The Effect of Wind Farms on Residential Property Values in Lee County, Illinois

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Table of Contents

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Abstract

Lee County, Illinois experienced significant wind energy development over the last decade. The county is home to the first commercial wind farm constructed in Illinois, which began operation in November of 2003. Additional wind farms began operating in April of 2007 and December of 2009. Although the County has been living with wind development for several years, there is still debate about its effect on residential property values. This study utilizes a hedonic price model to assess the impacts on 1,298 real estate transactions from 1998 to 2010. The analysis indicates that residential properties located near wind turbines in Lee County have not been affected by their presence.

I. Introduction

Location has long been recognized as the most important variable in real estate. Much can be changed about land except for, of course, its physical location. Given that location is paramount, development of neighboring land can be controversial, and sometimes can leave nearby landowners indignant. Installation of wind energy projects over the last decade has been one of these controversial forms of land development. Consequently, analysis of the effects from the installation of wind turbines on nearby residential housing values is in order.

Four stigmas could result from wind energy development, three of which were formalized by Hoen et al. (2009). The first theorized by Hoen et al. is nuisance stigma, where homes are devalued due to sounds or shadow flicker from nearby wind turbines. The second is area stigma or the assumption that having turbines near properties make the area appear more developed and consequently lower property values in the area. That is, area stigma supposes that people receive utility from living in a bucolic setting and wind energy development subtracts from that utility. The final stigma formalized by Hoen et al. is scenic vista stigma, which occurs when turbines degrade what would otherwise be considered a desirable view. Hinman (2010) formalized a fourth stigma, wind farm anticipation stigma. This stigma decreases property values due to the uncertainty surrounding where turbines will be placed and what effect the wind farm will have on area residents when the development is initially proposed.

Of the four stigmas, only area stigma is tested for in this study. Testing for additional stigmas, especially wind farm anticipation stigma, would have been desirable, but data and time constraints limited the ability to do so. This should not be too problematic, though. Area stigma is the most important to test for because the different stigmas are not mutually exclusive. As area stigma is the most general of the stigmas and easiest to test for, it makes sense to test for its presence first and investigate further if necessary. Note, however, that not all stigmas affect properties to the same extent. For example, shadow flicker and turbine noise may have a significant impact on one property near turbines, but have hardly any impact on another. Additionally, area and scenic vista degradation are subjective and very personal in nature. While some may not prefer to look into a field and see a turbine, others enjoy their modern design and view them as symbols of environmentally friendly living and technological progress.

A person's general perception of stigmas associated with wind energy development largely derives from their opinion on wind turbine aesthetics and renewable energy. Unfortunately for wind developers, the predominant perception of wind turbines is they lower nearby housing values. This is substantiated by a number of surveys conducted in areas where wind farms are proposed (see Hinman (2010) and Hoen et al. (2009) for reviews of the surveys). But does wind energy development affect nearby housing values?

The most reliable way to explore the issue is not by polling to gauge public opinion, but through analyzing market transactions. Several papers have addressed the matter and the results largely depend on the type of analysis used. This paper will add to the emerging area of study by testing for area stigma using a series of hedonic price models for 1,298 residential property transactions in Lee County, Illinois over the 1998 to 2010 period. While others have investigated the issue in this way, there are gaps in past analyses this study will fill.

It improves on some previous studies in important ways. First, it not only uses transaction data from near the wind farms, but also further away from the wind farms. This trains the model to allow for the identification of similarities or differences that could be occurring on a region wide basis. Second, it uses data from before any wind farms were proposed, instead of only using data from the post-construction period. This allows for analysis on how property values have changed since the development occurred. Also, it uses a 13 year time period, which is much longer than most studies examine. This allows time for any slow developing effects from wind energy development to surface. Finally, it focuses solely on Lee County wind farms. It is the only study utilizing a hedonic price model to analyze just this area. Hoen et al. (2009) include two of the Lee County wind farms in their analysis, but also look at wind farms in eight other states. They do not report any specific Lee County findings in their study.

The paper proceeds as follows. The next section, Section Two, will discuss past literature on wind farm development and its effects on property values. Section Three will discuss the hedonic price model and its appropriateness in addressing this issue. Section Four will detail the data used in the analysis. Section Five will discuss the results of the model. Section Six puts the paper in context with past research, gives ideas for future research, and briefly discusses public policy implications, while Section Seven offers a summation of the research.

II. Literature Review

There have been numerous analyses on the effects of wind energy projects on nearby property values. Even with several studies exploring the issue, the ultimate effect of wind farms on neighboring properties is still debated. There are two primary reasons for this. A number of the studies use incomplete data to analyze the issue or incorrect methodologies. Other studies suffer from clear biases, as they are commissioned by proponents or opponents of wind energy development. Consequently, the literature review focuses solely on published studies or studies that use a hedonic price model, the preferred model for disamenity research (as will be discussed in Section Three). For literature reviews that cover methodologies beyond the hedonic price model see Hinman (2010) and Hoen et al. (2009).

Studies published in peer-reviewed journals include Sims and Dent (2007), Sims, Dent and Oskrochi (2008), and Laposa and Mueller (2010). Sims and Dent (2007) used a hedonic price model to assess the effect of three wind farms on local housing values in North Cornwall, United Kingdom over the 2000 to 2005 time period. They found property values were diminished near one wind farm, though they attribute the diminution to the area being a former military base and having homogenous homes. Besides not properly accounting for the former military base, the study had significant shortcomings. First, the wind farms were relatively small, with only 37 turbines total between them. Also, the analysis did not include enough information to control for different housing and neighborhood characteristics. Variables used included only house type, selling price, date of sale, and proximity to the nearest wind farm.

Sims, Dent, and Oskrochi (2008) used a more developed hedonic price model that better accounted for housing and neighborhood characteristics. The authors reexamined one of the wind farms located in North Cornwall, UK that was included in their previous study. They concluded wind farm proximity does not have an effect on nearby housing values. Much like Sims and Dent's previous analysis, the study had shortcomings. The authors look at approximately 200 transactions within one half mile of a wind farm over an eight year period. While this type of analysis would reveal diminution of property value over the eight year period considered, it would not reveal price effects relative to properties not in the direct vicinity of the wind farm. Thus, the wind farm could have devalued nearby properties relative to those further away, but it would not be detectable in this analysis.

Laposa and Mueller (2010) look at 2,910 residential real estate transactions in Northern Colorado and test for wind farm anticipation stigma. The authors only test for the one stigma because the farm was never constructed (at least not by the time of publication) due to problems with the developer. Laposa and Mueller found the announcement reduced the selling price of property by approximately 2%, but the authors attributed the diminution in value more to the coincidence of the timing of the announcement and problems that were occurring in the national housing market. The authors' claim their opinion is substantiated by a survey they conducted of local real estate brokers as part of their analysis.

The seminal study on wind energy development and housing values is Hoen et al. (2009). The authors looked at 7,459 real estate transactions from 10 different communities near wind farms. Lee County, IL, the focus of this analysis, was included in the areas analyzed by them. Hoen et al. investigated the presence of area stigma, scenic vista stigma, and nuisance stigma using several different methodologies, including different variations of the hedonic price model, a sales volume model, and repeat sales model. The authors found some indication of nuisance and scenic vista stigma in their analysis, but the stigmas did not appear consistently across their specifications. This led them to conclude that "home prices surrounding wind facilities are [not] consistently, measurably, and significantly affected by either the view of wind facilities or the distance of the home to those facilities" (Hoen et al., 2009, 75).

Though this study examines an area included in Hoen et. al. (2009), it is different than their analysis in two important aspects. First, it considers the effects of wind energy development on residential properties solely in Lee County, Illinois. Any specific Lee County effects could have been outweighed by opposing effects in one of the other nine areas included in Hoen et al. Thus, the focus of this study makes it more important to the Lee County locality, but less generalizable to other localities. Also, this study includes a longer time period and additional transactions that allow for the analysis of a third wind farm. A priori, the results of the two studies are expected to differ.

Hoen (2006) looked at 280 real estate transactions in Madison County, New York over a 10 year period that ended in 2005. All transactions occurred within five miles of a twenty turbine wind farm. Like Hoen et al. (2009), the analysis did not reveal a statistically significant relationship between property values and proximity to wind turbines.

Both Hoen (2006) and Hoen et al. (2009) are exemplary in the level of detail employed in the analyses. The authors were able to collect additional information that would not otherwise be available without site visits. For instance, they were able to rate the view of the turbines from each property and did not rely solely on distance as a proxy for any effects stemming from the view of the turbines. Unfortunately, time constraints limited the ability to undertake similar actions for this study.

Hinman (2010) looked at the effect of Twin Groves Wind Farm on nearby property values in McLean County, Illinois. Results from the analysis provide support for wind farm anticipation stigma theory, but not for wind farm area stigma theory. When the wind farm was initially announced, property values near the prospective wind farm site sold for less than those located elsewhere. However, after the wind farm entered the operational stage, property values near the wind farm appreciated faster than those located elsewhere in the county. Both Hoen et al. (2009) and Hinman (2010) demonstrated the importance of including real estate transactions before a wind farm's announcement, as the site of the eventual wind farm had depressed property values relative to areas further away from the wind farm before the development was ever proposed. Had either not included pre-wind farm announcement observations, the analyses could have erroneously concluded that being near the wind farm devalued the property.

III. Methodology

The hedonic price model is capable of effectively assessing the effects of wind turbines on nearby property values as evidenced by the models frequent use with comparable applications in the real estate appraisal and economic literature. Along with Sims and Dent (2007), Sims, Dent and Oskrochi (2008), Laposa and Mueller (2010), Hoen (2006), Hoen et al. (2009), and Hinman (2010), other studies that use hedonic price models and look at similar, environmental phenomenon and their effects on housing values include Bond (2007), Cohen and Coughlin (2008), Herriges et al. (2005), and Cho et al. (2006). This is by no means a comprehensive list. See Jackson (2001), Boyle and Kiel (2001), and Simons and Saginor (2006) for more thorough literature reviews.

The hedonic price model was developed by Lancaster (1966) and Rosen (1974). It works by separating an item into its component qualities and characteristics, so their marginal contribution to the overall value of the item can be assessed. In residential real estate, a home's selling price is the total value of the item. The home's amenities and neighborhood characteristics are the individual components that considered collectively reveal the home's value. The generic hedonic price model for housing looks like:

$$\text{Selling Price} = f(\text{Home Characteristics, Neighborhood Characteristics})$$

Home characteristics include structural and design characteristics such as number of bedrooms, number of bathrooms, and home layout. Neighborhood characteristics include environment and location attributes such as socioeconomic characteristics, proximity to water, and proximity to wind turbines. Ideally, a hedonic price model for housing would include the aforementioned variables and everything else potential buyers value in a home. Because buyer tastes and preferences are heterogeneous and the number of factors considered when buying are numerous, it is simply not possible to account for everything that adds value to a home. With that in mind, the variables that are accounted for in any hedonic price model are often the ones that data can be collected on and are believed to be correlated with the variables of interest..

The data available for this analysis was not as extensive as desired. First, not all housing characteristics that would ideally be accounted for were accessible. Information on the number of bedrooms, bathrooms, and fireplaces was not able to be obtained. However, variables were able to be specified for the age of the home, square footage, and a general home description (e.g. whether the home is one story, two stories, or a mobile home). Since the focus is on wind turbine's effects on property values, as long as no variable is omitted that would bias the measurement of that effect, the model will accomplish its purpose. No variable is excluded that would bias this effect, so the results from the regression to this end should be decent approximations to reality.

The form of the hedonic model specified for the analysis is as follows:

$$Ln(SP)_i = \beta_0 + \alpha_j \; PC_{ji} + \; \gamma_j \; NWF_{ji} + \; \delta_j \; PC_{ji} * NWF_{ji} + x\delta \; + \; \varepsilon$$

Where:

- $Ln(SP)_i$ is the natural log of the inflation adjusted selling price of a home
- $\alpha_j \; PC_{ji}$ is a vector of binary variables that equal 1 if a home sale occurred after construction began on wind farm j and 0 otherwise. The coefficients (α_j) will measure if homes sold after construction began sold for more or less compared to those sold before construction. It is important to note that the variable is a temporal measure, and does not indicate the construction of a wind farm increased or decreased residential property values.
- $\gamma_j \; NWF_{ji}$ is a vector of binary variables that equal 1 if a home is located within three miles of turbines at wind farm j, 0 otherwise. Note that the turbines do not actually have to be constructed for this variable to equal 1. The variable seeks to control for endogeneity by measuring residential property values near the wind farm sites over the sample period relative to homes located further than three miles from the turbine sites. Since the sample contains transactions that occurred in the wind farm areas before the wind farms were actually constructed, the coefficient will reveal if the wind farms were located in areas that had lower property values relative to other areas in the County.
- $\delta_j \; PC_{ji} * NWF_{ji}$ is the group of variables that are of interest. The interaction between post construction for wind farm j and near wind farm j equals 1 if a home sold after construction of

wind farm j and is located within three miles of wind farm j. This is referred to as a difference in difference estimator and follows the specification of Hinman (2010). The sign, magnitude, and statistical significance of δ_j will reveal if being located within three miles of wind turbines has affected the value of the home. For example, if δ_j is negative and statistically significant, it would indicate that the average home sold near the wind farm sold for a lower price due to the presence of the farm.

- $x\delta$ is a vector of variables to control for other housing and neighborhood characteristics. These variables will be discussed in greater detail in the next section.

Hedonic price models have problems with heteroskedasticity and spatial and temporal autocorrelation. The following adjustments were made to account for these problems. To correct for heteroskedasticity in the error term, White heteroskedasticity-consistent standard errors were computed for each coefficient. Special controls were used to limit the influence of spatial and temporal autocorrelation. To control for the problem spatially, independent variables were included in each specification to account for neighborhood characteristics that would influence the value of all homes within the area. Separate regressions are utilized, one with township binary variables to indicate a property's location, another with binary variables for school districts, and finally one with X-Y GIS coordinates to control for more localized effects. The results will be judged on how robust they are across all specifications. To account for temporal autocorrelation, the home values were deflated using the average of the Rockford, Quad Cities, and Peoria metropolitan statistical area home price indices from Freddie Mac. This adjustment should limit any error term correlation over time. The next section will go into additional detail about the data used in the study.

V. Data

Most of the data used in this study came from Lee County Assessor's Office. Data was provided on the sale price, date of sale, parcel identification number, square footage of the home, year the home was constructed, house type, and township location for approximately 3,300 real estate transactions over the 1998 to 2010 period. In the process of cleaning the data and specifying variables, omissions and irregularities were noted in some transactions. For example, several transactions were not coded for their transaction type or were a transaction type that could bias the results. Examples of transaction types that were omitted include commercial real estate, farm land, vacant residential lots, apartments, and newly constructed homes. Only normal market transactions, commonly referred to as arms-length transactions, for parcels smaller than five acres in size were used in the analysis. The final data set ended up containing 1,298 real estate transactions from 1998 through 2010.

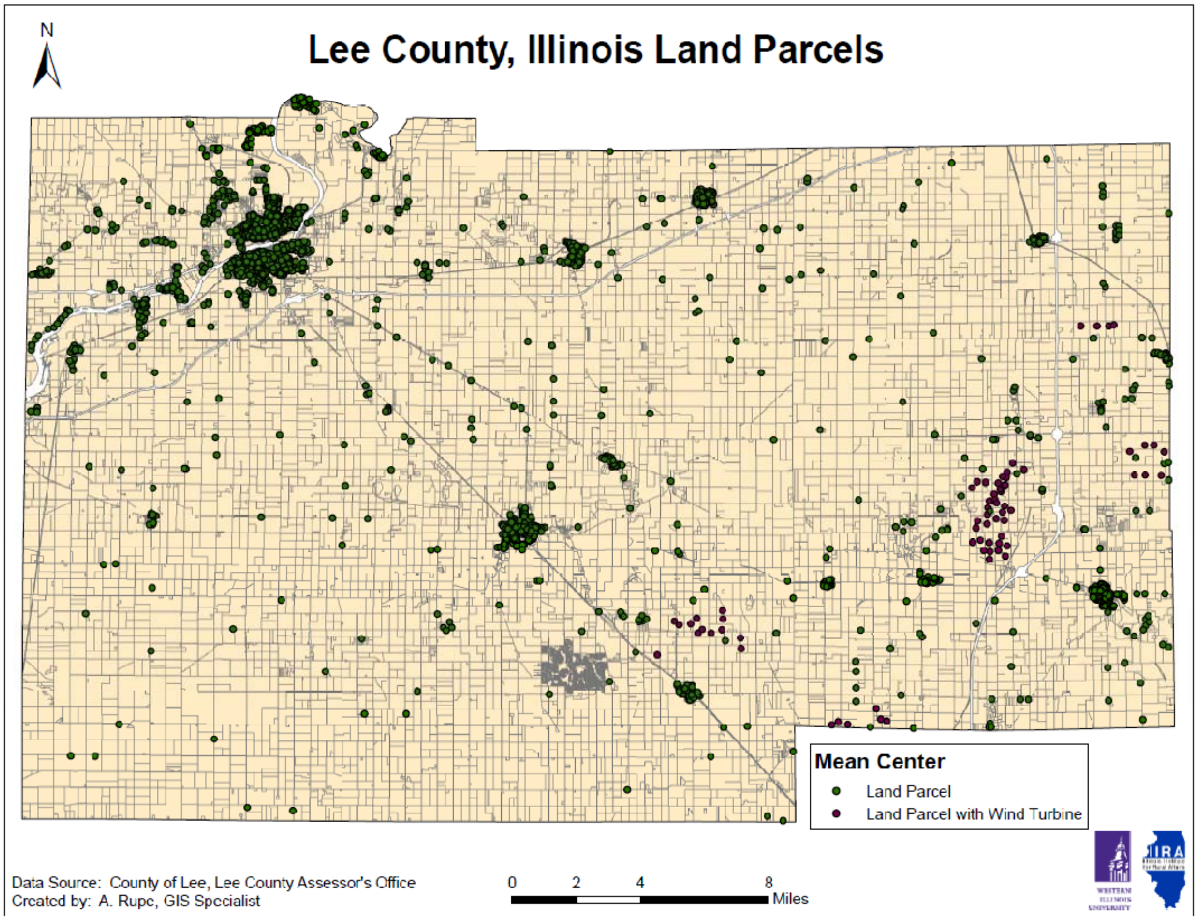
Lee County Assessor's office also provided information on the County's wind farms, including information on which tax parcels contained turbines and the wind farm each parcel was associated with. Most parcels only contained one wind turbine, but a small number of parcels contained up to four turbines.

Lee County's GIS Department provided shapefiles for the tax parcels and school districts. See Image 1 below for a GIS generated map of Lee County with the wind turbine parcels marked by purple dots and the property transactions that occurred in the County over the sample period marked by green dots. To obtain the distance from the real estate transactions to the closest turbine, the parcel identification number for each transaction and turbine were linked to the parcel shapefile. The distance in feet from the center of the transaction's parcel to the center of the closest parcel containing a wind turbine was then calculated.

One shortcoming of the analysis is that only distance to the center of the parcel that contained a turbine was able to be used, and not the exact distance to the closest turbine. While the method employed was not ideal, it still should not have an undue effect on the results of the analysis. The parcels that contain the turbines are specially zoned and, in most cases, are not large. Thus, calculating the distance from the center of a residential parcel smaller than five acres to the center of a small wind turbine parcel should provide a close approximation to the actual distance between the turbine and the home.

An additional shortcoming is that parcels containing only one turbine were treated the same as those containing more than one turbine. It is possible that home values are not affected when they are

Image 1 – Lee County, IL – Real Estate Transactions and Wind Turbine Parcels



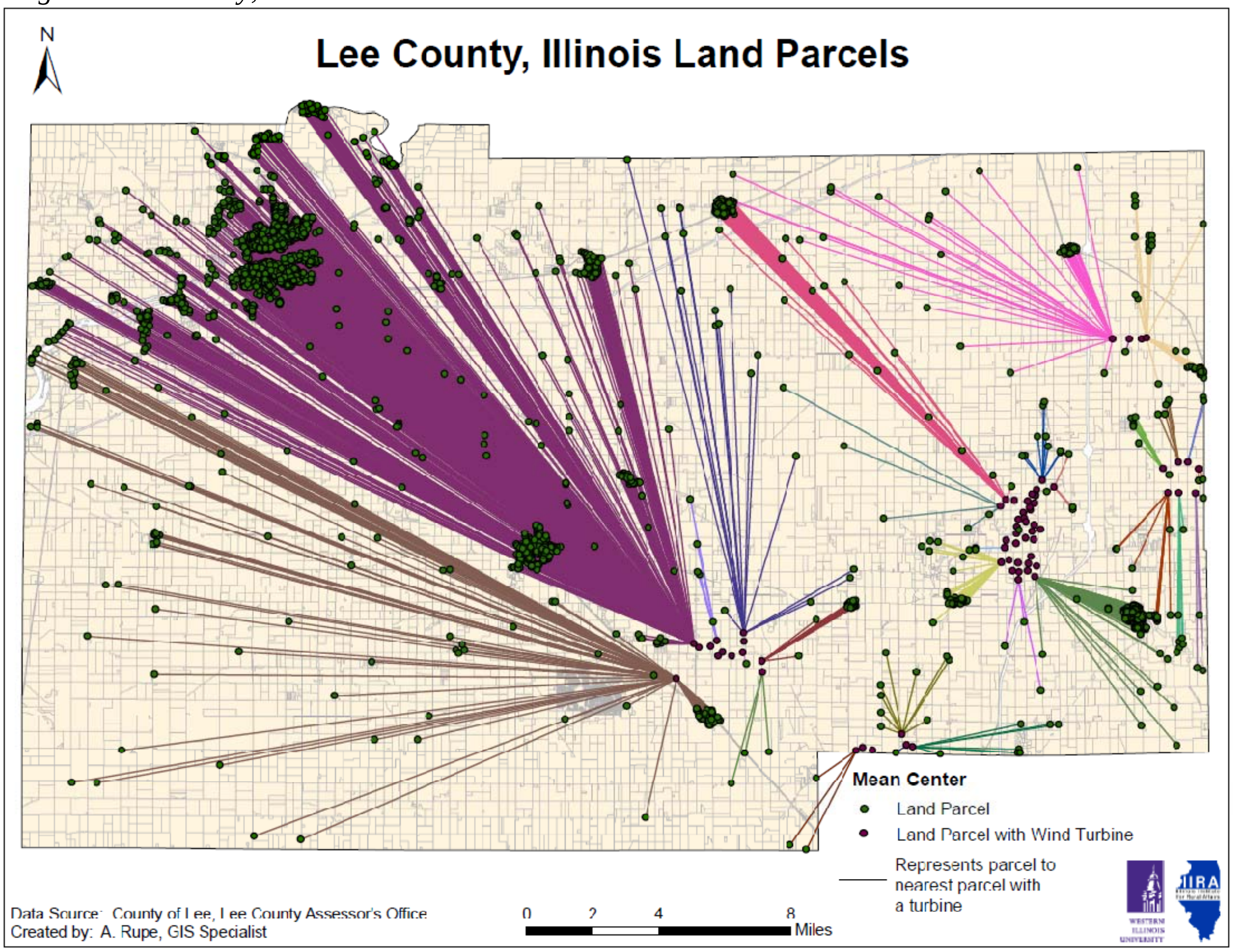
**Note: All land parcels shown in this image were part of the original data set, but were not necessarily included in the final analysis.*

close to one turbine, but are affected when they are near more than one turbine (i.e. there is a cumulative effect). Hoen et al. (2009) partially tested for this through their scenic vista stigma variable and failed to find a difference between proximity to one and several turbines. Even though past evidence indicates there is not an effect, it is an important consideration to bear in mind when reviewing the results of this analysis.

After the distances between the property transactions and the nearest turbine were calculated, the distances were divided by 5,280 to change the unit of measurement from feet to miles. Binary variables were then created for transactions that occurred within three miles of a wind turbine, which is the accepted maximum distance a wind turbine effects a home's value from previous literature (Hinman

2010). See Image 2 below for a visualization of the process of linking the transaction parcels to the turbine parcels. The lines on the image flow from each transaction parcel to the turbine parcel that is nearest the transaction.

Image 2 – Lee County, IL – Transaction Parcels Linked to Closest Turbine Parcel



**Note: All land parcels shown in this image were part of the original data set, but were not necessarily included in the final analysis.*

Other variables were also transformed from their received form to simplify interpretation, including the dependent variable. Property selling price was adjusted in two different ways. First, to deflate the values, a home price index for Lee County over the 1998 to 2010 time period was constructed. Freddie Mac, the government-sponsored mortgage corporation, releases monthly home price indices by metropolitan statistical areas (MSAs) across the U.S. Lee County is not covered by an MSA. To obtain a suitable index to deflate the Lee County home prices by, the average of the Rockford, IL, Peoria, IL, and Quad Cities, IL/IA MSAs was taken. These three MSAs triangulate Lee County. The real estate transactions for the County were deflated by the averages of the indices and put in December, 2010 dollar levels. After the values were deflated, the natural log of the selling price was calculated to normalize the variable's distribution and allow for easier interpretation. See Histogram 1 and Histogram 2 in the Appendix for the distribution and descriptive statistics on deflated selling price and the natural log of the deflated selling price for the sample used in the analysis.

The square footage variable was also changed to allow for easier interpretation. The variable was divided by 1,000 so the coefficient could be interpreted as the increase in price for every 1,000 square foot increase in living space. This variable is expected to have a positive effect on selling price. Assuming all other home characteristics are equal, the larger the home is, the more expensive it will be. See Table 1 for descriptive statistics for square footage and other key variables.

To arrive at the age of the home at time of sale, the year that the home was built was subtracted from the year of sale. Age was also squared and used in the regression due to the assumption that age has a non-linear effect on the price of a home. While newer homes are often preferred for reasons like

Table 1 – Selected Variable Descriptive Statistics

	Mean	Median	Std. Dev.	Maximum	Minimum
Adj. Price	106,969.00	89,299.00	62,576.00	495,834.00	4,910.00
LN(Price)	11.43	11.40	0.55	13.11	8.50
Age	66.79	62.00	41.35	155.00	0.00
Age^2	6,168.70	3,844.00	5,953.78	24,025.00	0.00
Square Feet/1000	1.46	1.36	0.57	6.38	0.48
Post Cons. GSG	0.07	0.00	0.26	1.00	0.00
Post Cons. MH	0.59	1.00	0.49	1.00	0.00
Post Cons. LD	0.02	0.00	0.13	1.00	0.00
Miles to Turbine	12.21	16.54	6.83	22.74	0.13
Homes w/in 0-1 mile	0.01	0.00	0.11	1.00	0.00
Homes w/in 1-2 miles	0.08	0.00	0.28	1.00	0.00
Homes w/in 2-3 miles	0.03	0.00	0.18	1.00	0.00
Homes < 3 miles	0.13	0.00	0.33	1.00	0.00

See all variables in Table 3 in the appendix.

modern layouts and amenities, older homes may also be valued for reasons like historical characteristics and charm. The inclusion of both variables allows for the age of the home to lower its value at a decreasing rate and at an inflection point begin increasing the home's value again.

Six residential property types were included in the analysis, which were coded as fixed effect variables, and were as follows: one story, one and one-half stories, two stories, duplex, bi-level (split level), and mobile home. Several transactions in the original data set were not coded for their house type. Rather than omit the property description variable from the analysis, those observations that were not coded were not used.

Township indicator variables were built from numerically coded data on what township the transaction took place in. Lee County townships include Alto, Amboy, Ashton, Bradford, Brooklyn, Franklin Grove, Dixon, East Grove, Hamilton, Harmon, Lee Center, Marion, May, Nachusa, Nelson, Palmyra, Reynolds, South Dixon, Sublette, Viola, Willow Creek, and Wyoming. May Township was completely left out of the analysis due to its transactions missing information used in variable construction. See Table 1 in the Appendix for selected socio-economic characteristics of Lee County and each township.

School district indicator variables were also constructed for the analysis using GIS. Lee County provided a school district shapefile that was layered on top of the parcel shapefile to discern the school district each transaction took place in. An important consideration for families thinking of purchasing a home is the quality of area schools. Additionally, the variable serves as a substitute for the township indicators to absorb neighborhood characteristics and check for robustness of the results across specifications. Lee County school districts include Amboy School District 272, Ashton-Franklin Center School District 275, Bureau Valley School District 340, Creston School District 161, Dixon School District 170, Earlville School District 9, Indian Creek School District 425, Lamoille School District 303, Mendota School District 280, Montmorency School District 145, Nelson School District 8, Ohio School District 17, Paw Paw School District 271, Polo School District 222, Rochelle School District 212, and Sterling School District 5.

For a more localized control of spatial trends the X and Y coordinates for each property transaction were included in part of the analysis. The specification is similar to that used in Hinman (2010), Dubin (1992), Pace and Gilley (1997, 1998), Pavlov (2000), Fik et al. (2003), and Beron et al. (2004). The coordinates were obtained from GIS portion of the analysis. These variables were substitutes for the township and school district indicators and consequently allowed for robustness testing of the parameters of interest across different spatial modeling techniques.

Post wind farm construction indicator variables were specified to account for sales that occurred after each wind farm was constructed. Mendota Hills Wind Farm began construction in August of 2003 and began operation in November of 2003. GSG 1 Wind Farm began construction in September of 2006 and began full operation in August of 2007. The Lee-Dekalb Wind Center began construction in July of 2009 and operation in December of 2009. Because of the short period of time between construction and operation, this variable was set equal to one as soon as construction began on each wind farm.

VI. Results

Three hedonic price models were run with slightly different specifications to assess the robustness of the results. One model was specified with a group of township binary variables to control for neighborhood effects. The reference township from the group is Dixon, which had the largest number of real estate transactions of any township in the analysis and is not near any of the wind farms. Another specification had school district binary variables instead of the township group. Dixon School District 170 was used as the reference district for this regression. The final specification contained the GIS X and Y coordinates for each transaction parcel. All neighborhood effects groups were jointly significant in their respective regressions.

Other reference groups in each equation include two story homes for the group of house-type variables. Additionally, those properties that are farther than three miles from a wind farm are a reference group. The final reference group is the transactions that occurred pre-wind farm construction. The results

Table 2 – Wind Farm Proximity Hedonic Price Models

	Townships		School Districts		X-Y	
C	11.1901***	(.0764)	11.2651***	(.0799)	3.2732	(2.0775)
Age	-0.0107***	(.0011)	-0.0124***	(.0010)	-0.0126***	(.0011)
Age^2	0.00004***	(.0000)	0.00004***	(.0000)	0.00005***	(.0000)
Square Feet	0.3856***	(.0284)	0.4037***	(.0293)	0.4220***	(.0298)
Bi-level	-0.0454	(.0654)	-0.0878	(.0685)	-0.0749	(.0749)
Duplex	-0.1878***	(.0518)	-0.2209***	(.0708)	-0.2625***	(.0884)
Mobile	-1.1944***	(.2376)	-1.2204***	(.2216)	-1.2420***	(.2307)
One & one-half story	0.0803**	(.0343)	0.0657*	(.0353)	0.0768**	(.0357)
One story	-0.0011	(.0354)	-0.0129	(.0369)	-0.0094	(.0373)
Near MH	0.0697	(.1058)	0.0706	(.1084)	0.0594	(.1024)
Near GSG	0.1834	(.1244)	0.2338	(.0774)	0.1107	(.0806)
Near L-D	0.2327	(.1208)	0.2143**	(.1026)	0.1601**	(.0605)
Post-construction MH	0.0597***	(.0203)	0.0566***	(.0208)	0.0677***	(.0213)
Post-construction GSG	-0.0715	(.0555)	-0.0691	(.0558)	-0.0329	(.0548)
Post-construction L-D	-0.1597	(.1237)	-0.1367	(.1298)	-0.1492	(.1265)
Post-Con*Near MH	-0.0241	(.1156)	-0.0183	(.1201)	-0.0307	(.1203)
Post-Con*Near GSG	0.4099**	(.1749)	0.2966*	(.1565)	0.4170***	(.1529)
Post-Con*Near L-D	0.0356	(.1685)	-0.0112	(.1665)	0.0054	(.1590)
Adj. R-squared	0.5852		0.5611		0.5461	
S.E. of regression	0.3545		0.3647		0.3708	
Sum Squared Residuals	158.3351		168.7445		175.7318	
Log Likelihood	-476.3731		-517.6961		-544.0283	
F-statistic	50.4640		60.2222		83.1497	
AIC	0.7926		0.8424		0.8691	
SIC	0.9439		0.9578		0.9487	
Durbin-Watson	1.9446		1.9469		1.8988	

*Notes: Dependent Variable: LN(Adj. Selling Price). N=1,298. ***Significance at the 1% level. **Significance at the 5% level. *Significance at the 10% level. Standard errors are White heteroskedasticity-consistent.*

from each model are contained in Table 2. Note that the coefficients are semi-elasticities, and the smaller coefficients can be easily transformed into the percentage change in price by multiplying the number by 100. For example, the coefficient on one and a half story homes is .08. This can be can be interpreted as one and a half story homes selling for an 8% premium, on average, over the price of the average two story home. To obtain the marginal effect for larger coefficients, the following formula should be used [$\%\Delta y = 100*(\exp(\beta_{sq\ ft})-1)$].

The variables age and age-squared are both significant at the 1% level across all specifications. The variables maintain the same sign and general magnitude across specifications, also. As predicted, an additional year of age decreases home value, but does so at a decreasing rate. The quadratic function reveals that, on average, when a home in Lee County reaches the age of 138 years it starts appreciating in value. The oldest home contained in the data set was 155 years old at the time it was sold.

Home square footage is also highly statistically significant and at the same approximate magnitude across all specifications. Because the semi-elasticity is so large, an adjustment needs to be made to get the actual average change in price [i.e. $\%\Delta y = 100*(\exp(\beta_{sq\ ft})-1)$]. The coefficient on square footage is .3840. When properly adjusted, a 1000 square foot increase in home size is associated with a 46.8% higher selling price, ceteris paribus.

The group of property description variables stay at the same magnitude and significance levels throughout the three specifications. While not all are significant, they are jointly significant in every regression. As noted previously, this group of variables is interpreted in reference to the average two story home in Lee County. The coefficient for one story homes is not significant in any specification, indicating that the average one story home does not sell at a premium or discount relative to the average two story home in the County.

Near GSG, Near MH, and Near L-D are binary variables that equal 1 if a home transaction occurred within three miles of the respective wind farm areas over the 1998 to 2010 period. Note these coefficients are not picking up the property value effects of being located near a wind turbine. Rather, the coefficients measure the neighborhood effects of the area within three miles of the wind farm area. The coefficients will reveal if the wind farms were constructed in areas that had lower, similar or higher property values relative to other areas in the County.

The coefficients for Near GSG and Near MH are not statistically significant in any specification, indicating that home values near those wind farm areas were not materially different from elsewhere in the County over the 1998 to 2010 period. The coefficient on Near L-D is significant at the 5% level for two of the three specifications. The positive coefficient reveals that residential properties near Lee-Dekalb Wind Center sell at a 17% to 24% premium (after adjustments) compared to similar properties elsewhere in the County. This does not indicate that the construction of the Lee-Dekalb Wind Center increased values of nearby residential properties, but rather the wind farm happened to locate itself in an area with higher residential property values relative to the rest of Lee County.

The coefficient on Near L-D is interesting because one would expect wind farms to be located in cheaper areas rather than more expensive ones. The difference between the expectation and what the model indicates could be due to the comparison of residential property to farm land. Wind turbines are typically located on the latter and the relationship between farm land prices and nearby residential property prices was not explored in this study. It is possible that residential properties are in demand in the area around the Lee-Dekalb Wind Center, but the farm land is not as productive as other areas in the County. Therefore, the farm land is relatively less expensive to lease for wind energy development. Alternatively, the area surrounding the Lee-Dekalb Wind Center could be an attractive place to put a wind farm because of wind speeds and existing infrastructure from the previous wind developments. Thus, the developers were willing to pay more for land because of other advantages related to the site.

The group of post-construction binaries for the three wind farms indicate transactions that occurred after that particular wind farm was constructed. Across all specifications, the only statistically significant coefficient is Post-Construction Mendota Hills. This indicates that homes sold after August 2003 went for approximately 6.5% higher than those that sold before the wind farm was constructed.

Note this is a temporal measure marked by the construction of the respective wind farms in the variables' names. Residential properties not near the wind farm are included in the variable, also.

The variables of interest for each specification are the interaction terms between the near wind farm area variables and post wind farm construction variables, which are the difference-in-difference estimators. The interaction term for Mendota Hills is not significant in any of the specifications, indicating that the construction and operation of the wind farm has not affected the selling price of homes within a three mile radius of it. The same result is found for Lee-Dekalb Wind Center. Even though the coefficient indicates the Wind Center has not affected neighboring residential property selling prices, there is not much confidence in the result as the coefficient was estimated with only four observations. This applies to the coefficient for GSG Wind Farm, also. The coefficient indicates that GSG Wind Farm has increased the value of neighboring properties by 35% to 52% (after adjustments), depending on the model specification. This finding is particularly hard to believe and most likely is an indicator of omitted variable bias. That is, the coefficient is picking up the effect of some characteristic of the homes near GSG that was not able to be accounted for in any of the models. Additionally, the coefficient was estimated with only five observations. Consequently, there is no confidence in the precision of the estimation and any one observation could have undue influence on the results. The only result obtained with confidence for the variables of interest is for Mendota Hills Wind Farm. Regardless, none of the specifications indicate that wind energy development in the County has had an effect on the selling prices of nearby residential properties.

All three hedonic models' F statistics indicate significance at the 1% level. The best performing model of the three is the one with township indicators controlling for neighborhood effects. The AIC, SIC, and R-squared model performance measures all select this model. The next best model is the school district model. Although, the SIC criterion prefers the X-Y model over school district model. This is because the SIC rewards parsimonious models. The school district model has nine more variables than the X-Y model, and according to the SIC, the additional variables are not worth the loss in degrees of freedom. The Durbin-Watson statistics are sufficiently close to two for all specifications, indicating no autocorrelation of degree one. The residuals were obtained from each regression to check for higher-order autocorrelation. The residuals were regressed on themselves lagged up to six periods. None of the lags were statistically significant, indicating the absence of higher-order autocorrelations.

As a further test of robustness, the sample was broken down by wind farm and the township binary variable specification was estimated for each wind farm individually. The results from these models are reported in Table 3 alongside the results from the full township model.

Some of the coefficients show wide variations across models. This is easily explained in all cases, though. In the Mendota Hills regression, for example, a bi-level house is valued 45% less (after adjustments) relative to a two-story house. In the aggregate model, there is no statistical difference between the two home types. The problem is when the observations are split up by wind farms there are only three transactions that occurred for bi-level homes in the Mendota Hills area, which is simply not enough observations to get a reliable coefficient estimate. This is the case for all coefficients that show significant variation from the aggregate model. Overall, the coefficients hold up fairly well across the wind farm models when comparing them to the aggregate township model.

Table 3 – Township Binary Variable Specification by Wind Farm vs. Aggregate Model

	Mendota Hills (244 obs.)		GSG (965 obs.)		Lee-Dekalb (89 obs.)		Townships (1298 obs.)	
C	11.2362***	(.1874)	11.1800***	(.0088)	11.3609***	(.3844)	11.1901***	(.0764)
Age	-0.0077***	(.0028)	-0.0110***	(.0012)	-0.0113*	(.0057)	-0.0107***	(.0011)
Age^2	0.00002	(.0000)	0.00004***	(.0000)	0.00004	(.0000)	0.00004***	(.0000)
Square Feet	0.3149**	(.0782)	0.4128	(.0342)	0.3878***	(.1242)	0.3856***	(.0284)
Bi-level	-0.3718**	(.1551)	0.0309	(.0674)	-0.2097	(.1666)	-0.0454	(.0654)
Duplex	-0.0104	(.0729)	-0.2060***	(.0674)	---------	------	-0.1878***	(.0518)
Mobile	-0.8365***	(.1701)	-1.3382***	(.2875)	---------	------	-1.1944***	(.2376)
One & one-half story	0.0548	(.0719)	0.0771*	(.0411)	0.1026	(.1524)	0.0803**	(.0343)
One story	-0.0716	(.0953)	0.0357	(.0415)	-0.1699	(.1894)	-0.0011	(.0354)
Near GSG	---------	------	0.1770	(.1335)	---------	------	0.1834	(.1244)
Near MH	0.1332	(.1022)	--------	------	---------	------	0.0697	(.1058)
Near L-D	---------	------	--------	------	0.3706**	(.1738)	0.2327	(.1208)
Post-construction GSG	---------	------	0.0244	(.1688)	---------	------	-0.0715	(.0555)
Post-construction MH	-0.0032	(.0428)	--------	------	---------	------	0.0597***	(.0203)
Post-construction L-D	---------	-------	--------	------	-0.3588***	(.1025)	-0.1597	(.1237)
Post-Con*Near GSG	---------	------	0.3482	(.2224)	--------	------	0.4099**	(.1749)
Post-Con*Near MH	-0.0220	(.1303)	--------	------	--------	------	-0.0241	(.1156)
Post-Con*Near L-D	---------	------	--------	------	0.2494	(.1677)	0.0356	(.1685)
Adj. R-squared	0.4269		0.5758		0.5061		0.5852	
S.E. of regression	0.3771		0.3481		0.3716		0.3545	
Sum Squared Residuals	32.1442		113.5321		10.2157		158.3351	
Log Likelihood	-98.9347		-336.7052		-29.9557		-476.3731	
F-statistic	11.6461		49.4699		7.4401		50.4640	
Durbin-Watson Statistic	2.1312		1.9174		2.1799		1.9446	

*Notes: Dependent Variable: LN(Adj. Selling Price). ***Significance at the 1% level. **Significance at the 5% level. *Significance at the 10% level. Standard errors are White heteroskedasticity-consistent.*

VII. Discussion

The results of the analysis showed that wind farms in Lee County have not had a statistically significant or reliably quantifiable impact on nearby residential property values. The results largely mirror those of other studies that use a hedonic price model to look at other locations with wind development (Sims and Dent 2007; Sims, Dent and Oskrochi 2008; Laposa and Mueller 2010; Hoen 2006; Hoen et al. 2009; and Hinman 2010).

It is tough to reconcile the consistent findings that wind farms do not affect neighboring property values when the general public harbors the expectation that they do. If the general public believes turbines affect property values, that belief should eventually show up in residential real estate transaction data.

Hinman's (2010) finding of wind farm anticipation stigma was a promising result and can explain the difference in public perception and what empirical studies have found. The stigma allows for the predominant public perception expressed in surveys to manifest itself in the wind farm announcement phase, and reduce the selling prices of homes near wind farms. Assuming the wind farm is appropriately sited and minimizes nuisances to nearby residents, property values eventually rebound once the uncertainty surrounding how homeowners are affected by the development disappears. All additional studies should use three stages of development in their analysis to test for this effect, if possible. A three stage development model would have been used in this study had there been enough transactions during the announcement phase to allow for reliable estimation of wind farm anticipation stigma.

Most other studies do not account for the different stages of wind farm development either, which could be the reason for the consistent finding that wind energy development has not had an effect on the selling prices of nearby homes. Additionally, the lack of a discernible effect across previous studies could be due to other factors that most previous analyses did not address and future ones will want to. One consistent problem in much of the literature is that the results presented are not able to say anything about whether being in close proximity to a wind farm affects the ease of selling a home. It could be that those who live in the spots most affected by turbine disturbance are simply unable to sell their home and consequently a study that uses real estate transaction data would miss that. This does not seem very likely, however. If a property owner needed to sell their home and was having problems doing so, they would more than likely lower the price until they could. The transaction would then show up in the data and its effect would be registered. A thirteen year period, like this analysis used, should be a sufficient amount of time to let transactions like this occur. Additionally, Hoen et al. (2009) estimated a sales volume model alongside their base hedonic price model and conclude that sales volumes did not diminish as wind energy development took place. While there is evidence to suggest that wind farms do not affect the ease of selling a home, additional exploration of the issue should occur.

Another factor that could potentially be biasing the effect of turbine proximity is that wind farm owners often give nearby residents annual payments (Chicago Tribune 2009). According to the Chicago Tribune article, non-participating landowners closest to the turbines at the Lee-Dekalb Wind Energy Center receive $1,000 annually. Assuming the payment is transferrable to new owners if the house is sold, this could serve as an inducement to purchase the house at the asking price. A future study that includes several different wind farms, like Hoen et al. (2009), could account for incentives given to local property owners to see if there is a price difference between those that offer incentives and those that do not. However, obtaining this type of detailed data may be a potential barrier.

Due to the diversity in quality of data and analysis in past literature, the effect of wind energy development on nearby residential housing values needs to continue to be examined. As more property transactions occur near turbines and the theory of how turbines affect housing values develops, researchers should continually revisit the issue.

VIII. Conclusion

The results of the analysis show that Mendota Hills Wind Farm in Lee County, Illinois has not impacted the average selling price of nearby residential real estate. The results indicate the same for Lee-Dekalb Wind Center, but due to lack of transactions this result is not as reliable. Surprisingly, GSG Wind Farm is shown to have significantly increased the selling values of nearby residential properties. Here again, though, the coefficient is not estimated with much confidence due to the extremely small number of observations. Overall, wind energy development in Lee County does not appear to have had an effect on residential property transactions that occurred in close proximity.

Hoen et al. (2009), which included Lee County as one of the sample areas in their analysis, found similar results of no consistent effect on property values. This study is important relative to Hoen et al. (2009) because its results are specific to Lee County and location is often the key variable in real estate. Additionally, this study's results add credence to numerous others that have found similar results (Sims and Dent 2007; Sims, Dent and Oskrochi 2008; Laposa and Mueller 2010; Hoen 2006; Hoen et al. 2009; and Hinman 2010).

This study advanced the literature in three ways. First, it not only used transaction data from near the wind farms, but also farther away from the wind farms, which several past studies did not do. This trains the model to allow for the identification of similarities or differences in residential real estate selling prices that could be occurring on a region wide basis. Second, it contained observations for transaction that occurred before any wind farm was even proposed in the County, instead of just after the wind farm was built. This allows an analysis on how property values have changed since the development occurred. Again, several past studies have neglected this important factor. Finally, the analysis used a 13 year time period, which is the longest period of analysis from all of the past studies. This allows more time for any slow developing effects from wind energy development to surface and for additional transactions near wind farms to occur.

Even with research mounting that wind turbines do not affect nearby residential properties, no definitive conclusions can be reached at this time. Public opinion and perception still seems to indicate that the presence of wind turbines diminish property values. Wind farm anticipation stigma theory is appealing in that it was found in past studies (Hinman 2010) and can reconcile the gap between public opinion and empirical research. The stigma was not able to be tested for in this study, unfortunately. It seems probable that any public unhappiness with wind development has more to do with the uncertainty surrounding where the turbines will be placed and their ultimate impacts on neighboring residents. Thus, public relations and education are paramount for wind energy developers and public officials hoping to see additional development.

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Appendix

Table 1 - County& Township Socio-Economic Characteristics

Name	Type	2008 Population	Land Area	Population Per Mile	Median Age	Median Income	Median House Value
Lee	County	34,919	725	48	38	$ 47,452	$ 137,716
Alto	Township	577	35	17	37	$ 61,457	$ 189,803
Amboy	Township	3,230	35	92	37	$ 45,564	$ 134,909
Ashton	Township	1,317	18	74	37	$ 48,711	$ 142,264
Bradford	Township	362	36	10	34	$ 61,483	$ 232,040
Brooklyn	Township	876	36	24	37	$ 48,280	$ 147,565
Franklin Grove	Township	1,472	27	55	42	$ 51,762	$ 152,514
Dixon	Township	17,925	29	616	38	$ 53,237	$ 142,068
East Grove	Township	267	36	8	38	$ 42,245	$ 136,962
Hamilton	Township	236	36	7	36	$ 40,305	$ 135,018
Harmon	Township	400	36	11	39	$ 25,002	$ 128,126
Lee Center	Township	593	36	16	38	$ 67,014	$ 152,691
Marion	Township	268	36	8	40	$ 64,575	$ 180,967
May	Township	395	36	11	53	$ 39,228	$ 159,406
Nachusa	Township	497	29	17	35	$ 56,283	$ 174,074
Nelson	Township	854	23	38	41	$ 52,901	$ 126,358
Palmyra	Township	2,610	35	75	41	$ 57,064	$ 172,939
Reynolds	Township	333	36	9	37	$ 62,048	$ 235,044
South Dixon	Township	828	30	28	40	$ 47,777	$ 152,957
Sublette	Township	807	37	22	38	$ 57,607	$ 198,639
Viola	Township	279	35	8	40	$ 41,295	$ 257,665
Willow Creek	Township	700	35	20	36	$ 62,363	$ 255,721
Wyoming	Township	1,236	36	34	38	$ 52,505	$ 186,445

Notes: Land area is in square miles. Source: City-data.com

Table 2 - Data Sources

Data Type	Data Source	Publicly Available?
Transaction Data (1998-2010)	Lee County Assessor's Office	Yes
Wind Turbine Parcel Information	Lee County Assessor's Office	Yes
PIN and School District Shapefiles	Lee County GIS	Yes
House Price Indices	Freddie Mac	Yes

Table 3 – Restricted Data Set Descriptive Statistics

	Mean	Median	Std. Dev.	Maximum	Minimum
Adj. Price	106,969.00	89,299.00	62,576.00	495,834.00	4,910.00
LN (Price)	11.43	11.40	0.55	13.11	8.50
Age	66.79	62.00	41.35	155.00	0.00
Age^2	6,168.70	3,844.00	5,953.78	24,025.00	0.00
Square Footage/1000	1.46	1.36	0.57	6.38	0.48
Alto	0.02	0.00	0.15	1.00	0.00
Amboy	0.06	0.00	0.24	1.00	0.00
Ashton	0.02	0.00	0.16	1.00	0.00
Bradford	0.01	0.00	0.09	1.00	0.00
Brooklyn	0.07	0.00	0.25	1.00	0.00
Dixon	0.49	0.00	0.50	1.00	0.00
East Grove	0.00	0.00	0.06	1.00	0.00
Franklin Grove	0.03	0.00	0.17	1.00	0.00
Hamilton	0.00	0.00	0.04	1.00	0.00
Harmon	0.01	0.00	0.08	1.00	0.00
Lee Center	0.01	0.00	0.09	1.00	0.00
Marion	0.00	0.00	0.03	1.00	0.00
May	0.00	0.00	0.00	0.00	0.00
Nachusa	0.01	0.00	0.09	1.00	0.00
Nelson	0.02	0.00	0.13	1.00	0.00
Palmyra	0.05	0.00	0.22	1.00	0.00
Reynolds	0.00	0.00	0.06	1.00	0.00
South Dixon	0.01	0.00	0.12	1.00	0.00
Sublette	0.01	0.00	0.11	1.00	0.00
Viola	0.01	0.00	0.09	1.00	0.00
Willow Creek	0.04	0.00	0.19	1.00	0.00
Wyoming	0.13	0.00	0.33	1.00	0.00
X	2,523,225.00	2,486,430.00	56,959.00	2,631,140.00	2,443,410.00
Y	1,870,235.00	1,883,385.00	26,320.00	1,911,020.00	1,793,160.00
Sch. Dist. 17	0.00	0.00	0.03	1.00	0.00
Sch. Dist. 170	0.55	1.00	0.50	1.00	0.00
Sch. Dist. 212	0.02	0.00	0.16	1.00	0.00
Sch. Dist. 271	0.13	0.00	0.34	1.00	0.00
Sch. Dist. 272	0.09	0.00	0.29	1.00	0.00
Sch. Dist. 275	0.07	0.00	0.26	1.00	0.00
Sch. Dist. 280	0.07	0.00	0.26	1.00	0.00
Sch. Dist. 340	0.00	0.00	0.06	1.00	0.00
Sch. Dist. 425	0.03	0.00	0.18	1.00	0.00
Sch. Dist. 5	0.01	0.00	0.11	1.00	0.00

	Mean	Median	Std. Dev.	Maximum	Minimum
Sch. Dist. 8	0.01	0.00	0.08	1.00	0.00
Sch. Dist. 9	0.00	0.00	0.03	1.00	0.00
Bi-Level	0.02	0.00	0.15	1.00	0.00
Duplex	0.01	0.00	0.07	1.00	0.00
Mobile	0.01	0.00	0.07	1.00	0.00
One and a half stories	0.15	0.00	0.36	1.00	0.00
One Story	0.50	0.00	0.50	1.00	0.00
Two Stories	0.32	0.00	0.47	1.00	0.00
Post Cons. GSG	0.07	0.00	0.26	1.00	0.00
Post Cons. MH	0.59	1.00	0.49	1.00	0.00
Post Cons. LD	0.02	0.00	0.13	1.00	0.00
Miles to Turbine	12.21	16.54	6.83	22.74	0.13
Prop. w/in 0-1 mile	0.01	0.00	0.11	1.00	0.00
Prop. w/in 1-2 miles	0.08	0.00	0.28	1.00	0.00
Prop. w/in 2-3 miles	0.03	0.00	0.18	1.00	0.00
Prop. <3 miles	0.13	0.00	0.33	1.00	0.00

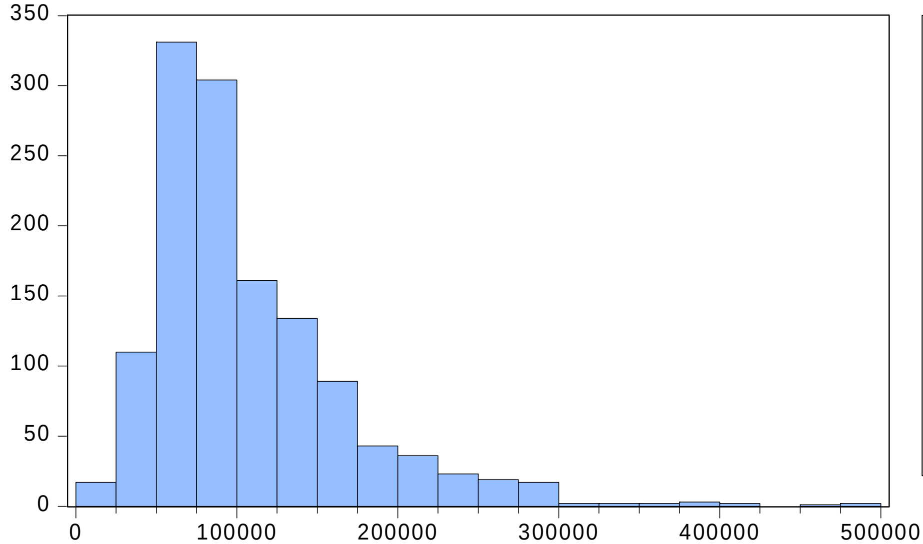
Table 4 - Full Data Set Descriptive Statistics

	Mean	Median	Std. Dev.	Maximum	Minimum
Sq. Feet	1,460.95	1,360.00	585.19	8,640.00	480.00
Adj. Price	104,629.00	87,909.00	60,474.00	570,195.00	4,910.00
LN (Price)	11.41	11.38	0.54	13.25	8.50
Age	66.95	61.00	41.02	198.00	0.00
Age^2	6,163.89	3,721.00	5,974.47	39,204.00	0.00
One Story	0.50	1.00	0.50	1.00	0.00
One & a Half Stories	0.15	0.00	0.36	1.00	0.00
Two Stories	0.29	0.00	0.45	1.00	0.00
Duplex	0.00	0.00	0.07	1.00	0.00
Bi-Level	0.03	0.00	0.17	1.00	0.00
Mobile	0.00	0.00	0.06	1.00	0.00
Alto	0.02	0.00	0.12	1.00	0.00
Amboy	0.08	0.00	0.27	1.00	0.00
Ashton	0.03	0.00	0.17	1.00	0.00
Bradford	0.01	0.00	0.08	1.00	0.00
Brooklyn	0.03	0.00	0.16	1.00	0.00
Franklin Grove	0.04	0.00	0.19	1.00	0.00
Dixon	0.55	1.00	0.50	1.00	0.00
East Grove	0.00	0.00	0.06	1.00	0.00

	Mean	Median	Std. Dev.	Maximum	Minimum
Hamilton	0.00	0.00	0.04	1.00	0.00
Harmon	0.01	0.00	0.08	1.00	0.00
Lee Center	0.01	0.00	0.12	1.00	0.00
Marion	0.00	0.00	0.06	1.00	0.00
May	0.00	0.00	0.04	1.00	0.00
Nachusa	0.01	0.00	0.09	1.00	0.00
Nelson	0.02	0.00	0.15	1.00	0.00
Palmyra	0.05	0.00	0.22	1.00	0.00
Reynolds	0.01	0.00	0.07	1.00	0.00
South Dixon	0.02	0.00	0.13	1.00	0.00
Sublette	0.02	0.00	0.14	1.00	0.00
Viola	0.01	0.00	0.07	1.00	0.00
Willow Creek	0.02	0.00	0.15	1.00	0.00
Wyoming	0.07	0.00	0.26	1.00	0.00
Post Cons. GSG	0.41	0.00	0.49	1.00	0.00
Post Cons. MH	0.78	1.00	0.42	1.00	0.00
Post Cons. LD	0.11	0.00	0.31	1.00	0.00
Miles to Turbine	13.49	16.82	6.22	22.74	0.13
SD272	0.12	0.00	0.32	1.00	0.00
SD275	0.09	0.00	0.28	1.00	0.00
SD340	0.00	0.00	0.05	1.00	0.00
SD170	0.63	1.00	0.48	1.00	0.00
SD9	0.00	0.00	0.02	1.00	0.00
SD425	0.02	0.00	0.14	1.00	0.00
SD280	0.03	0.00	0.18	1.00	0.00
SD8	0.01	0.00	0.08	1.00	0.00
SD17	0.00	0.00	0.03	1.00	0.00
SD271	0.08	0.00	0.27	1.00	0.00
SD212	0.02	0.00	0.13	1.00	0.00
SD5	0.01	0.00	0.12	1.00	0.00
Prop. w/in 0-1 miles	0.01	0.00	0.10	1.00	0.00
w/in 1-2 miles	0.05	0.00	0.22	1.00	0.00
w/in 2-3 miles	0.02	0.00	0.15	1.00	0.00
Prop. < 3 miles	0.08	0.00	0.28	1.00	0.00

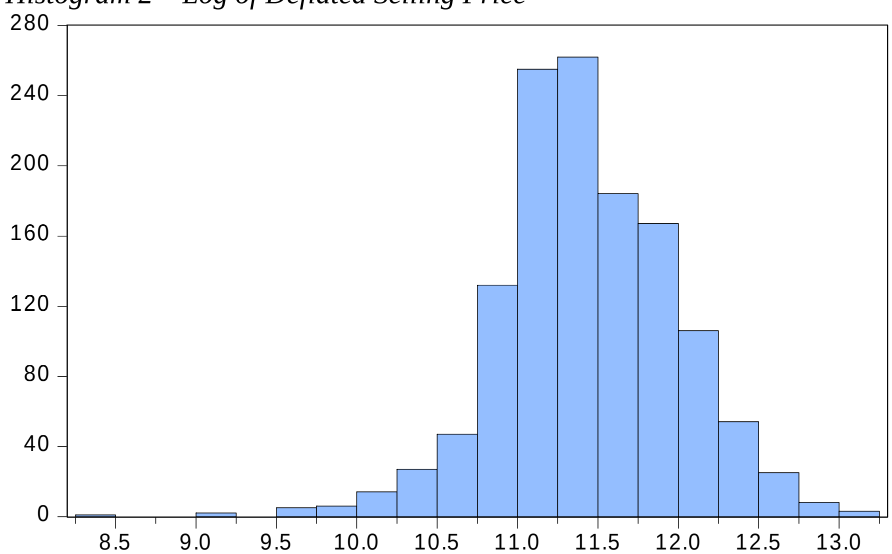
Notes: N=3,258

Histogram 1 – Deflated Selling Price



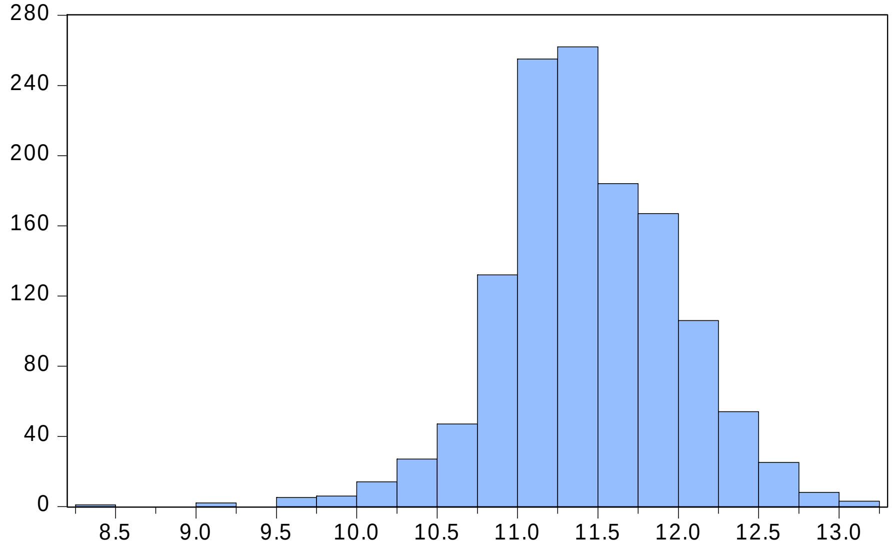
Series: ADJPRICE	
Sample 1 1298	
Observations 1298	
Mean	106968.5
Median	89299.37
Maximum	495834.0
Minimum	4910.372
Std. Dev.	62575.90
Skewness	1.835059
Kurtosis	8.242444
Jarque-Bera	2214.874
Probability	0.000000

Histogram 2 – Log of Deflated Selling Price



Series: LPRICE	
Sample 1 1298	
Observations 1298	
Mean	11.43195
Median	11.39975
Maximum	13.11400
Minimum	8.499105
Std. Dev.	0.550439
Skewness	-0.219402
Kurtosis	4.157174
Jarque-Bera	82.83410
Probability	0.000000

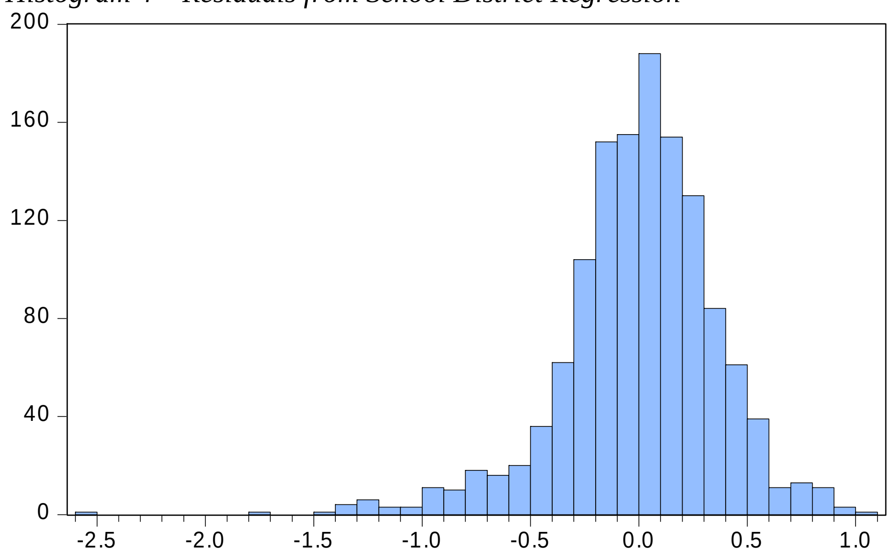
Histogram 3 – Residuals from Township Regression



Series: LPRICE
Sample 1 1298
Observations 1298

Mean	11.43195
Median	11.39975
Maximum	13.11400
Minimum	8.499105
Std. Dev.	0.550439
Skewness	-0.219402
Kurtosis	4.157174
Jarque-Bera	82.83410
Probability	0.000000

Histogram 4 – Residuals from School District Regression



Series: SDRESID
Sample 1 1298
Observations 1298

Mean	2.80e-15
Median	0.022938
Maximum	1.097083
Minimum	-2.570146
Std. Dev.	0.362014
Skewness	-0.910057
Kurtosis	6.519402
Jarque-Bera	849.0548
Probability	0.000000

Histogram 5 – Residuals from X-Y Regression