns the investors and project developers, energy suppliers, utilities and grid owners, but also electricity consumers.
2. Socio-political acceptance concerns public opinion of wind power as an acceptable and useful technology and the tone of debate in the media, politics and national institutions.
3. Community acceptance concerns the opinion of the people living in the surroundings of specific wind power projects and therefore bearing most of the direct external impacts of wind energy.

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[3] www.iwea.com

I believe the third issue to be the most important and in order to get an understanding of this it is first necessary to take a look at the planning requirements.

Planning Regulations:

Ireland is considered to have the most liberal regulations in the EU for installing wind turbines. While there are basic planning guidelines set down by the Department of the Environment, Heritage and Local Government, actual guidelines vary per local development authority. There has been an attempt to set down uniform guidelines, with the proposal of the 2012 Wind Turbine Bill. This Bill provides for a minimum distance requirement between wind turbines and residential properties based on the size of the turbine and concerns raised about resulting noise pollution and visual impact. These requirements are as follows:

If the height of the wind turbine generator is:

I. Greater than 25 metres but does not exceed 50 metres, the minimum distance to be maintained is 500 metres
II. Greater than 50 metres but does not exceed 100 metres, the minimum distance to be maintained is 1000 metres
III. Greater than 100 metres but does not exceed 150 metres, the minimum distance to be maintained is 1500 metres
IV. Greater than 150 metres, the minimum distance to be maintained is 2000 metres[4].

However it has been claimed that these targets are unrealistic and the wind energy association, citing NUI Maynooth's All-Island Research Observatory as its source, said even a 1km "buffer zone" would leave only 9.4 per cent of the land area available for new development – mainly because of the spread of housing in rural areas. Current Department of the Environment guidelines suggest a setback of 500m between wind turbines and homes. On that basis, according to the observatory's calculations, nearly 24 per cent of the State's land area would remain available for wind development. For larger wind turbines used on commercial wind farms, while current guidance suggests a 500m separation distance from houses, the increase to 2 kilometres would increase the area within which turbines cannot be located by a factor of 16. A 500m separation distance around a house would prevent turbines being proposed on 78 hectares (193 acres) of land around each house. This is an internationally accepted standard and one that the wind industry has been able to work with. A 2-kilometre separation distance around a house would prevent 1,256 hectares (3,104) around every house being considered for siting wind turbines. This would effectively prevent any further wind farm development in Ireland, given the extent of one-off houses in rural areas[5].

The importance of the maintenance of a sufficient distance between houses and wind turbines is borne out in the perceived impact that wind farm construction has on property prices in its general vicinity. This issue has become more relevant as, stated previously, Ireland will have to more than triple the amount of wind farms in the country. Property values are an important component of any cost-benefit analysis and should be accounted for as new projects are proposed and go through the approval process. Wind farm construction should only be supported if wider benefits should make sure not to cross-subsidise. In many instances property owners in close proximity to turbines are left with no market leverage to offset the impacts that they believe turbines will have on their property values. This is the externality problem that is at the heart of the issue.

[4] www.oireachtas.ie
[5] www.airo.ie

The Hedonic Model:

The hedonic model was first used in the development of value indices for manufactured goods that combined measures of both quantity and quality. It's origins lie in two seminal papers, the first by Griliches (1961) which derived a hedonic price index for motor cars and the second by Rosen (1974) which assessed the welfare effects that changes in goods and services not traded in formal markets has, using residential property decisions to illustrate this.

Kuminoff et al (2010) states that the hedonic property value model is among our foremost tools for evaluating the economic consequences of policies that target the supply of local public goods, environmental services and urban amenities

Hedonic regressions allow us to statistically estimate the relationship between a property's characteristics and its market value. The assumption underlying the hedonic model is that when purchasing a good, such as a house, an individual is actually buying a bundle of utility bearing commodities which all contribute to the overall price of the good. A house has structural characteristics such as floor size, number of bedrooms and garden space. These characteristics along with neighbourhood characteristics (environmental characteristics, access to transports, schools, etc) will all have an impact on the price of the house.

An econometric analysis is used to separate out the marginal willingness to pay for individual characteristics, this is also known as the implicit price. If we are able to estimate the effect that a marginal change in one characteristic has on housing expenditure, holding all other characteristics fixed, then we can interpret this as its implicit price. This is done by regressing (some transformation of) the property price, while controlling for unobserved time and area effects, on the set of variables which measure quality (Mayor et al. 2012). Thus, we can say that house price is a function of all of the characteristics relating to the house and the resulting coefficients are the marginal implicit prices of these characteristics.

Housing is seen as a differentiated or heterogeneous commodity, i.e. a commodity where the characteristics are fundamental to its value in the marketplace. Thus we can define the mathematical form as:

$$P = f(X)$$

The characteristics are combined to make $f(X)$ into a linear function:

$$P = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots \ldots + \beta_u X_u + e$$

here X_1 to X_u are the attribute levels assigned for u selected attributes. The β values are the weights assigned to the attributes and e represents the error term. If characteristic X_1, representing house size in square foot, increases by one unit then the price of the property will increase by β_1 euro. It is not necessary to include the characteristics of either the seller or the buyer, as all potential buyers collectively set the market price (Palmquist, 1991).

There are two common problems with hedonic models, namely Omitted Variable Bias and Endogeneity. Wind Farms are generally located in areas of low property value and this factor needs to be taken into account as if it is not then the disamenity value of the wind farm will be overestimated, leading to an endogeneity bias. Omitted Variable Bias is seen as being the main concern associated with the Hedonic Pricing Model. Including all characteristics that affect the valuation of a house can be extremely difficult and some may be omitted by the individual undertaking the study. The importance of using both time and locality dummies in order to correct for these two problems is outlined in Conniffe and Duffy (1999).

While examining the impact of nearby developments on property prices is not a new idea, the examination of wind turbines effects is still a developing process with no definitive conclusion as yet arrived at. Empirical findings have contrasted greatly with some such as Sterzinger et al.(2003) finding that turbines did not appear to be harming property values. This however was not a true hedonic analysis. Hoen et al (2006 & 2009) also failed to find a significant impact from being within viewing range of wind turbines. However the sample size in both instances was extremely small and neither controlled for regional characteristics. This can be contrasted with other empirical findings where wind facilities have been predicted to negatively impact property values by some (Firestone et al.), sometimes by as much as 24-43% (Kielisch). Locke (2012) found that houses located within 1,000 feet of communication antennas sell for 7.9% less than a comparable house more than 3,000 feet away. Although this last example is not directly related to wind farms, it is still relevant as the construction of communications antennas has similar end characteristics to wind farm construction.

Data:

The data set used in this paper consists of a sample of 24,769 residential property transactions, covering all 26 counties of the Irish Republic in 2012. This data set is composed of both the characteristics of the house and the house price. The house price data was provided by the Central Statistics Office (CSO) and was compiled as part of the Irish Governments process of imposing a property tax on all residential dwellings. This data was then related to information on the location of wind farms and environmental amenities. The complete address was used, along with the An Post Geodirectory, to geo-code the data. Not all addresses in the original database were amenable to geo-coding, location data for these dwellings was obtained using the Irish Residential Property Price Register website. The valid sample size after geo-coding was 22,672, covering a wide range of prices and a large geographical spread. The geo-coding allowed us to map the individual house locations in GIS.

The available structural variables are: the floor space, measured in square metres; the number of bedrooms; the presence or not of a utility room, of parking and of a garden; whether the heating system is gas fired or not; and the condition of the house as assessed by the real estate agent (excellent, fair, poor, very poor, unknown). The type of dwelling is also included (apartment, detached house, semi-detached house, terraced house, and cottage), as well as in what period the house was built (pre-1900, 1900-50, 1950-75, 1975-2000, post-2000)

We also use GIS data from a number of sources. The environmental variables included the distance to the nearest bathing area and to the coastline. This data was provided by the Environmental Protection Agency (EPA). The distance to the nearest public access park is also included; this data was extracted from the CORINE 2000 project courtesy of the EPA. Wind Farm data was provided by the Sustainable Energy Authority of Ireland (SEAI). This data gave the location of all wind farms located in Ireland while also allowing for the power line grid to be accurately mapped in GIS. The use of GIS data allows for accurate mapping of not only wind farms but also Geo-coded house, and environmental and transport amenities. This makes it possible to accurately measure the distance between each of the houses and the surrounding amenities.

Unobserved heterogeneity in area characteristics is allowed for through the use of locality dummy variables and quarterly dummy variables are included to control for house price inflation. The inclusion of dummy variables for each calendar month helps to account potential seasonality in house pricing. Locality dummies are used to account for locality fixed effects and each dummy variable consists of one electoral district. Data on the electoral districts was provided by Ordnance Survey Ireland.

The Irish housing market has suffered a recent period of reduced demand, resulting from the global financial crisis and the impact that this had on credit availability. This reduced demand coupled with excess supply, a legacy of the Celtic Tiger years, has led to significant deflation in the Irish housing market. This study does not look at absolute prices rather it looks at relative prices and thus the quarterly dummies should account for the house price deflation.

Results:

Pending

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