WIND FARM PROXIMITY AND PROPERTY VALUES: A POOLED HEDONIC REGRESSION ANALYSIS OF PROPERTY VALUES IN CENTRAL ILLINOIS

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Abstract
The objectives of this study are to examine whether proximity to the 240-turbine, Twin Groves wind farm (Phases I and II) in eastern McLean County, Illinois, has impacted nearby residential property values and whether any impact on nearby property values remains constant over different stages of wind farm development with the different stages corresponding to different levels of risk as perceived by nearby property owners. This study uses 3,851 residential property transactions from January 1, 2001 through December 1, 2009 from McLean and Ford Counties, Illinois. This is the first wind farm proximity and property value study to adopt pooled hedonic regression analysis with difference-in-differences estimators. This methodology significantly improves upon many of the methodologies found in the wind farm proximity and property value literature. This study finds some evidence that supports wind farm anticipation stigma theory and the results strongly reject the existence of wind farm area stigma theory.

TABLE OF CONTENTS

TABLES

FIGURES

About the Author

Jennifer L. Hinman

In 2010, Jennifer earned her Master of Science degree in Applied Economics with a specialization in the Electricity, Natural Gas, and Telecommunications Economics Regulatory sequence at Illinois State University in Normal, Illinois. Some research areas pursued during her graduate studies include short-term electricity load forecasting[1] and economic impact estimation. In 2008, Jennifer earned her Bachelor of Arts degree in Economics with a Financial Certificate and graduated Summa Cum Laude from the University Honors Program at Armstrong Atlantic State University in Savannah, Georgia. As an undergraduate, Jennifer presented a study she completed regarding the impact of oil price shocks on the U.S. inflation rate at the *35th Annual Meeting of the Academy of Economics and Finance* in Nashville, Tennessee, and she has the article published in the *Academy of Economics and Finance Papers and Proceedings, Volume 32, 2008.* Jennifer has recently accepted a position as an Economist in the Policy Department of the Energy Division under the Bureau of Public Utilities at the Illinois Commerce Commission in Springfield, Illinois. Jennifer completed this report in an unbiased manner while earning her Master's degree. She is available to answer any legitimate questions via e-mail HinmanJenL@gmail.com.

[1] Available online <http://www.irps.ilstu.edu/research/documents/LoadForecastingHinman-HickeyFall2009.pdf>

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Executive Summary

The objectives of this study are to examine whether proximity to the 240-turbine, Twin Groves wind farm (Phases I and II) in eastern McLean County, Illinois, has impacted nearby residential property values and whether any impact on nearby property values changes over the different stages of wind farm development. This study uses 3,851 residential property transactions from January 1, 2001 through December 1, 2009 from McLean and Ford Counties, Illinois. This is the first wind farm proximity and property value study to adopt pooled hedonic regression analysis with difference-in-differences estimators. This methodology significantly improves upon many of the previous methodologies found in the wind farm proximity and property value literature.

The estimation results provide evidence that a "location effect" exists such that before the wind farm was even approved, properties located near the eventual wind farm area were devalued in comparison to other areas. Additionally, the results show that property value impacts vary based on the different stages of wind farm development. These stages of wind farm development roughly correspond to the different levels of risk as perceived by local residents and potential homebuyers. Some of the estimation results support the existence of "wind farm anticipation stigma theory," meaning that property values may have diminished in "anticipation" of the wind farm after the wind farm project was approved by the McLean County Board. Wind farm anticipation stigma is likely due to the impact associated with a fear of the unknown, a general uncertainty surrounding a proposed wind farm project regarding the aesthetic impacts on the landscape, the actual noise impacts from the wind turbines, and just how disruptive the wind farm will be. However, during the operational stage of the wind farm project, as surrounding property owners living close to the wind turbines acquired additional information on the aesthetic impacts on the landscape and actual noise impacts of the wind turbines to see if any of their concerns materialized, property values rebounded and soared higher in real terms than they were prior to wind farm approval. Thus, this study presents evidence that demonstrates close proximity to an operating wind farm does not necessarily negatively influence property values or property value appreciation rates. The estimation results strongly reject the existence of "wind farm area stigma theory" for the area surrounding Twin Groves I and II.

I. Introduction

A home is generally the largest investment that a family will make in their lifetime. Thus, factors that impact the value of one's home are of prime importance to homeowners. Over the past few years, all across the United States, wind farms have been sprouting up. Many homeowners have expressed concern at public zoning hearings for proposed wind farms that their homes may be devalued because of the close proximity to a proposed wind turbine. Although over 35 studies have examined this issue of whether a negative relationship exists between property values and those homes in close proximity to wind turbines, there does not exist a general consensus in the literature. This lack of a consensus may be likely due to various degrees of rigor that the studies have demonstrated along with the various methodologies adopted. Many of the studies have been funded by wind energy companies as well as wind farm opponents. Thus, an unbiased analysis of this very important issue is difficult to come by. Hence, this study proposes an improved methodology to examine these issues going forward.

Is there a stigma associated with properties located in close proximity to a proposed or operating wind farm? Does a negative relationship exist between property values and homes closer to wind turbines? Does the impact of a wind farm on nearby property values change over different stages of development[2]? This study uses pooled hedonic regression analysis to examine whether Twin Groves wind farm (Twin Groves Phase I and Phase II[3]) located in eastern McLean County, Illinois, has had an impact on local property values. The hedonic pricing model is based on the microeconomic theoretical framework developed by Lancaster (1966) and Rosen (1974) that decomposes the price of a good into its component attributes.

Residential property sales were obtained from the Supervisors of Assessments Offices in McLean and Ford Counties for the 2001 through 2009 study period. It is important to obtain data both before and after construction of the wind facility and not just for the target and control areas, because there likely exists a *location effect,* which when properly controlled for takes into account any housing price differential between properties near the wind farm and far from the wind farm before wind farm operations. Thus, any devaluation found using only data from after construction may not be telling the whole story.

A difference-in-differences estimator[4] is utilized to examine whether a *wind farm anticipation stigma*[5] developed after the approval of the wind farm and during the construction stage of the wind farm development. In addition, a difference-in-differences estimator is utilized to examine whether a *wind farm area stigma* developed due to the presence of the wind farm. This study examines the appreciation in real property values near the wind farm site in relation to surrounding areas over the different stages of wind farm development, which are thought to roughly correspond to the different levels of risk as perceived by local residents and homebuyers.

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[2] The different stages of the adjustment process correspond to different levels of risk as perceived by local residents and prospective homebuyers surrounding a wind farm project proposal, and these stages of the adjustment process are thought to correspond to the stages of wind farm development.

[3] Twin Groves I and II will be denoted as "TG I and II" or "wind farm(s)" throughout this article.

[4] Difference-in-differences estimators are popular estimation techniques utilized in the policy evaluation literature.

[5] *Wind farm anticipation stigma theory* is a concern surrounding a proposed or approved wind farm project that is primarily due to factors stemming from a fear of the unknown: a general uncertainty surrounding a wind farm project regarding the aesthetic impacts on the landscape, the actual noise impacts from the wind turbines, and just how disruptive the wind farm will actually be.

In addition, real property value levels in percentage terms are examined over the different stages of wind farm development. A few local real estate experts were interviewed and a local wind farm zoning hearing was attended, such that the author gained a better understanding of the local housing market and the attitudes of residents of the community.

The estimation results provide evidence that a *location effect* exists such that before the wind farm was even approved, properties located near the eventual wind farm area were devalued in comparison to other areas. Additionally, the results show that property value impacts vary based on the different stages of wind farm development. Some of the estimation results support the existence of *wind farm anticipation stigma theory*, meaning that property values may have diminished in *anticipation* of the wind farm, possibly because of the impact associated with a *fear of the unknown*: a general uncertainty surrounding a wind farm project regarding the aesthetic impacts on the landscape, the actual noise impacts from the wind turbines, and just how disruptive the wind farm will be. However, during the operational stage of the wind farm project, as surrounding property owners living close to the wind turbines acquired additional information on the aesthetic impacts on the landscape and actual noise impacts of the wind turbines to see if any of their concerns materialized, property values rebounded and soared higher in real terms than they were prior to wind farm approval. The author does not believe that property values near the wind farm rose strictly because of the wind farm locating there. However, it does seem to imply that property values in this particular area of McLean County do not necessarily decline because of a wind farm locating in the area near the properties, which is a common assumption and is often voiced during the wind farm permitting process. Thus, this study presents evidence that demonstrates close proximity to an operating wind farm does not necessarily negatively influence property values or property value appreciation rates and these results strongly reject the existence of *wind farm area stigma theory* for the area surrounding Twin Groves I and II. The results are consistent with views of some local real estate experts.

The rest of the paper is organized as follows. Section II contains a review of the wind farm proximity and property value literature. Section III provides the theoretical basis for the model. Section IV provides an overview of the methodology. Section V contains an overview of the project location and data. Section VI presents the estimation results. Section VII provides recommendations for further research and some general conclusions. Appendix A describes community attitudes and survey results. Appendix B provides a detailed description of the data and estimation assumptions. Appendix C provides descriptive statistics including summary statistics of the variables by stage of the wind farm project. Appendix D provides a review of the difference-in-differences estimator as well as several simple estimations and explanations of the proper interpretation of the estimated coefficients. Appendix E provides the full estimation results.

II. LITERATURE REVIEW

This section provides a brief overview of the wind farm proximity and property value literature. For those readers interested in reviewing literature relevant to the wind farm proximity and property value topic, a comprehensive list of the studies reviewed (author, publication date, and type of study are listed) as part of this project appears in Table 1. Sample size, study type, property value impact, and location of the wind farms for the regional and national studies involving actual wind farms are presented in Table 2. The localized analyses are presented in Table 3[6] along with detailed statistics regarding the wind farm size, study dates, number of observations, study area location, and property value impact. This section proceeds as follows: a comparison of the national and regional property value studies is undertaken followed by a discussion of how this study contributes to and compares with the existing wind farm proximity and property value literature involving hedonic regression analysis.

Table 2 contains a summary of the regional and national property value studies that involved actual wind farms (as opposed to studies based on proposed wind farms[7]). Two studies conclude that properties are stigmatized surrounding wind farms: one based on an expert survey of realtors in Scotland, Wales, and England (Khatri, 2004), and the other study was based on a statistical model based on survey responses from homeowners in Denmark (Jordal-Jørgensen et al., 1996). The estimation results from the Denmark study could not be obtained, thus the statistical significance and details regarding the data utilized were not able to be scrutinized.

There have been a couple studies involving wind farms across the United States and they all found no impact on property values as a result of the wind farms. Hoen et al. (2009) completed the most comprehensive and rigorous study by far that involved examining residential home sales surrounding 24 wind farms across the United States[8]. Hoen et al. (2009) utilized ten different estimation models, including a repeat sales model and a sales volume model, to determine whether an area stigma, a scenic vista stigma, or a nuisance stigma existed in relation to properties located near wind farms. Hoen et al. (2009) found that none of the models uncovered any conclusive evidence of the presence of any of the property value stigmas surrounding the wind farms.

Table 3 contains a summary of the literature regarding localized property value impact studies involving actual wind farms (as opposed to proposed wind farms). All of the multiple linear regression analyses have been completed within the past four years, and so far there have not been any that specifically address the impact on property values for a wind farm located in the Midwest. In general, there have been quite a few studies addressing the impact of wind farms on property values in the Midwest; however, none of them involved rigorous statistical analysis[9]. The studies using the hedonic housing price model that focused on the impact of one particular wind farm on property values involve wind farms with less than 21 turbines. Therefore, this analysis involving 240 wind turbines is important because of the recent expansion of large wind projects.

As indicated by the asterisks in Table 3, only two studies have actually been published in academic, peer-reviewed journals. Both published studies utilized multiple regression analysis which provides support of that method in the present study. The two published studies analyzed

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[6] The only strong correlations associated with the results across studies have to do with who funds the study, i.e., those funded by wind farm developers or wind energy proponents generally do not find a negative impact, while those studies funded by wind farm opponents generally find a negative impact on property values. Also, some correlation exists between the timing of the study and the results. For example, many of the studies conducted in areas where a wind farm is proposed involve surveys posed to local real estate experts. These studies find that there is an expectation that property values will decline if the wind farm is permitted and becomes operational. Thus, this gives rise to what this author terms, wind farm anticipation stigma theory.

[7] Several studies involved interviewing local residents and real estate experts regarding their opinion of the impact that a proposed wind farm would have on local property values if the wind farm was built. The results of these studies are consistent with wind farm anticipation stigma theory.

[8] The residential homes sales were collected from nine different states (ten different study areas).

property values in the United Kingdom and the data available[10] were “limited to house type and selling price, and therefore not sufficiently detailed to highlight any small changes in value” (Sims and Dent, 2007, 626). All previous multiple regression analyses, except one, use the log-linear functional form. Sims and Dent (2007) use the linear form and include yearly dummy variables to capture inflation. Both of the published studies use property transactions that occurred after the wind farms were constructed. After Sims and Dent (2007) found a negative relationship between distance to the wind farm and property values, they spoke with local realtors and found out that before the wind farm was constructed, properties close to the eventual wind farm site were valued less than properties farther away. Thus, the present study contributes to the existing literature by taking into consideration the time period prior to wind farm operations explicitly in the model and controlling for an extensive list of housing characteristics.

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[9] Rigorous statistical analysis is an important factor because the results of a study are essentially meaningless without this factor.

[10] The explanatory variables included in their models were limited to dummy variables. Though Malpezzi et al. (1980) point out that using mostly dummy variables allows maximum flexibility in estimation.

Table 1. Wind Farm Proximity and Property Value Studies.

Author (Year) – Study Type
**Canning and Simmons (2010) – Hedonic Regression Analysis and Statistics†
Nillen (2010) – Expert Opinion
**Hoen et al. (2009) – Hedonic Regression Analysis and Statistics
Kielisch (2009) – Simplified Regression Analysis and Expert Survey
Gardner (2009) – Statistics
Poletti (2009a) – Statistics and Expert Opinion
Poletti (2009b) – Statistics and Expert Opinion
*Firestone et al. (2009) – Homeowner Survey and Statistics
*Firestone et al. (2008) – Homeowner Survey and Statistics
Crosson (2008) – Expert Opinion
*Sims et al. (2008) – Hedonic Regression Analysis
Luxemburger (2008) – Statistics
McCann (2008) – Expert Opinion
*Bond (2008) – Homeowner Survey
*Sims and Dent (2007) – Hedonic Regression Analysis
Poletti (2007) – Statistics
*Firestone et al. (2007) – Homeowner Survey and Statistics
*Edinburgh Solicitors' Property Centre (2007) – Statistics
Lloyd, Jr. (2007) – Statistics
Lloyd, Jr. (2006) – Statistics
*Hoen (2006) – Hedonic Regression Analysis
**Goldman and Goldman (2006) – Homeowner and Expert Survey
*Bobechko and Bourne (2006) – Statistics
DeLacy (2006) – Statistics
DeLacy (2005) – Statistics
Poletti (2005) – Statistics
Beck (2004) – Statistics
**Khatri (2004) – Expert Survey
*Haughton et al. (2004) – Homeowner and Expert Survey
Sterzinger et al. (2003) – Simplified Regression Analysis
*Braunholtz and McWhannell (2003) – Homeowner Survey
*Grover (2002, 2006) – Expert Survey
Jerabek (2002) – Statistics
Jerabek (2001) – Statistics
Robertson Bell Associates (1998) – Homeowner Survey
Robertson Bell Associates (1997) – Homeowner Survey
Jordal-Jørgensen et al. (1996) – Homeowner Survey and Statistics
BWEA (1996) – Homeowner Survey

*indicates studies that the author recommends reviewing for those interested in reviewing the literature.
†The study type "statistics" includes a wide variety of techniques: grouped paired sales analysis, paired sales analysis using repeat sales, direct comparison paired sales analysis, difference in means calculations between a control and target group using averages of similar property types, and sales volume analysis.

Table 2. Literature: Wind Farms and Property Values: Regional and National Analyses.

Author	Type	*n*	Before or After Construction	Property Value Impact*	Location of the Wind Farms
Hoen, Wiser, Cappers, Thayer, and Sethi (2009)	Hedonic Regression Analysis	4,937	After	None	USA
Hoen, Wiser, Cappers, Thayer, and Sethi (2009)	Hedonic Regression Analysis	7,459	Before and After	None	USA
Khatri (2004)	Expert Survey (Residential Properties)	81	After	Negative†	Scotland, Wales, and England
Khatri (2004)	Expert Survey (Agricultural Land)	81	After	None	Scotland, Wales, and England
Braunholtz and McWhannell (2003)	Homeowner Survey	1,547	After	None	Scotland
Grover (2002)	Expert Survey (Residential Properties)	13	After	None	USA
Jordal-Jørgensen, Munksgaard, Pedersen, and Larsen (1996)	Homeowner Survey and Statistics	?	After	Negative	Denmark

*Property Value Impact: "None" = There was no evidence of wind farms impacting property values.
"Positive" = Property values rose in areas surrounding a wind farm, though this *does not necessarily* imply that property values rose because of the wind farm. i.e., property values could have risen for other reasons.
"Negative" = Property values declined in areas surrounding a wind farm, though this *does not necessarily* imply that property values declined because of the wind farm. i.e., property values could have declined for other reasons.
†Slightly Negative, 40% of Chartered Surveyors found there was no impact on property values, while 60% found there was a negative impact on property values.
n=number of observations.

Table 3. Literature: Wind Farms and Property Values: Localized Analyses.

Author(s) (Year)	Type	*n*	Before or After Construction	Property Value Impact†	Study Area	# Turbines	Total MW	Hub Height (meters)	Study Dates
Canning and Simmons (2010)	Hedonic Regression Analysis	40	During and After	None	Municipality of Chatham-Kent, Ontario	64	96	80	2007-2009
Canning and Simmons (2010)	Hedonic Regression Analysis	20	During and After	None	Municipality of Chatham-Kent, Ontario	64	96	80	2007-2009
Canning and Simmons (2010)	Hedonic Regression Analysis	83	During and After	Negative	Municipality of Chatham-Kent, Ontario	64	96	80	2007-2009
Canning and Simmons (2010)	Property Resale Analysis	14	Before and After	None	Municipality of Chatham-Kent, Ontario	64	96	80	2003-2009
Theron (2010)	Homeowner Survey	75	After	None	McLean County, IL	240	396	80	2009
Gardner (2009)	Property Sales - Statistics (Rural Land)	7	After	Negative	Taylor County, TX	?	?	?	?
Kielisch (2009)	Property Sales - Statistics (Vacant Residential Land Sales)	68	Before and After	Negative	Fond du Lac County, WI	88	145	80	2006-2009
Kielisch (2009)	Property Sales - Statistics (Vacant Residential Land Sales)	34	Before and After	Negative	Fond du Lac and Dodge Counties, WI	86	129	65	2005-2009
Poletti (2009)	Property Sales - Statistics (All Residential Classed Sales)	195	After	None	McLean County, IL	240	396	80	2006-2009
Poletti (2009)	Property Sales - Statistics (Residential Sales Excluding Vacant Lots, Duplex, Condos, Modular, Bi-Levels, Greater Than 5 Acres, Sales With Price Per Sqft Less Than $40)	98	After	None	McLean County, IL	240	396	80	2006-2009
Poletti (2009)	Property Sales - Statistics (Selective Residential Sales $/Sqft)	26	After	None	Lee County, IL	63	50.4	65	2003-2005
Poletti (2009)	Property Sales - Statistics (Single Family Residential Sales All, $/Sqft)	46	After	Negative	Lee County, IL	63	50.4	65	2003-2005
Poletti (2009)	Property Sales - Statistics (Agricultural Tracts, 20+Acres, $/Acre)	50	After	None	Lee County, IL	63	50.4	65	2005-2009
Poletti (2009)	Property Sales - Statistics (Small Residential Tract Sales, $/Acre)	30	After	None	Lee County, IL	63	50.4	65	2005-2009
Poletti (2009)	Property Sales - Statistics (Residential Sales, $/Sqft, Post 1955)	61	After	None	Lee County, IL	63	50.4	65	2005-2009
Poletti (2009)	Property Sales - Statistics (Residential Sales, $/Sqft)	148	After	None	Lee County, IL	63	50.4	65	2005-2009
Poletti (2009)	Property Sales - Statistics (Residential Sales, $/Sqft, Matched Paired Sales Analysis)	6	After	None	Lee County, IL	63	50.4	65	2003-2006
Bond (2008)	Homeowner Survey	304	After	None	Albany, Southwest Australia	12	21.6	65	2008
Luxemburger (2008)	Property Sales - Statistics	600	After	Negative	Canada	?	?	?	?
McCann (2008)	Expert Opinion	1	After	Negative	Lee County, IL	63	50.4	65	2008
*Sims, Dent, and Oskrochi (2008)	Hedonic Regression Analysis	199	After	None	St Eval, Cornwall, UK	16	9.6	35	2000-2007
Edinburgh Solicitors' Property Centre (2007)	Property Sales - Statistics	?	Before and After	Positive	Scottish Borders, Dunbar	20	49		2000-2006
Lloyd, Jr. (2007)	Property Sales - Statistics	88	Before and After	None	Madison County, NY	7	11.55	67	1995-2006
Lloyd, Jr. (2007)	Property Sales - Statistics	35	Before and After	None	Wyoming County, NY	10	6.6	65	1995-2006

Author(s) (Year)	Type	*n*	Before or After Construction	Property Value Impact†	Study Area	# Turbines	Total MW	Hub Height (meters)	Study Dates
Lloyd, Jr. (2007)	Property Sales - Statistics	157	Before and After	None	Madison County, NY	20	30	65	1995-2006
Lloyd, Jr. (2007)	Property Sales - Statistics, Paired Sales Analysis (Repeat Sales)	46	Before and After	None	Madison County, NY	7	11.55	67	1995-2006
Lloyd, Jr. (2007)	Property Sales - Statistics, Paired Sales Analysis (Repeat Sales)	16	Before and After	None	Wyoming County, NY	10	6.6	65	1995-2006
Lloyd, Jr. (2007)	Property Sales - Statistics, Paired Sales Analysis (Repeat Sales)	36	Before and After	None	Madison County, NY	20	30	65	1995-2006
Poletti (2007)	Property Sales - Statistics (Small Residential Tract Sales, $/Sqft)	21	After	None	Kewaunee County, WI	31	20.46	65	1998-2004
Poletti (2007)	Property Sales - Statistics (Large Tract Sales, $/Acre)	48	After	None	Kewaunee County, WI	31	20.46	65	1998-2004
Poletti (2007)	Property Sales - Statistics (Single-Family Residential Values, $/Sqft)	65	After	None	Kewaunee County, WI	31	20.46	65	1998-2004
Poletti (2007)	Property Sales - Statistics (Sales Of Residences Constructed After 1960)	19	After	None	Kewaunee County, WI	31	20.46	65	1998-2004
Poletti (2007)	Property Sales - Statistics (Agricultural Tracts, 20+Acres, $/Acre)	26	After	None	Lee County, IL	63	50.4	65	2003-2005
Poletti (2007)	Property Sales - Statistics (Small Residential Tract Sales, 5 Acres Or Less, $/Acre)	30	After	None	Lee County, IL	63	50.4	65	2003-2005
Poletti (2007)	Property Sales - Statistics (Selective Residential Sales $/Sqft)	29	After	None	Lee County, IL	63	50.4	65	2003-2005
Poletti (2007)	Property Sales - Statistics (Single Family Residential Sales All, $/Sqft)	53	After	Negative	Lee County, IL	63	50.4	65	2003-2005
Poletti (2007)	Property Sales - Statistics (Agricultural Tracts, 20+Acres, $/Acre)	20	After	None	Lee County, IL	63	50.4	65	2005-2006
Poletti (2007)	Property Sales - Statistics (Small Residential Tract Sales, $/Acre)	14	After	None	Lee County, IL	63	50.4	65	2005-2006
Poletti (2007)	Property Sales - Statistics (Residential Sales, $/Sqft)	35	After	None	Lee County, IL	63	50.4	65	2005-2006
*Sims and Dent (2007)	Hedonic Regression Analysis	919	After	Negative	St Breock Downs, Wadebridge; St Eval, Cornwall, UK	27	14.55	35	2000-2005
Bobechko and Bourne (2006)	Property Sales - Statistics, Sales Analysis, Combined Acreage	173	Before and After	Positive	Township of Melancthon, Ontario, Canada	45	67.5	80	2002, 2006
Bobechko and Bourne (2006)	Property Sales - Statistics, Sales Analysis, 1-10Acres	72	Before and After	Positive	Township of Melancthon, Ontario, Canada	45	67.5	80	2002, 2006
Bobechko and Bourne (2006)	Property Sales - Statistics, Sales Analysis, 10 Acres Plus	56	Before and After	None	Township of Melancthon, Ontario, Canada	45	67.5	80	2002, 2006
Bobechko and Bourne (2006)	Property Sales - Statistics, Sales Analysis, 50 Acres Plus	45	Before and After	None	Township of Melancthon, Ontario, Canada	45	67.5	80	2002, 2006
Bobechko and Bourne (2006)	Property Sales - Statistics, Resale Analysis	10	Before and After	Positive	Township of Melancthon, Ontario, Canada	45	67.5	80	2002, 2003, 2006
Bobechko and Bourne (2006)	Property Sales - Statistics, MLS Statistical Analysis, Detached Property And Then 1-50 Plus Acres	583	Before and After	None	Dufferin County, Melancthon, Ontario, Canada	45	67.5	80	2002, 2006
Goldman and Goldman (2006)	Expert Survey - Appraisers, Realtors, Assessors	17	After	None	Tucker County, WV, Backbone Mountain	44	66	68	2006

Author(s) (Year)	Type	*n*	Before or After Construction	Property Value Impact†	Study Area	# Turbines	Total MW	Hub Height (meters)	Study Dates
Goldman and Goldman (2006)	Homeowner Survey - Property Value, Noise, And View Questions	21	After	None	Tucker County, WV, Backbone Mountain	44	66	68	2006
Hoen (2006)	Hedonic Regression Analysis	280	Before and After	None	Madison County, NY	20	30	66	1996-2005
Lloyd, Jr. (2006)	Property Sales - Statistics	84	Before and After	None	Madison County, NY	7	11.55	67	1995-2006
Lloyd, Jr. (2006)	Property Sales - Statistics	33	Before and After	None	Wyoming County, NY	10	6.6	65	1995-2006
Lloyd, Jr. (2006)	Property Sales - Statistics	148	Before and After	None	Madison County, NY	20	30	80	1995-2006
Lloyd, Jr. (2006)	Property Sales - Statistics, Paired Sales Analysis (Repeat Sales)	46	Before and After	None	Madison County, NY	7	11.55	67	1995-2006
Lloyd, Jr. (2006)	Property Sales - Statistics, Paired Sales Analysis (Repeat Sales)	16	Before and After	None	Wyoming County, NY	10	6.6	65	1995-2006
Lloyd, Jr. (2006)	Property Sales - Statistics, Paired Sales Analysis (Repeat Sales)	36	Before and After	None	Madison County, NY	20	30	65	1995-2006
Poletti (2005)	Property Sales - Statistics (Small Residential Tract Sales, $/Sqft)	21	After	None	Kewaunee County, WI	31	20.46	65	1998-2004
Poletti (2005)	Property Sales - Statistics (Residential Tract Sales, $/Sqft)*New	14	After	None	Kewaunee County, WI	31	20.46	65	1998-2004
Poletti (2005)	Property Sales - Statistics (Large Tract Sales, $/Acre)	48	After	None	Kewaunee County, WI	31	20.46	65	1998-2004
Poletti (2005)	Property Sales - Statistics (Single-Family Residential Values, $/Sqft)	65	After	None	Kewaunee County, WI	31	20.46	65	1998-2004
Poletti (2005)	Property Sales - Statistics (Sales Of Residences Constructed After 1960)	19	After	None	Kewaunee County, WI	31	20.46	65	1998-2004
Poletti (2005)	Property Sales - Statistics (Agricultural Tracts, 20+Acres, $/Acre)	26	After	None	Lee County, IL	63	50.4	65	2003-2005
Poletti (2005)	Property Sales - Statistics (Small Residential Tract Sales, 5 Acres Or Less, $/Acre)	30	After	None	Lee County, IL	63	50.4	65	2003-2005
Poletti (2005)	Property Sales - Statistics (Selective Residential Sales $/Sqft)	29	After	None	Lee County, IL	63	50.4	65	2003-2005
Beck (2004)	Property Sales - Statistics	2	After	None	Hull, MA	1	0.66	50	2002-2004
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - View Shed And Comparable	9,105	Before and After	Positive	Riverside County, CA	3,067	485.6	40-63	1996-2002
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - View Shed And Comparable	810	Before and After	Positive	Madison County, NY	7	11.6	67	1997-2003
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - View Shed And Comparable	1,044	Before and After	Positive	Madison County, NY	20	30	66	1997-2003
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - View Shed And Comparable	624	Before and After	Positive	Kewaunee County, WI	31	20.46	65	1996-2002
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - View Shed And Comparable	3,340	Before and After	Positive	Bennington and Windham Counties, VT	11	6	40	1994-2002
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - View Shed And Comparable	1,384	Before and After	Positive	Somerset County, PA	14	19.4	60-64	1997-2002
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - View Shed And Comparable	3,213	Before and After	Positive	Buena Vista County, IA	364	192.7	63	1996-2002

Author(s) (Year)	Type	*n*	Before or After Construction	Property Value Impact†	Study Area	# Turbines	Total MW	Hub Height (meters)	Study Dates
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - View Shed And Comparable	2,867	Before and After	None	Kern County, CA	3,569	600.7	55	1996-2002
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - View Shed And Comparable	269	Before and After	Positive	Carson County, TX	80	80	70	1998-2002
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - View Shed And Comparable	89	Before and After	None	Fayette County, PA	10	15	70	1997-2002
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - Viewshed Before And After	5,513	Before and After	Positive	Riverside County, CA	3,067	485.6	40-63	1996-2002
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - Viewshed Before And After	219	Before and After	None	Madison County, NY	7	11.6	67	1997-2003
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - Viewshed Before And After	453	Before and After	Negative	Madison County, NY	20	30	66	1997-2003
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - Viewshed Before And After	329	Before and After	Positive	Kewaunee County, WI	31	20.46	65	1996-2002
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - Viewshed Before And After	2,788	Before and After	Positive	Bennington and Windham Counties, VT	11	6	40	1994-2002
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - Viewshed Before And After	962	Before and After	Positive	Somerset County, PA	14	19.4	60-64	1997-2002
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - Viewshed Before And After	1,557	Before and After	Positive	Buena Vista County, IA	364	192.7	63	1996-2002
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - Viewshed Before And After	745	Before and After	Positive	Kern County, CA	3,569	600.7	55	1996-2002
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - Viewshed Before And After	45	Before and After	Positive	Carson County, TX	80	80	70	1998-2002
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - Viewshed Before And After	39	Before and After	Positive	Fayette County, PA	10	15	70	1997-2002
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - Viewshed And Comparable	?	After	Positive	Riverside County, CA	3,067	485.6	40-63	1999-2002
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - Viewshed And Comparable	?	After	None	Madison County, NY	7	11.6	67	2000-2003
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - Viewshed And Comparable	?	After	None	Madison County, NY	20	30	66	2001-2003
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - Viewshed And Comparable	?	After	Positive	Kewaunee County, WI	31	20.46	65	1999-2002
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - Viewshed And Comparable	?	After	Positive	Bennington and Windham Counties, VT	11	6	40	1997-2002
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - Viewshed And Comparable	?	After	Positive	Somerset County, PA	14	19.4	60-64	2000-2002
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - Viewshed And Comparable	?	After	Positive	Buena Vista County, IA	364	192.7	63	1999-2002
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - Viewshed And Comparable	?	After	None	Kern County, CA	3,569	600.7	55	1999-2002
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - Viewshed And Comparable	?	After	Positive	Carson County, TX	80	80	70	2001-2002
Sterzinger, Beck, and Kostiuk (2003)	Simplistic Regression Analysis - Viewshed And Comparable	?	After	Positive	Fayette County, PA	10	15	70	2001-2002
Jerabek (2002)	Property Sales - Statistics	25	Before and After	None	Kewaunee County, WI	14	9.2	65	1998-2001

Author(s) (Year)	Type	*n*	Before or After Construction	Property Value Impact†	Study Area	# Turbines	Total MW	Hub Height (meters)	Study Dates
Jerabek (2001)	Property Sales - Statistics	7	After	None	Kewaunee County, WI	14	9.2	65	1999-2001
Robertson Bell Associates (1998)	Homeowner Survey	203	After	None	Alness, Scotland	34	17	35	1998
Robertson Bell Associates (1997)	Homeowner Survey	336	After	None	Wales	20	9	35	1997

†Property Value Impact: "None" = There was no evidence of wind farms impacting property values. *n* = number of observations
"Positive" = Property values rose in areas surrounding a wind farm, though this *does not necessarily* imply that property values rose because of the wind farm. i.e., property values could have risen for other reasons.
"Negative" = Property values declined in areas surrounding a wind farm, though this *does not necessarily* imply that property values declined because of the wind farm. i.e., property values could have declined for other reasons.
*indicates the study has been published in an academic peer-reviewed journal.
Notes: All numbers are approximations and accuracy cannot be guaranteed. Please note that although this table acknowledges the results of other studies, it does not in any way support the methods used to reach the conclusions. There are quite a few studies that reach conclusions that this author does not support, either due to a lack of statistical rigor or incorrect analyses of results.

III. THEORETICAL ANALYSIS

This study uses a hedonic pricing model to estimate the marginal willingness to pay for specific house structural characteristics and neighborhood characteristics including location (proximity to amenities or disamenities)[11]. The hedonic pricing model is based on the microeconomic theoretical framework developed in the landmark papers by Lancaster (1966) and Rosen (1974). Lancaster (1966) focused on the demand side of the market, he "developed a sophisticated branch of microeconomic theory in which utility is generated, not by goods *per se*, but by *characteristics* of the goods" (Malpezzi, 2002, 10). Rosen (1974) focused on "how suppliers and consumers interact within a framework of bids and offers for characteristics" (Malpezzi, 2002, 11). Hedonic pricing models have not only been applied to housing studies but to many other sectors as well (e.g., automobiles). Literally hundreds of academic, peer-reviewed journal articles have been published over the years utilizing hedonic regression analysis with a focus specifically on housing. This well-accepted use of hedonic pricing models in relation to housing provides a basis for the use of this framework for the current analysis.

Follain and Jimenez (1985) point out that Rosen's theory leads to a two-step approach to estimating the compensated demand curve; however, they do note the possible simultaneity issues that may arise in this type of estimation. Malpezzi (2002) notes that "the identification problems, imperfect specifications, and the general non-robustness of coefficient estimates—suggest that reliable two-stage structural estimation of the demand for characteristics will be difficult" (15). Thus, a simple hedonic approach utilizing one equation is taken in this analysis, and appears to be well accepted in the prevailing literature on this topic[12].

A simple hedonic pricing model for housing relates the price at which the house sold to the individual characteristics of the property. The house price (value) is the selling price that two unrelated parties acting in their own interest, namely the buyer (grantee) and the seller (grantor) of the property willingly agree upon. The price of a property can be thought of as being a function of its characteristics:

$$\mathrm{P} = P(\mathrm{S}, \mathrm{N}) \qquad (1)$$

Where

- P represents the selling prices of properties;
- S represents a vector of structural characteristics of the houses (properties);
- N represents a vector of neighborhood characteristics and location characteristics.

An individual's utility may be expressed as:

$$\mathrm{U} = U(\mathrm{X}, \mathrm{S}, \mathrm{N}) \qquad (2)$$

The homebuyer's problem is to maximize their utility [$U(.)$] subject to their budget

[11] The time period in which the property sold is also appropriately controlled for.
[12] The abundance of published articles using a simple hedonic approach and the continuing publication of articles using a simple hedonic approach exemplifies its acceptance.

constraint [$I=X+P$], where I is income and X is a composite commodity with price equal to one. For a specific utility bearing attribute s, it is assumed that an individual will choose a property such that their marginal willingness to pay will equal the price of that characteristic.

$$\frac{\left(\frac{\partial U}{\partial s}\right)}{\left(\frac{\partial U}{\partial X}\right)} = \frac{\partial P}{\partial s} \qquad (3)$$

Structural characteristics of the house may include items such as the living area square feet, the age of the home, the garage square feet, the number of fireplaces, and the acres of the lot, among many other things. An increase in the size of the living area, the number of square feet in a garage, and the number of fireplaces inevitably imposes material costs on the construction on the home. To the degree that these material costs are reflected in the value of a house, these increases can reasonably be expected to put upward pressure on the selling price of the house, *ceteris paribus*[13] (holding everything else relevant constant). Though the previous variables may not be linearly related to selling price by any means, the number of acres in a lot[14] and the age of a home may have a more complicated relationship than the former.

In particular, the value one places on lot size may vary by market: the market for properties less than or equal to one acre and the market for properties greater than one acre in size. For example, one may place a very high value on increasing the lot size from 0.17 acre to 0.35 acre in an area with a very limited number of available lots, if it means they are still able to be located within a particular neighborhood or school district of their preference. However, there exist homebuyers that may not be concerned with locating in a particular school district and in fact would rather not be located in a neighborhood in close proximity to other homes (e.g., they may actually prefer the view of a rural landscape rather than the view of their neighbor's home). Consequently, demand for lots less than one acre, and demand for lots greater than one acre (which are typically located in the more rural areas, not neighborhoods) may not involve a smooth demand function. To the extent that the demand for lots less than one acre exceeds the demand for lots greater than one acre, it can be expected that the lots with less than one acre will experience upward pressure on the incremental 0.1 acre value.

As a home ages, the building materials age as well, this puts downward pressure on the price of the house. However, old homes that are built really well, have been properly maintained over the years and possibly renovated, and may be desirable for their historical characteristics would tend to put upward pressure on the price of the house. Thus, there may be a quadratic relationship in that as age increases the price of the home decreases and then after a certain age the price begins to increase. In general, the living area square feet, the garage square feet, the number of fireplaces, and the acres of the lot are expected to be an increasing function of the house price, while age is expected to be a decreasing function, *ceteris paribus*.

Neighborhood characteristics may include the quality of schools, or the socioeconomic characteristics of the neighborhood. The location characteristics within the market include the township (or school district) in which the property is located and undoubtedly represent many things such as distance/access to shopping, schools, sub-centers of employment, and other

[13] Latin, "other things being equal."
[14] It is assumed that the land is not contaminated in any way.

important amenities.

A valuable locational characteristic may include a property being located next to a lake which allows the owner to have a nice view and this tends to put upward pressure on the price of the property, *ceteris paribus*. A property located in a cul-de-sac or amidst trees would enable the owner to have more privacy and potentially experience less noise from road traffic, thus putting upward pressure on the value of the home, *ceteris paribus*. A property located close to railroad tracks would tend to experience the negative externalities resulting from trains operating. Loud noise and vibrations, negative externalities that a property near railroad tracks would be subject to, would tend to put downward pressure on the value of that property, *ceteris paribus*.

Location may also include being located in close proximity to a wind farm. In a landmark paper, Hoen et al. (2009) formalized some potential theoretical relationships between wind turbines and homebuyers (these are not mutually exclusive and thus are likely to occur in combination with each other):

> • Area Stigma: A concern that the general area surrounding a wind energy facility will appear more developed, which may adversely affect home values in the local community regardless of whether any individual home has a view of the wind turbines.
> • Scenic Vista Stigma: A concern that a home may be devalued because of the view of a wind energy facility, and the potential impact of that view on an otherwise scenic vista.
> • Nuisance Stigma: A concern that factors that may occur in close proximity to wind turbines, such as sound and shadow flicker, will have a unique adverse influence on home values. (2)

Of the stigmas that Hoen et al. (2009) addressed, primarily *wind farm area stigma* will be addressed in this analysis[15]. The author realizes these theoretical stigmas may occur together and that overlap of these stigmas is actually what is being measured in the results. For example, the vast majority of rural properties near the wind farm in this study have a view of the wind turbines. Thus, although this analysis refers to testing for wind farm area stigma, the area stigma being tested actually incorporates the view of the wind turbines (i.e., the view of the wind turbines is so highly correlated with properties in close proximity to the wind turbines that these effects cannot be separated out[16]).

There was a recent survey conducted surrounding the wind farm in which this study is focused on, Twin Groves I and II. A random sample of residents of the Ellsworth, Saybrook, and Arrowsmith communities was surveyed in 2009 (Theron, 2010). Sixty percent of respondents claimed they were either not concerned at all or not very concerned regarding wind farms negatively impacting their property values. This survey response is significant considering it was taken during the wind farm operation stage of Twin Groves I and II. Therefore, after living with the wind turbines, approximately 60% of the randomly sampled residents of the communities

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[15] Hoen et al. (2009) considered homes within a distance of one mile to be in close proximity. Nuisance Stigma was investigated in this analysis, but since only 11 properties sold within one mile of the wind farm during wind farm operations, the results of the nuisance stigma investigation should not be taken with great confidence.
[16] If two separate explanatory variables were included in the estimation to model distance and view of the wind farm separately, then this high correlation between the two variables would result in multicollinearity. Multicollinearity occurs when there is a relationship among some of the explanatory variables such that two or more explanatory variables are so highly correlated that they largely or totally nullify one another (thus, insignificance of estimated coefficients).

were not concerned about their property values declining because of the wind farm. This finding is inconsistent with wind farm area stigma theory. Thus, this study investigates wind farm area stigma theory by analyzing the actual property transactions around the wind farm rather than opinions of local property owners.

It is important to control for the time period in which the property sold in the analysis, which is an often ignored factor in the prevailing literature. The time period the price is observed may include the year in which the property sold (e.g., including dummy variables for different years in which properties sold). Yearly dummy variables are extremely important to include in the estimation if the prices are not adjusted for inflation. It is also important to include a particular time or stage dummy variable[17] and interact it with the most important property characteristics that will likely vary with time. For example, it is important to include a dummy variable if a significant change occurred during a particular time period, where the dummy variable would take a value of one for properties that sold during the time period in which the change was in effect, and it would take a zero value for properties that sold when the change was not in effect (e.g., a wind farm constructed in an area may be considered a significant change). More will be discussed on this topic in Sections IV and V. Also, the amount of time the house takes to sell, commonly referred to as "time-on-the-market"[18] can potentially impact the selling price.

Following some excellent studies completed by Kiel and McClain (1995a, 1995b)[19], the author recognizes that the effect of a wind farm on property values may not be constant over time and that important information may be lost if the stages of the adjustment process are ignored, where the stages of the adjustment process correspond to different levels of risk as perceived by local residents, homebuyers, and sellers[20]. Theoretically, there could exist a *wind farm anticipation stigma* associated with properties that sell in a location near a proposed wind farm project. *Wind farm anticipation stigma theory* is a concern surrounding a proposed or approved wind farm project that is primarily due to factors stemming from a fear of the unknown: a general uncertainty surrounding a wind farm project regarding the aesthetic impacts

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[17] A dummy variable is a binary variable taking a value of one to indicate the presence of some categorical effect that may be expected to shift the outcome and a value of zero to indicate the absence of some categorical effect.

[18] Sirmans et al. (2005) state "Typically, a seller's goal is to sell the house at the highest possible price in the shortest possible time. These two objectives are generally reconciled with the setting of the listing price. A listing price that is too high may have the effect of both lengthening the selling time and limiting the pool of potential buyers. Setting the listing price too low may minimize the selling time but may also result in a selling price lower than what otherwise could be attained" (7).

Sirmans et al. (2005) reviewed studies that have focused on the relationship between time-on-the-market and selling price. Sirmans et al. (2005) observe, "when time-on-the-market is included and statistically significant in the selling price equation, it is generally negative. This indicates that a longer selling time results in a lower selling price. When selling price is included in a time-on-the-market estimation, the results are much less clear. In some cases, a higher selling price leads to a longer selling time whereas in others, a higher selling price results in a shorter selling time" (7). Of the 18 time-on-the-market studies Sirmans et al. (2005) examine, 50% of the time, time-on-the-market is not statistically significant, 44.4% of the time, time-on-the-market is negative and statistically significant, and 5.6% of the time, time-on-the-market is positive and significant.

The author would have loved to be able to include time-on-the-market in the estimation. Unfortunately, time-on-the-market data are not freely available for all of the property sales included in this analysis. In general, there may be inherent measurement errors in time-on-the-market data due to property owners relisting their properties.

[19] Kiel and McClain (1995a, 1995b) examine the impact of an incinerator on housing values in North Andover, Massachusetts.

[20] These stages of the adjustment process are thought to roughly correspond to the stages of wind farm development.

on the landscape, the actual noise impacts from the wind turbines, and just how disruptive the wind farm will actually be. "The uncertainty surrounding the project—whether and where the facility is located and how undesirable the facility might be—will change through time and should be reflected in the prices of houses" (Kiel and McClain, 1995a, 242). Kiel and McClain (1995a) state that the "effect of a facility on house values may change over time as neighbors acquire more information, good or bad, on the aesthetic and health consequences of the facility" (242). This statement may give light to the fact that most surveys done in areas surrounding a "proposed" wind farm find that there is an expectation that property values will diminish, yet a large number of the studies completed in areas surrounding "actual" wind farms find that property values do not diminish.

As surrounding property owners acquire additional information on the aesthetic impacts on the landscape and actual noise impacts of the wind turbines after the wind farm becomes operational, residents of the local area may get used to them (e.g., the turbines become part of the landscape such as telephone poles[21] have outside of homes) and they may not take the turbines into account when moving to another house in the local area.

Interestingly, even if evidence reveals that the wind farm has no impact, research has revealed that initial risk perceptions may persist because of the way new information is interpreted. New information which is consistent with an individual's existing beliefs is accepted as reliable and accurate, while conflicting information is labeled erroneous, unrepresentative, or propaganda (Kiel and McClain, 1995a; Slovic, 1987). Thus, any downward pressure on prices, if any, could be quite prolonged, especially if the majority of local residents are opposed to the wind farm prior to wind farm approval.

Accordingly, this study incorporates these important theoretical considerations into the econometric model (most importantly, wind farm anticipation stigma theory and wind farm area stigma theory). Utilizing the econometric method described in the next section, this study will test whether these theories hold for the specific housing market under study.

IV. EMPIRICAL METHOD

This study uses a data structure known as pooled cross sections over time and an estimation technique known as Ordinary Least Squares (OLS) multiple regression analysis. Every method used for pure cross section analysis can be applied to pooled cross sections, such as corrections for heteroskedasticity. Important "control" variables will be included in the multiple regression analysis to explain housing prices and these will help alleviate any self-selection problem[22]. In using pooled cross sections, time period dummies are usually included in the model to account for aggregate changes over time (Wooldridge, 2002). A difference-in-differences estimation approach is adopted to explicitly analyze the relationship between property price and wind farm proximity over the different stages of development. It is assumed that the relationship between the dependent variable *ln(Real Property Price)* and most of the

[21] However, telephone poles do not have moving parts and they are much smaller than industrial size wind turbines.
[22] A self selection problem occurs when a dummy variable indicator is systematically related to unobserved factors resulting in biased estimators.

independent variables remains constant over time[23]. Using this assumption, pooling is helpful because it can allow for more precise estimators. More estimation assumptions are included in Appendix B.

Spatial dependence or spatial autocorrelation exists when there is a lack of independence among cross-sectional units' relative space or location (multi-directional); i.e., the existence of a functional relationship between what happens at one point in space and what happens elsewhere (Anselin, 1988). Although prices from adjacent units are likely to be correlated (neighborhood effects), if the correlation arises mainly through the explanatory variables (as opposed to unobservables), then nothing needs to be done on a practical level (Wooldridge, 2002). When the unobservables are correlated across nearby geographical units, OLS can still have desirable properties—often unbiasedness, consistency, and asymptotic normality can be established (Wooldridge, 2002). Thus, this analysis assumes that any correlation arises mainly through the explanatory variables rather than unobservables and a spatial weights matrix is not adopted.

If it is believed that several housing submarkets[24] exist within a sample, there are two ways of dealing with them in the estimation of hedonic equations. Malpezzi et al. (1980) state "separate regressions could be estimated for each submarket. This implies rather extreme separation because it assumes all the hedonic prices are different in each submarket. The second alternative is to introduce dummy (or indicator) variables for each submarket. This is more restrictive than the first alternative in the sense that it forces the coefficients to be equal in each submarket. Only the constant term, or the base price is allowed to differ across submarket" (21-22). The latter approach is adopted and the estimated coefficients of the location dummy variables represent the base price differential between the submarkets.

Spatial heterogeneity[25] exists when there is a lack of stability over space of the relationships; i.e., functional forms and parameters vary with location and are not homogenous throughout the dataset (Anselin, 1988). Several conditions would lead to this: a byproduct of measurement errors for observations in contiguous spatial units and the existence of a variety of spatial interaction phenomena (Anselin, 1988). The former is likely to occur when data is collected only at an aggregate level, thus there may be little correspondence between the spatial scope for the phenomenon under study and the delineation of the spatial units of observation, and as a result measurement errors are likely. Spatial spillover in measurement errors is one cause for the presence of spatial dependence, which can lead to non-spherical disturbance terms and errors in variables problems (Anselin, 1988). "Each housing market produces a set of hedonic prices. This means that each set of hedonic prices… estimate[d] must be derived from a set of observations from the same housing market. To use too broad a geographical definition of a housing market would produce biased estimates from an improperly aggregated sample. To use too narrow a definition would produce inefficient estimates because the estimates would not be based on all available information" (Malpezzi et al., 1980, 21). Thus, a balance must be determined[26].

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[23] For the relationships that may not remain constant over time, time period interaction terms with the specific variables are included (e.g., properties close to wind turbines interacted with time period).

[24] Fletcher et al. (2000) provide a great overview of modeling housing submarkets.

[25] Distinguishing between spatial dependence (autocorrelation) and spatial heterogeneity can be a highly complex problem.

[26] Too broad a geographical definition of a housing market in the study sample would be *county level*. Too narrow a geographical definition of a housing market in the study sample would be *neighborhood/subdivision*. Thus, *school districts* and *townships* are included where *townships* are a narrower geographical definition of a housing market in

Several measures that address these spatial aspects are utilized in this analysis. Each of the base equations was estimated three times, each time using one of the three measures adopted to control for spatial heterogeneity, spatial trends, and/or spatial submarkets (neighborhood effects). First, the {X, Y}-coordinates[27] of the property locations were included in some of the models to address the impact that absolute location has on property values and to model any spatial trends. Second, school district dummy variables were utilized as proxies for the housing submarkets. Third, township dummy variables were used as proxies for the housing submarkets. These three specifications were utilized to demonstrate the results are robust to either specification and to allow for a more detailed comparison of property values near the wind farm to property values in each of the other housing submarkets over time.

A. DIFFERENCE-IN-DIFFERENCES ESTIMATOR

In order to analyze the relationship between the price of a property and its proximity to a wind farm over the different stages of wind farm development (stages of the adjustment process), a difference-in-differences estimator is adopted. Consider the following equation:

$$\text{RealPrice} = \beta_0 + \delta_0 \text{wfoperation} + \gamma_0 \text{nearwf} + \delta_1 \text{wfoperation} * \text{nearwf} + \varepsilon \quad (4)$$

Where

- *RealPrice* represents the selling prices of houses adjusted for inflation;
- *wfoperation* is a dummy variable equal to 1 for properties that sold during the time period in which the wind farm was operational (and 0 otherwise);
- *nearwf* is a dummy variable equal to 1 for properties that sold near the wind farm area (and 0 otherwise);
- *wfoperation*nearwf* is a dummy variable equal to 1 for properties that sold that are located near the wind farm area during the time period in which the wind farm was operational (and 0 otherwise);
- ε is an error term[28];
- $\beta_0, \delta_0, \gamma_0, \delta_1$ represent parameters[29] to be estimated.

The estimated[30] coefficients of Eq. (4) can literally be calculated using simple averages[31].

$$\hat{\beta}_0 = \overline{\text{RealPrice}}_{\text{farwf,B4Operation}} \quad (5)$$

the sample than *school districts*, but not nearly as narrow as *towns* or *subdivisions*.

[27] More details regarding the {X,Y}-coordinates can be found in Appendix B.

[28] An error term contains unobserved factors that affect the dependent variable. It may also include measurement errors in the observed dependent or independent variables (Wooldridge, 2009).

[29] A parameter is an unknown value that describes a population relationship (Wooldridge, 2009).

[30] The equation is estimated using Ordinary Least Squares (OLS) multiple regression analysis. OLS is a method for estimating the parameters of a multiple linear regression model. The ordinary least squares estimates are obtained by minimizing the sum of squared residuals (Wooldridge, 2009). There is a residual for each observation in the sample used to obtain an OLS regression line, where a residual is calculated as the difference between the actual value and the fitted (or predicted) value (Wooldridge, 2009).

[31] The "mean" or "average" is defined as the sum of n numbers divided by n.

$$\hat{\delta}_0 = \left(\overline{\text{RealPrice}}_{farwf,wfOperation} - \overline{\text{RealPrice}}_{farwf,B4Operation}\right) \quad (6)$$

$$\hat{\gamma}_0 = \left(\overline{\text{RealPrice}}_{nearwf,B4Operation} - \overline{\text{RealPrice}}_{farwf,B4Operation}\right) \quad (7)$$

$$\hat{\delta}_1 = \left(\overline{\text{RealPrice}}_{nearwf,wfOperation} - \overline{\text{RealPrice}}_{nearwf,B4Operation}\right) - \left(\overline{\text{RealPrice}}_{farwf,wfOperation} - \overline{\text{RealPrice}}_{farwf,B4Operation}\right) \quad (8)$$

Where[32]

- $\overline{RealPrice}_{farwf,B4Operation}$ is the real average price of properties that sold *far* from the wind farm *before* the time period when the wind farm was operational.
- $\overline{RealPrice}_{farwf,wfOperation}$ is the real average price of properties that sold *far* from the wind farm during the time period when the wind farm was *operating*.
- $\overline{RealPrice}_{nearwf,B4Operation}$ is the real average price of properties that sold *near* the wind farm area *before* the time period when the wind farm was operational.
- $\overline{RealPrice}_{nearwf,wfOperation}$ is the real average price of properties that sold *near* the wind farm during the time period when the wind farm was *operating*.

The bar over *RealPrice* denotes the average and the subscript *B4Operation* denotes the time period prior to wind farm operation and the subscript *wfOperation* denotes the time period in which the wind farm was operational. The subscript *farwf* denotes properties that sold far away from the wind farm and the subscript *nearwf* denotes properties that sold near the wind farm. Thus, the estimated coefficients have the following interpretations:

- $\hat{\beta}_0$ the intercept or constant term represents the real average price of a home far from the wind farm prior to operation of the wind farm. See Eq. (5).
- $\hat{\delta}_0$ captures aggregate factors that affect real property price over time; it captures changes in housing values of properties far from the wind farm from the time period before wind farm operations to the time period when the wind farm was operational. See Eq. (6).
- $\hat{\gamma}_0$ measures the *location effect* that is *not* due to the presence of the wind farm. This takes into account any housing price differential between properties near the wind farm and far from the wind farm prior to wind farm operations. See Eq. (7).
- $\hat{\delta}_1$ the coefficient on the interaction term *wfoperation*nearwf* is the estimated parameter of interest: it measures the change in housing values due to the new wind farm, provided that houses both near and far from the site did not appreciate at different rates for other reasons. Wind farm area stigma would occur if $\hat{\delta}_1$ is negative and statistically significant. See Eq. (8).

The difference-in-differences estimator $(\hat{\delta}_1)$ applied to the present study estimates the

[32] Column (1) of Table D.1 of Appendix D contains the results of estimating Eq. (4). The real average prices of properties that sold can be found in Table C.1 of Appendix C.

difference over time in the average difference of real housing prices near the wind farm (*nearwf*) and farther away from the wind farm (*farwf*). $\hat{\delta}_1$ has also been called the average treatment effect because it measures the effect of the "treatment" or policy on the average outcome of the dependent variable (Wooldridge, 2009). $\hat{\delta}_1$ tests whether a wind farm area stigma exists, where a negative and statistically significant $\hat{\delta}_1$ would provide support for the existence of an area stigma. Please see Appendix D for more complex examples and explanations of how to interpret each of the estimated coefficients.

To see how effective the difference-in-differences estimator is for estimating housing price impacts from a wind farm, it can be compared with some alternative estimators. For example, properties farther away from the wind farm[33] could be ignored and instead the change in the real average property price over time for properties near the wind farm[34] could be used to measure the impact of the wind farm on property values near the wind farm:

$$\left(\overline{\text{RealPrice}}_{nearwf,wfOperation} - \overline{\text{RealPrice}}_{nearwf,B4Operation}\right) \quad (9)$$

The problem with this estimator in Eq. (9) is that the average response can change over time for reasons unrelated to the wind farm (e.g., housing crisis and economic recession). Thus, it is important to be able to compare the property value changes over time for the area near the wind farm to the property value changes over time for an area far from the wind farm.

Another possibility is to use the approach that most authors have used in analyzing the impact of wind farms on property values, that is to use a pure cross-section approach and ignore the time period before the wind farm achieved commercial operations and compute the difference in averages of real property prices for properties near the wind farm and properties farther away from the wind farm for the time period in which the wind farm was operational:

$$\left(\overline{\text{RealPrice}}_{nearwf,wfOperation} - \overline{\text{RealPrice}}_{farwf,wfOperation}\right) \quad (10)$$

The problem with Eq. (10) is that there might be systematic, unmeasured differences in properties near the wind farm and properties farther away from the wind farm that have nothing to do with the wind farm (e.g., distance to sub-centers of employment, grocery stores, and shopping). Thus, attributing the difference in averages of the housing prices to the wind farm would be misleading[35] (Wooldridge, 2002).

By comparing the time changes in real average property prices for the properties near the wind farm and farther away from the wind farm, both group-specific[36] and time-specific effects are allowed for[37] (Wooldridge, 2002). Please see Appendix D for more examples and explanations.

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[33] Properties farther away from the wind farm are the control group. A control group in a program evaluation is the group that does not participate in the program.
[34] Properties near the wind farm are the treatment or target group. A treatment or target group in a program evaluation is the group that participates in the program.
[35] This approach that is often misleading is demonstrated in Section VI by estimation of each stage of the wind farm separately.
[36] e.g., neighborhood effects.
[37] Nevertheless, unbiasedness of the difference-in-differences estimator still requires that the change (operation of a wind farm) not be systematically related to other factors that affect housing values (and are hidden in the error term).

V. PROJECT LOCATION AND DATA

This section begins with an explanation as to why Twin Groves I and II were chosen for this analysis. Next, maps of the study areas are presented along with area descriptions. Finally, this section concludes with a description of the data collected including summary statistics of the variables included in this study.

A. WHY TWIN GROVES WIND FARM?

The largest wind farm east of the Mississippi River, Twin Groves I and II (TG I and II) in McLean County, Illinois, was chosen for this analysis because Illinois State University, the university the author was attending while completing this study, is also located in McLean County. Thus, the site was chosen for its convenience[38]. Also, at the time of the decision, there had not been any hedonic regression studies that had examined properties that sold around a wind farm of this magnitude, 240 turbines, 1.65 megawatts (MW) per turbine, 22,000 acres, with a hub height of 262.5 feet (~80 meters) or 398 feet (~121 meters) from the base of the tower to the top of the blade.

B. STUDY AREA

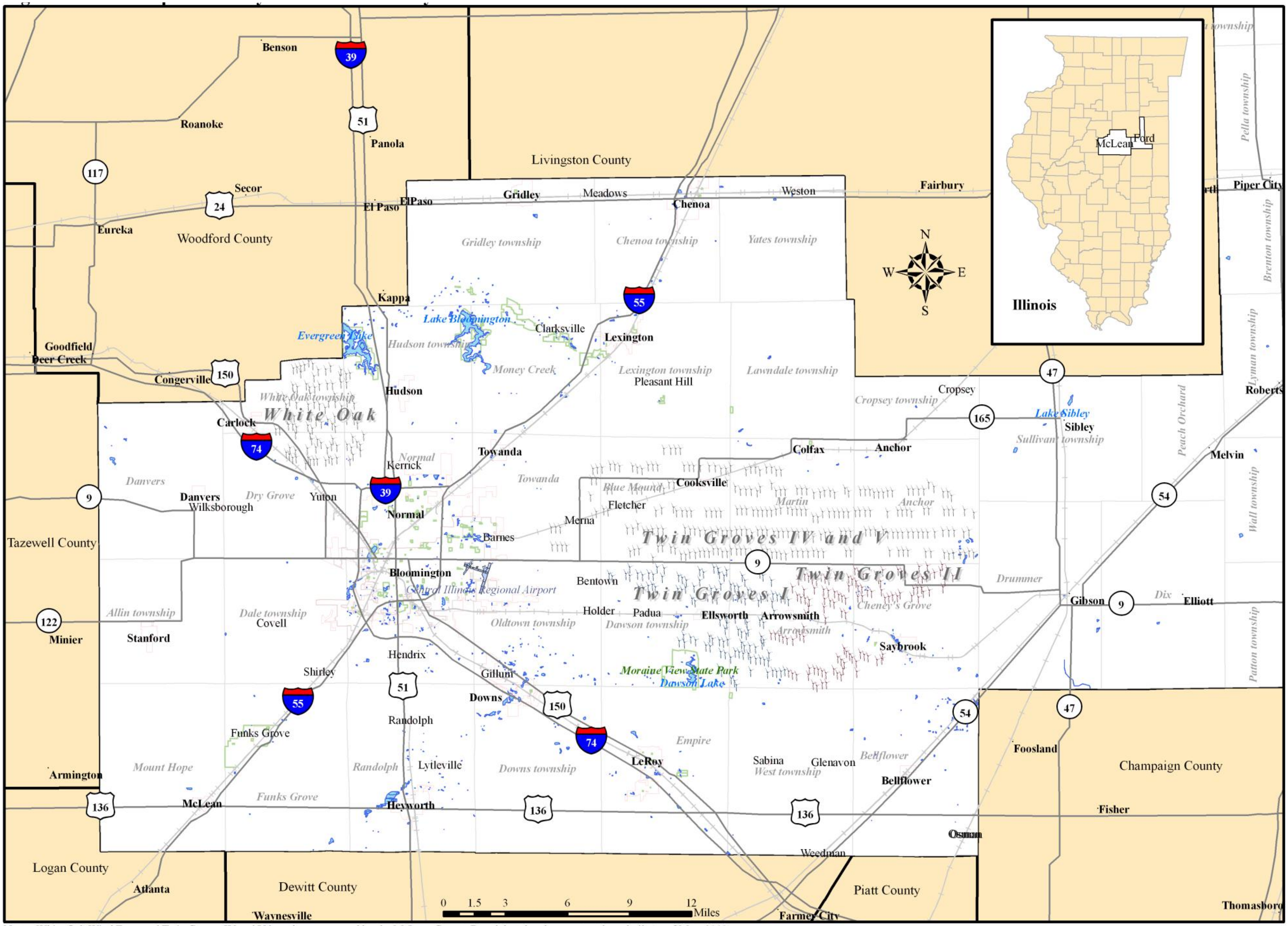
The study area for this analysis consists of 21 townships in eastern McLean County, Illinois and four townships in western Ford County, Illinois. Table 4 contains a list of the townships included in the study as well as the size of the township, in terms of land area. The total study area consists of 1,023 square miles (654,239 acres). The wind farm area consists of 22,000 acres. Fig. 1 contains a map of the study area along with identifiers for the wind turbines from Twin Groves I and II. Several wind farms that have been approved by the McLean County Board but have not yet been built are pictured in Fig. 1, namely White Oak wind farm and Twin Groves IV and V[39]. It was decided to extend the study area beyond the townships immediately surrounding Twin Groves I and II because of the McLean County Board approval of Twin Groves IV and V (TG IV and V will reside in several of those townships that border TG I and II). Consequently, 1,023 square miles are included in the study area to ensure there are appropriate control areas (i.e., areas not affected by a wind farm) in the analysis.

[38] Since the author had a $0 budget, it was important to have access to McLean County GIS data for the purpose of calculating distances from properties to the wind farm. Luckily, Mr. Phil Dick, Director of McLean County Building and Zoning, agreed to support the project which gave the author access to McLean County GIS data (McGIS, 2010).
[39] The planned turbine locations are identified on the map for White Oak wind farm and Twin Groves IV and V, but the actual turbine locations may differ.

Table 4. Study Area Township Size

Township	Acres	SqMiles
Gridley township	34,879	54
Dix township	34,552	54
Drummer township	34,339	54
Randolph township	31,755	50
Downs township	31,666	49
Empire township	31,619	49
Bellflower township	31,169	49
West township	31,104	49
Sullivant township	30,329	47
Lexington township	26,213	41
Lawndale township	25,439	40
Money Creek township	25,148	39
Hudson township	24,193	38
Blue Mound township	24,161	38
Dawson township	24,013	38
Oldtown township	23,677	37
Yates township	23,389	37
Anchor township	23,377	37
Cheney's Grove township	23,364	37
Chenoa township	23,334	36
Martin township	23,192	36
Arrowsmith township	23,112	36
Towanda township	23,021	36
Peach Orchard township	15,483	24
Cropsey township	11,710	18
Total Study Area	654,239	1,023

Source: U.S. Census Bureau
Notes: SqMiles=Square Miles



Notes: White Oak Wind Farm and Twin Groves IV and V have been approved by the McLean County Board, but they have not yet been built (as of May, 2010). Thus, the planned turbine locations are identified on the map, but the actual turbine locations may differ.

Data Sources: McLean County Regional GIS Consortium (McGIS), U.S. Census Bureau, Horizon Wind Energy, Invenergy

Map Designed by Jennifer L. Hinman

Fig. 1. Study Area: McLean and Ford Counties, Illinois: Wind Farms Approved as of May, 2010

According to a local realtor the top three townships that are considered prime home location spots are *Oldtown, Downs,* and *Hudson*. The top three villages that are considered prime home location spots are Downs, Hudson, and Heyworth. The top school districts within the study area include *Normal Community Unit School District (CUSD) 5, Trivalley CUSD 3,* and *Heyworth CUSD 4.*

Table 5 contains township population over the past 110 years. The percent changes in population from 1900 to 2000 for the top home location spots are -19% *Downs*, 82% *Hudson*, 178% *Oldtown*, and 104% *Randolph*[40]. The percent changes in population from 1900 to 2000 for the townships in which Twin Groves I and II are located are -47% Arrowsmith, -38% Cheney's Grove, and -48% Dawson. Thus, it appears that the wind farm was sited in areas that had a declining population over the past century.

Table 6 contains the number of housing units by township from 1970 through 2000. The percent changes in the number of housing units from 1970 to 2000 for the top home location spots are 10% *Downs*, 53% *Hudson*, 199% *Oldtown,* and 61% *Randolph.* The percent changes in the number of housing units from 1970 to 2000 for the townships in which TG I and II are primarily located are -9% Arrowsmith, 8% Cheney's Grove, and -9% Dawson. Although the number of housing units in Cheney's Grove township has increased by 8% from 1970 to 2000, the number of housing units has declined by 8.75% from 1980 to 2000. Before TG I and II were proposed, there apparently had not been any significant growth in population nor in the number of housing units within the townships where TG I and II eventually located. This fact could have contributed to the relative lack of opposition to the wind farm during the approval process[41]

[40] The village of Heyworth is in *Randolph* township.
[41] The audio recordings from the McLean County Zoning Board of Appeals hearings for the TG I and II special-use permits were obtained and listened to by the author.

Table 5. Census Population: 1890-2000 Townships

	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000	1900-2000
Illinois	3.8M	4.8M	5.6M	6.485M	7.6M	7.9M	8.7M	10M	11M	11.4M	11.4M	12.4M	158%
Ford County, Illinois	17,035	18,359	17,096	16,466	15,489	15,007	15,901	16,606	16,382	15,265	14,275	14,241	-22%
McLean County, Illinois	63,036	67,843	68,008	70,107	73,117	73,930	76,577	83,877	104,389	119,149	129,180	150,433	122%
Allin township, McLean	1,209	1,302	1,197	1,115	1,006	1,037	967	938	1,053	1,057	996	1,047	-20%
Anchor township, McLean	903	957	932	825	763	666	643	644	528	441	393	376	-61%
Arrowsmith township, McLean	1,090	1,081	1,013	946	907	783	798	782	646	566	549	569	-47%
Bellflower township, McLean	1,294	1,241	1,167	1,183	1,220	1,070	964	927	952	794	702	682	-45%
Bloomington City township	20,484	23,286	25,768	28,725	30,930	32,868	34,163	36,271	39,992	44,189	51,972	64,808	178%
Bloomington township, McLean		2,250	2,025	2,034	2,211	2,239	2,582	3,514	4,896	4,939	3,835	3,176	41%
Blue Mound township, McLean	1,057	1,158	1,176	1,053	1,025	919	782	693	685	616	478	473	-59%
Brenton township, Ford	1,315	1,377	1,355	1,299	1,262	1,147	1,176	1,283	1,124	1,073	994	929	-33%
Button township, Ford	862	876	766	729	614	560	470	426	385	335	299	290	-67%
Cheney's Grove township	1,849	1,723	1,557	1,479	1,379	1,455	1,314	1,310	1,192	1,223	1,051	1,069	-38%
Chenoa township, McLean	2,004	2,219	2,117	2,002	2,002	2,021	2,032	2,053	2,440	2,368	2,228	2,305	4%
Cropsey township, McLean	543	544	531	514	500	454	424	387	341	288	240	256	-53%
Dale township, McLean	1,010	1,063	1,022	866	906	802	778	838	953	1,018	1,192	1,276	20%
Danvers township, McLean	1,665	1,760	1,543	1,497	1,412	1,496	1,468	1,461	1,486	1,595	1,692	1,953	11%
Dawson township, McLean	1,264	1,275	1,235	1,109	1,041	1,039	870	766	756	688	649	668	-48%
Dix township, Ford	1,450	1,436	1,366	1,343	1,133	1,071	1,066	957	898	792	711	686	-52%
Downs township, McLean	1,330	1,330	1,278	1,137	1,128	1,038	998	1,133	1,170	1,014	992	1,079	-19%
Drummer township, Ford	2,997	3,304	3,165	3,178	3,043	3,225	3,745	4,243	4,580	4,071	3,897	3,898	18%
Dry Grove township, McLean	1,092	1,218	903	848	812	716	756	750	993	1,501	1,494	1,649	35%
Empire township, McLean	2,325	2,639	2,635	2,523	2,391	2,517	2,437	2,694	2,957	3,473	3,379	3,845	46%
Funks Grove township, McLean	777	916	791	624	796	677	588	574	425	358	302	293	-68%
Gridley township, McLean	1,699	1,836	1,833	1,753	1,653	1,579	1,561	1,568	1,628	1,805	1,813	1,914	4%
Hudson township, McLean	1,269	1,277	1,095	1,062	1,017	956	910	1,144	1,619	1,766	1,853	2,318	82%
Lawndale township, McLean	945	840	755	685	637	554	457	447	357	273	237	227	-73%
Lexington township, McLean	2,174	2,498	2,211	2,123	2,050	2,036	1,789	1,887	2,206	2,441	2,271	2,331	-7%
Lyman township, Ford	1,298	1,413	1,248	1,212	1,052	936	924	920	838	688	617	578	-59%
Martin township, McLean	1,428	1,911	1,601	1,624	1,429	1,387	1,345	1,339	1,287	1,180	1,154	1,229	-36%
Mona township, Ford	756	853	850	801	818	721	656	533	510	479	383	387	-55%
Money Creek township, McLean	882	843	753	716	676	631	590	597	780	780	824	1,084	29%
Mount Hope township, McLean	1,432	1,361	1,486	1,497	1,520	1,367	1,313	1,329	1,276	1,170	1,130	1,172	-14%
Normal township, McLean		4,651	4,844	5,959	7,519	7,713	10,444	14,122	27,532	36,163	40,449	45,637	881%
Oldtown township, McLean	906	970	946	774	820	763	730	778	960	1,570	1,738	2,692	178%
Patton township, Ford	3,559	4,425	4,160	4,040	3,928	4,005	4,694	5,247	5,410	5,327	5,226	5,413	22%
Peach Orchard township, Ford	1,008	1,017	953	959	838	830	838	810	720	700	654	614	-40%

Pella township, Ford	800	734	624	517	558	503	495	369	341	285	206	220	-70%
Randolph township, McLean	1,833	1,891	1,829	1,978	1,983	1,970	2,022	2,181	2,700	3,010	2,934	3,856	104%
Rogers township, Ford	851	809	695	643	610	557	515	516	457	569	460	414	-49%
Sullivant township, Ford	1,322	1,397	1,185	1,123	1,065	963	893	954	827	692	608	594	-57%
Towanda township, McLean	1,255	1,242	1,210	1,123	1,134	1,094	959	1,059	1,031	1,375	1,191	1,024	-18%
Wall township, Ford	757	718	729	622	568	489	429	348	292	254	220	218	-70%
West township, McLean	1,135	1,035	999	871	896	798	677	551	424	318	264	278	-73%
White Oak township, McLean	594	607	692	655	636	627	598	541	647	761	803	807	33%
Yates township, McLean	1,017	919	864	807	718	658	618	599	477	409	375	340	-63%

Source: U.S. Census Bureau

Table 6. Housing Units: Townships

	1970	1980	1990	2000	1970-2000
Anchor township, McLean County	181	170	146	125	-31%
Arrowsmith township, McLean County	215	226	203	196	-9%
Bellflower township, McLean County	323	307	282	258	-20%
Bloomington City township, McLean County	14,459	20,050	22,640	26,642	84%
Bloomington township, McLean County	1,642	1,925	1,546	1,231	-25%
Blue Mound township, McLean County	232	249	204	194	-16%
Cheney's Grove township, McLean County	404	480	439	438	8%
Chenoa township, McLean County	788	886	870	867	10%
Cropsey township, McLean County	115	112	100	86	-25%
Dawson township, McLean County	264	289	232	240	-9%
Dix township, Ford County	290	321	281	261	-10%
Downs township, McLean County	357	356	363	393	10%
Drummer township, Ford County	1,679	1,776	1,728	1,668	-1%
Empire township, McLean County	1,030	1,346	1,338	1,489	45%
Funks Grove township, McLean County	132	137	120	109	-17%
Gridley township, McLean County	550	680	670	721	31%
Hudson township, McLean County	549	657	692	842	53%
Lawndale township, McLean County	113	99	90	75	-34%
Lexington township, McLean County	730	950	884	913	25%
Martin township, McLean County	488	524	493	486	0%
Money Creek township, McLean County	307	379	389	411	34%
Normal township, McLean County	6,586	10,548	12,454	15,257	132%
Oldtown township, McLean County	294	566	588	880	199%
Peach Orchard township, Ford County	292	307	288	245	-16%
Randolph township, McLean County	879	1,138	1,123	1,417	61%
Sullivant township, Ford County	289	293	256	221	-24%
Towanda township, McLean County	327	470	435	410	25%
West township, McLean County	136	123	99	88	-35%
Yates township, McLean County	159	149	135	125	-21%

Source: U.S. Census Bureau

Two villages are completely surrounded by the TG I and II wind turbines. Aerial photos of the village of Ellsworth and the village of Arrowsmith are pictured in Fig. 2 and Fig. 3, respectively. Ellsworth is located within the *Trivalley School District 3* and had a population of 271 in 2000 (U.S. Census Bureau, 2000). Arrowsmith is located within the *Ridgeview School District 19* and had a population of 298 in 2000 (U.S. Census Bureau, 2000). The village of Saybrook is located within the Cheney's Grove township and the *Ridgeview School District 19.* Wind turbines are located to the north and west of Saybrook. Saybrook had a population of 764 in 2000, which is a population decline of 13% from 1900 to 2000[42] (U.S. Census Bureau). None of the three villages contain a grocery store, though Saybrook does have a gas station.

[42] Saybrook had a population of 879 in 1900 (U.S. Census Bureau).

The land in the wind farm area is primarily farmland used to grow corn and soybeans. McLean County is the largest land area county in Illinois and is one of the most productive agricultural areas in the United States; fortunately, the wind turbines took only a small percentage of farm acreage out of production[43]. The wind turbines are located across moraines that formed during the Wisconsin Glacial Episode. The land area surrounding the wind farm is slightly rolling with very limited relief (i.e., generally relatively flat and is sloping in some areas). The land to the south of the wind farm gradually declines in elevation. TG I and II are primarily surrounded by land in the A-Agriculture District, though some turbines are adjacent to land in the R-1 Single Family Residence District. Although the minimum distance needed to maintain compliance with the State of Illinois Noise Regulations is 655 feet from the turbine to the nearest residence, the developer proposed and implemented a minimum 1,500 foot setback from a wind turbine to the nearest residence.

Fig. 2. Ellsworth Village

[43] Each turbine takes anywhere from one to two acres depending on how long the access road is (E-mail from Marie Streenz, Horizon Wind Energy, May 5, 2010).

Fig. 3. Arrowsmith Village

C. DATA

The property sales and a portion of the property characteristic data[44] used in this analysis were obtained from the Supervisors of Assessments Offices in McLean and Ford Counties (2010). A list of the main variables used in this analysis is presented in Table 7. These variables will be described in the subsections that follow and more details regarding the construction of some of the variables can be found in Appendix B. The final dataset contains 3,851 property transactions from 01/01/2001 through 12/01/2009[45] and the properties that sold are identified on

[44] This information is publically available.

[45] The original McLean County dataset consisted of 4,088 property transactions. The following types of transactions were not considered to be "arm's length" in nature and were accordingly removed: vacant lots, multi-parcel transactions, duplexes, triplexes, quadplexes, judicial, family, mobile homes, contract, compulsory, auctions, DHUD (Department of Housing and Urban Development), veteran's deed, foreclosures, properties that sold for less than \$25,000 and above \$400,000, and those that had incomplete data regarding the characteristics of the properties (e.g., missing year built, missing square feet). Market value (and a transaction considered to be "arm's length") is the highest price in terms of money, that the property will bring to a willing seller if exposed for sale on the open market; allowing a reasonable time to find a willing buyer, buying with the knowledge of all the uses to which it is adapted and for which it can be legally used, and with neither buyer nor seller acting under necessity, compulsion, nor peculiar and special circumstances. To further verify there were only "arm's length" transactions included, the

the map in Fig. 4. The time period and explanatory variables chosen were based on the available electronic data[46].

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author took a rather time-consuming approach and verified the records of every single transaction near the wind farm via the following website <http://www.mcleancountyil.gov/resolution/>.
Regarding the removal of properties that sold below $25,000, this price was chosen because a local appraiser suggested that homes that sell for less than $25,000 are not likely to be in livable condition; and this analysis is concerned with the potential impact that close proximity to an operating wind farm may have on the value of properties that are indeed in livable condition. Properties that sold above $400,000 were removed because these outliers were considered to be "influential" observations which would adversely impact the parameter estimation; i.e., "OLS is susceptible to outlying observations because it minimizes the sum of squared residuals: large residuals (positive or negative) receive a lot of weight in the least squares minimization problem. If the estimates change by a practically large amount when we slightly modify our sample, we should be concerned" (Wooldridge, 2009, 325). A regression was estimated excluding the variables of interest, and the standardized residuals were obtained. The observations with high standardized residuals (greater than three) were removed (none were within a three mile distance of the wind farm).

[46] The variables included in the analysis were based on the available data. Property sales from Champaign County could not be obtained, but the author does not believe this to have any impact on the analysis because of the very small population (and likely few property sales that occurred) located in the northwest corner of Champaign County (which is the area in the Champaign County closest to TG I and II).

Table 7. Variable Definitions

Variables (Definitions)
ln(Real Property Price) or *ln(Real Price)* (Natural Logarithm of Real Price of Property in 2009 Q2 $)
Real Property Price or *Real Price* (Real Price of Property in 2009 Q2 $)
Square Feet (above grade living area of the dwelling in 1000s of square feet)
Garage (area of the garage in 180s of square feet; number of cars that can fit in garage)
Acre (tenths of acres of the property, when total acreage is 1 acre or less, 0 otherwise)
Acres (number of acres of the property, when total acreage is greater than 1 acre, 0 otherwise)
Age (decades) (deed year minus year built)
Age^2 (the square of the age of the home in decades)
Fireplaces (number of fireplaces)
Railroad Tracks (1 if within 180 meters of railroad tracks, 0 otherwise)
Lakefront (1 if within 70 meters of a lake, 0 otherwise)
Cul-de-sac (1 if property located near a cul-de-sac, 0 otherwise)
Trees (1 if within 180 meters of Deciduous or Evergreen forests, 0 otherwise)
Near Wind Farm or *nearwf* (1 if property located within three mile buffer of wind farm, 0 otherwise)
Before Wind Farm Approval or *Before WF Approval* (1 if property sold 01/01/2001-09/20/2005, 0 otherwise)
Post WF Approval and Construction or *Post WF Approval/Construction* (1 if property sold 09/21/2005-02/02/2008, 0 otherwise)
Before WF Operation or *B4Operation* (1 if property sold 01/01/2001-02/02/2008, 0 otherwise)
Wind Farm Operation or *wfoperation* or *WF Operation* (1 if property sold 02/02/2008-12/01/2009, 0 otherwise)
Near Wind Farm, Post WF Approval/Construction (1 if property located within three mile buffer of wind farm and sold 09/21/2005-02/02/2008, 0 otherwise)
Near Wind Farm, WF Operation (1 if property located within three mile buffer of wind farm and sold 02/02/2008-12/01/2009, 0 otherwise)
{X,Y}-coordinates (mapping coordinates in meters of the location of the property)
C (Intercept or constant term)
Community Unit School District *(CUSD)* ∈ *Blue Ridge CUSD 18, El Paso-Gridley CUSD 11, Gibson City-Sibley-Melvin CUSD 5, Heyworth CUSD 4, LeRoy CUSD 2, Lexington CUSD 7, Normal CUSD 5, Prairie Central CUSD 8, Ridgeview CUSD 19,* and *Trivalley CUSD 3* (1 if property located far from the wind farm within specific school district (CUSD), 0 otherwise)
CUSD, Post WF Approval and Construction (1 if property located far from the wind farm within specific school district and sold 09/21/2005-02/02/2008, 0 otherwise)
CUSD, Wind Farm Operation or *CUSD, WF Operation* (1 if property located far from the wind farm within specific school district and sold 02/02/2008-12/01/2009, 0 otherwise)
Township ∈ *Anchor, Bellflower, Blue Mound, Chenoa, Cropsey, Dix, Downs, Drummer, Empire, Gridley, Hudson, Lawndale, Lexington, Martin, Money Creek, Oldtown, Peach Orchard, Randolph, Sullivant, Towanda, West,* and *Yates* (1 if property located far from the wind farm within specific township, 0 otherwise)
Township, Post WF Approval and Construction (1 if property located far from the wind farm within specific township and sold 09/21/2005-02/02/2008, 0 otherwise)
Township, Wind Farm Operation (1 if property located far from the wind farm within specific township and sold 02/02/2008-12/01/2009, 0 otherwise)

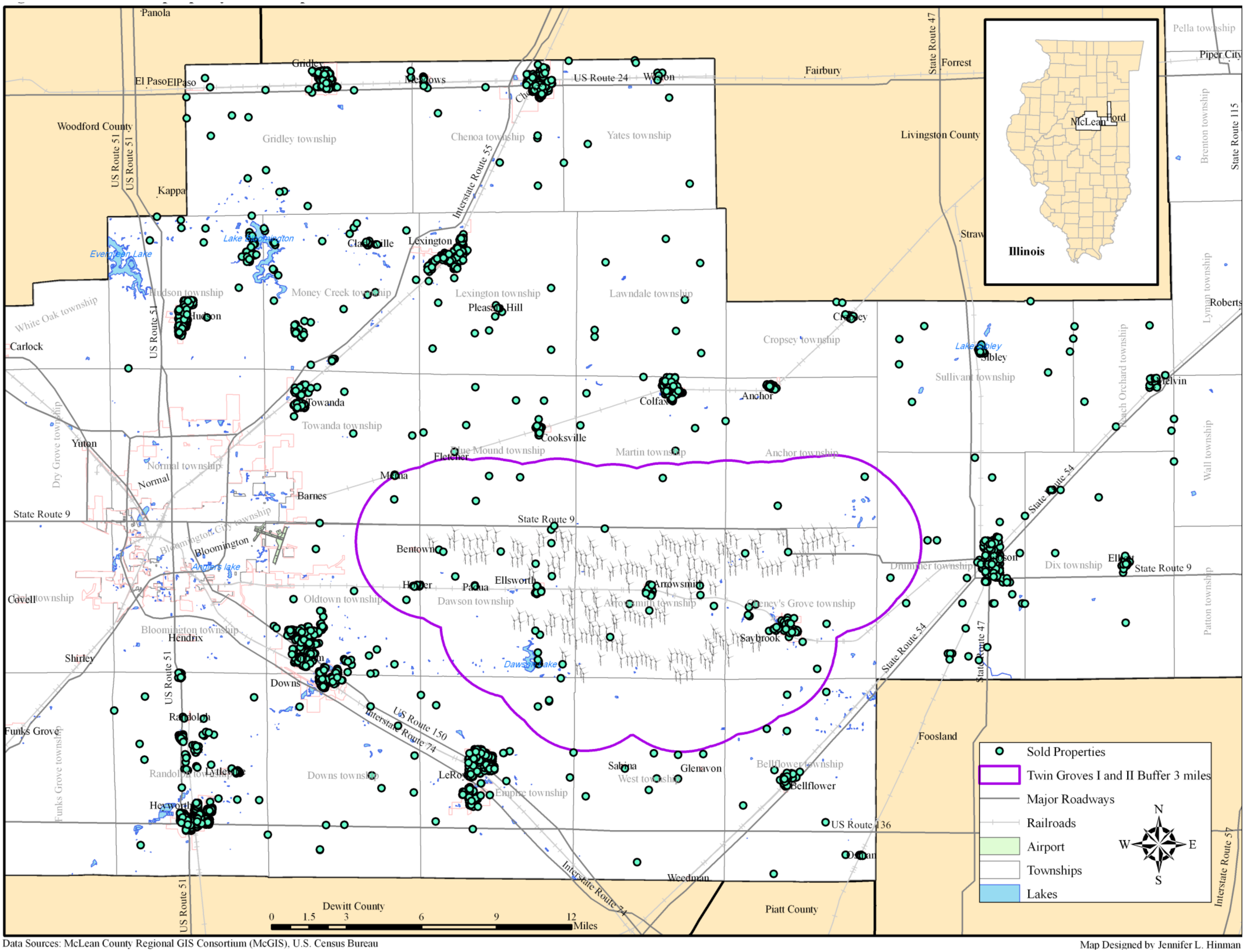

Fig. 4. Study Area Residential Property Sales: 2001-2009

1. DEPENDENT VARIABLE

The dependent[47] variable is the natural logarithm of the real property transaction price in 2009Q2 U.S. dollars[48] (*ln(Real Price)* or *ln(Real Property Price)*). The actual (nominal) property transaction prices for properties that sold in the study area are available to the public and they were obtained from the Supervisors of Assessments offices in McLean and Ford Counties (2010). This nominal transaction price was converted to real dollars in order to allow meaning in comparisons over the time period. Sirmans et al. (2005) claim that generally the observed recent selling price is used as a proxy for the value of a house, because it is thought to be the least biased proxy (e.g., a home owner's self-assessment is thought to be biased).

Freddie Mac's Conventional Mortgage Home Price Index[49] (CMHPI) for the Bloomington-Normal, IL[50] Metropolitan Statistical Area (B-N MSA) that provides a measure of typical price inflation for houses was used to adjust for inflation (Freddie Mac©, 2010). As can be seen in Eq. (11) below, this involved multiplying the nominal property transaction price ($NominalPrice_t$) of a property that sold in year and quarter *(t)* by the ratio of the 2009Q2 B-N CMHPI to the B-N CMHPI that corresponds to the year and quarter (*t*) in which the property transaction occurred[51].

$$\text{RealPrice}_t = \text{NominalPrice}_t * \frac{\text{B-N CMHPI}_{2009Q2}}{\text{B-N CMHPI}_t} \qquad (11)$$

The natural logarithm of real property price *ln(RealPrice)* was ultimately chosen as the dependent variable. The natural log transformed the data to a closer to normal distribution than the level form. Sirmans et al. (2005) assert that the empirical specification generally used for hedonic pricing studies has been linear or semi-logarithmic functional forms, but that the most used is the semi-log form. The semi-log specification has several benefits: (1) it helps to minimize the heteroskedasticity problem; (2) the dollar value of each characteristic is allowed to vary; and (3) the estimated coefficients (*coeff*) have convenient interpretations: $(e^{coeff}-1)*100$ is the percentage change in the transaction price given a one-unit change in the characteristic (Bond and Wang, 2005; Halvorsen and Palmquist, 1980; Halvorsen and Pollakowski, 1981; Kiel and McClain, 1995b; Sirmans et al., 2005). Accordingly, the semi-log specification was adopted.

2. TIMELINE

In order to take into account the different stages of the adjustment process that correspond to different levels of risk as perceived by local residents surrounding a wind farm project proposal, a timeline for the wind farm project had to be determined[52]. Many articles

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[47] A dependent variable is the variable to be explained in a multiple regression model.
[48] Quarter two of 2009 dollars.
[49] This index has been utilized in other housing studies to adjust for inflation, including Hoen et al. (2009).
[50] Although properties that sold in the cities of Bloomington and Normal were not included in the analysis, the Bloomington-Normal, IL MSA was chosen because it was the closest MSA to the project area.
[51] The base year, 2009, was chosen because it was thought that people could relate more with relatively current prices of homes when analyzing the descriptive statistics.
[52] A significant amount of time was spent investigating the proper dates for the break points in the stages of

published in *The Pantagraph*, a local newspaper, were reviewed as well as the developer's website in determining this timeline. The dates were then verified by the Midwest Director of Development for Horizon Wind Energy (2009). The various stages are listed in Table 8.

This study analyzes two different specifications for the various stages of the wind farm development. The first is a naïve specification that ultimately involves separating the wind farm development process into two stages: (A) the time period before TG I and II became fully operational *(Before Wind Farm Operation)*; and (B) the time period that both TG I and II had achieved commercial operations *(Wind Farm Operation)*. The second specification allows for a more dynamic approach to the housing value adjustment process. In this arguably more appropriate approach, the wind farm development process is divided into three stages: (1) the time period before TG I and II were approved by the McLean County Board *(Before Wind Farm Approval)*; (2) the time period after TG I and II were approved by the McLean County Board and during construction of TG I and II *(Post WF Approval/Construction)*; and (3) the time period that both TG I and II had achieved commercial operations *(Wind Farm Operation)*.

Table 8. Twin Groves I and II Timeline: Stages of Wind Farm Development

	2 Stage Approach	Time Period
Stage A	Before TG I and II are Fully Operational; Before WF Operation	01/01/2001 – 02/01/2008
Stage B	Twin Groves I and II Online; Wind Farm Operation	02/02/2008 – 12/01/2009
	3 Stage Approach	**Time Period**
Stage 1	Before TG I and II Approval; Before WF Approval	01/01/2001 – 09/20/2005
Stage 2	Post WF Approval and during Construction	09/21/2005 – 02/01/2008
Stage 3	Twin Groves I and II Online; Wind Farm Operation	02/02/2008 – 12/01/2009

Sources: The Pantagraph (2001 – 2009), Horizon Wind Energy (2009)
Notes: WF=Wind Farm=TG I and II=Twin Groves I and II

The stages of the adjustment process (corresponding to perceived risk by local residents and prospective homebuyers) are thought to roughly correspond to the stages of wind farm development. Property values before the wind farm was approved (*Before Wind Farm Approval*; Stage 1) should reflect the normal supply of and demand for housing and the various structural, neighborhood, and locational characteristics of the properties.

In McLean County, Illinois, a wind farm is designated as a Major Utility and a wind farm developer must apply for a special-use[53] permit[54] as part of the development process. The

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development in the wind farm timeline. All wind farm related articles appearing in the local newspaper, *The Pantagraph*, were reviewed with a focus on the content and date of the articles. The stages of the adjustment process (corresponding to perceived risk by local residents and prospective homebuyers) are thought to roughly correspond to the stages of wind farm development.

[53] Because of their unique characteristics, the uses set forth in Article 8 – Special Use Permits, shall be located in a district or districts only upon consideration in each case of the impact of such use upon neighboring land and of the

McLean County Board is authorized to decide whether special-use permits shall be granted subject to the general and specific standards contained in the McLean County, Illinois Zoning Ordinance (more specifically, Section 803 of Article 8 and Section 2 of Article 6). A public hearing must be held by the McLean County Zoning Board of Appeals (ZBA) prior to the granting of any special-use permit. The ZBA shall submit a written report that contains findings certifying that adequate provision has been made for complying with the standards for issuance of special-use permits (Chapter 40 – McLean County, Illinois Zoning Ordinance, Article 8, Section 803; Article 6, Section 2). The ZBA shall submit the written report and recommendation to the McLean County Board within 30 days after the close of the public hearing. The concurring vote of at least four members of the ZBA is necessary in order to recommend approval to the County Board of a special-use permit application[55]. If a special use is approved by the McLean County Board, then the wind farm developer is allowed to apply for building permits for each of the wind turbines (before sunset of the special-use permit). During the wind farm permitting process, the main hurdle the wind farm developer has to surmount is to provide sufficient evidence to convince the ZBA that the standards set forth in Section 803 of Article 8 are satisfied such that the ZBA will recommend approval of the special-use permit to the County Board. Meeting specific conditions that the ZBA may stipulate in its recommendation to the County Board would also be advised[56].

For this analysis, Stage 2 *(Post WF Approval/Construction)* began the day after the McLean County Board officially approved the special-use permit, and therefore construction of the wind farm was almost inevitable, September 21, 2005[57]. Construction literally began June 29, 2006, and the first towers were erected around September 28, 2006 (The Pantagraph, 2006).

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public need for such a use at the particular location.

[54] Material in this paragraph is adapted from Article 8 – Special Use Permits in Chapter 40 – McLean County, Illinois Zoning Ordinance which may be downloaded from the McLean County website. Available at <http://www.mcleancountyil.gov/build/pdf/Zoning_ordinance.pdf>.

[55] The Zoning Board of Appeals may recommend and the County Board may stipulate such conditions and restrictions upon the establishment, location, construction, maintenance and operation of the special use permit as is deemed necessary for the protection of the public interest and to secure compliance with the standards and conditions contained within Chapter 40 – McLean County, Illinois Zoning Ordinance, Article 8.

[56] For example, the ZBA found that the special-use application in case SU-05-09 (for TG I and II) met all the standards found in the McLean County Zoning Ordinance provided the following conditions were met: "1) a mitigation agreement is made between the applicant and Craig and Rose Grant to provide a planting screen between two proposed wind turbines in Section 36 in Dawson Township and the Grant property; 2) no wind turbine tower is located closer than 600 feet to the nearest R-1 Single Family Residence District boundary as measured from the tip of the turbine blade; 3) a written road agreement is approved by the County Board and Dawson, Arrowsmith, and Cheney's Grove Townships as a condition of this approval; and 4) the following has occurred after completion of Phase I and before beginning Phase II: 1) the applicant has requested a meeting with the Director of Building and Zoning; 2) a meeting takes place with the applicant and staff of the McLean County Department of Building and Zoning where the applicant will adequately address problems or concerns that are identified through Phase I by the Director of Building and Zoning; and 3) any items brought up at this meeting that cannot be adequately addressed according to the Director of Building and Zoning will need to be appealed to the Zoning Board of Appeals for resolution at their next available meeting; and the applicant will provide engineering plans certified by a registered engineer that each tower and wind turbine is designed and built according to appropriate national standards." Available at <http://www.mcleancountyil.gov/boardnotes/pdf/September2005/pro.pdf>.

[57] The McLean County Board approved the special-use permit September 20, 2005 with a waiver to allow up to 16 wind towers to be as close as 600 feet to an R-1 Single Family Residence District rather than 2,000 feet as required and to be allowed to apply for Building Permits for TG I up to three years after County Board approval and for TG II up to five years after the beginning of construction of TG I, rather than one year as allowed.

During Stage 2 *(Post WF Approval/Construction)*, the probability that the wind turbines are to be constructed and go online is assumed to be one, "so a mobility decision will be based on expected damages relative to expected moving costs and future property losses" (Kiel and McClain, 1995a, 244). Uncertainty arises regarding how disruptive the wind farm will actually be; and as a result this uncertainty may be reflected in the form of lower property prices (wind farm anticipation stigma theory) or longer days-on-the-market. Consequently, from a theoretical standpoint, it is plausible that during Stage 2 *(Post WF Approval/Construction),* a property owner, who is fearful of living near wind turbines or one who just does not want to live near wind turbines, may try to sell their property before the wind farm becomes operational (wind farm anticipation stigma theory). A property owner may fear that their property will not be able to sell once the wind farm project is fully operational; and as a consequence, the owner may end up selling their property for much less than it is actually worth[58]. The author denotes this property value impact from this uncertainty as *wind farm anticipation stigma theory*.

The *Wind Farm Operation* stage, Stage 3, begins when all of the wind turbines of TG I and II are generating electricity[59]. Knowledge of any "facility effects" (e.g., noise, visual) will accumulate over this period until no more uncertainty about the effects exist. Thus, damage should be measurable as an actual figure rather than an expected value. As this knowledge moves through the market, prices should make their final adjustment (Kiel and McClain, 1995a). Finally, if after adjustment is complete the facility is regarded as harmless, prices will rebound and the total change in social welfare will be zero (Kiel and McClain, 1995a). Interestingly, even if evidence reveals that the wind farm has no impact, research has revealed that initial risk perceptions may persist because of the way new information is interpreted. New information which is consistent with an individual's existing beliefs is accepted as reliable and accurate, while conflicting information is labeled erroneous, unrepresentative, or propaganda[60] (Kiel and McClain, 1995a; Slovic, 1987). Thus, any downward pressure on prices, if any, could be quite prolonged, especially if the majority of local residents are opposed to the wind farm prior to wind farm approval.

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[58] Some people have stated that property values might initially diminish when a project that they would prefer not to live next to (e.g., nuclear facility, incinerator) is proposed (a so-called "rumor" stage) because they think the likelihood of it becoming a reality is high so they immediately try to sell their home to get out of the area (which could lower the price the seller is willing to accept because of the "urgency" of getting out of the area) . Kiel and McClain state that "Households which assign a high probability to a facility going on-line and/or which expect to suffer a great deal from the arrival of the facility are likely to try to move out, even if they 'take a loss' on their unit" (1995a, 244). At the time the Twin Groves wind farm was originally proposed (late November of 2001 was the earliest landowner contact that the author is aware of), there existed zero wind farm projects in Illinois, thus the likelihood that property values would be impacted during a so-called "rumor" phase is slim because the expectation that the wind farm would actually be built was likely low because there were not any wind farms in the state of Illinois. Accordingly, this study seeks to identify whether there has been any impact on property values after the wind farm project was approved and during construction, as well as during the operational phase of the wind farm project when property owners living close to the wind turbines will actually have had a chance to see if any of their concerns materialize.

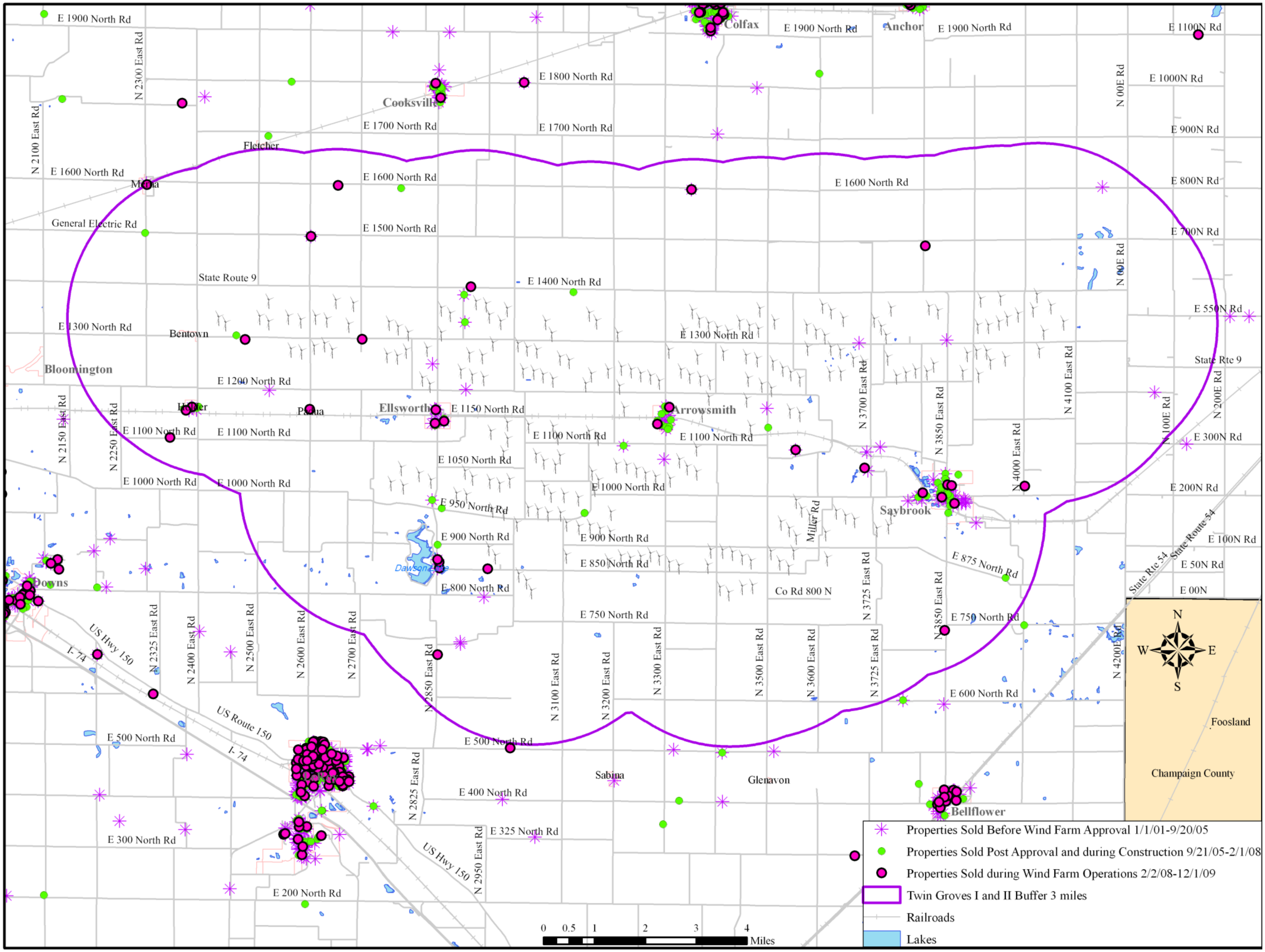
[59] Stage (3) starts when TG II achieved commercial operations.

[60] For example, the author received a letter in the mail about wind farms and it contained testimony from a local resident regarding impacts on an autistic child. The author later found out that the testimony was written by the same person who filed a lawsuit against the wind farm developer before the wind farm was even constructed (see the reference to the article in *The Pantagraph*). Thus, it appears that the initial perceptions of wind farm impacts have lasted through the operational stage for certain residents.
Source: Miller, S., 2006. Lawyer: Wind farm presents hazards. *The Pantagraph.* Money Section: C1. May 23, 2006.

3. DISTANCE – NEAR TWIN GROVES I AND II

Distance from the home to the nearest turbine was determined by spatially joining the wind turbines to the properties that sold using Geographic Information Systems (GIS) software[61]. Thus, each property received the distance measured from the nearest turbine to the property. The wind turbine locations were obtained from McGIS (2010) and Horizon Wind Energy (2010). A local real estate agent with over 23 years of experience was consulted regarding the local real estate market. The realtor was completely confident that there had been zero impact from the wind farm on housing values at a distance greater than three miles[62]. The author also visited all of the areas within three miles of the wind farm. Almost all of those homes that were not located within a small town had a crystal clear view of the wind farm towers. In the author's opinion, the wind farm towers still appear "large" at a three-mile distance[63]. A map of the area near TG I and II can be found in Fig. 5. Each residential property included in the dataset is identified by the wind farm stage in which the transaction occurred.

[61] ESRI® ArcMap™ 9.3 (2010) was the GIS software utilized in this study.
[62] A map of the study area with various distance buffers surrounding the wind farm was given to the realtor to examine. The realtor had been involved in only a couple transactions within three miles of the wind turbines. While the realtor had not noticed a negative impact on the property values of those transactions and had not heard of any negative impact in the area, the author has more confidence in the opinion that there has definitely not been an impact outside of three miles because of the realtor's experience with many transactions in that area.
[63] Only one property from the dataset sold at a distance between 2.5 and 3 miles of a wind turbine.



Data Sources: McLean County Regional GIS Consortium (McGIS), U.S. Census Bureau

Map Designed by Jennifer L. Hinman

Fig. 5. Residential Property Sales Near Twin Groves I and II: 2001-2009

Table 9 provides descriptive statistics for *Real Property Price* for properties within three miles of the wind farm categorized by wind farm stage (using the two stage approach: before and after the wind farm became operational) and distance from the wind farm in miles. By comparing the means (or medians) of properties that sold before and after wind farm operation at the various distance ranges within three miles, it is clear that there is no *linear* relationship whatsoever between distance from a wind turbine and *Real Property Price*. During *the Wind Farm Operation* stage, the average *Real Property Price* is $138,806 (within 0.5 mile), $89,356 (0.5-1 mile), and then $100,158 (1-1.5 miles), which is clearly not a linear relationship between *Real Property Price* and distance from a wind turbine. As a result, a linear distance variable was not included in any of the models, and this provides support for the use of an indicator (dummy) variable for properties within three miles of the wind farm (as opposed to using a linear, quadratic, or inverse distance variable to model wind farm proximity stigma).

Beyond 1 mile, price rebounded once operational. At closer distances, mean remained depressed--but modest, ~10% (but median rebounded; what does this tell us about the distribution? 1st guess: a few were greatly devalued to bring mean down)

See next table for all three stages broken out

Table 9. Descriptive Statistics for Real Property Price for Properties Near TG I and II

Categorized by Wind Farm Stage (2 Stage Approach) and Distance from the Wind Farm in Miles								
Distance‡	Wind Farm Stages†	Mean$	Median$	Max$	Min.$	Quant.*$	StDev$	*n*
[0, 0.5)	Before Wind Farm Operation	154,509	151,970	344,704	43,690	187,870	61,647	26
[0, 0.5)	Wind Farm Operation	138,806	164,650	174,529	82,541	167,394	41,200	5
[0, 0.5)	All Stages	151,976	154,978	344,704	43,690	176,554	58,547	31
[0.5, 1)	Before Wind Farm Operation	97,305	93,789	199,480	33,445	120,904	35,647	45
[0.5, 1)	Wind Farm Operation	89,356	96,910	144,197	30,000	125,000	47,161	6
[0.5, 1)	All Stages	96,370	93,789	199,480	30,000	121,022	36,706	51
[1, 1.5)	Before Wind Farm Operation	88,496	83,758	186,045	30,146	115,217	37,873	58
[1, 1.5)	Wind Farm Operation	100,158	83,544	154,915	52,645	134,002	36,734	11
[1, 1.5)	All Stages	90,355	83,612	186,045	30,146	119,989	37,673	69
[1.5, 2)	Before Wind Farm Operation	116,743	100,849	218,312	52,440	155,548	51,553	11
[1.5, 2)	Wind Farm Operation	136,626	136,626	144,899	128,354	144,899	11,699	2
[1.5, 2)	All Stages	119,802	117,774	218,312	52,440	154,014	47,770	13
[2, 2.5)	Before Wind Farm Operation	105,113	100,898	148,765	55,854	132,249	32,741	6
[2, 2.5)	Wind Farm Operation	148,638	148,194	211,550	103,729	154,425	36,166	6
[2, 2.5)	All Stages	126,875	128,991	211,550	55,854	149,383	39,981	12
[2.5, 3)	Wind Farm Operation	124,236	124,236	124,236	124,236			1
[2.5, 3)	All Stages	124,236	124,236	124,236	124,236			1
0-3 mi	Before Wind Farm Operation	105,778	95,385	344,704	30,146	130,051	49,006	146
0-3 mi	Wind Farm Operation	116,814	124,342	211,550	30,000	146,142	42,814	31
0-3 mi	All Stages	107,711	98,576	344,704	30,000	133,492	48,050	177

Notes: Area: Properties that sold within three miles of the wind farm. *n*=177=# of observations; Max=Maximum; Min.=Minimum; StDev=Standard Deviation; 0-3 mi=All properties that sold within three miles of Twin Groves I and II;
Statistics reported for Real Property Price are 2009Q2 dollars ($).
‡Distance from the property to the nearest wind turbine in miles.
Please see Appendix B for a detailed account of property identification and distance calculations.
†Before Wind Farm Operation (01/01/2001 - 02/01/2008): Stage A;
Wind Farm Operation (02/02/2008 - 12/01/2009): Stage B;
All Stages (01/01/2001 - 12/01/2009).
*Quant.=Quantiles computed for p=0.75, using the Rankit (Cleveland) definition.

Table 10 provides descriptive statistics for *Real Property Price* for properties within three miles of the wind farm categorized by wind farm stage (using the three stage approach) and distance from the wind farm in miles. By comparing the means (or medians) of the real property prices during each of the three stages (*Before Wind Farm Approval, Post WF Approval/Construction, Wind Farm Operation*) at the various distance ranges within three miles, it is clear that there is no *linear* relationship whatsoever between distance from a wind turbine and *Real Property Price*. Accordingly, a linear distance variable was not included in any of the models, and this provides support for the use of an indicator variable for properties within three miles of the wind farm.

A proxy for property transactions that occurred near TG I and II was formed, *Near Wind Farm*. A dummy variable was created such that homes located within a three mile buffer of the wind farm receive a value of one, and zero otherwise. Thus, properties that are far from TG I and II (greater than three miles away) receive a value of zero.

similar pattern: steady decrease in mean up close. must be some very devalued properties, but not too many (Ns are very small. could be just 1 very devalued one bringing down the mean) Here, 1-1.5 has DEPRESSED MEDIAN, not MEAN

Table 10. Descriptive Statistics for Real Property Price for Properties Near TG I and II

Categorized by Wind Farm Stage (3 Stage Approach) and Distance from the Wind Farm in Miles								
Distance (miles)	Wind Farm Stages‡	Mean$	Median$	Max$	Min.$	Quant.*$	Std. Dev.$	*n*
[0, 0.5)	Stage 1	157,558	163,508	344,704	43,690	195,867	72,047	16
[0, 0.5)	Stage 2	149,631	148,176	223,645	97,236	165,849	43,152	10
[0, 0.5)	Stage 3	138,806	164,650	174,529	82,541	167,394	41,200	5
[0, 0.5)	All Stages	151,976	154,978	344,704	43,690	176,554	58,547	31
[0.5, 1)	Stage 1	98,794	93,559	187,862	38,942	120,845	33,049	30
[0.5, 1)	Stage 2	94,326	94,356	199,480	33,445	119,990	41,435	15
[0.5, 1)	Stage 3	89,356	96,910	144,197	30,000	125,000	47,161	6
[0.5, 1)	All Stages	96,370	93,789	199,480	30,000	121,022	36,706	51
[1, 1.5)	Stage 1	88,570	85,414	186,045	31,318	113,086	38,833	35
[1, 1.5)	Stage 2	88,383	83,612	162,476	30,146	118,670	37,226	23
[1, 1.5)	Stage 3	100,158	83,544	154,915	52,645	134,002	36,734	11
[1, 1.5)	All Stages	90,355	83,612	186,045	30,146	119,989	37,673	69
[1.5, 2)	Stage 1	135,875	135,511	218,312	76,534	156,314	51,375	6
[1.5, 2)	Stage 2	93,785	83,249	169,458	52,440	118,001	46,230	5
[1.5, 2)	Stage 3	136,626	136,626	144,899	128,354	144,899	11,699	2
[1.5, 2)	All Stages	119,802	117,774	218,312	52,440	154,014	47,770	13
[2, 2.5)	Stage 1	111,725	94,396	148,765	92,014	135,173	32,100	3
[2, 2.5)	Stage 2	98,501	107,401	132,249	55,854	126,037	38,967	3
[2, 2.5)	Stage 3	148,638	148,194	211,550	103,729	154,425	36,166	6
[2, 2.5)	All Stages	126,875	128,991	211,550	55,854	149,383	39,981	12
[2.5, 3)	Stage 3	124,236	124,236	124,236	124,236			1
[2.5, 3)	All Stages	124,236	124,236	124,236	124,236			1
0-3 mi	Stage 1	108,168	94,112	344,704	31,318	130,396	51,475	90
0-3 mi	Stage 2	101,937	97,545	223,645	30,146	129,858	44,940	56
0-3 mi	Stage 3	116,814	124,342	211,550	30,000	146,142	42,814	31
0-3 mi	All Stages	107,711	98,576	344,704	30,000	133,492	48,050	177

Notes: Area: Properties that sold within three miles of the wind farm. *n*=177=# of observations; Max=Maximum; Min.=Minimum; Std. Dev.=Standard Deviation; 0-3 mi=All properties that sold within three miles of Twin Groves I and II;
Statistics reported for Real Property Price are 2009Q2 dollars ($).
‡Stage 1: Before Wind Farm Approval (01/01/2001 - 09/20/2005);
Stage 2: Post Wind Farm Approval and during Construction (09/21/2005 - 02/01/2008);
Stage 3: Wind Farm Operation (02/02/2008 - 12/01/2009);
All Stages (01/01/2001 - 12/01/2009).
*Quant.=Quantiles computed for p=0.75, using the Rankit (Cleveland) definition.

4. EXPLANATORY VARIABLES

The explanatory variables (e.g., house structural and neighborhood characteristics) included in the model were primarily limited to those available from the McLean County Supervisor of Assessments Office. Table 11 contains descriptive statistics of all of the variables.

Table 11. Descriptive Statistics

Variable	Mean	Median	Max.	Min.	Std. Dev.	Sum
Real Property Price	126,347	115,390	399,314	25,047	63,435	
ln(Real Property Price)	11.62	11.66	12.90	10.13	0.51	
Square Feet *(1000s)*	1.51	1.40	4.05	0.43	0.54	
Garage	2.46	2.67	16.67	0.00	1.71	
Acre *(tenths)*	2.98	2.70	10.00	0.00	1.96	
Acres	0.30	0.00	13.64	0.00	1.12	
Age *(decades)*	5.44	4.30	18.00	0.00	4.06	
Age^2	46.07	18.49	324.00	0.00	54.05	
Fireplaces	0.29	0.00	3.00	0.00	0.47	1,102
Railroad Tracks	0.19	0.00	1.00	0.00	0.39	731
Lakefront	0.02	0.00	1.00	0.00	0.14	76
Cul-de-sac	0.08	0.00	1.00	0.00	0.27	314
Trees	0.11	0.00	1.00	0.00	0.31	429
Year Built	1951	1962	2008	1824	40.50	
Acreage	0.60	0.30	13.64	0.04	1.06	2,296
Before WF Approval: 01/01/2001 - 09/20/2005	0.53	1.00	1.00	0.00	0.50	2,036
Post WF Approval/Construction: 9/21/05 - 2/1/08	0.29	0.00	1.00	0.00	0.45	1,121
Wind Farm Operation: 02/02/2008 - 12/01/2009	0.18	0.00	1.00	0.00	0.38	694
X	263,956	262,421	308,440	240,199	17,164	
Y	425,601	421,667	454,066	401,697	16,120	
XY	1.12E+11	1.10E+11	1.34E+11	9.76E+10	8.55E+09	
X^2	7.00E+10	6.89E+10	9.51E+10	5.77E+10	9.32E+09	
Y^2	1.81E+11	1.78E+11	2.06E+11	1.61E+11	1.38E+10	
X^2Y^2	1.27E+22	1.22E+22	1.80E+22	9.53E+21	1.94E+21	
Blue Ridge CUSD 18	0.02	0.00	1.00	0.00	0.13	71
El Paso-Gridley CUSD 11	0.06	0.00	1.00	0.00	0.24	229
Gibson City-Melvin-Sibley CUSD 5	0.14	0.00	1.00	0.00	0.34	530
Heyworth CUSD 4	0.15	0.00	1.00	0.00	0.35	559
LeRoy CUSD 2	0.13	0.00	1.00	0.00	0.34	519
Lexington CUSD 7 - Reference	0.09	0.00	1.00	0.00	0.29	352
Normal CUSD 5	0.12	0.00	1.00	0.00	0.33	475
Prairie Central CUSD 8	0.08	0.00	1.00	0.00	0.27	314
Ridgeview CUSD 19	0.06	0.00	1.00	0.00	0.24	245
Trivalley CUSD 3	0.10	0.00	1.00	0.00	0.30	380
Near Wind Farm	0.05	0.00	1.00	0.00	0.21	177
Anchor Township	0.01	0.00	1.00	0.00	0.08	24
Bellflower Township	0.02	0.00	1.00	0.00	0.13	68
Blue Mound Township	0.01	0.00	1.00	0.00	0.11	43
Chenoa Township	0.07	0.00	1.00	0.00	0.26	282
Cropsey Township	0.00	0.00	1.00	0.00	0.06	15
Dix Township	0.01	0.00	1.00	0.00	0.09	35
Downs Township	0.04	0.00	1.00	0.00	0.19	138
Drummer Township	0.11	0.00	1.00	0.00	0.31	419
Empire Township	0.13	0.00	1.00	0.00	0.34	503
Gridley Township	0.06	0.00	1.00	0.00	0.24	228
Hudson Township	0.09	0.00	1.00	0.00	0.28	336
Lawndale Township	0.00	0.00	1.00	0.00	0.05	11
Lexington Township - Reference	0.08	0.00	1.00	0.00	0.28	325
Martin Township	0.04	0.00	1.00	0.00	0.20	169
Money Creek Township	0.02	0.00	1.00	0.00	0.13	64
Oldtown Township	0.07	0.00	1.00	0.00	0.25	254
Peach Orchard Township	0.01	0.00	1.00	0.00	0.10	42

Randolph Township	0.14	0.00	1.00	0.00	0.35	558
Sullivant Township	0.01	0.00	1.00	0.00	0.09	34
Towanda Township	0.03	0.00	1.00	0.00	0.16	99
West Township	0.00	0.00	1.00	0.00	0.05	10
Yates Township	0.00	0.00	1.00	0.00	0.07	17

Notes: The school district and township dummy variables exclude properties near TG I and II (*Near Wind Farm*) (within three miles).
Time period: 01/01/2001 - 12/01/2009. *n*=3,851.
CUSD=Community Unit School District

The data regarding the number of square feet of the house and garage were provided with the original dataset from the counties. The variable, *Square Feet,* is the above grade living area of the dwelling. These variables were transformed to allow for more convenient interpretations. Living area square feet has been divided by 1,000 such that a one unit increase in *Square Feet* corresponds to a 1,000 square feet increase. Garage square feet has been divided by 180 such that a one unit increase in *Garage* corresponds to an increase in garage size by one car.

Lot size was provided with the original dataset from the counties. Properties in Ford County that had an irregular lot size were excluded from the analysis because there was no way to quantify the lot size. Properties in McLean County that did not contain the lot size in the original dataset received the parcel area in acres that was calculated using ESRI® ArcMap™ 9.3 (2010). Lot size was divided into two variables, lot size of one acre or less (*Acre*[64]) and lot size greater than one acre (*Acres*[65]). Including two separate variables for lot size allowed for a more precise estimation of the parameter on lot size. However, the results are robust to the inclusion of either measure (using two variables for lot size or just using one variable). By using two variables instead of one, the magnitude of the estimated coefficient on *Acres* decreases and on *Acre* increases (using the same units), which may indicate that there is a stronger demand for lots less than one acre, which would put upward pressure on the tenth of an acre price for these lots. Lot size of one acre or less was multiplied by ten such that a one unit increase in *Acre* corresponds to a tenth of an acre increase in lot size. A one unit increase in *Acres* corresponds to a one acre increase in lot size.

Age of the home was determined by subtracting the year built from the deed year. Actual age (deed year – year built) was the only proxy available for effective age[66]. It is expected that housing price will decrease with age up to a certain point because of physical depreciation. Very old houses that are "historical" in nature may sell for a premium because of their uniqueness and a proven ability to survive that may be linked to quality. In order to model the nonlinear nature of these effects, variables for both age and age-squared (age^2) are included in the model. Age of the home has been divided by ten such that a one unit increase in *Age* corresponds to an increase in *Age* by one decade. The results are robust to exclusion of age-squared (Age^2); however, the Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC) both preferred the

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[64] *Acre*: All properties greater than one acre receive a zero, while properties less than or equal to one acre receive the acreage of the lot size (in tenths of acres).
[65] *Acres:* All properties less than or equal to one acre receive a zero, while properties greater than one acre receive the acreage of the lot size.
[66] "Effective age is an appraiser's estimate of the physical condition of a building. The actual age of a building may be shorter or longer than its effective age." Available at <http://homesbykathybrown.com/FrameSet.aspx?RedirectTo=http://www.realestateabc.com/glossary/index.htm>.

model with age-squared (*Age*^{2}) included.

Fireplaces is a count variable that indicates the number of fireplaces within the home and was provided with the original dataset from the counties.

Railroad Tracks is a dummy variable that takes on a value of one if the home is located within 180 meters (590.55 feet) of railroad tracks, and zero otherwise. A distance of 180 meters was chosen by viewing a map of the houses located near railroad tracks and determining the distance in which adjacent homes are typically positioned from the railroad tracks.

Lakefront is a dummy variable that takes on a value of one for properties that sold that were less than 70 meters (229.66 feet) from a lake, and a zero value otherwise. A distance of 70 meters was chosen as a proxy for lake view because time would not permit individually viewing each property close to a lake or pond. Thus, a distance of 70 meters was chosen by viewing a map of the houses located next to lakes and determining the distance that adjacent homes are typically positioned from the lake.

Cul-de-sac is a dummy variable such that a value of one indicates properties that sold that were located close to a cul-de-sac. *Cul-de-sac* is a proxy for reduced road traffic, because homes located in a cul-de-sac typically do not experience "through" traffic. The benefits of reduced road traffic include safer environments for kids and less noise from vehicles, among other things.

An attempt was made to code specific properties as wooded lots, as both an appraiser and a real estate agent from the local area indicated having a wooded lot is an amenity that is highly valued in the area. A dummy variable named *Trees* was created such that homes located within a distance of 180 meters (590.55 feet) from a Deciduous[67] Forest or an Evergreen[68] Forest point (created using GIS software) receive a value of one, and zero otherwise. Please note that this variable does not capture all properties with trees[69]. A distance of 180 meters was chosen by viewing a map of the houses located close to trees and determining the distance in which the homes are typically positioned from the trees. Please see Appendix B for details regarding this variable's construction.

Several measures that address spatial heterogeneity were utilized in this analysis. Following Dubin (1992), Pace and Gilley (1997, 1998), Pavlov (2000), Fik et al. (2003), and Beron et al. (2004), the {X, Y}-coordinates[70] were included in some of the models to address the impact that absolute location has on property values, to model any spatial trends, and in an attempt to avoid some of the errors that occur by choosing neighborhood boundaries. Often times in practice these chosen boundaries tend to be the same as those used by the data collector, such as census tract boundaries (Dubin, 1992)[71].

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[67] Deciduous Forest - Areas dominated by trees generally greater than five meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change (U.S. Geological Survey, 2001).

[68] Evergreen Forest - Areas dominated by trees generally greater than five meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage (U.S. Geological Survey, 2001).

[69] Please note that not every home that has a tree on their property is reflected in this variable.

[70] {X,Y}-coordinates are the mapping coordinates of the locations of each of the properties as determined by the GIS software (ESRI® ArcMap™ 9.3, 2010). The {X,Y}-coordinates are measured in meters. Please see Appendix B for details regarding how these coordinates were determined.

[71] Due to the fact that there exist locational attributes that might not be picked up by the {X,Y}-coordinates (this may result if there are only a few houses which are impacted by these attributes directly and only one impacted home in the area actually sold during the entire study period), the influences of lakes, trees, cul-de-sacs, and railroad tracks on property values were addressed through the inclusion of dummy variables representing the presence of

School district dummy variables are utilized in some of the models as proxies for housing submarkets. Township dummy variables are utilized in some of the models as proxies for housing submarkets. These three specifications (XY[72], SD[73], TWP[74]) were utilized to demonstrate the results are robust to the various specifications and to allow for a more detailed analysis of the housing submarkets over the different stages of wind farm development.

VI. EMPIRICAL RESULTS

This section will proceed as follows: first, the results are presented from estimating the model[75] involving the two stages. The estimation regarding the two stages tests whether properties near the wind farm have appreciated[76] at a different rate on average than properties farther from the wind farm from the time period before wind farm operation (Stage A) to the time period after the wind farm became operational (Stage B). Three separate regression models are estimated to test this hypothesis: the first involves the spatial expansion of the {X,Y}-coordinates, the second involves school district dummy variable interactions by stage, and the third involves township dummy variable interactions by stage, and these results are presented in Table 12, Columns (1), (2), and (3), respectively (Table E.1 of Appendix E contains the full set of estimated coefficients including the spatial variables).

Next, the results are presented in Table 13 from estimating the model involving three stages of wind farm development. The model involving three stages essentially tests whether the rates of appreciation in property values near the wind farm and far from the wind farm are significantly different on average over the different stages of wind farm development, which are thought to roughly correspond to different levels of risk as perceived by homebuyers. In particular, to test for wind farm anticipation stigma, the appreciation in property values is measured from the time period before the wind farm was approved (Stage 1) to the time period post wind farm approval and during construction (Stage 2). To test for wind farm area stigma, the appreciation in property values is measured from the time period before the wind farm was approved (Stage 1) to the time period when the wind farm was fully operational (Stage 3).

Next, each stage of the wind farm development process is estimated separately (Tables 14-16). These estimations allow for comparisons in real property value levels (rather than the appreciation in real property values) near to and far from the wind farm site for each stage of wind farm development. Column (3) of Tables 14-16 demonstrates the inherent problems with

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each of these attributes directly.

[72] XY={X,Y}-Coordinates

[73] SD=School Districts

[74] TWP=Townships

[75] Each estimated coefficient is the semi-elasticity of *Real Property Price* with respect to the independent variable. The estimated coefficients and standard errors presented in this section are for the standard explanatory variables (control variables, e.g., property characteristics) as well as the variables of interest (e.g., *Near Wind Farm*, and *Near Wind Farm, WF Operation*), and the full estimation results including the estimated coefficients for the spatial variables (i.e., {X,Y}-coordinates (XY), school districts (SD), and townships (TWP)) are presented in Appendix E. The percentage listed in front of the estimated coefficient is the actual interpretation of the coefficient, calculated as $[e^{coeff}-1]*100$.

[76] Appreciation is calculated using *Real Property Price*s (i.e., adjusted for inflation).

trying to estimate the effect from a wind farm without appropriately controlling for property values in the area before the wind farm located there.

Next, the results from an investigation of wind farm nuisance stigma for properties within one mile of a wind turbine are presented (Table 17). The number of properties actually located within one mile of a wind turbine is small[77] and this limits the number of properties available for sale in the housing market. A limited number of potential properties available for sale results in a very limited number of properties sold within one mile of a wind turbine. Thus, the results from the nuisance stigma estimations are not very compelling, and they should not be construed as the main results of this study.

Finally, Section VI concludes with an analysis of the estimation results. Potential reasons for these findings are also presented.

For those unfamiliar with difference-in-differences estimators, it is *strongly* recommended to thoroughly review Appendix D in order to avoid misrepresenting the results presented in this section and Appendix E.

A. TWO WIND FARM DEVELOPMENT STAGES ESTIMATIONS

The results from estimating the pooled hedonic house price model involving two stages are presented in Table 12 (Table E.1 of Appendix E contains the full set of estimated coefficients including the spatial variables). Taking into account two different time periods explicitly in the model tests whether properties near the wind farm have appreciated at a different rate on average than properties farther from the wind farm from the time period before wind farm operation (Stage A) to the time period after the wind farm became fully operational (Stage B). Three separate regression models are estimated to test this hypothesis: the first involves the spatial expansion of the {X,Y}-coordinates, the second involves school district dummy variable interactions by stage (i.e., by time period), and the third involves township dummy variable interactions by stage (i.e., by time period), and these results are presented in Table 12, Columns (1), (2), and (3), respectively.

1. RESULTS: TWO WIND FARM STAGES, {X,Y}-COORDINATES

In Column (1) of Table 12, all estimated coefficients (with the exception of *Wind Farm Operation*) are statistically significant beyond the 5% level, and most at the 1% level[78]. The *F-*

[77] Homes located in rural areas typically have larger lot sizes, thus the likelihood of many houses close together within one mile of a wind turbine is quite slim.

[78] Statistically significant at the 10% level means that, over many trials, one expects to *reject* the null hypothesis that the coefficient is zero, when it is in fact zero, one time out of ten (Malpezzi et al., 1980). Statistically significant at the 5% level means that, over many trials, one expects to *reject* the null hypothesis that the coefficient is zero, when it is in fact zero, one time out of twenty. Statistically significant at the 1% level means that, over many trials, one expects to *reject* the null hypothesis that the coefficient is zero, when it is in fact zero, one time out of one hundred. Thus, statistically significant at the 1% level is a more powerful result than statistically significant at the 10% level. Small levels of statistical significance are evidence against the null hypothesis. The null hypothesis is that there is no significant relationship between the dependent variable and the independent variable; i.e., the coefficient is zero. Thus small levels of statistical significance are evidence against the null hypothesis, since they indicate that the outcome of the data occurs with small probability if the null hypothesis is true. An estimated coefficient that is statistically significant at the 1% level implies that it is statistically significant at the 5% and 10% level. However, the opposite is not necessarily true. The strongest level of statistical significance is reported throughout this report;

statistic is relatively large at 380 and is statistically significant at the 1% level. The coefficient of determination indicates that approximately 66% of the variation in *ln(Real Property Price)* can be explained by all of the independent variables taken together. Spatial expansion[79] of the {X,Y}-coordinates of the sold properties are included such that spatial heterogeneity is incorporated into the model, (X, Y, XY, X^2, Y^2, and X^2Y^2). Please see Appendix B for more details.

A one unit (1,000 square feet) increase in the living area of a dwelling (*Square Feet*) is expected to increase price by 40.4%, *ceteris paribus (holding constant all other explanatory variables included in the model).* A one unit (180 square feet) increase in *Garage* (one car increase in garage space) is expected to increase price by 2.7%, *ceteris paribus.* A one unit increase in *Acre* (a tenth of an acre increase in lot size for lots one acre or less) is expected to increase price by 2.1%, *ceteris paribus.* A one unit increase in *Acres* (an acre increase in lot size for lots greater than one acre) is expected to increase price by 7.6%, *ceteris paribus.* The slope of the relationship between *Age* and *ln(Real Property Price)* depends on the *Age* of the property. A U-shape arises and this captures an increasing effect of *Age* on *ln(Real Property Price)* that occurs after a certain *Age* (after a turning point). The turning point or minimum of the function is when the age of a house is 149 years (when *Age*=14.9). A one unit increase in the number of fireplaces (*Fireplaces*) is expected to increase price by 8.7%, *ceteris paribus*. This estimate is consistent with previous empirical findings[80]. *Railroad Tracks* are expected to depress the value of nearby properties by 9.5%, *ceteris paribus.* A property located next to a lake (*Lakefront*) is expected to increase the property's price by 29.8%, *ceteris paribus.* A property located near a *Cul-de-sac* (amenities of less road traffic and increased privacy) is expected to increase the property's price by 3.2%, *ceteris paribus.* A property located in close proximity to wooded areas (*Trees*) is expected to increase the property's price by 3.5%, *ceteris paribus.* The signs of the estimated coefficients mentioned in this paragraph are all consistent with theory as presented in Section III.

Before wind farm operation, properties near the eventual wind farm site (*Near Wind Farm*) were valued 11.8% less on average than properties farther away from the eventual wind farm site, *ceteris paribus*; and this estimated coefficient on *Near Wind Farm* is statistically significant at the 1% level. This measures the *location effect* that is *not* due to the presence of the wind farm. Thus, even before the wind farm was operational, homes near the wind farm site sold for less than homes farther away from the site. This *location effect* is a factor that is often ignored in the literature and is one that the author feels is essential to almost any property value impact evaluation.

The estimated coefficient on *Wind Farm Operation* captures changes in housing values for houses far from the wind farm from the time period prior to wind farm operation to the period when the wind farm was operational. The estimated coefficient on *Wind Farm Operation* indicates that housing values farther from the wind farm, after the wind farm began operating, are not statistically different on average from values before the wind farm became operational.

The estimated coefficient of interest is on the interaction term, *Near Wind Farm, WF Operation*. The estimated coefficient measures the change in housing values due to the new wind

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e.g., 1% would be reported instead of reporting 1%, 5%, and 10%.

[79] Trend surface polynomials in terms of coordinates of the locations of the observations (properties).

[80] Sirmans et al. (2005) report the estimated coefficients from hedonic pricing models for fireplaces by geographic area. The fireplace coefficient estimates for the Midwest range from 0.045 to 0.110, and the current estimate of 0.083 lies within this range.

farm, provided that houses both near and far from the wind farm site did not appreciate at different rates for other reasons. From the time period before the wind farm was operational to the time period after TG I and II achieved commercial operations (during *Wind Farm Operation)*, the appreciation in the value of properties located near the wind farm site (*Near Wind Farm)* was 17.2% greater[81] on average than the appreciation in the value of properties located farther from the wind farm site, *ceteris paribus*. This estimate is statistically significant at the 1% level. This estimate is opposite in sign than wind farm area stigma theory suggests. Thus, the results presented in Column (1) of Table 12 reject the existence of a wind farm area stigma[82] for the area under study. The 95% confidence interval[83] for the coefficient of the variable of interest is (0.0292, 0.2877) or (2.96%, 33.34%). If random samples were obtained over and over again, with lower and upper bounds of the confidence intervals computed each time, then the ("unknown" or "true") population value would lie in this confidence interval, (2.96%, 33.34%), for 95% of the samples. Since the confidence interval contains only positive values, wind farm area stigma theory is strongly rejected for the local area.

2. Two Wind Farm Stages, School Districts and Townships

Table 12 displays the estimation results for regressions using school districts as the spatial controls in Column (2), and townships as the spatial controls in Column (3) (instead of the spatial expansion of the {X,Y}-coordinates as was used in Column (1) of Table 12). School districts and townships are proxies for various housing submarkets in the area. Dummy variables for properties that sold in *Lexington Community Unit School District (CUSD) 7* and *Lexington* township were excluded from each of the regressions and they are considered the base groups or benchmark groups, the groups against which comparisons are made. These areas were chosen as the base groups for a number of reasons. The average and median *Real Property Price*s for properties located within *Lexington CUSD 7* and *Lexington* township were closest to the average and median *Real Property Price*s for properties located throughout the entire study area (see Appendix C, Tables C.7 and C.10). Accordingly, it was thought that using *Lexington CUSD 7* and *Lexington* township as benchmark groups would allow for easier to understand estimated

[81] The appreciation in property values for each area is calculated from the time period before the wind farm achieved commercial operations to the time period in which the wind farm was fully operational. 17.2% is roughly the difference between the appreciation for the area near the wind farm and the appreciation for the area farther from the wind farm.

[82] Please note that even though property values near the wind farm rose during wind farm operations, the author does not believe that the property values rose strictly because of the wind farm locating there; however, it does seem to imply that property values do not necessarily decline because of a wind farm locating in the area near the properties.

[83] A confidence interval is a rule used to construct a random interval so that a certain percentage of all datasets, determined by the confidence level, yields an interval that contains the population value. Confidence level is the percentage of samples in which we want our confidence interval to contain the population value; 95% is the most common confidence level, but 90% and 99% are also used. If random samples were obtained over and over again, with lower and upper bounds of the confidence intervals computed each time, then the ("unknown" or "true") population value would lie in the confidence interval for 95% of the samples. Unfortunately, for the single sample that is used to construct the confidence interval, it is not possible to know if the ("unknown" or "true") population value is contained in the interval. It is hoped that the sample would be one of the 95% of all samples where the interval estimate contains the "true" population parameter, but there is no guarantee (Wooldridge, 2009).

coefficients[84]. It was also thought that the base groups should not be located near any approved wind farms (e.g., Twin Groves IV and V) because of the complications that may arise; e.g., because of the complicated nature of property values in those areas due to the approval of wind farms (see Fig. 1).

Results for the variables of interest and main explanatory variables are presented in Columns (2) and (3) of Table 12 for the estimations including wind farm operation dummy variable interactions between each of the school district dummy variables and each of the township dummy variables[85]. The full sets of results are presented in Columns (12.2) and (12.3) of Table E.1 in Appendix E. The estimated coefficients do not change in any meaningful way as compared to the results from the regression involving the {X,Y}-coordinates presented in Column (1) of Table 12. However, the main impact is a loss of degrees of freedom as is evident by the decline in the *F-statistic* from 380 in Column (1) to 240 in Column (2) and 148 in Column (3) of Table 12.

a. RESULTS: TWO WIND FARM STAGES, SCHOOL DISTRICTS

Lexington Community Unit School District 7 is excluded from the regression in Column (2) of Table 12 and is considered to be the base or benchmark group, the group against which comparisons are made. *C*, the intercept or constant term of the regression model, is the intercept for *Lexington CUSD 7*. The intercept for each school district (or *Near Wind Farm*) is the constant term *C* plus the estimated coefficient of the school district under consideration. The estimated coefficient of each school district represents the difference in intercepts between the school district under consideration and *Lexington CUSD 7*. Please see Appendix D for examples and proper interpretations of the estimated coefficients.

The coefficient of determination indicates that approximately 66.5% of the variation in *ln(Real Property Price)* can be explained by all of the independent variables taken together. Before wind farm operation, properties located near the eventual wind farm site (*Near Wind Farm)* were worth 18.4% less on average than properties located within *Lexington Community Unit School District*[86] *7*, *ceteris paribus*; and this estimated coefficient on *Near Wind Farm* is statistically significant at the 1% level. This measures the *location effect* that is *not* due to the presence of the wind farm. Thus, even before the wind farm was in operation, homes near the wind farm site sold for less than homes in *Lexington CUSD 7*. Before Twin Groves I and II achieved commercial operations, properties located near the eventual wind farm site were devalued in comparison to properties located in the following school districts: *El Paso-Gridley CUSD 11, Heyworth CUSD 4, LeRoy CUSD 2, Lexington CUSD 7, Normal CUSD 5*, and *Trivalley CUSD 3*. See Column (12.2) of Table E.1 in Appendix E.

The estimated coefficient of interest is on the interaction term, *Near Wind Farm, WF Operation*. From the time period before the wind farm was operational to the time period after

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[84] Since *Lexington CUSD 7* and *Lexington* township are the base groups or benchmark groups, the groups against which comparisons of the estimated coefficients are made, and since they have average and median *Real Property Price*s that are closest to the overall average and median *Real Property Price*s for the entire study area, one could roughly interpret the coefficients as compared to the entire study area rather than focusing solely on *Lexington* being the base group (if this helps with understanding better—though not technically accurate).

[85] A time period interaction with West township is not included because there were no properties that sold during the wind farm operations stage in this township.

[86] Community Unit School District (CUSD)

TG I and II achieved commercial operations (during *Wind Farm Operation)*, property values near the wind farm site (*Near Wind Farm)* appreciated[87] 22.4% more[88] on average than property values in *Lexington CUSD 7*, *ceteris paribus;* and this estimated coefficient on *Near Wind Farm, WF Operation* is statistically significant at the 1% level. The 95% confidence interval for the coefficient of the variable of interest is (0.0433, 0.3611) or (4.42%, 43.49%). Since the confidence interval contains only positive numbers, there is a strong rejection of wind farm area stigma theory. In addition, from the time period before the wind farm was operational to the time period after TG I and II achieved commercial operations (during *Wind Farm Operation)*, the value of properties located near the wind farm site (*Near Wind Farm)* appreciated more on average than the value of properties located in the following school districts: *Blue Ridge CUSD 18, El Paso-Gridley CUSD 11, Gibson City-Melvin-Sibley CUSD 5, Heyworth CUSD 4, LeRoy CUSD 2, Lexington CUSD 7, Normal CUSD 5, Prairie Central CUSD 8, Ridgeview CUSD 19*, and *Trivalley CUSD 3.* Please see Column (12.2) of Table E.1 in Appendix E. Thus, surprisingly there does not appear to be a stigma associated with locating near the wind farm, given that since Twin Groves I and II achieved commercial operations, houses near the wind farm have appreciated at a faster rate on average than houses in all of the school districts which are located farther from the wind farm.

b. RESULTS: TWO WIND FARM STAGES, TOWNSHIPS

Lexington township is excluded from the regression in Column (3) of Table 12 and is considered to be the base or benchmark group, the group against which comparisons are made. The constant term *C*, the intercept of the regression model, is the intercept for *Lexington* township. Therefore, the intercept for each township (or *Near Wind Farm*) is the constant term *C* plus the estimated coefficient of the township under consideration. The estimated coefficient of each township represents the difference in intercepts between the township under consideration and *Lexington* township. The results from the estimation that allows for all of the township intercepts to vary by wind farm development stage are presented in Column (3) of Table 12 and Column (12.3) of Table E.1 found in Appendix E.

The coefficient of determination indicates that approximately 68% of the variation in *ln(Real Property Price)* can be explained by all of the explanatory variables taken together. The housing submarkets are most narrowly defined using the townships as the spatial controls, as is evidenced by the relatively high coefficient of determination. Though due to the large number of townships, this resulted in a loss in the degrees of freedom as is evidenced by the decline in the *F-statistic* (though still statistically significant at the 1% level). The *Durbin-Watson statistic* is

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[87] The coefficient on *Near Wind Farm, WF Operation* can be interpreted as roughly equaling $\left(\overline{\ln(\text{RealPrice})}_{nearwf,wfOperation} - \overline{\ln(\text{RealPrice})}_{nearwf,B4Operation}\right) - \left(\overline{\ln(\text{RealPrice})}_{Lex,wfOperation} - \overline{\ln(\text{RealPrice})}_{Lex,B4Operation}\right)$ after partialling out (controlling for the housing characteristics which are important in determining the price of a home) the housing characteristics included in the estimation. The bar over *ln(RealPrice)* indicates the average value. Taking the difference of the natural logarithm of a variable can be interpreted as the growth of the variable. Please review Appendix D for more information.

[88] Property value appreciation for each area is calculated from the time period before the wind farm achieved commercial operations to the time period in which the wind farm was fully operational. 22.4% is roughly the difference between property value appreciation for the area near the wind farm and property value appreciation for the area in *Lexington CUSD 7*. Thus, the appreciation in the value of properties near the wind farm was 22.4% more on average than the appreciation in the value of properties in *Lexington CUSD 7*, *ceteris paribus.*

very close to a value of two indicating that serial correlation is not a serious issue in the regression. The estimated coefficient of the *Trees* variable is not statistically significant indicating the possibility of multicollinearity[89] among *Trees* and the townships.

Roughly speaking, before Twin Groves I and II achieved commercial operations, properties located near the eventual wind farm site (*Near Wind Farm)* were valued 20% less on average than properties located in *Lexington* township, *ceteris paribus;* and this estimated coefficient on *Near Wind Farm* is statistically significant at the 1% level. This measures the *location effect* that is *not* due to the presence of the wind farm. Thus, even before the wind farm was in operation, homes near the eventual wind farm site sold for less than homes in *Lexington* township. Before Twin Groves I and II achieved commercial operations, properties located near the eventual wind farm site *(Near Wind Farm)* were devalued in comparison to properties in the following townships: *Blue Mound*, *Downs*, *Drummer*, *Empire*, *Gridley*, *Hudson*, *Lawndale*, *Lexington*, *Money Creek*, *Oldtown*, *Randolph*, and *Towanda.* See Column (12.3) of Table E.1 in Appendix E.

The estimated coefficient of interest is on the interaction term, *Near Wind Farm*, *WF Operation*. From the time period before the wind farm was operational to the time period after TG I and II achieved commercial operations (during *Wind Farm Operation)*, the appreciation in the value of properties located near the wind farm site (*Near Wind Farm)* was 26% greater[90] on average than the appreciation in the value of properties located in *Lexington* township, *ceteris paribus;* and this estimated coefficient on *Near Wind Farm, WF Operation* is statistically significant at the 1% level. The 95% confidence interval for the coefficient of the variable of interest is (0.0704, 0.3916) or (7.30%, 47.94%). Since the confidence interval contains only positive numbers, there is a strong rejection of wind farm area stigma theory. In addition, the value of properties located near the wind farm site (*Near Wind Farm)* appreciated[91] more on average than the value of properties located in the following townships: *Anchor*, *Bellflower*, *Blue Mound*, *Chenoa*, *Dix*, *Downs*, *Drummer*, *Empire*, *Gridley*, *Hudson*, *Lawndale*, *Lexington*, *Martin*, *Money Creek*, *Oldtown*, *Peach Orchard*, *Randolph*, *Sullivant*, *Towanda*, and *Yates*[92]. *Cropsey* is the only township in which property values appreciated more on average than property values near the wind farm *(Near Wind Farm)*. Thus, there does not appear to be a wind farm area stigma associated with locating near Twin Groves I and II, given that houses near the wind farm have appreciated at a faster rate on average in real terms after Twin Groves I and II achieved commercial operations than most houses in the townships in the surrounding area.

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[89] Multicollinearity is a condition that exists when two or more explanatory variables are so highly correlated that they largely or totally nullify one another. Thus, *Trees* may be insignificant in the township regression because the township submarkets (represented by the township dummy variables) may be capturing this effect already.

[90] Property value appreciation for each area is calculated from the time period before the wind farm achieved commercial operations to the time period in which the wind farm was fully operational. 26% is roughly the difference between the property value appreciation for the area near the wind farm (*Near Wind Farm*) and the property value appreciation for the *Lexington* township area.

[91] Property value appreciation for each area is calculated from the time period before Twin Groves I and II achieved commercial operations to the time period in which the wind farm was fully operational.

[92] See Column (12.3) of Table E.1 in Appendix E. A local realtor stated that home values in the higher-end market have taken the hardest hit during the recession (housing market crisis). This factor could potentially explain why homes near the wind farm appreciated at a faster rate than homes within the *Downs* and *Empire* townships, which consist of many high-end properties; however, it does not explain why homes near the wind farm appreciated at a faster rate than comparable homes in many of the other townships.

3. SUMMARY OF RESULTS INVOLVING TWO WIND FARM DEVELOPMENT STAGES

The two stages of wind farm development estimations involved estimating three equations[93] using three different controls for neighborhood effects, namely: the trend surface polynomials in terms of the {X,Y}-coordinates of the property locations, which controls for the effect of a property's individual location on property price and models any spatial trends; school district dummy variable interactions with the stages of the wind farm development, which allows for different intercepts and wind farm impacts across the different housing submarkets for each stage of the wind farm development process; and township dummy variable interactions with the stages of the wind farm development, which allows for different intercepts and wind farm impacts across the different housing submarkets for each stage of the wind farm development process.

The results of all three estimations demonstrate that before Twin Groves I and II were fully operational, properties near the eventual wind farm site were devalued in comparison to properties farther away from the eventual wind farm site, and these results are statistically significant at the 1% level across all three estimations. This demonstrates the *location effect* that is *not* due to the presence of the wind farm. This result is further supported by the evidence of a declining population and a declining number of housing units that the areas near the wind farm have been experiencing for a number of years (e.g., see Tables 5 and 6 from Section V).

The results of all three estimations demonstrate that from the time period before Twin Groves I and II were fully operational to the time period after TG I and II achieved commercial operations (during *Wind Farm Operation)*, the value of properties located near the wind farm site (*Near Wind Farm)* had a higher appreciation rate on average in real terms than the value of properties located farther from the wind farm site, and this estimate is statistically significant at the 1% level for all three estimations. Using various spatial controls, a *wind farm area stigma* associated with properties near the wind farm that sold after Twin Groves I and II both achieved commercial operation is strongly rejected.

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[93] Essentially the same equation three times with the only difference being the spatial controls included in the model.

Table 12. Results: Two Wind Farm Development Stages

Dependent Variable: ln(Real Property Price)									
Explanatory Variable		XY			SD			TWP	
(Description/units)		(1)			(2)			(3)	
Square Feet *(1000s)*	40.4%	0.339	***	40.6%	0.341	***	40.2%	0.338	***
		(0.011)			(0.011)			(0.011)	
Garage	2.7%	0.026	***	2.6%	0.026	***	2.5%	0.025	***
		(0.003)			(0.004)			(0.003)	
Acre *(tenths)*	2.1%	0.021	***	2.2%	0.022	***	2.5%	0.024	***
		(0.003)			(0.003)			(0.003)	
Acres	7.6%	0.073	***	7.7%	0.074	***	8.0%	0.077	***
		(0.007)			(0.007)			(0.008)	
Age *(decades)*	-6.9%	-0.072	***	-6.9%	-0.072	***	-6.8%	-0.070	***
		(0.005)			(0.005)			(0.005)	
Age^2	0.2%	0.002	***	0.2%	0.002	***	0.2%	0.002	***
		(0.000)			(0.000)			(0.000)	
Fireplaces *(number)*	8.7%	0.083	***	8.9%	0.085	***	8.4%	0.081	***
		(0.012)			(0.012)			(0.011)	
Railroad Tracks	-9.5%	-0.100	***	-8.2%	-0.086	***	-7.4%	-0.077	***
		(0.014)			(0.015)			(0.014)	
Lakefront	29.8%	0.261	***	26.5%	0.235	***	25.6%	0.228	***
		(0.053)			(0.052)			(0.053)	
Cul-de-sac	3.2%	0.031	**	3.9%	0.039	***	4.0%	0.040	***
		(0.014)			(0.014)			(0.014)	
Trees	3.5%	0.035	**	2.6%	0.026	*	2.3%	0.023	
		(0.015)			(0.015)			(0.015)	
C *(Intercept)*		262.841	***		11.310	***		11.317	***
		(63.436)			(0.031)			(0.032)	
Wind Farm Operation	-1.4%	-0.014		-3.4%	-0.034		-6.2%	-0.064	
(02/02/2008 - 12/01/2009)		(0.014)			(0.042)			(0.043)	
Near Wind Farm	-12%	-0.126	***	-18%	-0.204	***	-20%	-0.221	***
		(0.031)			(0.035)			(0.035)	
Near Wind Farm, WF Operation	17.2%	0.158	***	22.4%	0.202	***	26.0%	0.231	***
		(0.065)			(0.079)			(0.080)	
Adjusted R-squared		0.6634			0.6648			0.6777	
Standard Error of Regression		0.2981			0.2975			0.2917	
Sum Squared Residuals		340.36			337.93			322.92	
Log Likelihood		-792.9			-779.1			-691.6	
F-statistic		380.40	***		239.57	***		148.20	***
Mean ln(Real Property Price)		11.62			11.62			11.62	
Standard Deviation ln(Real Property Price)		0.51			0.51			0.51	
Akaike Information Criterion (AIC)		0.42			0.42			0.39	
Schwarz Criterion (SIC)		0.46			0.48			0.48	
Durbin-Watson Statistic		1.90			1.95			1.97	

***denotes significance at 1% level **denotes significance at 5% level *denotes significance at 10% level
Notes: White Heteroskedasticity-Consistent Standard Errors & Covariance are in parentheses (White, 1980).
Estimation sample includes the period 01/01/2001 - 12/01/2009. *n*=3,851. %=$[e^{coeff}-1]*100$

Base Groups: (1) Before Wind Farm Operation (01/01/2001 - 02/01/2008); Far from the wind farm;
(2) Before Wind Farm Operation (01/01/2001 - 02/01/2008); Lexington CUSD 7;
(3) Before Wind Farm Operation (01/01/2001 - 02/01/2008); Lexington Township.

B. THREE WIND FARM DEVELOPMENT STAGES ESTIMATIONS

Considering the sign on the estimated coefficient of the variable of interest (*Near Wind Farm, WF Operation*) was not as expected[94], a more detailed analysis of the wind farm development stages[95] is necessary. In particular, the time period post wind farm approval and during construction is analyzed. The results are presented in Table 13 and the full set of results can be found in Columns (13.1), (13.2), and (13.3) of Table E.1 in Appendix E.

1. RESULTS: THREE WIND FARM STAGES, {X,Y}-COORDINATES

Results are presented in Column (1) of Table 13 using the spatial expansion of the {X,Y}-coordinates to control for spatial effects. The coefficient of determination indicates that roughly 66% of the variation in *ln(Real Property Price)* can be explained by all of the explanatory variables taken together. The *F-statistic* is relatively large at 346 and is statistically significant at the 1% level.

Most of the estimated coefficients are statistically significant at the conventional levels of statistical significance except two: *Post WF Approval/Construction* and *Wind Farm Operation*. The estimated coefficient on *Post WF Approval/Construction* captures changes in housing values for houses far from the wind farm from the time period before the wind farm was approved to the time period after the wind farm was approved and was under construction. The estimated coefficient on *Post WF Approval/Construction* is not statistically significant at conventional levels indicating that housing values far from the wind farm during the post wind farm approval and construction period *(Post WF Approval/Construction)* are not statistically different on average from housing values before wind farm approval. The estimated coefficient on *Wind Farm Operation* captures changes in housing values for houses far from the wind farm from the time period prior to wind farm approval to the period when the wind farm was operational. The estimated coefficient on *Wind Farm Operation* is not statistically significant at conventional levels indicating that housing values far from the wind farm during wind farm operations are not statistically different on average from housing values before approval of the wind farm.

The results presented in Column (1) of Table 13 and in Column (13.1) of Table E.1 of Appendix E indicate that a 1,000 square feet increase in the living area of a dwelling (*Square Feet*) is expected to increase price by 40.4%, *ceteris paribus.* A 180 square feet increase in the area of a *Garage* (one car increase in garage space) is expected to increase price by 2.7%, *ceteris paribus.* A tenth of an acre increase in lot size for lots one acre or less (*Acre*) is expected to increase price by 2.2%, *ceteris paribus.* An acre increase in lot size for lots greater than one acre (*Acres*) is expected to increase price by 7.6%, *ceteris paribus.* The slope of the relationship between *Age* and *ln(Real Property Price)* depends on the *Age* of the property. A U-shape arises and this captures an increasing effect of *Age* on *ln(Real Property Price)* that occurs after a certain *Age*. The turning point or minimum of the function is when the age of a house is 149 years (when *Age*=14.9). A one unit increase in the number of fireplaces (*Fireplaces*) is expected to increase price by 8.6%, *ceteris paribus*. This estimate is consistent with previous empirical

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[94] The sign of the estimated coefficient of *Near Wind Farm, WF Operation* was not consistent with wind farm area stigma theory.

[95] The stages of the adjustment process (corresponding to perceived risk by local residents and prospective homebuyers) are thought to roughly correspond to the stages of wind farm development.

findings[96]. A property located in close proximity to railroad tracks (*Railroad Tracks*) is expected to depress the property's price by 9.5%, *ceteris paribus.* A property located next to a lake (*Lakefront*) is expected to increase the property's price by 29.6%, *ceteris paribus.* A property located near a *Cul-de-sac* (amenities of less road traffic, less noise, and increased privacy) is expected to increase the property's price by 3.1%, *ceteris paribus.* A property located in close proximity to wooded areas (*Trees*) is expected to increase the property's price by 3.4%, *ceteris paribus.* The signs of the estimated coefficients mentioned in this paragraph are all consistent with theory.

Before wind farm approval, properties near the eventual wind farm site (*Near Wind Farm)* were valued 7.6% less on average than properties farther away from the eventual wind farm site, *ceteris paribus*; and this estimated coefficient on *Near Wind Farm* is statistically significant beyond the 5% level. This measures the *location effect* that is *neither* due to the approval *nor* the presence of the wind farm. Thus, before the wind farm was even approved, properties in the eventual wind farm area exhibited lower property values than properties in areas farther away. This finding is significant to point out because the time periods prior to wind farm approval and prior to wind farm operations are often ignored in the wind farm and property value literature[97].

One of the estimated coefficients of interest is on the interaction term *Near Wind Farm, Post WF Approval/Construction*. The estimated coefficient measures the change in housing values due to the approval of the wind farm, provided that houses both near and far from the site did not appreciate at different rates for other reasons. From the time period before the McLean County Board approved Twin Groves I and II, to the time period after McLean County Board approval of the wind farm and during construction of Twin Groves I and II (*Post WF Approval/Construction*), the appreciation in the value of properties located near the wind farm site was 11.7% lower on average than the appreciation in the value of properties located in areas farther from the wind farm site, *ceteris paribus;* and this estimated coefficient on *Near Wind Farm, Post WF Approval/Construction* is statistically significant at the 5% level. The 95% confidence interval for the estimated coefficient of *Near Wind Farm, Post WF Approval/Construction* is (-0.2458, -0.0019) or (-21.80%, -0.19%). The confidence interval containing only negative values provides strong support for wind farm anticipation stigma theory. Thus, there does appear to be some depression in the appreciation of property values near TG I and II after the wind farm was approved and during the construction stage of the wind farm development process, presumably because some of the residents located near the eventual wind farm location did not want to live near the wind farm, so they may have sold their houses and were willing to accept a lower value because they assumed the property was going to be devalued even more after the wind farm achieved commercial operations. Thus, the results are consistent with wind farm anticipation stigma theory, meaning that property values may have diminished in anticipation of the wind farm, possibly due to the general uncertainty surrounding a wind farm project regarding the aesthetic impacts on the landscape, the actual noise impacts

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[96] Sirmans et al. (2005) report the estimated coefficients from hedonic pricing models for fireplaces by geographic area. The fireplace coefficient estimates for the Midwest range from 0.045 to 0.110, and the current estimate of 0.083 lies within this range.

[97] *Location effect* is rarely taken into consideration and almost never directly controlled for in the model in the wind farm and property value literature. The author believes this to be a serious flaw of previous wind farm proximity and property value impact studies.

from the wind turbines, and just how disruptive the wind farm will be.

The second estimated coefficient of interest is on the interaction term *Near Wind Farm, WF Operation.* From the time period prior to wind farm approval[98] to the time period that Twin Groves I and II were fully operational, the appreciation in the value of properties located near the wind farm site was 11.7% greater[99] on average than the appreciation in the value of properties located farther from the wind farm site, *ceteris paribus*; and this estimated coefficient on *Near Wind Farm, WF Operation* is statistically significant at the 10% level. The 95% confidence interval for the coefficient of *Near Wind Farm, WF Operation* is (-0.0235, 0.2457) or (-2.33%, 27.85%). If random samples were obtained over and over again, with lower and upper bounds of the confidence intervals computed each time, then the ("unknown" or "true") population value would lie in the confidence interval for 95% of the samples. The confidence interval contains very small negative values and practically large positive values. Consequently, wind farm area stigma theory is not as overwhelmingly rejected as in the estimations involving the two stages of wind farm development presented in Table 12 (though the 90% confidence interval contains only positive values).

This estimation provides evidence that the impacts of a wind farm on surrounding property values are not constant across the wind farm development process, as the depression in property value appreciation rates for the time period after the wind farm was approved and during construction clearly demonstrates. During the operational stage of the wind farm project, when property owners living close to the wind turbines actually had a chance to see if any of their concerns materialized, property values rebounded. These results provide evidence that support wind farm anticipation stigma theory and reject wind farm area stigma theory.

2. RESULTS: THREE WIND FARM STAGES, SCHOOL DISTRICTS

Column (2) of Table 13 and Column (13.2) of Table E.1 of Appendix E contain the estimation results using school districts as proxies for the spatial housing submarkets and the estimated coefficients are presented in comparison to *Lexington* School District *(Lexington CUSD 7*, the base or benchmark group). The coefficient of determination indicates that over 66% of the variation in *ln(Real Property Price)* can be explained by all of the explanatory variables taken together. The *F-statistic* is relatively large at 179 and is statistically significant at the 1% level.

Before TG I and II were approved by the McLean County Board, properties located near the eventual wind farm site (*Near Wind Farm*) were valued 17.4% less on average than properties located within *Lexington CUSD 7*, *ceteris paribus*; and this estimated coefficient on *Near Wind Farm* is statistically significant at the 1% level. This measures the *location effect* that is *neither* due to the approval of the wind farm *nor* the presence of the wind farm. Thus, before Twin Groves I and II were fully operational and even before TG I and II were approved by the McLean County Board, properties located near the eventual wind farm site (*Near Wind Farm*)

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[98] The time period prior to wind farm approval, houses near the eventual wind farm location were valued 7.6% less on average than houses in the surrounding areas.

[99] The appreciation in property values for each area is calculated from the time period before wind farm approval to the time period during wind farm operations. 11.7% is roughly the difference between the property value appreciation for the area near the wind farm and the property value appreciation for the area farther from the wind farm.

were devalued in comparison to properties located farther away from the site, including properties within the following school districts: *El Paso-Gridley CUSD 11, Heyworth CUSD 4, LeRoy CUSD 2, Lexington CUSD 7, Normal CUSD 5,* and *Trivalley CUSD 3*[100].

One of the estimated coefficients of interest is on the interaction term *Near Wind Farm, Post WF Approval/Construction*. From the time period before Twin Groves I and II were approved by the McLean County Board to the time period after McLean County Board approval of the wind farm and during construction of Twin Groves I and II (*Post WF Approval/Construction*), the appreciation in the value of properties located near the wind farm site (*Near Wind Farm*) was *not* statistically different on average from the appreciation in the value of properties in *Lexington CUSD 7*, *ceteris paribus*; this coefficient (-0.0295 or -2.9%) on *Near Wind Farm, Post WF Approval/Construction* is *not* statistically significant at the conventional levels of significance, at least 10%. The 95% confidence interval for the coefficient of *Near Wind Farm, Post WF Approval/Construction* is (-0.1752, 0.1163) or (-16.07%, 12.33%)[101]. However, from the time period before wind farm approval to the time period after the wind farm was approved and during construction of Twin Groves I and II, the value of properties located near the eventual wind farm site (*Near Wind Farm*) appreciated less on average than the value of properties located in the following school districts: *Gibson City-Sibley-Melvin CUSD 5, Heyworth CUSD 4, LeRoy CUSD 2,* and *Trivalley CUSD 3.*The confidence interval contains a wide range of negative and positive values. Thus, a wind farm anticipation stigma is not overwhelmingly apparent in this specific estimation using school districts as spatial controls for the various housing submarkets.

The second estimated coefficient of interest is on the interaction term *Near Wind Farm, WF Operation.* From the time period before wind farm approval[102] to the time period that Twin Groves I and II were fully operational (*Wind Farm Operation*), housing values near the wind farm site appreciated 20.8% more[103] on average than housing values in *Lexington CUSD 7*, *ceteris paribus*; and this estimated coefficient on *Near Wind Farm, WF Operation* is statistically significant at the 5% level. The 95% confidence interval for the coefficient of *Near Wind Farm, WF Operation* is (0.0238, 0.3543) or (2.41%, 42.51%). If random samples were obtained over and over again, with lower and upper bounds of the confidence intervals computed each time, then the ("unknown" or "true") population value would lie in the confidence interval, (2.41%, 42.51%), for 95% of the samples. Since the confidence interval contains only positive values, wind farm area stigma theory is strongly rejected for the local area. In addition, from the time period before wind farm approval to the time period when the wind farm was operational, the value of properties located near the wind farm (*Near Wind Farm*) appreciated more on average than the value of properties located in the following school districts[104]: *Blue Ridge CUSD 18, El*

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[100] See Column (13.2) of Table E.1 in Appendix E.

[101] If random samples were obtained over and over again, with lower and upper bounds of the confidence intervals computed each time, then the ("unknown" or "true") population value would lie in the confidence interval for 95% of the samples.

[102] The time period before wind farm approval was when houses near the eventual wind farm location were valued 17.4% less on average than those in *Lexington CUSD 7*.

[103] The appreciation in property values for each area is calculated from the time period before wind farm approval to the time period after Twin Groves I and II achieved commercial operations. 20.8% is roughly the difference between housing value appreciation for the area near the wind farm and housing value appreciation for the *Lexington CUSD 7* area.

[104] Although not all of the estimated coefficients of the *School District, Wind Farm Operation* interaction terms are

Paso-Gridley CUSD 11, Gibson City-Melvin-Sibley CUSD 5, Heyworth CUSD 4, LeRoy CUSD 2, Lexington CUSD 7, Normal CUSD 5, Prairie Central CUSD 8, Ridgeview CUSD 19, and *Trivalley CUSD 3*. Given this appreciation in housing values in areas near an operating wind farm, the results reject the existence of wind farm area stigma theory associated with locating near Twin Groves I and II.

3. RESULTS: THREE WIND FARM STAGES, TOWNSHIPS

Column (3) of Table 13 and Column (13.3) of Table E.1 of Appendix E contain the estimation results using townships as proxies for the spatial housing submarkets and the estimated coefficients are presented in comparison to *Lexington* township (the base or benchmark group). The coefficient of determination (*adjusted R-squared*) indicates that roughly 67.8% of the variation in *ln(Real Property Price)* can be explained by all of the explanatory variables taken together. The *F-statistic* is large at 106 and is statistically significant at the 1% level.

Before Twin Groves I and II were approved by the McLean County Board, properties located near the eventual wind farm site (*Near Wind Farm*) were valued 18% less on average than properties within *Lexington* township, *ceteris paribus*; and this estimated coefficient on *Near Wind Farm* is statistically significant at the 1% level. This measures the *location effect* that is *neither* due to the approval of the wind farm *nor* the presence of the wind farm. Thus, even before Twin Groves I and II were approved by the McLean County Board, properties located near the eventual wind farm site (*Near Wind Farm*) were devalued in comparison to properties located farther away from the site, including properties located within the following townships: *Blue Mound, Downs, Empire, Gridley, Hudson, Lawndale, Lexington, Money Creek, Oldtown, Randolph,* and *Towanda.*[105]. Before Twin Groves I and II were approved by the McLean County Board, properties located near the eventual wind farm site (*Near Wind Farm*) were valued more on average than properties located in the following townships: *Anchor, Bellflower, Chenoa, Cropsey, Dix, Drummer, Martin, Peach Orchard, Sullivant,* and *Yates.*

From the time period before Twin Groves I and II were approved by the McLean County Board to the time period after McLean County Board approval of the wind farm and during construction of Twin Groves I and II (*Post WF Approval/Construction*), the appreciation in the value of properties located near the wind farm site (*Near Wind Farm*) was *not* statistically different on average from the appreciation in the value of properties located in *Lexington* township, *ceteris paribus*; this estimated coefficient (-0.0553 or -5.4%) on *Near Wind Farm, Post WF Approval/Construction* is *not* statistically significant at the conventional levels of significance. The 95% confidence interval for the coefficient of *Near Wind Farm, Post WF Approval/Construction* is (-0.1994, 0.0888) or (-18.08%, 9.28%). If random samples were obtained over and over again, with lower and upper bounds of the confidence intervals computed each time, then the ("unknown" or "true") population value would lie in the confidence interval, (-18.08%, 9.28%), for 95% of the samples. The confidence interval contains a wide range of

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statistically significant, this lack of statistical significance means that the estimated coefficients are not statistically different from that of *Lexington CUSD 7*. Thus, it is okay to compare the statistically significant appreciation of property values near the wind farm *(Near Wind Farm)* to those that are not statistically different from *Lexington CUSD 7*.

105 See Column (13.3) of Table E.1 in Appendix E.

negative and positive values (though admittedly a larger number of negative values than positive). From the time period before wind farm approval to the time period after the wind farm was approved and during construction, the value of properties located near the eventual wind farm site (*Near Wind Farm*) appreciated less on average than the value of properties located in the following townships: *Downs*, *Drummer*, *Empire*, *Oldtown*, and *Towanda*. From the time period before wind farm approval to the time period after the wind farm was approved and during construction of Twin Groves I and II, the value of properties located near the eventual wind farm site (*Near Wind Farm*) appreciated more on average than the value of properties located in *Cropsey* township. Wind farm anticipation stigma is not strongly apparent in this specific estimation using townships as spatial controls for the various housing submarkets.

From the time period before wind farm approval[106] to the time period that Twin Groves I and II were fully operational (*Wind Farm Operation*), property values near the wind farm site appreciated 23.2% more[107] on average than property values in *Lexington* township, *ceteris paribus*; and this estimated coefficient on *Near Wind Farm, WF Operation* is statistically significant at the 1% level. The 95% confidence interval for the coefficient of *Near Wind Farm, WF Operation* is (0.0410, 0.3758) or (4.18%, 45.61%). If random samples were obtained over and over again, with lower and upper bounds of the confidence intervals computed each time, then the ("unknown" or "true") population value would lie in the confidence interval, (4.18%, 45.61%), for 95% of the samples. Since the confidence interval contains only positive values, wind farm area stigma theory is strongly rejected for the local area. From the time period before wind farm approval to the time period that Twin Groves I and II were fully operational (*Wind Farm Operation*), the value of properties located near the eventual wind farm site (*Near Wind Farm*) appreciated more on average than the value of properties located in the following townships[108]: *Anchor*, *Bellflower*, *Blue Mound*, *Chenoa*, *Cropsey*, *Drummer*, *Empire*, *Gridley*, *Hudson*, *Lawndale*, *Lexington*, *Martin*, *Money Creek*, *Oldtown*, *Peach Orchard*, *Randolph*, *Towanda*, and *Yates*. From the time period before wind farm approval to the time period that Twin Groves I and II were fully operational (*Wind Farm Operation*), the value of properties located near the eventual wind farm site (*Near Wind Farm*) appreciated less on average than the value of properties located in the following townships: *Dix*, *Downs*, and *Sullivant*. Considering the fact that housing values near the wind farm have appreciated more[109] on average than housing values in most of the other townships, wind farm area stigma theory is strongly rejected for the area near Twin Groves I and II[110].

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[106] The time period before wind farm approval was when houses near the eventual wind farm location were valued 18% less on average than those in *Lexington* township.
[107] Property value appreciation for each area is calculated from the time period before wind farm approval to the time period during wind farm operations. 23.2% is roughly the difference between housing value appreciation for the area near the wind farm and housing value appreciation for the *Lexington* township area.
[108] Although not all of the estimated coefficients of the *Township, Wind Farm Operation* interaction terms are statistically significant, this lack of statistical significance means that the estimated coefficients are not statistically different from that of *Lexington* township. Thus, it is okay to compare the statistically significant rate of appreciation of the properties near the wind farm to those that are not statistically different from *Lexington* township.
[109] The appreciation in property values for each area is calculated from the time period before wind farm approval to the time period after Twin Groves I and II achieved commercial operations.
[110] The author is *not* claiming that wind farm area stigma theory can be rejected for any other wind farm area.

4. Summary of Results involving Three Wind Farm Development Stages

The stages of the adjustment process (corresponding to perceived risk by local residents and prospective homebuyers) are thought to roughly correspond to the stages of wind farm development. The three wind farm development stage estimations involved estimating three equations (essentially the same equation three times with the only difference being the spatial controls included in the model) using three different controls for neighborhood effects, namely: the trend surface polynomials in terms of the {X,Y}-coordinates of the property locations, which controls for the effect of a property's individual location on property price and models any spatial trends; school district dummy variable interactions with the stages of the wind farm development, which allows for different intercepts and wind farm impacts across the different housing submarkets for each stage of the wind farm development process; and township dummy variable interactions with the stages of the wind farm development, which allows for different intercepts and wind farm impacts across the different housing submarkets for each stage of the wind farm development process.

The results of all three estimations demonstrate that before Twin Groves I and II were even approved by the McLean County Board, properties near the eventual wind farm site were valued less on average than properties located farther away from the eventual wind farm site, and these results are statistically significant across all three estimations. Thus, a *location effect* exists such that the wind farm happened to locate in an area that already exhibited depressed property values in comparison to other areas within parts of McLean and Ford Counties. This result is further supported by the evidence of a declining population and a declining number of housing units that the areas near the wind farm have been experiencing for a number of years (e.g., see Tables 5 and 6 from Section V).

The results indicate that from the time period before Twin Groves I and II were approved by the McLean County Board to the time period after McLean County Board approval of the wind farm and during construction of Twin Groves I and II, the appreciation rate of property values near the eventual wind farm site may have been diminished in comparison to other surrounding areas because of the uncertainty as to how disruptive the wind farm would actually be. Thus, there is some evidence that supports *wind farm anticipation stigma theory*.

The results of all three estimations demonstrate that from the time period before the wind farm was approved to the time period in which the wind farm achieved commercial operations, the value of properties located near the wind farm site appreciated[111] at a greater rate on average than the value of properties located farther from the wind farm site, and this estimate is statistically significant across all three estimations. Using various spatial controls, *wind farm area stigma theory* is strongly rejected. Thus, during the operational stage of the wind farm project, when property owners living close to the wind turbines actually had a chance to see if any of their concerns materialized, property values rebounded[112].

[111] The appreciation rate for each area is calculated from the time period before the wind farm was approved by the McLean County Board to the time period in which the wind farm was fully operational.
[112] Property values rebounded above their levels before approval of the wind farm.

Table 13. Results: Three Wind Farm Development Stages

Dependent Variable: ln(Real Property Price)									
	XY			SD			TWP		
	(1)			(2)			(3)		
Square Feet *(1000s)*	40.4%	0.3393	***	40.6%	0.3404	***	40.3%	0.3384	***
		(0.011)			(0.011)			(0.011)	
Garage	2.7%	0.0264	***	2.6%	0.0255	***	2.5%	0.0251	***
		(0.003)			(0.004)			(0.004)	
Acre *(tenths)*	2.2%	0.0214	***	2.2%	0.0221	***	2.5%	0.0247	***
		(0.003)			(0.003)			(0.003)	
Acres	7.6%	0.0732	***	7.7%	0.0743	***	8.0%	0.0770	***
		(0.007)			(0.007)			(0.008)	
Age *(decades)*	-7.0%	-0.0721	***	-7.0%	-0.0727	***	-6.8%	-0.0706	***
		(0.005)			(0.005)			(0.005)	
Age^2	0.2%	0.0024	***	0.3%	0.0025	***	0.2%	0.0024	***
		(0.000)			(0.000)			(0.000)	
Fireplaces *(number)*	8.6%	0.0830	***	8.8%	0.0845	***	8.3%	0.0801	***
		(0.012)			(0.012)			(0.011)	
Railroad Tracks	-9.5%	-0.1002	***	-8.4%	-0.0879	***	-7.5%	-0.0781	***
		(0.014)			(0.015)			(0.014)	
Lakefront	29.6%	0.2596	***	26.4%	0.2339	***	25.5%	0.2272	***
		(0.053)			(0.052)			(0.053)	
Cul-de-sac	3.1%	0.0305	**	3.7%	0.0363	***	3.9%	0.0382	***
		(0.014)			(0.014)			(0.014)	
Trees	3.4%	0.0339	**	2.6%	0.0253	*	2.2%	0.0221	
		(0.015)			(0.015)			(0.016)	
C *(Intercept)*		261.7872	***		11.3386	***		11.3340	***
		(63.437)			(0.032)			(0.033)	
Post WF Approval/Construction	1.1%	0.0107		-7.2%	-0.0747	**	-4.8%	-0.0495	
		(0.011)			(0.039)			(0.037)	
Wind Farm Operation	-1.0%	-0.0102		-5.9%	-0.0613		-7.8%	-0.0810	*
		(0.014)			(0.043)			(0.044)	
Near Wind Farm	-7.6%	-0.0790	**	-17.4%	-0.1909	***	-18.0%	-0.1988	***
		(0.036)			(0.041)			(0.042)	
Near Wind Farm, Post WF Approval/Construction	-11.7%	-0.1239 (0.061)	**	-2.9%	-0.0295 (0.073)		-5.4%	-0.0553 (0.072)	
Near Wind Farm, WF Operation	11.7%	0.1111	*	20.8%	0.1890	**	23.2%	0.2084	***
		(0.067)			(0.083)			(0.084)	
Adjusted R-squared		0.6637			0.6655			0.6780	
Standard Error of Regression		0.2980			0.2972			0.2916	
Sum Squared Residuals		339.84			336.23			320.74	
Log Likelihood		-789.99			-769.37			-678.59	
F-statistic		346.43	***		179.12	***		106.29	***
Mean ln(Real Property Price)		11.62			11.62			11.62	
Standard Deviation ln(Real Price)		0.514			0.514			0.514	
Akaike Information Criterion		0.422			0.422			0.393	
Schwarz Criterion		0.460			0.494			0.520	
Durbin-Watson Statistic		1.91			1.95			1.97	

***denotes significance at 1% level **denotes significance at 5% level *denotes significance at 10% level

Notes: White Heteroskedasticity-Consistent Standard Errors & Covariance are in parentheses (White, 1980). Estimation sample includes the period 01/01/2001 - 12/01/2009. n=3,851. %=[e^{coeff}-1]*100.

Base Groups: (1) Before Wind Farm Approval (01/01/2001 - 09/20/2005); Far from the wind farm;

(2) Before Wind Farm Approval (01/01/2001 - 09/20/2005); Lexington CUSD 7;

(3) Before Wind Farm Approval (01/01/2001 - 09/20/2005); Lexington Township.

C. SEPARATE WIND FARM DEVELOPMENT STAGES ESTIMATIONS

This section provides separate estimations for each stage of the wind farm development process. These estimations allow for comparisons in real property value levels in percentage terms, rather than comparisons in appreciation rates of properties, near to and far from the wind farm across the different stages of wind farm development. These estimations also highlight the inherent problems with excluding property sales that occur during the time period before wind farm operations in an analysis of wind farm area stigma. The results reveal that a lot of information is lost by using only property sales occurring after wind farm operations and this illustrates that inappropriate conclusions may be drawn by exclusion of property sales prior to wind farm operations in an analysis.

1. RESULTS: SEPARATE WIND FARM STAGES, {X,Y}-COORDINATES

Table 14 contains estimation results by each stage of the development process using the {X,Y}-coordinates to model any spatial trend. The full set of results may be found in Table E.2 of Appendix E.

Column (1) of Table 14 uses data from property transactions that occurred before wind farm approval, 01/01/2001 – 09/20/2005. The coefficient of determination *(adjusted R-squared)* indicates that roughly 68.5% of the variation in *ln(Real Property Price)* can be explained by all of the explanatory variables taken together. The *F-statistic* is relatively large at 246 and is statistically significant at the 1% level. Before wind farm approval, properties located near the eventual wind farm site *(Near Wind Farm)* were valued 5.82% less on average than properties farther from the eventual wind farm site, *ceteris paribus*; and this result is statistically significant at the 10% level. This result demonstrates the *location effect* that is *neither* due to the approval *nor* the presence of the wind farm. Thus, before the wind farm was even approved, home values near the eventual wind farm area exhibited lower property values than homes in areas farther away.

Column (2) of Table 14 uses data from property transactions that occurred after the wind farm was approved by the McLean County Board and during the construction stage of the wind farm project (09/21/2005 – 02/01/2008). The coefficient of determination *(adjusted R-squared)* indicates that roughly 66.8% of the variation in *ln(Real Property Price)* can be explained by all of the explanatory variables taken together. The *F-statistic* is relatively large at 126 and is statistically significant at the 1% level. After the wind farm was approved by the McLean County Board and during the construction stage of the wind farm project, properties near the eventual wind farm site *(Near Wind Farm)* were valued 16.2% less on average than properties farther from the eventual wind farm site, and this result is statistically significant at the 1% level. This result[113] provides evidence to support wind farm anticipation stigma theory.

Column (3) of Table 14 uses data from property sales that occurred after Twin Groves I and II achieved commercial operations (02/02/2008 – 12/01/2009). The coefficient of determination *(adjusted R-squared)* indicates that roughly 61.8% of the variation in *ln(Real*

[113] The result being that properties near the wind farm *(Near Wind Farm)* sold at a much lower level in percentage terms than properties farther from the wind farm during the time period after the wind farm was approved and during construction (-16.2%), as compared with the time period before wind farm approval (-5.82%).

Property Price) can be explained by all of the explanatory variables taken together. The *F-statistic* is large at 63 and is statistically significant at the 1% level. Using only property transactions from the wind farm operational period, the value of properties located near the wind farm site *(Near Wind Farm)* were *not* statistically different on average from the value of properties located farther from the wind farm site, *ceteris paribus*. This does not provide any evidence to support or reject wind farm area stigma theory. Thus, if one used only property transactions occurring after the wind farm began operating, a great deal of information is lost (e.g., the fact that values were depressed in the area near the eventual wind farm site to begin with). The insignificance of the estimated coefficient of the property value impact variable when using only data from after the wind farm is in operation is a typical finding in the wind farm and property value impact literature. This loss of valuable information by using only data from wind farm operations clearly demonstrates the importance of taking into consideration the *location effect*, the relationship between property values near to and far from the eventual wind farm site before wind farm approval.

Table 14. Results: Separate Wind Farm Development Stages, {X,Y}-Coordinates

Dependent Variable: ln(Real Property Price)									
		Stage 1 (1)			Stage 2 (2)			Stage 3 (3)	
Square Feet *(1000s)*	40.49%	0.340	***	43.88%	0.364	***	33.41%	0.288	***
		(0.015)			(0.020)			(0.031)	
Garage	2.78%	0.027	***	2.79%	0.028	***	2.22%	0.022	***
		(0.005)			(0.007)			(0.008)	
Acre *(tenths)*	2.48%	0.025	***	1.80%	0.018	***	1.62%	0.016	**
		(0.004)			(0.006)			(0.008)	
Acres	7.16%	0.069	***	7.14%	0.069	***	9.75%	0.093	***
		(0.010)			(0.013)			(0.015)	
Age *(decades)*	-6.56%	-0.068	***	-7.25%	-0.075	***	-9.66%	-0.102	***
		(0.007)			(0.010)			(0.015)	
Age^2	0.24%	0.002	***	0.23%	0.002	***	0.43%	0.004	***
		(0.000)			(0.001)			(0.001)	
Fireplaces *(number)*	6.90%	0.067	***	5.94%	0.058	***	17.29%	0.159	***
		(0.016)			(0.023)			(0.025)	
Railroad Tracks	-11.15%	-0.118	***	-6.83%	-0.071	***	-9.87%	-0.104	***
		(0.020)			(0.026)			(0.037)	
Lakefront	42.08%	0.351	***	29.33%	0.257	***	4.65%	0.045	
		(0.074)			(0.100)			(0.088)	
Cul-de-sac	2.34%	0.023		6.14%	0.060	**	1.47%	0.015	
		(0.019)			(0.027)			(0.035)	
Trees	4.15%	0.041	**	3.16%	0.031		1.38%	0.014	
		(0.019)			(0.030)			(0.033)	
C *(Intercept)*		250.698	***		281.035	**		326.052	*
		(81.204)			(121.094)			(171.067)	
Near Wind Farm	-5.82%	-0.060	*	-16.2%	-0.177	***	-7.71%	-0.080	
		(0.037)			(0.052)			(0.072)	
n		2,036			1,121			694	
Time Period		1/1/01 - 9/20/05			9/21/05 - 2/1/08			2/2/08 - 12/1/09	
Adjusted R-squared		0.6846			0.6684			0.6183	
Std Error of Regression		0.2856			0.2970			0.3248	
Sum Squared Residuals		164.51			97.23			71.19	
Log Likelihood		-327.92			-220.24			-194.60	
F-statistic		246.42	***		126.43	***		63.36	***
Mean ln(RealPrice)		11.63			11.61			11.60	
Std Deviation ln(RealPrice)		0.51			0.52			0.53	
AIC		0.34			0.43			0.62	
Schwarz Criterion		0.39			0.51			0.74	
Durbin-Watson Statistic		1.93			1.97			1.83	

***denotes significance at 1% level **denotes significance at 5% level *denotes significance at 10% level

Notes: White Heteroskedasticity-Consistent Standard Errors & Covariance are in parentheses (White, 1980).
Base Group: Far from the wind farm.

2. RESULTS: SEPARATE WIND FARM STAGES, SCHOOL DISTRICTS

Table 15 contains estimation results by each stage of the wind farm development process using school district dummy variables as spatial controls for the housing submarkets. The full set of results may be found in Table E.3 of Appendix E.

Column (1) of Table 15 uses data from property transactions that occurred before wind farm approval, 01/01/2001 – 09/20/2005. The coefficient of determination *(adjusted R-squared)* indicates that roughly 68.2% of the variation in *ln(Real Property Price)* can be explained by all of the explanatory variables taken together. The *F-statistic* is relatively large at 208.9 and is statistically significant at the 1% level. Before the wind farm was approved, properties located near the eventual wind farm site *(Near Wind Farm)* were valued 17.7% less on average than properties located in *Lexington CUSD 7*, *ceteris paribus*; and this result is statistically significant at the 1% level. This result demonstrates the *location effect* that is *neither* due to the approval *nor* the presence of the wind farm. Thus, before the wind farm was even approved, properties located in the eventual wind farm area exhibited lower property values than properties in areas within *Lexington CUSD 7*. Before the wind farm was approved, properties located near the eventual wind farm site *(Near Wind Farm)* were valued less on average in percentage terms than properties located in the following school districts: *El Paso-Gridley CUSD 11, Heyworth CUSD 4, LeRoy CUSD 2, Lexington CUSD 7, Normal CUSD 5,* and *Trivalley CUSD 3* (see Column (15.1) of Table E.3 of Appendix E). Before the wind farm was approved, properties located near the eventual wind farm site *(Near Wind Farm)* were valued higher on average in percentage terms than properties located in the following school districts: *Blue Ridge CUSD 18, Gibson City-Melvin-Sibley CUSD 5, Prairie Central CUSD 8,* and *Ridgeview CUSD 19.*

Column (2) of Table 15 uses data from property transactions that occurred after the wind farm was approved by the McLean County Board and during the construction stage of the wind farm project (09/21/2005 – 02/01/2008). The coefficient of determination *(adjusted R-squared)* indicates that roughly 67% of the variation in *ln(Real Property Price)* can be explained by all of the explanatory variables taken together. The *F-statistic* is relatively large at 109 and is statistically significant at the 1% level. After the wind farm was approved and during the construction stage of the wind farm project, properties located near the eventual wind farm site *(Near Wind Farm)* were valued 19.1% less on average than properties located in *Lexington CUSD 7, ceteris paribus*; and this result is statistically significant at the 1% level. This result[114] supports wind farm anticipation stigma theory. After the wind farm was approved and during the construction stage of the wind farm project, properties located near the eventual wind farm site *(Near Wind Farm)* were valued less on average in percentage terms than properties located in the following school districts: *El Paso-Gridley CUSD 11, Gibson City-Sibley-Melvin CUSD 5, Heyworth CUSD 4, LeRoy CUSD 2, Lexington CUSD 7, Normal CUSD 5, Ridgeview CUSD 19,* and *Trivalley CUSD 3* (see Column (15.2) of Table E.3 of Appendix E). After the wind farm was approved and during the construction stage of the wind farm project, properties located near the eventual wind farm site *(Near Wind Farm)* were valued higher on average in percentage terms than properties located in the following school districts: *Blue Ridge CUSD 18* and *Prairie*

[114] The result being that properties near the wind farm *(Near Wind Farm)* sold at a lower level in percentage terms on average than properties that sold in *Lexington CUSD 7* during the post wind farm approval and construction stage (-19.1%) as compared to the before wind farm approval stage (-17.7%).

Central CUSD 8. Thus, wind farm anticipation stigma theory is strongly supported considering property value levels in percentage terms for the area near the eventual wind farm site were lower on average than those in a large number of school districts after the wind farm was approved and during the construction stage.

Column (3) of Table 15 uses data from property transactions that occurred after Twin Groves I and II achieved commercial operations (02/02/2008 – 12/1/2009). The coefficient of determination *(adjusted R-squared)* indicates that roughly 62% of the variation in *ln(Real Property Price)* can be explained by all of the explanatory variables taken together. The *F-statistic* is large at 54.72 and is statistically significant at the 1% level. The value of properties located near the wind farm *(Near Wind Farm)* during the operational stage of the wind farm project were not statistically different on average from the value of properties located in *Lexington CUSD 7*. Properties located near the wind farm *(Near Wind Farm)* during the operational stage of the wind farm project were valued higher on average in percentage terms than properties located in the following school districts: *Blue Ridge CUSD 18*, *El Paso-Gridley CUSD 11*, *Gibson City-Melvin-Sibley CUSD 5*, *Prairie Central CUSD 8*, and *Ridgeview CUSD 19* (see Column (15.3) of Table E.3 of Appendix E). Properties located near the wind farm *(Near Wind Farm)* that sold during the wind farm operational stage were valued less on average in percentage terms than properties located in *Trivalley CUSD 3*. These results provide sufficient evidence to reject the existence of wind farm area stigma theory.

Here, modest decrease in effect of proximity. got better, near null, once operational; close to RR far bigger effect
Interestingly, other variables that pushed price higher became far less powerful once wind farm operational (sq feet, and especially lakefront).

Table 15. Results: Separate Wind Farm Development Stages, School Districts

Dependent Variable: ln(Real Property Price)		Stage 1 (1)			Stage 2 (2)			Stage 3 (3)	
Square Feet *(1000s)*	41.32%	0.346	***	42.88%	0.357	***	33.65%	0.290	***
		(0.015)			(0.020)			(0.031)	
Garage	2.72%	0.027	***	2.61%	0.026	***	2.18%	0.022	***
		(0.005)			(0.007)			(0.008)	
Acre *(tenths)*	2.63%	0.026	***	1.86%	0.018	***	1.41%	0.014	*
		(0.004)			(0.006)			(0.008)	
Acres	7.48%	0.072	***	7.19%	0.069	***	9.24%	0.088	***
		(0.010)			(0.013)			(0.015)	
Age *(decades)*	-6.44%	-0.067	***	-7.28%	-0.076	***	-9.90%	-0.104	***
		(0.007)			(0.010)			(0.015)	
Age^2	0.24%	0.002	***	0.25%	0.002	***	0.45%	0.004	***
		(0.000)			(0.001)			(0.001)	
Fireplaces *(number)*	7.21%	0.070	***	6.38%	0.062	***	16.86%	0.156	***
		(0.016)			(0.023)			(0.025)	
Railroad Tracks	-10.3%	-0.109	***	-5.39%	-0.055	**	-7.93%	-0.083	**
		(0.020)			(0.025)			(0.037)	
Lakefront	39.33%	0.332	***	26.04%	0.231	**	1.69%	0.017	
		(0.074)			(0.097)			(0.085)	
Cul-de-sac	3.01%	0.030		6.23%	0.060	**	3.13%	0.031	
		(0.019)			(0.027)			(0.032)	
Trees	3.30%	0.032	*	3.33%	0.033		-0.78%	-0.008	
		(0.020)			(0.030)			(0.034)	
C *(Intercept)*		11.299	***		11.274	***		11.453	***
		(0.037)			(0.057)			(0.085)	
Near Wind Farm	-17.7%	-0.195	***	-19.1%	-0.212	***	-1.3%	-0.013	
		(0.042)			(0.060)			(0.080)	
n		2,036			1,121			694	
Time Period		1/1/01 - 9/20/05			9/21/05 - 2/1/08			2/2/08 - 12/1/09	
Adjusted R-squared		0.6821			0.6702			0.6195	
Std Error of Regression		0.2867			0.2962			0.3243	
Sum Squared Residuals		165.59			96.42			70.66	
Log Likelihood		-334.58			-215.60			-191.97	
F-statistic		208.90	***		109.40	***		54.72	***
Mean ln(RealPrice)		11.63			11.61			11.60	
Std Deviation ln(RealPrice)		0.51			0.52			0.53	
AIC		0.35			0.42			0.62	
Schwarz Criterion		0.41			0.52			0.76	
Durbin-Watson Statistic		1.96			2.01			1.90	

***denotes significance at 1% level **denotes significance at 5% level *denotes significance at 10% level
Notes: White Heteroskedasticity-Consistent Standard Errors & Covariance are in parentheses (White, 1980).
Base Group: Lexington CUSD 7.

3. RESULTS: SEPARATE WIND FARM STAGES, TOWNSHIPS

Table 16 contains estimation results by each stage of the wind farm development process using the township dummy variables as the spatial controls for the housing submarkets. The full set of results may be found in Table E.4 of Appendix E.

Column (1) of Table 16 uses data from property sales that occurred prior to wind farm approval, 01/01/2001 – 09/20/2005. Before the wind farm was approved, properties located near the eventual wind farm location *(Near Wind Farm)* were valued 18.24% less on average than properties located in *Lexington* township, *ceteris paribus*; and this result is statistically significant at the 1% level. This result demonstrates the *location effect* that is *neither* due to the approval *nor* the presence of the wind farm. Thus, before the wind farm was even approved, homes in the eventual wind farm area exhibited lower property values than homes in areas within *Lexington* township. Before the wind farm was approved, properties located near the eventual wind farm location *(Near Wind Farm)* were valued less on average in percentage terms than properties located in the following townships: *Blue Mound, Downs, Empire, Gridley, Hudson, Lawndale, Lexington, Money Creek, Oldtown, Randolph, Towanda,* and *West* (see Column (16.1) of Table E.4 of Appendix E). Before the wind farm was approved, properties located near the eventual wind farm location *(Near Wind Farm)* were valued higher on average in percentage terms than properties located in the following townships: *Anchor, Bellflower, Chenoa, Cropsey, Dix, Drummer, Martin, Peach Orchard, Sullivant,* and *Yates.*

Column (2) of Table 16 uses data from property sales that occurred after the wind farm was approved by the McLean County Board and during the construction stage of the wind farm project (09/21/2005 – 02/01/2008). After the wind farm was approved and during the construction stage of the wind farm project, properties located near the eventual wind farm site *(Near Wind Farm)* were valued 21.63% less on average than properties located in *Lexington* township, *ceteris paribus*; and this result is statistically significant at the 1% level. This result[115] supports wind farm anticipation stigma theory. After the wind farm was approved and during the construction stage of the wind farm project, properties located near the eventual wind farm site *(Near Wind Farm)* were valued less on average in percentage terms than properties located in the following townships: *Blue Mound, Downs, Drummer, Empire, Gridley, Hudson, Lawndale, Lexington, Martin, Money Creek, Oldtown, Randolph, Towanda,* and *West* (see Column (16.2) of Table E.4 of Appendix E). After the wind farm was approved and during the construction stage of the wind farm project, properties located near the eventual wind farm site *(Near Wind Farm)* were valued higher on average in percentage terms than properties located in the following townships: *Anchor, Bellflower, Chenoa, Cropsey, Dix, Peach Orchard, Sullivant,* and *Yates.*

Column (3) of Table 16 uses data from property transactions that occurred after Twin Groves I and II achieved commercial operations (02/02/2008 – 12/1/2009). During wind farm operations, the value of properties located near the wind farm *(Near Wind Farm)* were not statistically different on average from the value of properties located in *Lexington* township. Properties located near the wind farm *(Near Wind Farm)* during the operational stage of the wind farm project were valued higher on average in percentage terms than properties located in the

[115] The result being that properties near the wind farm *(Near Wind Farm)* were more depressed in value in than properties that sold in *Lexington* township during the post approval and construction stage (-21.63%) as compared to the before wind farm approval stage (-18.24%).

following townships: *Anchor*, *Bellflower*, *Blue Mound*, *Chenoa*, *Cropsey*, *Gridley*, *Martin*, *Peach Orchard*, *Sullivant*, and *Yates* (see Column (16.3) of Table E.4 of Appendix E). Properties located near the wind farm *(Near Wind Farm)* during the operational stage of the wind farm project were valued less on average in percentage terms than properties located in the following townships: *Downs* and *Oldtown.* These results provide sufficient evidence to reject the existence of wind farm area stigma theory.

similar to last one. wind farm proximity settles into nearly null

what do they call "near" here? within 3 miles?? or more likely, a scale as used before, decreasing distance

Table 16. Results: Separate Wind Farm Development Stages, Townships

Dependent Variable: ln(Real Property Price)									
		Stage 1 (1)			Stage 2 (2)			Stage 3 (3)	
Square Feet *(1000s)*	40.80%	0.342	***	42.77%	0.356	***	33.99%	0.293	***
		(0.015)			(0.020)			(0.030)	
Garage	2.77%	0.027	***	2.44%	0.024	***	2.12%	0.021	***
		(0.005)			(0.007)			(0.008)	
Acre *(tenths)*	2.80%	0.028	***	2.10%	0.021	***	2.06%	0.020	***
		(0.004)			(0.006)			(0.008)	
Acres	7.73%	0.074	***	7.30%	0.070	***	9.82%	0.094	***
		(0.011)			(0.014)			(0.015)	
Age *(decades)*	-6.27%	-0.065	***	-7.23%	-0.075	***	-9.29%	-0.097	***
		(0.007)			(0.010)			(0.015)	
Age^2	0.22%	0.002	***	0.24%	0.002	***	0.41%	0.004	***
		(0.001)			(0.001)			(0.001)	
Fireplaces *(number)*	7.04%	0.068	***	6.07%	0.059	***	15.00%	0.140	***
		(0.015)			(0.023)			(0.025)	
Railroad Tracks	-8.94%	-0.094	***	-4.60%	-0.047	*	-8.38%	-0.088	**
		(0.020)			(0.025)			(0.037)	
Lakefront	38.03%	0.322	***	26.81%	0.238	**	-0.63%	-0.006	
		(0.074)			(0.100)			(0.083)	
Cul-de-sac	3.87%	0.038	*	5.63%	0.055	**	2.14%	0.021	
		(0.020)			(0.027)			(0.032)	
Trees	2.75%	0.027		3.44%	0.034		-0.51%	-0.005	
		(0.021)			(0.031)			(0.034)	
C *(Intercept)*		11.296	***		11.301	***		11.404	***
		(0.039)			(0.059)			(0.086)	
Near Wind Farm	-18.24%	-0.201	***	-21.63%	-0.244	***	-0.79%	-0.008	
		(0.042)			(0.059)			(0.081)	
n		2,036			1,121			694	
Time Period		1/1/01 - 9/20/05			9/21/05 - 2/1/08			2/2/08 - 12/1/09	
Adjusted R-squared		0.6923			0.6786			0.6418	
Standard Error of Regression		0.2821			0.2924			0.3146	
Sum Squared Residuals		159.29			92.96			65.42	
Log Likelihood		-295.10			-195.08			-165.26	
F-statistic		139.77	***		72.66	***		39.80	***
Mean ln(Real Property Price)		11.63			11.61			11.60	
Std Dev ln(RealPrice)		0.51			0.52			0.53	
AIC		0.32			0.41			0.57	
SIC		0.42			0.56			0.79	
Durbin-Watson Statistic		1.98			2.02			1.93	

***denotes significance at 1% level **denotes significance at 5% level *denotes significance at 10% level

Notes: White Heteroskedasticity-Consistent Standard Errors & Covariance are in parentheses (White, 1980).

Base Group: Lexington Township.

4. SUMMARY OF SEPARATE WIND FARM STAGE ESTIMATIONS

The results of the individual wind farm development stage estimations using the various spatial controls have some commonalities. The estimations using only data from before wind farm approval (Column (1) of Tables 14-16) show that properties located near the eventual wind farm area exhibited lower property values on average than those of some of the other areas within McLean and Ford Counties; this demonstrates the *location effect* that is *neither* due to the approval *nor* presence of the wind farm. The results strongly support *wind farm anticipation stigma theory*. The results provide some evidence to reject the existence of *wind farm area stigma theory*.

D. SUMMARY OF TWO, THREE, AND SEPARATE WIND FARM STAGES ESTIMATIONS

Across all stages of wind farm development, property values near Twin Groves I and II *(Near Wind Farm)* were significantly higher on average than property values in *Blue Ridge CUSD 18* and *Prairie Central CUSD 8*. Across all stages of wind farm development, property values near the wind farm *(Near Wind Farm)* were significantly lower on average than property values in *Trivalley CUSD 3*. Although the rate of appreciation[116] for properties near the wind farm *(Near Wind Farm)* was significantly higher on average than the rate of appreciation for properties in *Trivalley CUSD 3*, property value levels near the wind farm *(Near Wind Farm)* were significantly lower on average than property value levels in *Trivalley CUSD 3*, across all stages of wind farm development. This suggests that it may be a good idea to look at the impact of a wind farm on a local housing market in terms of the appreciation rates of properties in addition to property value levels, both in comparison to other areas.

The rate of appreciation of property values near the wind farm *(Near Wind Farm)* was significantly lower on average than the rate of appreciation of property values in *Downs* township across all stages of wind farm development. In addition, across all stages of wind farm development, property value levels near the wind farm *(Near Wind Farm)* were significantly lower on average than property value levels in *Downs* and *Oldtown* townships.

The rate of appreciation of property values near the wind farm *(Near Wind Farm)* was significantly higher on average than the rate of appreciation of property values in *Cropsey* township across all stages of wind farm development. In addition, across all stages of wind farm development, property value levels near the wind farm *(Near Wind Farm)* were significantly higher on average than the property value levels in the following townships: *Anchor, Bellflower, Chenoa, Cropsey, Peach Orchard, Sullivant,* and *Yates.*

The results demonstrate that before Twin Groves I and II were even approved by the McLean County Board, properties near the eventual wind farm site *(Near Wind Farm)* were valued less on average than properties located farther away from the eventual wind farm site, and these results are statistically significant across all estimations. Thus, a *location effect* exists such that the wind farm happened to locate in an area that already exhibited depressed property values

[116] The appreciation rate for each area is calculated from the time period before the wind farm was approved by the McLean County Board to the time period in which the wind farm was fully operational.

in comparison to other areas within parts of McLean and Ford Counties. This result is further supported by the evidence of a declining population and a declining number of housing units that the areas near the wind farm have been experiencing for a number of years (e.g., see Tables 5 and 6 from Section V).

The results indicate that from the time period before Twin Groves I and II were approved by the McLean County Board to the time period after McLean County Board approval of the wind farm and during construction of Twin Groves I and II, the appreciation rate of property values near the eventual wind farm site *(Near Wind Farm)* may have been diminished in comparison to other surrounding areas because of the uncertainty as to how disruptive the wind farm facility would actually be[117]. In addition, after the wind farm was approved and during construction, properties located near the eventual wind farm site *(Near Wind Farm)* were valued less on average in percentage terms than properties located in many of the school districts and townships in the surrounding area. Thus, there is some evidence that supports *wind farm anticipation stigma theory*.

The results demonstrate that from the time period before the wind farm was approved to the time period in which the wind farm achieved commercial operations, the value of properties located near the wind farm site *(Near Wind Farm)* appreciated[118] at a greater rate on average than the value of properties located farther from the wind farm site, and this estimate is statistically significant across all estimations. Using various spatial controls, *wind farm area stigma theory* is strongly rejected. Thus, during the operational stage of the wind farm project, when property owners living close to the wind turbines actually had a chance to see if any of their concerns materialized, property values rebounded[119].

E. NUISANCE STIGMA ESTIMATION

Table 17 contains the estimation results investigating wind farm nuisance stigma (properties within one mile of a wind turbine) using the {X,Y}-coordinates for the spatial controls[120].

Column (1) of Table 17 contains the estimation results examining the time periods before wind farm operations and after the wind farm began operating. The estimated coefficient of interest in on the interaction term *1 mile, Wind Farm Operation* located in Column (1) of Table 17. From the time period before the wind farm was operational to the time period after the wind farm achieved commercial operations (*Wind Farm Operation*), the appreciation in the value of properties within one mile of the wind farm (*1 mile)* was *not* statistically different on average

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[117] Meaning property values may have diminished due to a fear of the unknown: a general uncertainty surrounding a wind farm project regarding the aesthetic impacts on the landscape, the actual noise impacts from the wind turbines, and just how disruptive the wind farm will actually be.

[118] The appreciation rate for each area is calculated from the time period before the wind farm was approved by the McLean County Board to the time period in which the wind farm was fully operational.

[119] Property values rebounded above their levels before approval of the wind farm.

[120] Only {X,Y}-coordinates are used for the spatial controls in the investigation of nuisance stigma rather than including the results for the school districts and townships for the sake of brevity (i.e., this report is already long enough as it is). If anyone is sincerely interested in the results from the test of nuisance stigma using the school districts and townships as spatial controls for the housing submarkets, please e-mail the author (HinmanJenL@gmail.com) and author will estimate the models and e-mail back the results. The results are not expected to be any different from those presented here.

than the appreciation in the value of properties in areas outside of one mile from the wind farm. Thus, the results presented in Column (1) of Table 17 neither support nor reject the existence of a wind farm nuisance stigma after the wind farm achieved commercial operations.

Column (2) of Table 17 contains the estimation results examining property value impacts for the time periods before wind farm approval, post wind farm approval and during wind farm construction, and after the wind farm achieved commercial operations. The first estimated coefficient of interest is on the interaction term *1 mile, Post WF Approval and Construction* located in Column (2) of Table 17. From the time period before the wind farm was approved to the time period after the wind farm was approved and during construction (*Post WF Approval and Construction*), the value of properties located within one mile of the wind farm (*1 mile)* appreciated 15.3% less on average than the value of properties located in areas outside of one mile of the wind farm, *ceteris paribus*; and this estimated coefficient is statistically significant at the 10% level. This result is consistent with wind farm anticipation stigma theory. Thus, there does appear to be some depression in the appreciation of property values within one mile of the wind farm (*1 mile)* after the wind farm was approved and during the construction stage of the wind farm development process (*Post WF Approval and Construction*), presumably because there was an increase in the level of risk as perceived by homebuyers. In addition, some of those residents located within one mile of the wind farm (*1 mile)* that did not want to live so close to the wind farm sold their houses and were willing to accept a lower value because they assumed the property was going to be devalued even more after the wind farm achieved commercial operations. Thus, the results support the existence of *wind farm anticipation stigma theory*, meaning that property values may have diminished due to the uncertainty surrounding a wind farm project regarding the aesthetic impacts on the landscape, the actual noise impacts from the wind turbines, and just how disruptive the wind farm will actually be.

The second estimated coefficient of interest is on the interaction term *1 mile, Wind Farm Operation* located in Column (2) of Table 17*.* From the time period before the wind farm was approved to the time period that the wind farm was fully operational *(Wind Farm Operation)*, the appreciation in the value of properties within one mile of the wind farm (*1 mile)* was *not* statistically different on average than the appreciation in the value of properties in areas outside of one mile from the wind farm. Thus, the results neither support nor reject the existence of a *wind farm nuisance stigma* after the wind farm achieved commercial operations. The author believes this to likely be due to only 11 properties selling during wind farm operations within one mile of the wind farm.

within 1 mile, minimal nuisance effect. about balances out presence of a garage or a tenth of an acre more land or presence of trees

Table 17. Nuisance Stigma Test

Dependent Variable: ln(Real Property Price)				
	2 Stage (1)		3 Stage (2)	
Square Feet *(1000s)*	0.339	***	0.339	***
Garage	0.027	***	0.027	***
Acre *(tenths)*	0.020	***	0.021	***
Acres	0.070	***	0.070	***
Age *(decades)*	-0.072	***	-0.072	***
Age^2	0.002	***	0.002	***
Fireplaces *(number)*	0.084	***	0.084	***
Railroad Tracks	-0.099	***	-0.100	***
Lakefront	0.262	***	0.263	***
Cul-de-sac	0.034	**	0.034	**
Trees	0.034	**	0.033	**
C *(Intercept)*	245.407	***	244.617	***
1 mile (properties sold located within 1 mile buffer of wind farm)	-0.049		0.010	
Post Wind Farm Approval and Construction (09/21/2005 - 02/01/2008)			0.008	
1 mile, Post WF Approval and Construction			-0.166	*
Wind Farm Operation (02/02/2008 - 12/01/2009)	-0.008		-0.005	
1 mile, Wind Farm Operation	0.030		-0.029	
X	-0.001	***	-0.001	***
Y	-0.001	***	-0.001	***
XY	0.000	***	0.000	***
X^2	0.000	***	0.000	***
Y^2	0.000	**	0.000	**
X^2Y^2	0.000	***	0.000	***
Adjusted R-squared	0.6616		0.6619	
Standard Error of Regression	0.2989		0.2988	
Sum Squared Residuals	342.16		341.72	
Log Likelihood	-803.09		-800.56	
F-statistic	377.39	***	343.58	***
Mean ln(Real Property Price)	11.62		11.62	
Standard Deviation ln(Real Property Price)	0.5138		0.5138	
Akaike Information Criterion	0.4280		0.4277	
Schwarz Criterion	0.4621		0.4651	
Durbin-Watson Statistic	1.90		1.90	

***denotes significance at 1% level **denotes significance at 5% level *denotes significance at 10% level

Notes: White Heteroskedasticity-Consistent Standard Errors & Covariance are in parentheses (White, 1980).

Base Group: Outside of 1 mile of TG I and II.

F. ANALYSIS OF RESULTS

The results demonstrate that before Twin Groves I and II were even approved by the McLean County Board, properties near the eventual wind farm site were valued less on average than properties located farther away from the eventual wind farm site, and these results are statistically significant across all estimations. Thus, a *location effect* exists such that the wind farm happened to locate in an area that already exhibited depressed property values in comparison to other areas within parts of McLean and Ford Counties. This result is further supported by the evidence of a declining population and a declining number of housing units that the areas near the wind farm have been experiencing for a number of years (e.g., see Tables 5 and 6 from Section V).

The results of this study provide some evidence that a transfer of welfare between buyers and sellers may have occurred[121]. As Kiel and McClain state "if a house was sold during a phase when fears of the facility depressed prices, the seller would suffer a capital loss. If those fears are later unrealized and prices rebound, that loss becomes the buyer's gain" (1995a, 242). The net effect on social welfare could potentially be zero as a result of this welfare transfer.

Some of the estimation results support the existence of *wind farm anticipation stigma theory*, meaning that property values may have diminished due to the uncertainty surrounding a wind farm project regarding the aesthetic impacts on the landscape, the actual noise impacts from the wind turbines, and just how disruptive the wind farm will actually be.

However, the results demonstrate that in comparison to properties in many of the surrounding areas in McLean and Ford Counties, properties in close proximity to Twin Groves I and II *(Near Wind Farm)* experienced higher appreciation rates[122], in addition to, higher property value levels (in percentage terms) after the wind farm achieved commercial operations *(Wind Farm Operation).* Thus, during the operational stage of the wind farm project, as surrounding property owners living close to the wind turbines acquired additional information on the aesthetic impacts on the landscape and actual noise impacts of the wind turbines to see if any of their concerns materialized, property values rebounded and soared higher in real terms than they were prior to wind farm approval. This may be due to the fact that residents of the local area became accustomed to them (e.g., the turbines became part of the landscape such as telephone poles do outside of homes) such that they do not even consider the wind turbines when moving to another house in the local area. In addition, environmentally conscious homebuyers may be

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[121] The results from the regression that includes the {X,Y}-coordinates and the three stages (Column (13.1) of Table E.1 in Appendix E) show that before TG I and II were approved by the McLean County Board, properties near the eventual wind farm site were valued less on average than properties farther away from the eventual wind farm site, *ceteris paribus*. From the time period before the wind farm was approved to the time period in which the TG I and II were approved by the McLean County Board and during construction of TG I and II, the value of properties located near the wind farm site experienced a lower appreciation rate on average than the value of properties located farther from the wind farm site, *ceteris paribus*. From the time period before the wind farm was approved to the time period in which the TG I and II achieved commercial operations, the value of properties located near the wind farm site appreciated at a greater rate on average than the value of properties located farther from the wind farm site, *ceteris paribus*. Thus, after TG I and II achieved full commercial operations, property values had rebounded and soared higher in real terms than even before wind farm approval.

[122] The appreciation in property values for each area is calculated from the time period before wind farm approval to the time period during wind farm operations.

attracted to the area because of the wind farm. Thus, *wind farm area stigma theory* is strongly rejected for the area surrounding Twin Groves I and II.

The author believes that to some extent the particular circumstances in which Twin Groves I and II developed contributed to the final results of this study (i.e., property values near TG I and II did not decline during wind farm operations). These particular circumstances include the following[123]:

- There was not much vocal opposition during the McLean County Zoning Board of Appeals public hearing.
- Property tax rates declined in the wind farm townships because of the huge new revenue stream that the wind farm generated in local property taxes.
- School districts received and still receive substantial property tax revenues from the wind farm and this may increase the attractiveness of the area for families.
- The wind farm developer was very upfront with area residents and explained the wind farm was going to have a *significant impact* on the area.
- Residents in the local area were very aware of the wind farm project before the ZBA hearing (i.e., the developer did not try to keep it a secret and the developer made an effort to inform area residents early on in the development process such that they were able to be included in the process and any concerns could be addressed).
- Nonparticipating landowners (no turbine on their property) in close proximity to a wind turbine have the option to sign a contract to receive "Good Neighbor Payments" over the life of the wind farm project.
- The wind farm developer's regional office (headquarters) is located in the local area. Thus, the wind farm supports the members of the community who work at the regional headquarters in addition to the local wind farm operation and maintenance jobs.
- Many local construction jobs were created during the construction period.
- Some of the construction materials were obtained from local companies which supports the local economy.
- There had not been much population growth in the immediate area surrounding the wind farm over the past century. PLACE IDENTITY IS TRADITIONAL, NOT RESTORATIVE
- There were not too many "pocket farms"[124] located in the immediate area surrounding the wind farm.
- Residents seemed interested in keeping the area farmland, rather than have a nearby city[125] expand over the territory.
- Residents seemed supportive of clean alternative energy, and appeared to prefer a wind farm move to the area over a coal or nuclear plant.
- There appeared to be a great deal of community outreach. The developer even made a donation to the Arrowsmith Fire Department to be used toward the purchase of an ambulance.
- Instead of building a new facility for the operation and maintenance center, the

[123] Some of these are based on the McLean County Zoning Board of Appeals hearing that the author listened to.
[124] Residential lots consisting of less than five acres.
[125] Bloomington-Normal

developer decided to convert an existing home in the community into their operation and maintenance facility, which allowed the facility to blend in nicely with the surrounding area.

Slovic states that "Research further indicates that disagreements about risk should not be expected to evaporate in the presence of evidence. Strong initial views are resistant to change because they influence the way that subsequent information is interpreted. New evidence appears reliable and informative if it is consistent with one's initial beliefs; contrary evidence tends to be dismissed as unreliable, erroneous, or unrepresentative" (1987, 281). Consequently, in areas where a large percentage of local residents strongly oppose the development of a wind farm; there is no reason to think that their opposition will end after the wind farm achieves commercial operation. Thus, the results from this study should *not* be extended to other areas[126] near proposed or operating wind farm projects[127].

VII. CONCLUSION

The estimation results provide evidence that a *location effect* exists such that before the wind farm was even approved, properties located near the eventual wind farm area were devalued in comparison to other areas. Additionally, the results show that property value impacts vary based on the different stages of wind farm development. These stages of wind farm development roughly correspond to the different levels of risk as perceived by local residents and potential homebuyers. Some of the estimation results support the existence of *wind farm anticipation stigma theory*, meaning that property values may have diminished due to a *fear of the unknown*: a general uncertainty surrounding a wind farm project regarding the aesthetic impacts on the landscape, the actual noise impacts from the wind turbines, and just how disruptive the wind farm will actually be.

However, during the operational stage of the wind farm project, as property owners, living in close proximity to Twin Groves I and II wind turbines, acquired additional information on the aesthetic impacts on the landscape and actual noise impacts of the wind turbines to see if any of their concerns materialized, property values rebounded and soared higher in real terms than they were even before wind farm approval. Thus, this study presents evidence that demonstrates close proximity to an operating wind farm does not necessarily negatively influence property value appreciation rates or property value levels (in percentage terms). The estimation results strongly reject the existence of *wind farm area stigma theory* for the area surrounding Twin Groves I and II. The results from this study are consistent with the results from a recent survey conducted surrounding Twin Groves I and II. A random sample of residents of the Ellsworth, Saybrook, and Arrowsmith communities were surveyed in 2009, during the time period that Twin Groves I and II were operational; and approximately sixty percent of respondents claimed they were not concerned about their property values declining because of the wind farm (Theron, 2010).

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[126] Property values may not rise in other areas immediately surrounding a wind farm.
[127] The results of this study should not even be extended to other areas within the same county.

It is recommended that authors of future studies take different stages[128] of wind farm development into consideration in their analyses to allow for more precise estimations of the property value impacts from a wind farm development. Furthermore, when examining the impact of a wind farm on surrounding properties, it is recommended to compare properties near the wind farm and farther away from the wind farm, in terms of both property value levels and the appreciation rates of property values. Many more studies of properties surrounding individual wind farms around the country are recommended using the methodology adopted in this study (i.e., pooled hedonic regression analysis with difference-in-differences estimators) such that general conclusions can start to form regarding this subject. Currently, the severe lack of statistical rigor, unbiasedness, and reliable methodologies across the wind farm proximity and property value studies cannot allow *any* general conclusions to be made—only site-specific findings.

[128] The different stages of wind farm development should model the changes in risk as perceived by local homebuyers. Depending on the number of operating wind farms in the state at the time of the wind farm proposal, it may be important to take into consideration a "rumor" stage in the analysis (i.e., to allow the property value impacts to vary by a rumor stage in addition to a post wind farm approval and construction stage).

APPENDIX A: COMMUNITY VIEWS AND SURVEYS

A. ILLINOIS STATEWIDE SURVEY

Theron and Winter[129] (2010) sent out surveys to several communities around the state of Illinois in an attempt to quantify the level of support and opposition to wind farms in central Illinois and to evaluate the impact of the proximity of a wind farm on opinions and attitudes. They found that proximity to wind energy projects does not influence the respondents' opinions. The majority of the respondents in central Illinois support wind energy and its development in their community, state, or country. They also support policies and mandates to help achieve this development. However, wind energy must be cost competitive with other energy resources to be widely acceptable to Illinois consumers (Theron and Winter, 2010).

Respondents stated that they were very concerned about the following characteristics of wind energy:

- "Interferes with telecommunications (Radio/TV/Internet service/Cell phone)" at 20.7%
- "Cost of power generated is expensive" at 19.3%
- "Takes farmland out of production" at 18.1%

82% agrees or strongly agrees with the following statement:
"I support the development of a wind farm in my community."

Respondents agree or strongly agree with the statements:
- "Wind farms are good for the environment" at 78%
- "Wind farms are good for job creation" at 72%
- "Wind farms are good for rural economic development" at 70%

67.5% agrees or strongly agrees that "Human activity has a major impact on global warming."
55% believe that the Federal government should have a mandate for renewable energy.

Thus, the level of support for wind energy in Illinois appears to be relatively high (Theron and Winter, 2010).

B. TWIN GROVES I AND II ZONING BOARD OF APPEALS HEARING

Although the author was not present during the Twin Groves I and II Zoning Board of Appeals Hearing, July 5 and 6, 2005, the author obtained a copy of the audio from those hearings in order to analyze the attitudes of members of the community during the wind farm approval

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[129] Theron, S., Winter, R., 2010. Public Beliefs and Attitudes Concerning Wind Farms in Central Illinois. Presentation at Peoria Civic Center - Peoria, IL. Illinois Wind Working Group – Siting, Zoning, and Taxing Conference. February 24, 2010.
The full report by Theron et al. (2010) is available at <http://renewableenergy.illinoisstate.edu/wind/publications/2010%20Public%20Attitudes%20Report%20FINAL.pdf>.

process. The Mendota Hills Wind Farm (63 turbines less than 1 MW each) in Lee County was the only wind farm operating in Illinois at the time of this hearing. A wind farm being located in the eastern part of McLean County was first mentioned in the local newspaper, *The Pantagraph*, in February of 2002.

The attorney for the wind farm developer started out the hearing by saying that the company does not want to hide anything from anybody and that this wind farm proposal is a significant project and it *will* have a significant impact on the area in which it is located. There also appeared to be a great deal of community outreach by the developer. The developer even made a donation to the Arrowsmith Fire Department toward the purchase of an ambulance.

There were about eight people during the first half of the first hearing that had general questions for the developer regarding a variety of issues, including the following: environmental benefits of wind energy, power purchasers, vibrations, TV interference, sounds, blade throws during fierce tornados, transferability of lease agreements, reasons for height limitations surrounding population centers with greater than 20,000 people, impact on community-based wind projects, concerns regarding request to allow turbines to be 400 feet from an R1-zoned district, road agreements, property tax assessment, decommissioning, and property value guarantee. Other issues raised during the testimony portion of the ZBA hearing include aerial spraying, ice throws, drainage, careful placement of towers, application should be posted on a website[130], visual impact, shadow flicker, and school district benefits. Though the list of concerns may seem rather large, these are fairly typical questions, especially in a state that had only one wind farm operating at that time. There were not many objectors who actually spoke out against the wind farm and said that it should not be approved.

One resident of a local village asked what the towers are going to do to the property values in Ellsworth with the towers sitting so close to the town. The resident noted that there are some people now that do not want to live in Ellsworth, which is out of town, and that is normal. There are a lot of people who want to live in the city limits and do not want to live 12 miles out of town. The resident asked the developer if they were going to guarantee that their properties are going to be valued the same after the towers are put up. The developer's attorney stated that of course not, there cannot be a property value guarantee because there may be a lot of reasons that people may not want to live out of town in Ellsworth, as the resident had previously noted. The attorney claimed that it would be virtually impossible to separate out property value impacts due to the wind farm and those resulting from Ellsworth's out-of-town location.

Based on comments from the hearing, it seemed as if most residents had been made aware of the proposed wind farm early in the process. However, there was one person who gave testimony on behalf of a property owner that stated they were unaware of any plans for the wind farm until June 13, 2005. The property owner resides out of state and does not follow the local media.

There appeared 16 articles in *The Pantagraph*, a local newspaper, mentioning the potential for a wind farm in eastern McLean County before the Public Hearing article on June 21, 2005. The Public Hearing took place on July 5, 2005 and July 6, 2005. On July 6, 2005, the McLean County Zoning Board of Appeals voted to recommend the approval of the special-use permit in case SU-05-09 because it met all the standards found in the McLean County Zoning Ordinance provided the following conditions were met[131]: "1) a mitigation agreement is made

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[130] The author strongly agrees with this issue of having the application posted on a website.
[131] Available at <http://www.mcleancountyil.gov/boardnotes/pdf/September2005/pro.pdf>.

between the applicant and Craig and Rose Grant to provide a planting screen between two proposed wind turbines in Section 36 in Dawson Township and the Grant property; 2) no wind turbine tower is located closer than 600 feet to the nearest R-1 Single Family Residence District boundary as measured from the tip of the turbine blade; 3) a written road agreement is approved by the County Board and Dawson, Arrowsmith, and Cheney's Grove Townships as a condition of this approval; and 4) the following has occurred after completion of Phase I and before beginning Phase II: 1) the applicant has requested a meeting with the Director of Building and Zoning; 2) a meeting takes place with the applicant and staff of the McLean County Department of Building and Zoning where the applicant will adequately address problems or concerns that are identified through Phase I by the Director of Building and Zoning; and 3) any items brought up at this meeting that cannot be adequately addressed according to the Director of Building and Zoning will need to be appealed to the Zoning Board of Appeals for resolution at their next available meeting; and the applicant will provide engineering plans certified by a registered engineer that each tower and wind turbine is designed and built according to appropriate national standards." The McLean County Board approved the special-use permit September 20, 2005. As part of the permit, the developer received permission to go beyond the one-year construction deadline for each phase of the project. The permit gave the developer three years to build the first phase and five years for the second phase.

C. Twin Groves IV and V Zoning Board of Appeals Hearing

In preparation for this project and in order to see first-hand the attitudes and general sentiment of the community, the author attended the first three Twin Groves IV and V Zoning Board of Appeals Hearings in late October of 2009. The author obtained a copy of the audio to listen to the last hearing which the author was not able to attend. Consideration of a third phase of the wind farm was first mentioned in the local newspaper, *The Pantagraph,* in September of 2006, though no locations were given. In May of 2007, *The Pantagraph* newspaper mentioned that the developer may proceed with an expansion of about 48 towers near Colfax and Anchor townships, conditional on the test towers reporting favorable wind conditions over the next one to three years. There were over 1,000 MW of wind energy in Illinois at the time of these hearings, as compared with less than 60 MW just four years before.

There were approximately six landowner dinners from March of 2008 through June of 2009 and there were four open houses. Even though there were a number of dinners and informational meetings, many of the residents that testified during the hearing seemed to have been left in the dark regarding the projected locations of the wind turbines.

These hearings were completely different from the ones that occurred just four years earlier. There were a large number of supporters at the meetings and many that spoke out; however, there were also quite a few local residents that were opposed to the wind farm development. One supporter that the author spoke with stated he was able to pay off his house after working during the construction phases of Twin Groves I and II. Some benefits that supporters mentioned include: tax rate lowered in Cheney's Grove, Arrowsmith, and Dawson townships, significant revenue streams for the school districts, and around 45 permanent employees running the operations and maintenance center.

The reasons for the opposition include the following: aerial applicator concerns; low frequency noise vibrations; health concerns; economic development; noise; road agreements and repairs; setbacks from a turbine to the nearest residence; amount of energy actually produced; the electricity grid not being "smart" enough to efficiently utilize the intermittent renewable energy (e.g., there still has to be nuclear or coal power to back up the renewable energy when the wind doesn't blow); residents did not want to look at the turbines next to their homes; and lack finalized turbine choice and placement plans. Many of the residents have lived their entire lives in McLean County and enjoy living out in the country without towers "obstructing" their view. Interestingly, even though Twin Groves IV and V would be adjacent to Twin Groves I and II, those opposed to Twin Groves IV and V did not appear bothered at all by the already constructed Twin Groves I and II.

D. REALTOR SURVEY

A local real estate agent with 23 years of experience was consulted regarding the local real estate market. A questionnaire was completed and a discussion followed. This section will not go through every single question from the survey, but will provide some of the more interesting and useful responses that can help with understanding the estimation results better. In general, the realtor has not noticed any impact on home values due to the wind farm. Based on experience, the realtor was completely confident that there has been zero impact from the wind farm on housing values at a distance greater than three miles[132].

The realtor's responses tend to support the findings from the estimations and provide some background knowledge that helps explain some of the signs on the school district and township estimated coefficients. The top three townships considered to be prime home location spots: (1) *Oldtown*, desirable lots with trees and great schools; (2) *Downs*, desirable lots with trees and great schools; (3) *Hudson*, proximity to Bloomington/Normal and great schools. The top three villages considered to be prime home location spots: (1) Downs, rolling landscape and trees and great schools (*Trivalley CUSD 3*); (2) Hudson, proximity to Bloomington/Normal and great schools (*Normal CUSD 5*); and (3) Heyworth, larger lots with trees and good schools *(Heyworth CUSD 4)*. Thus, the top school districts within the study area include *Normal CUSD 5*, *Trivalley CUSD 3*, and *Heyworth CUSD 4*.

The top three characteristics of a home in the local area that have a positive impact on its value: (1) lot characteristics, private yard, non-busy street; (2) school district; and (3) effective age, age of roof, furnace, AC, electrical, and plumbing. The top three characteristics of a home in the local area that have a negative impact on its value: (1) located near a busy street, railroad, airport, etcetera; (2) zoning issues other than residential low density; and (3) undesirable school district. The realtor believed there were definitely going to be wind farms in the eastern part of McLean County in 2005. The realtor stated that a few clients have mentioned wind farms, but mainly as a "point of interest" regarding area current events and the comments were more positive to indifferent. The realtor is not aware of any change in time-on-the-market for homes located within the wind farm townships as compared with other comparable townships. However, the realtor noted that since the recession (housing market crisis), time-on-the-market has increased in pretty much all areas.

When asked about areas in Dawson township, and near Dawson Lake, the realtor stated that there is a big variance in the type of houses constructed (square feet, quality, etcetera). A

[132] A map of the study area with various distance buffers surrounding the wind farm was given to the realtor to examine.

person may move to areas near Dawson Lake if they want privacy, but in general, it is a little far for work. The author concluded that when comparing the *Downs* and *Oldtown* area to the west of the wind farm, with the Dawson area *(Near Wind Farm)*, both of which are primarily in *Trivalley CUSD 3*, there are significant differences in the way homebuyers value the two areas.

The realtor stated that, if anything, the wind farm has likely helped the local communities in which it resides because of the vast amount of property tax revenues it provides to the local school districts.

E. Appraiser Survey

A local McLean County appraiser with 17 years of experience was consulted regarding the local real estate market. The appraiser stated that there has been no evidence of a negative impact on property values from the wind farm. In addition, an appraiser located in the Gibson City area of Ford County has not seen any negative impact on property values from the wind farm.

A local landowner whose property has three wind turbines on it was looking to purchase some additional farmland and found out from an appraiser that farmland with wind turbines is selling for a premium in the local area. This is likely due to the guaranteed income stream the wind turbines provide over the 30-year life of the turbines.

Appendix B: Data Description and Modeling Assumptions

A. Data Acquisition and Validity

Data quality is the most important aspect of any statistical analysis. Quantity of data is also important; however, quantity of data is useless without quality. Thus this study tried to ensure the highest quality of data. The first data collection approach for this study involved obtaining an electronic copy of the sales from the Supervisor of Assessments and manually inputting characteristics using Multiple Listing Service information (thank you Su Hu). It turned out that not all sales were included in MLS so a trip to the Supervisor of Assessments office became inevitable. The manual pulling of property record cards revealed significant differences between the MLS square footage and the official square footage reported on the property record cards. This result was unacceptable and accordingly MLS property characteristic data were not used in this analysis.

The property sales and a portion of the property characteristic data used in this analysis were obtained from the McLean County Supervisor of Assessments and the Ford County Supervisor of Assessments Offices (2010).

All geographic analyses (e.g., distance calculations) were performed using the NAD_1983_StatePlane_Illinois_East_FIPS_1201 Projected Coordinate System.

NAD_1983_StatePlane_Illinois_East_FIPS_1201 Projected Coordinate System
Transverse Mercator Projection
Linear Unit: Meter
Projection: Transverse Mercator

False Easting: 300000.00
False Northing: 0.00
Central Meridian: -88.33
Scale Factor: 0.99997500
Latitude Of Origin: 36.667
Linear Unit: Meter
GCS_North_American_1983 Geographic Coordinate System
D_North_American_1983 Datum
Prime Meridian: Greenwich
Angular Unit: Degree

All maps included in this report as well as distance calculations were produced using ESRI® ArcMap™ 9.3 (2010). Ford County townships, roads, and hydrology shapefiles were obtained from the U.S. Census TIGER (2000) Topologically Integrated Geographic Encoding and Referencing system (http://www.census.gov/geo/www/tiger/). Illinois cities, major roads, and railroad shapefiles were obtained from the Illinois Natural Resources Geospatial Data Clearinghouse (2010) website (http://www.isgs.uiuc.edu/nsdihome/).

McLean County Geographic Information Systems (GIS) data were obtained from the McLean County Regional GIS Consortium (McGIS, 2010) (http://www.mcgis.org/). Parcel Identification Numbers (PIN) of the properties that sold, based on the data from the Assessor's office, were joined with the PIN shapefile to enable to the geographic location of the properties. A point shapefile was created to more precisely identify home locations within the parcels (this allows for greater accuracy in distance calculations, which is especially important for homes located in very close proximity to wind turbines). The {X,Y}-coordinates of the home locations from the point shapefile are included in the regression model to control for spatial trends. The following steps were taken to create a point shapefile for the homes that sold in McLean County: A parcel centroid (i.e., center point of a polygon) was calculated for each parcel. A building shapefile was obtained from McGIS and a building centroid was calculated for each building. Parcels that sold that contained one building received the building centroid {X,Y}-coordinates (~1300). Many parcels contained more than one building and several approaches were applied for those cases. If the parcel contained a building that was coded with an address, then the addressed building centroid {X,Y}-coordinates were chosen as the home location (~1219). In general, parcels that sold that did not have buildings coded or had more than one building (without addresses), were given the parcel centroid {X,Y}-coordinates. Oddly, there were about 11 parcels that contained multiple buildings with multiple addresses within each parcel; most of these were given the parcel centroid {X,Y}-coordinates. Properties that sold within five miles of the wind farm that had more than one building within the parcel were analyzed visually and given the appropriate building centroid {X,Y}-coordinates (~4). Overall, the building centroid assignments tremendously improved distance from the home accuracy over the typical parcel centroid (as was apparent by comparison of the distance calculations and visually inspecting the county orthophoto files).

Unfortunately, neither parcel nor building GIS data were available for the property transactions that occurred in Ford County. Geocoding of addresses to Latitude/Longitude was completed through the fantastic Stephen P. Morse website (2006) (https://stevemorse.org/jcal/latlonbatch.html?direction=forward) using the data provided by Google Maps (2010). The data was first transformed from WGS_1984 to

GCS_North_American_1983 using the NAD_1983_To_WGS_1984_5 transformation for the Continental U.S., and then projected to NAD_1983_StatePlane_Illinois_East_FIPS_1201. Several points did have to be manually moved to their correct location, but this was likely due to address recognition issues or formatting. It is recognized that the Ford County property locations are much less precise than those of the McLean County properties. The author thinks this does not have any impact on the estimation results since the Ford properties are located farther away from the turbines (and are thus classified as such in the estimations).

A viewshed calculation that takes into account surface elevation and turbine height was performed. It suffered from severe inaccuracies, and thus was not ultimately included in the model (e.g., land 35 miles away was considered to be in the viewshed of the turbines). Unfortunately, LIDAR data was not available for the rural areas of the county. LIDAR data takes into consideration trees, houses, and heights of other objects which may obstruct the view one has of the wind turbines.

B. VARIABLE CONSTRUCTION

The dummy variables for *Railroad Tracks* and *Lakefront* were created by first spatially joining railroad tracks (lines) and lakes (polygons) to the properties that sold (points) which created a distance field to the nearest line (railroad) and polygon (lake). Then dummy variables were created based on this distance field. *Railroad Tracks* is a dummy variable in which a value of 1 indicates the home is located within 180 meters (590.55 feet) of railroad tracks. A distance of 180 meters was chosen by viewing a map of the houses located near railroad tracks and determining the distance in which adjacent homes are positioned from the railroad tracks. *Lakefront* is a dummy variable (binary) such that a value of 1 indicates properties that sold that were less than 70 meters (229.66 feet) from a lake, and a 0 value otherwise. A distance of 70 meters was chosen as a proxy for lakefront because time would not permit individually viewing and visiting each property close to a lake or pond. Thus, a distance of 70 meters was chosen by viewing a map of the houses located next to lakes and determining the distance that adjacent homes are typically positioned from the lake.

Cul-de-sac is a dummy variable such that a value of 1 indicates properties that sold that were located close to a cul-de-sac. This variable was created by first coding all properties that were located in a court. Then visual inspection of the road layout via GIS software allowed for manual coding of the properties.

A land cover raster for the study area was downloaded from the National Land Cover Database 2001 (U.S. Geological Survey, 2001). The raster was converted to a point shapefile, consisting of 8,636,334 points (the polygon shapefile had 95,168 objects). Points coded as Deciduous Forest or Evergreen Forest were exported to a new shapefile and a spatial join was performed from the properties that sold to the points. A distance field to the near forest point resulted. A dummy variable named *Trees* was created such that homes located within a distance of 180 meters (590.55 feet) from a forest point receive a value of 1, and 0 otherwise. Please note that not every home that has a tree on their property is reflected in this variable. A distance of 180 meters was chosen by viewing a map of the houses located close to trees and determining the distance in which the homes are positioned from the trees.

Distance from the home to the nearest turbine was determined by spatially joining the wind turbines to the properties that sold. Thus, each property received the distance measured from the nearest turbine to the property[133]. The wind turbine locations were obtained from the county (McGIS, 2010) and the developer (Horizon Wind Energy, 2010). A dummy variable named *Near Wind Farm* was created such that homes located within a three mile buffer of the wind farm receive a value of 1, and 0 otherwise. A local real estate agent with over 23 years of experience was consulted regarding the local real estate market. In general, the realtor had not noticed any impact on home values due to the wind farm. The realtor felt confident that there had been zero impact from the wind farm on housing values at a distance greater than three miles[134].

The author visited all of the areas within three miles of the wind farm. It turned out that nearly all properties that sold within three miles of the wind farm that were not located within a village had a clear view of the wind farm towers. A view of the wind turbines was possible from a large portion of homes within the villages of Ellsworth and Arrowsmith. One of the closest located homes in Ellsworth to a wind turbine actually sold for a higher price (and multiple times over the study period) than all of the other homes within the village. This fact gives some indication that a direct view of the wind turbines may not be of much concern compared with the actual characteristics of the property.

In Saybrook village, a view of the wind turbines was not possible from many homes; e.g., if one were to look up inside the village, one probably could not see any wind turbines. Saybrook is the largest of the three villages near the wind farm and it even has a gas station. The trees within and around the village, as well as the closeness of houses, effectively block out the view of the turbines from a large portion of the houses.

The variety of houses on any given street was quite interesting; e.g., a newly constructed home, nice paint job, great lawn can be located right next to a 100 year old home with horrible landscaping that looks like it is falling apart. The diversity within the houses on any particular street in the villages further confirmed the recommendation by the appraiser of excluding the property sales below $25,000.

While visiting the areas near the wind farm, t he author listened to get an idea of the noise level from the wind turbines. The road noise in particular as well as the sound the wind makes in general majorly overpowered any sound from the turbines. The author did note some houses from which the author could hear a light whooshing sound and the distance from the house to the turbines. However, on days that are more windy, the sound would likely travel farther, thus the author does not think trying to incorporate sound into the model is a viable option at this time.

C. SPATIAL EFFECTS

Spatial dependence or spatial autocorrelation exists when there is a lack of independence among cross-sectional units' relative space or location (multi-directional); i.e., the existence of a functional relationship between what happens at one point in space and what happens elsewhere (Anselin, 1988). The standard rule of thumb is that autocorrelation is a problem in time series data, temporal autocorrelation. However, there are many instances in which an entity's location

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[133] The point shapefile that was created for the home locations was used to increase the accuracy of the distance calculations.

[134] A map of the study area with various distance buffers surrounding the wind farm was given to the realtor to examine. The realtor sold many properties at a distance just outside of three miles from the wind farm, which explains the level of confidence.

affects its behavior. Housing prices are a prime example: clearly the location of the house will have an effect on its selling price. In the case of housing prices, the location factors are called neighborhood effects (Dubin, 1998). If the location of the house influences its price, then the possibility arises that nearby houses will be affected by the same location factors. Any error in measuring these factors will cause their error terms to be correlated.

The consequences of spatial autocorrelation are the same as those of time series autocorrelation: the OLS estimators are unbiased but inefficient, and the estimates of the variance of the estimators are biased. Thus the precision of the estimates as well as the reliability of hypotheses testing can be improved by making a correction for autocorrelation (Dubin, 1998). Once the structure of the autocorrelation has been estimated, this information can be incorporated into any predictions, thereby improving their accuracy. Just as with time series autocorrelation, maximum likelihood (ML) techniques are commonly used to estimate the autocorrelation parameters and the regression coefficients. Despite the similarities, spatial autocorrelation is conceptually more difficult to model than time series autocorrelation, because of the ordering issue. In a time series context, the researcher typically assumes that earlier observations can influence later ones, but not the reverse. In the spatial context, an ordering assumption such as this is not possible: if A affects B, it is likely that the reverse is also true. Also, the direction of influence is not limited to one dimension as in time series, but can occur in any direction (Dubin, 1998). There are two commonly used methods of modeling the autocorrelation structure. The first is to model the process itself. This approach is based on the work of geographers (Cliff and Ord, 1981) and requires the use of a weight matrix (Dubin, 1998). This approach is probably the more common of the two in the real estate literature. The second approach is to model the covariance matrix of the error terms directly. This approach is based on the work of geologists (Matheron, 1963) and has also been used in the real estate literature. There are many complicated techniques to take care of this issue (Dubin, 1998). However, these complicated techniques introduce some major assumptions, such as an identification of the structure of the autocorrelation itself, of which may be virtually impossible to really know. So it is very important to note that although outcomes from adjacent units are likely to be correlated, if the correlation arises mainly through the explanatory variables (as opposed to unobservables), then nothing needs to be done on a practical level (Wooldridge, 2002). When the unobservables are correlated across nearby geographical units, OLS can still have desirable properties—often unbiasedness, consistency, and asymptotic normality can be established (Wooldridge, 2002). Thus, this analysis assumes that any correlation arises mainly through the explanatory variables rather than unobservables and a spatial weights matrix is not adopted.

Spatial heterogeneity[135] exists when there is a lack of stability over space of the relationships, i.e., functional forms and parameters vary with location and are not homogenous throughout the dataset (Anselin, 1988). Several conditions would lead to this: a byproduct of measurement errors for observations in contiguous spatial units and the existence of a variety of spatial interaction phenomena (Anselin, 1988). Please see Section IV for more details regarding spatial heterogeneity.

Several measures that address the spatial aspects were utilized in this analysis. The {X, Y}-coordinates were included in some of the models to address the impact that absolute location

[135] Distinguishing between spatial dependence (autocorrelation) and spatial heterogeneity can be a highly complex problem.

has on property values and to model any spatial trends. Township dummy variables were utilized in some of the models as proxies for the housing submarkets. School district dummy variables were utilized in some of the models as proxies for the housing submarkets. These three specifications were utilized to demonstrate the results were robust to either specification.

D. ASSUMPTIONS

The least controversial assumption is that a house is a bundle of size, quality, and locational characteristics (Malpezzi et al., 1980). The value of a property "stems from the quantity and type of characteristics it contains, and that the 'prices' of the characteristics can be estimated from the… values of many units via multivariate regression analysis" (Malpezzi et al., 1980, 11). It is assumed that the data were obtained as a random sample. Homoskedasticity assumption states that the variance of the unobservable error conditional on the explanatory variables is constant. Homoskedasticity fails whenever the variance of the unobservables changes across different segments of the population, where the segments are determined by the different values of the explanatory variables (Wooldridge, 2009). If the homoskedasticity assumption fails, and heteroskedasticity is present, then the estimators of the variances are biased[136], and consequently the OLS standard errors based directly on those variances are no longer valid for constructing confidence intervals and *t-statistics.* OLS *t-statistics* no longer have *t*-distributions and *F-statistics* are no longer *F*-distributed. Fortunately, heteroskedasticity-robust procedures have been developed that adjust standard errors and the corresponding test statistics that rely on the standard errors such that that they are valid in large samples regardless of the kind of heteroskedasticity present in the population (Wooldridge, 2009). Accordingly, White heteroskedasticity-robust standard errors are reported and utilized in determining the statistical significance of the estimated coefficients (White, 1980). It is assumed that each explanatory variable changes over time and no perfect linear relationships exist among the explanatory variables. It is assumed that the explanatory variables are strictly exogenous, conditioned on the unobserved effect. For each time period, the expected value of the idiosyncratic error given the explanatory variables in all time periods and the unobserved effect is zero.

[136] When an estimator is unbiased, one expects to estimate the "true" value of the parameter on average. In other words, if random samples are drawn from the population over and over, and an estimate is computed each time, and then an average of these estimates is taken over all random samples, then this average would equal the "true" parameter (Wooldridge, 2009). When an estimator is consistent, adding more observations gives more precise estimators. Thus, a sufficiently large sample is important such that the estimated coefficients are arbitrarily close to the "true" parameters. If a regressor (explanatory variable) is correlated with the error term, the estimator no longer has these desirable properties.

APPENDIX C. DESCRIPTIVE STATISTICS: CROSS TABULATIONS

Table C. 1. Near and Far from TG I and II and 2-Stage Wind Farm Development Cross Tabulations

Wind Farm Stages		*n*	RealPrice Mean	RealPrice Median	RealPrice Max	RealPrice Min.	RealPrice Std. Dev.	ln(RealPrice) Mean	ln(RealPrice) Median	ln(RealPrice) Max	ln(RealPrice) Min.	ln(RealPrice) Std. Dev.
Before WF Operations	Far WF	3,011	127,694	117,199	399,314	25,047	63,867	11.63	11.67	12.90	10.13	0.51
Before WF Operations	Near WF	146	105,778	95,385	344,704	30,146	49,006	11.46	11.47	12.75	10.31	0.47
Before WF Operations	All	3,157	126,680	115,797	399,314	25,047	63,418	11.63	11.66	12.90	10.13	0.51
WF Operation	Far WF	663	125,206	114,756	398,154	25,932	64,340	11.61	11.65	12.90	10.16	0.53
WF Operation	Near WF	31	116,814	124,342	211,550	30,000	42,814	11.59	11.73	12.26	10.31	0.45
WF Operation	All	694	124,831	114,834	398,154	25,932	63,536	11.60	11.65	12.90	10.16	0.53
All	Far WF	3,674	127,245	116,530	399,314	25,047	63,951	11.63	11.67	12.90	10.13	0.52
All	Near WF	177	107,711	98,576	344,704	30,000	48,050	11.49	11.50	12.75	10.31	0.46
All	All	3,851	126,347	115,390	399,314	25,047	63,435	11.62	11.66	12.90	10.13	0.51

Notes: n=# of observations; Std. Dev.=Standard Deviation; Max=Maximum; Min.=Minimum; ln=natural logarithm;
RealPrice=Real Price of Property in 2009 Q2 $; ln(RealPrice)=Natural Logarithm of the Real Price of Property in 2009 Q2 $, dependent variable;
Near WF=Near Twin Groves I & II=Near Wind Farm=1 if property located near the wind farm, 0 otherwise;
Far WF=Far Twin Groves I & II=1 if property located near the wind farm, 0 otherwise;
Before WF Operations=Before both Twin Groves I and II achieved commercial operation=01/01/2001 – 02/01/2008;
WF Operation=Wind Farm Operation=Both Twin Groves I and II achieved commercial operation=02/02/2008 – 12/01/2009.

Table C. 2. Near and Far from TG I and II and 2-Stage Wind Farm Development Cross Tabulations

Wind Farm Stages		n	SQFT Mean	SQFT Median	SQFT Max	SQFT Min.	SQFT St. Dev.	Garage Mean	Garage Median	Garage Max	Garage St. Dev.	Acreage Mean	Acreage Median	Acreage Max	Acreage Min.	Acreage Sum.	Acreage St. Dev.
Before WF Operations	Far WF	3,011	1.51	1.40	4.05	0.43	0.54	2.47	2.67	11.20	1.68	0.54	0.29	13.64	0.04	1616.26	0.93
Before WF Operations	Near WF	146	1.55	1.44	3.90	0.58	0.63	1.46	0.00	9.50	1.85	1.62	0.55	12.73	0.11	237.23	2.33
Before WF Operations	All	3,157	1.51	1.40	4.05	0.43	0.55	2.43	2.67	11.20	1.70	0.59	0.30	13.64	0.04	1853.49	1.06
WF Operation	Far WF	663	1.51	1.39	3.71	0.56	0.51	2.63	2.80	16.67	1.75	0.57	0.30	10.00	0.08	378.18	0.91
WF Operation	Near WF	31	1.38	1.32	2.14	0.62	0.40	1.65	1.71	6.00	1.66	2.09	1.10	6.84	0.13	64.69	2.14
WF Operation	All	694	1.51	1.39	3.71	0.56	0.51	2.59	2.69	16.67	1.75	0.64	0.32	10.00	0.08	442.87	1.04
All	Far WF	3,674	1.51	1.40	4.05	0.43	0.54	2.50	2.68	16.67	1.70	0.54	0.30	13.64	0.04	1994.44	0.93
All	Near WF	177	1.52	1.40	3.90	0.58	0.60	1.49	0.00	9.50	1.81	1.71	0.61	12.73	0.11	301.92	2.30
All	All	3,851	1.51	1.40	4.05	0.43	0.54	2.46	2.67	16.67	1.71	0.60	0.30	13.64	0.04	2296.36	1.06

Notes: n=# of observations; St. Dev.=Standard Deviation; Max=Maximum; Min.=Minimum; SQFT=Square Feet=above grade living area of the dwelling in 1000s of square feet;
Garage=area of the garage in 180s of square feet, approximately the number of standard cars that can fit in the garage; Acreage=total number of acres of the property; Sum.=Summation or Total;
Near WF=Near Twin Groves I & II=Near Wind Farm=1 if property located within 3 mile buffer of wind farm, 0 otherwise;
Far WF=Far Twin Groves I & II=1 if property located outside of 3 mile buffer of wind farm, 0 otherwise;
Before WF Operations=Before both Twin Groves I and II achieved commercial operation=01/01/2001 – 02/01/2008;
WF Operation=Wind Farm Operation=Both Twin Groves I and II achieved commercial operation=02/02/2008 – 12/01/2009.

Table C. 3. Near and Far from TG I and II and 2-Stage Wind Farm Development Cross Tabulations

Wind Farm Stages		*n*	Year Built Mean	Year Built Median	Year Built Max	Year Built Min.	Year Built Std. Dev.	Fireplaces Sum.	RR Tracks Sum.	Lakefront Sum.	Cul-de-sac Sum.	Trees Sum.
Before WF Operations	Far WF	3,011	1952	1963	2008	1824	40	886	561	57	254	326
Before WF Operations	Near WF	146	1927	1919	2006	1849	38	28	34	4	3	18
Before WF Operations	All	3,157	1951	1962	2008	1824	41	914	595	61	257	344
WF Operation	Far WF	663	1951	1962	2008	1867	40	184	129	15	56	77
WF Operation	Near WF	31	1927	1920	2004	1859	39	4	7	0	1	8
WF Operation	All	694	1950	1961	2008	1859	40	188	136	15	57	85
All	Far WF	3,674	1952	1963	2008	1824	40	1070	690	72	310	403
All	Near WF	177	1927	1919	2006	1849	39	32	41	4	4	26
All	All	3,851	1951	1962	2008	1824	41	1102	731	76	314	429

Notes: n=# of observations; Std. Dev.=Standard Deviation; Max=Maximum; Min.=Minimum; Sum.=Summation or Total; Year Built=the year the property was originally built; Fireplaces=# of fireplaces;
RR Tracks=Railroad Tracks=1 if within 180 meters of railroad tracks, 0 otherwise; Lakefront=1 if within 70 meters of a lake, 0 otherwise; Cul-de-sac=1 if property located near a cul-de-sac, 0 otherwise;
Near WF=Near Twin Groves I & II=Near Wind Farm=1 if property located within 3 mile buffer of wind farm, 0 otherwise; Trees=1 if within 180 meters of trees, 0 otherwise;
Far WF=Far Twin Groves I & II=1 if property located outside of 3 mile buffer of wind farm, 0 otherwise;
Before WF Operations=Before both Twin Groves I and II achieved commercial operation=01/01/2001 – 02/01/2008;
WF Operation=Wind Farm Operation=Both Twin Groves I and II achieved commercial operation=02/02/2008 – 12/01/2009.

Table C. 4. Near and Far from TG I and II and 3-Stage Wind Farm Development Cross Tabulations

Wind Farm Stages		*n*	RealPrice Mean	RealPrice Median	RealPrice Max	RealPrice Min.	RealPrice Std. Dev.	ln(RealPrice) Mean	ln(RealPrice) Median	ln(RealPrice) Max	ln(RealPrice) Min.	ln(RealPrice) Std. Dev.
Stage 1	Far WF	1,946	128,491	117,894	399,314	26,837	63,551	11.64	11.68	12.90	10.20	0.51
Stage 1	Near WF	90	108,168	94,112	344,704	31,318	51,475	11.49	11.45	12.75	10.35	0.47
Stage 1	All	2,036	127,593	116,665	399,314	26,837	63,194	11.63	11.67	12.90	10.20	0.51
Stage 2	Far WF	1,065	126,237	115,109	395,688	25,047	64,445	11.62	11.65	12.89	10.13	0.52
Stage 2	Near WF	56	101,937	97,545	223,645	30,146	44,940	11.43	11.49	12.32	10.31	0.47
Stage 2	All	1,121	125,023	114,587	395,688	25,047	63,818	11.61	11.65	12.89	10.13	0.52
Stage 3	Far WF	663	125,206	114,756	398,154	25,932	64,340	11.61	11.65	12.90	10.16	0.53
Stage 3	Near WF	31	116,814	124,342	211,550	30,000	42,814	11.59	11.73	12.26	10.31	0.45
Stage 3	All	694	124,831	114,834	398,154	25,932	63,536	11.60	11.65	12.90	10.16	0.53
All	Far WF	3,674	127,245	116,530	399,314	25,047	63,951	11.63	11.67	12.90	10.13	0.52
All	Near WF	177	107,711	98,576	344,704	30,000	48,050	11.49	11.50	12.75	10.31	0.46
All	All	3,851	126,347	115,390	399,314	25,047	63,435	11.62	11.66	12.90	10.13	0.51

Notes: n=# of observations; Std. Dev.=Standard Deviation; Max=Maximum; Min.=Minimum; ln=natural logarithm;
RealPrice=Real Price of Property in 2009 Q2 $; ln(RealPrice)=Natural Logarithm of the Real Price of Property in 2009 Q2 $, dependent variable;
Near WF=Near Twin Groves I & II=Near Wind Farm=1 if property located within 3 mile buffer of wind farm, 0 otherwise;
Far WF=Far Twin Groves I & II=1 if property located outside of 3 mile buffer of wind farm, 0 otherwise;
Stage 1=Before TG I and II Approval=Before Wind Farm Approval=01/01/2001 – 09/20/2005;
Stage 2=Post TG I and II (WF) Approval and during Construction=09/21/2005 – 02/01/2008;
Stage 3=Twin Groves I and II Online, WF Operation=Wind Farm Operation=02/02/2008 – 12/01/2009.

Table C. 5. Near and Far from TG I and II and 3-Stage Wind Farm Development Cross Tabulations

Wind Farm Stages		*n*	SQFT Mean	SQFT Median	SQFT Max	SQFT Min.	SQFT St.Dev.	Garage Mean	Garage Median	Garage Max	Garage St.Dev.	Acreage Mean	Acreage Median	Acreage Max	Acreage Min.	Acreage Sum.	Acreage St.Dev.
Stage 1	Far WF	1,946	1.51	1.41	4.05	0.43	0.54	2.44	2.67	10.27	1.71	0.54	0.30	13.64	0.04	1052.36	0.94
Stage 1	Near WF	90	1.50	1.36	3.90	0.58	0.62	1.29	0.00	8.00	1.79	1.51	0.56	9.70	0.11	135.97	2.16
Stage 1	All	2,036	1.51	1.41	4.05	0.43	0.54	2.39	2.67	10.27	1.73	0.58	0.30	13.64	0.04	1188.33	1.04
Stage 2	Far WF	1,065	1.51	1.39	3.78	0.57	0.55	2.54	2.69	11.20	1.63	0.53	0.29	10.00	0.06	563.90	0.92
Stage 2	Near WF	56	1.62	1.58	3.90	0.72	0.64	1.74	1.66	9.50	1.93	1.81	0.55	12.73	0.11	101.26	2.60
Stage 2	All	1,121	1.51	1.40	3.90	0.57	0.56	2.50	2.68	11.20	1.65	0.59	0.30	12.73	0.06	665.16	1.10
Stage 3	Far WF	663	1.51	1.39	3.71	0.56	0.51	2.63	2.80	16.67	1.75	0.57	0.30	10.00	0.08	378.18	0.91
Stage 3	Near WF	31	1.38	1.32	2.14	0.62	0.40	1.65	1.71	6.00	1.66	2.09	1.10	6.84	0.13	64.69	2.14
Stage 3	All	694	1.51	1.39	3.71	0.56	0.51	2.59	2.69	16.67	1.75	0.64	0.32	10.00	0.08	442.87	1.04
All	Far WF	3,674	1.51	1.40	4.05	0.43	0.54	2.50	2.68	16.67	1.70	0.54	0.30	13.64	0.04	1994.44	0.93
All	Near WF	177	1.52	1.40	3.90	0.58	0.60	1.49	0.00	9.50	1.81	1.71	0.61	12.73	0.11	301.92	2.30
All	All	3,851	1.51	1.40	4.05	0.43	0.54	2.46	2.67	16.67	1.71	0.60	0.30	13.64	0.04	2296.36	1.06

Notes: *n*=# of observations; St.Dev.=Standard Deviation; Max=Maximum; Min.=Minimum; SQFT=Square Feet=above grade living area of the dwelling in 1000s of square feet;
Garage=area of the garage in 180s of square feet, approximately the number of standard cars that can fit in the garage; Acreage=total number of acres of the property; Sum.=Summation or Total;
Near WF=Near Twin Groves I & II=Near Wind Farm=1 if property located within 3 mile buffer of wind farm, 0 otherwise;
Far WF=Far Twin Groves I & II=1 if property located outside of 3 mile buffer of wind farm, 0 otherwise;
Stage 1=Before TG I and II Approval=Before Wind Farm Approval=01/01/2001 – 09/20/2005;
Stage 2=Post TG I and II (WF) Approval and during Construction=09/21/2005 – 02/01/2008;
Stage 3=Twin Groves I and II Online, WF Operation=Wind Farm Operation=02/02/2008 – 12/01/2009.

Table C. 6. Near and Far from TG I and II and 3-Stage Wind Farm Development Cross Tabulations

Wind Farm Stages		*n*	Year Built Mean	Year Built Median	Year Built Max	Year Built Min.	Year Built Std. Dev.	Fireplaces Sum.	RR Tracks Sum.	Lakefront Sum.	Cul-de-sac Sum.	Trees Sum.
Stage 1	Far WF	1,946	1953	1964	2005	1824	40	596	355	34	165	224
Stage 1	Near WF	90	1929	1919	2001	1849	38	19	23	3	3	13
Stage 1	All	2,036	1952	1963	2005	1824	40	615	378	37	168	237
Stage 2	Far WF	1,065	1950	1961	2008	1849	41	290	206	23	89	102
Stage 2	Near WF	56	1924	1916	2006	1859	39	9	11	1	0	5
Stage 2	All	1,121	1949	1960	2008	1849	41	299	217	24	89	107
Stage 3	Far WF	663	1951	1962	2008	1867	40	184	129	15	56	77
Stage 3	Near WF	31	1927	1920	2004	1859	39	4	7	0	1	8
Stage 3	All	694	1950	1961	2008	1859	40	188	136	15	57	85
All	Far WF	3,674	1952	1963	2008	1824	40	1070	690	72	310	403
All	Near WF	177	1927	1919	2006	1849	39	32	41	4	4	26
All	All	3,851	1951	1962	2008	1824	41	1102	731	76	314	429

Notes: n=# of observations; Std. Dev.=Standard Deviation; Max=Maximum; Min.=Minimum; Sum.=Summation or Total; Year Built=the year the property was originally built; Fireplaces=# of fireplaces; RR Tracks=Railroad Tracks=1 if within 180 meters of railroad tracks, 0 otherwise; Lakefront=1 if within 70 meters of a lake, 0 otherwise; Cul-de-sac=1 if property located near a cul-de-sac, 0 otherwise; Near WF=Near Twin Groves I & II=Near Wind Farm=1 if property located within 3 mile buffer of wind farm, 0 otherwise; Trees=1 if within 180 meters of trees, 0 otherwise;
Far WF=Far Twin Groves I & II=1 if property located outside of 3 mile buffer of wind farm, 0 otherwise;
Stage 1=Before TG I and II Approval=Before Wind Farm Approval=01/01/2001 – 09/20/2005;
Stage 2=Post TG I and II (WF) Approval and during Construction=09/21/2005 – 02/01/2008;
Stage 3=Twin Groves I and II Online, WF Operation=Wind Farm Operation=02/02/2008 – 12/01/2009.

Table C. 7. School District and Wind Farm 3-Stage Cross Tabulations

Wind Farm Stages		*n*	RealPrice Mean	RealPrice Median	RealPrice Max	RealPrice Min.	RealPrice Std. Dev.	ln(RealPrice) Mean	ln(RealPrice) Median	ln(RealPrice) Max	ln(RealPrice) Min.	ln(RealPrice) Std. Dev.
Stage 1	Near WF	90	108,168	94,112	344,704	31,318	51,475	11.49	11.45	12.75	10.35	0.47
Stage 1	Trivalley	209	191,018	177,138	396,875	29,769	78,974	12.06	12.09	12.89	10.30	0.47
Stage 1	Lexington	173	129,761	116,642	388,113	36,881	53,664	11.70	11.67	12.87	10.52	0.39
Stage 1	LeRoy	281	123,468	123,290	314,025	26,872	47,632	11.64	11.72	12.66	10.20	0.41
Stage 1	El P-Gridley	111	106,534	95,985	270,973	26,837	46,917	11.48	11.47	12.51	10.20	0.45
Stage 1	Heyworth	302	144,341	138,935	341,951	27,990	54,004	11.80	11.84	12.74	10.24	0.41
Stage 1	Gibson City	305	89,218	79,246	298,402	28,259	43,531	11.29	11.28	12.61	10.25	0.47
Stage 1	NormalUnit 5	244	165,774	159,786	399,314	34,162	64,364	11.94	11.98	12.90	10.44	0.40
Stage 1	Ridgeview	134	96,721	91,015	230,266	26,837	42,182	11.38	11.42	12.35	10.20	0.47
Stage 1	Blue Ridge	38	87,143	79,896	182,732	28,699	39,949	11.27	11.29	12.12	10.27	0.47
Stage 1	Prair Central	149	91,472	83,115	251,792	29,149	42,023	11.32	11.33	12.44	10.28	0.46
Stage 1	All	2,036	127,593	116,665	399,314	26,837	63,194	11.63	11.67	12.90	10.20	0.51
Stage 2	Near WF	56	101,937	97,545	223,645	30,146	44,940	11.43	11.49	12.32	10.31	0.47
Stage 2	Trivalley	108	185,353	180,424	394,831	40,206	72,328	12.05	12.10	12.89	10.60	0.43
Stage 2	Lexington	98	124,620	122,454	280,959	25,694	55,186	11.62	11.72	12.55	10.15	0.50
Stage 2	LeRoy	142	124,715	120,430	395,688	36,580	53,624	11.65	11.70	12.89	10.51	0.40
Stage 2	El P-Gridley	70	105,150	95,482	311,454	29,996	44,494	11.48	11.47	12.65	10.31	0.43
Stage 2	Heyworth	145	140,011	132,581	333,001	39,940	57,011	11.77	11.80	12.72	10.60	0.41
Stage 2	Gibson City	158	101,996	92,891	261,152	27,496	50,578	11.41	11.44	12.47	10.22	0.52
Stage 2	NormalUnit 5	143	165,097	149,437	391,432	31,354	74,325	11.92	11.92	12.88	10.35	0.43
Stage 2	Ridgeview	78	89,111	79,605	211,020	25,047	40,860	11.29	11.29	12.26	10.13	0.47
Stage 2	Blue Ridge	22	77,578	72,347	174,445	30,154	39,093	11.14	11.19	12.07	10.31	0.50
Stage 2	Prair Central	101	83,744	80,051	195,368	25,129	34,576	11.25	11.29	12.18	10.13	0.43
Stage 2	All	1,121	125,023	114,587	395,688	25,047	63,818	11.61	11.65	12.89	10.13	0.52
Stage 3	Near WF	31	116,814	124,342	211,550	30,000	42,814	11.59	11.73	12.26	10.31	0.45
Stage 3	Trivalley	63	202,645	184,608	398,154	55,000	83,645	12.13	12.13	12.90	10.92	0.44
Stage 3	Lexington	81	117,826	117,750	272,500	30,016	47,451	11.58	11.68	12.52	10.31	0.46
Stage 3	LeRoy	96	122,972	110,482	287,793	35,669	50,236	11.64	11.61	12.57	10.48	0.41
Stage 3	El P-Gridley	48	94,045	88,504	174,093	30,003	39,219	11.35	11.39	12.07	10.31	0.48
Stage 3	Heyworth	112	137,532	125,407	319,321	28,579	57,555	11.74	11.74	12.67	10.26	0.46
Stage 3	Gibson City	67	107,523	83,044	283,900	34,003	60,005	11.45	11.33	12.56	10.43	0.53
Stage 3	NormalUnit 5	88	150,159	141,855	308,349	38,784	59,974	11.83	11.86	12.64	10.57	0.43
Stage 3	Ridgeview	33	80,827	70,193	183,018	29,834	37,859	11.20	11.16	12.12	10.30	0.45
Stage 3	Blue Ridge	11	78,900	69,359	175,483	30,016	40,547	11.17	11.15	12.08	10.31	0.48
Stage 3	Prair Central	64	78,508	69,222	180,000	25,932	36,450	11.17	11.15	12.10	10.16	0.47
Stage 3	All	694	124,831	114,834	398,154	25,932	63,536	11.60	11.65	12.90	10.16	0.53

All	Near WF	177	107,711	98,576	344,704	30,000	48,050	11.49	11.50	12.75	10.31	0.46
All	Trivalley	380	191,335	180,159	398,154	29,769	77,948	12.07	12.10	12.90	10.30	0.45
All	Lexington	352	125,583	118,148	388,113	25,694	52,809	11.65	11.68	12.87	10.15	0.44
All	LeRoy	519	123,718	120,331	395,688	26,872	49,723	11.65	11.70	12.89	10.20	0.41
All	El P-Gridley	229	103,493	95,474	311,454	26,837	44,747	11.45	11.47	12.65	10.20	0.45
All	Heyworth	559	141,854	133,981	341,951	27,990	55,488	11.78	11.81	12.74	10.24	0.42
All	Gibson City	530	95,341	82,567	298,402	27,496	48,487	11.34	11.32	12.61	10.22	0.49
All	NormalUnit 5	475	162,677	154,017	399,314	31,354	66,893	11.92	11.95	12.90	10.35	0.42
All	Ridgeview	245	92,158	84,988	230,266	25,047	41,430	11.33	11.35	12.35	10.13	0.47
All	Blue Ridge	71	82,902	75,148	182,732	28,699	39,473	11.22	11.23	12.12	10.27	0.48
All	Prair Central	314	86,344	81,167	251,792	25,129	38,880	11.27	11.30	12.44	10.13	0.46
All	All	3,851	126,347	115,390	399,314	25,047	63,435	11.62	11.66	12.90	10.13	0.51

Notes: n=# of observations; Std. Dev.=Standard Deviation; Max=Maximum; Min.=Minimum; ln=natural logarithm;
RealPrice=Real Price of Property in 2009 Q2 $; ln(RealPrice)=Natural Logarithm of the Real Price of Property in 2009 Q2 $, dependent variable;
Near WF=Near Twin Groves I & II=Near Wind Farm=1 if property located within 3 mile buffer of wind farm, 0 otherwise;
Blue Ridge CUSD 18; El Paso-Gridley CUSD 11; Gibson City-Melvin-Sibley CUSD 5; Heyworth CUSD 4; LeRoy CUSD 2; Lexington CUSD 7 (Reference Group); Normal CUSD 5; Prairie Central CUSD 8; Ridgeview CUSD 19; Trivalley CUSD 3; School district dummy variables exclude properties near TG I and II; Stage 1=Before TG I and II (WF) Approval=01/01/2001 – 09/20/2005;
Stage 2=Post TG I and II (WF) Approval and during Construction=09/21/2005 – 02/01/2008; Stage 3=Twin Groves I and II Online, Wind Farm Operation=02/02/2008 – 12/01/2009.

Table C. 8. School District and Wind Farm 3-Stage Cross Tabulations

Wind Farm Stages		n	SQFT Mean	SQFT Median	SQFT Max	SQFT Min.	SQFT St. Dev.	Garage Mean	Garage Median	Garage Max	Garage St. Dev.	Acreage Mean	Acreage Median	Acreage Max	Acreage Min.	Acreage Sum.	Acreage St. Dev.
Stage 1	NearWF	90	1.50	1.36	3.90	0.58	0.62	1.29	0.00	8.00	1.79	1.51	0.56	9.70	0.11	135.97	2.16
Stage 1	Trivalley	209	1.79	1.60	4.05	0.67	0.68	2.88	3.07	8.60	1.68	0.75	0.54	5.23	0.10	156.97	0.79
Stage 1	Lexington	173	1.46	1.29	3.87	0.60	0.56	2.32	2.53	6.84	1.69	0.60	0.30	13.64	0.09	104.06	1.44
Stage 1	LeRoy	281	1.51	1.42	3.83	0.62	0.53	2.50	2.67	6.67	1.50	0.46	0.27	10.41	0.04	128.23	0.75
Stage 1	EP-Gridley	111	1.52	1.39	3.23	0.76	0.53	1.99	1.96	6.73	1.36	0.60	0.28	6.18	0.10	66.64	1.07
Stage 1	Heyworth	302	1.51	1.43	3.39	0.43	0.51	2.66	2.86	9.07	1.47	0.47	0.25	7.13	0.06	141.66	0.81
Stage 1	Gibson City	305	1.31	1.20	3.33	0.48	0.46	2.03	2.00	9.33	1.92	0.53	0.25	11.00	0.09	161.44	1.10
Stage 1	NormUnit 5	244	1.60	1.57	3.52	0.57	0.51	3.02	3.02	8.53	1.55	0.43	0.31	2.41	0.14	105.02	0.36
Stage 1	Ridgeview	134	1.43	1.40	2.70	0.76	0.42	2.46	2.67	10.27	2.02	0.61	0.32	9.49	0.08	81.96	1.08
Stage 1	Blue Ridge	38	1.70	1.56	3.04	0.90	0.53	0.77	0.00	5.00	1.50	0.92	0.33	5.97	0.12	35.05	1.41
Stage 1	PrairCentral	149	1.50	1.41	3.54	0.72	0.48	2.01	2.13	10.00	1.75	0.48	0.29	5.79	0.10	71.33	0.79
Stage 1	All	2,036	1.51	1.41	4.05	0.43	0.54	2.39	2.67	10.27	1.73	0.58	0.30	13.64	0.04	1188.33	1.04
Stage 2	NearWF	56	1.62	1.58	3.90	0.72	0.64	1.74	1.66	9.50	1.93	1.81	0.55	12.73	0.11	101.26	2.60
Stage 2	Trivalley	108	1.73	1.64	3.31	0.64	0.63	2.73	2.78	8.86	1.50	0.72	0.52	5.01	0.15	78.24	0.82
Stage 2	Lexington	98	1.52	1.39	3.19	0.72	0.57	2.79	3.14	11.20	1.82	0.50	0.29	5.02	0.09	48.81	0.67
Stage 2	LeRoy	142	1.51	1.39	3.78	0.72	0.62	2.38	2.47	7.50	1.49	0.45	0.26	7.71	0.09	63.78	0.88
Stage 2	EP-Gridley	70	1.47	1.37	3.63	0.76	0.55	2.17	2.39	6.67	1.59	0.48	0.28	4.57	0.10	33.80	0.74
Stage 2	Heyworth	145	1.47	1.38	3.10	0.66	0.48	2.67	2.81	9.17	1.49	0.41	0.26	5.60	0.06	59.21	0.66
Stage 2	Gibson City	158	1.42	1.33	3.49	0.57	0.49	2.78	2.69	8.53	1.48	0.60	0.28	10.00	0.09	95.12	1.27
Stage 2	NormUnit 5	143	1.58	1.46	3.45	0.67	0.57	2.96	3.07	6.67	1.48	0.65	0.34	10.00	0.13	93.40	1.32
Stage 2	Ridgeview	78	1.43	1.44	2.52	0.58	0.43	2.40	2.67	9.77	1.99	0.46	0.30	4.08	0.11	36.01	0.59
Stage 2	Blue Ridge	22	1.39	1.21	2.50	0.58	0.58	0.46	0.00	5.38	1.30	0.69	0.33	2.86	0.15	15.20	0.82
Stage 2	PrairCentral	101	1.43	1.27	3.60	0.69	0.55	2.00	2.02	6.24	1.64	0.40	0.29	3.49	0.14	40.33	0.46
Stage 2	All	1,121	1.51	1.40	3.90	0.57	0.56	2.50	2.68	11.20	1.65	0.59	0.30	12.73	0.06	665.16	1.10
Stage 3	NearWF	31	1.38	1.32	2.14	0.62	0.40	1.65	1.71	6.00	1.66	2.09	1.10	6.84	0.13	64.69	2.14
Stage 3	Trivalley	63	1.70	1.56	3.01	0.73	0.53	2.79	2.93	6.27	1.64	0.96	0.63	5.27	0.17	60.61	1.11
Stage 3	Lexington	81	1.47	1.35	2.41	0.56	0.45	2.28	2.60	10.00	1.71	0.49	0.30	3.35	0.08	39.97	0.59
Stage 3	LeRoy	96	1.46	1.29	3.71	0.61	0.56	2.60	2.72	7.29	1.55	0.44	0.29	5.08	0.13	42.15	0.63
Stage 3	EP-Gridley	48	1.47	1.40	2.54	0.78	0.41	2.54	2.67	6.67	1.43	0.36	0.29	1.82	0.10	17.19	0.28
Stage 3	Heyworth	112	1.57	1.41	2.98	0.65	0.57	2.92	2.97	16.67	1.92	0.65	0.25	10.00	0.09	72.69	1.34
Stage 3	Gibson City	67	1.46	1.32	2.76	0.68	0.43	2.92	2.80	9.11	1.98	0.65	0.25	5.00	0.12	43.67	1.14
Stage 3	NormUnit 5	88	1.57	1.42	3.00	0.57	0.57	2.91	2.94	7.79	1.63	0.66	0.35	5.10	0.15	57.73	0.89
Stage 3	Ridgeview	33	1.44	1.35	2.77	0.93	0.43	2.30	2.67	4.36	1.43	0.55	0.33	5.40	0.14	18.30	0.95
Stage 3	Blue Ridge	11	1.44	1.39	2.45	0.93	0.40	0.85	0.00	4.36	1.39	0.42	0.33	1.36	0.16	4.63	0.35
Stage 3	PrairCentral	64	1.41	1.29	2.95	0.79	0.45	2.30	2.40	8.27	1.92	0.33	0.29	1.00	0.14	21.24	0.14
Stage 3	All	694	1.51	1.39	3.71	0.56	0.51	2.59	2.69	16.67	1.75	0.64	0.32	10.00	0.08	442.87	1.04

All	NearWF	177	1.52	1.40	3.90	0.58	0.60	1.49	0.00	9.50	1.81	1.71	0.61	12.73	0.11	301.92	2.30
All	Trivalley	380	1.76	1.60	4.05	0.64	0.64	2.82	2.93	8.86	1.62	0.78	0.55	5.27	0.10	295.82	0.86
All	Lexington	352	1.48	1.34	3.87	0.56	0.54	2.44	2.68	11.20	1.74	0.55	0.30	13.64	0.08	192.84	1.11
All	LeRoy	519	1.50	1.40	3.83	0.61	0.56	2.49	2.67	7.50	1.51	0.45	0.27	10.41	0.04	234.16	0.76
All	EP-Gridley	229	1.50	1.38	3.63	0.76	0.51	2.16	2.13	6.73	1.46	0.51	0.28	6.18	0.10	117.63	0.86
All	Heyworth	559	1.51	1.40	3.39	0.43	0.51	2.71	2.89	16.67	1.57	0.49	0.25	10.00	0.06	273.56	0.91
All	Gibson City	530	1.36	1.25	3.49	0.48	0.47	2.37	2.40	9.33	1.85	0.57	0.26	11.00	0.09	300.23	1.15
All	NormUnit 5	475	1.59	1.50	3.52	0.57	0.54	2.98	3.01	8.53	1.54	0.54	0.32	10.00	0.13	256.15	0.86
All	Ridgeview	245	1.43	1.40	2.77	0.58	0.42	2.42	2.67	10.27	1.93	0.56	0.32	9.49	0.08	136.27	0.93
All	Blue Ridge	71	1.56	1.43	3.04	0.58	0.54	0.69	0.00	5.38	1.42	0.77	0.33	5.97	0.12	54.88	1.14
All	PrairCentral	314	1.46	1.38	3.60	0.69	0.50	2.07	2.12	10.00	1.75	0.42	0.29	5.79	0.10	132.90	0.61
All	All	3,851	1.51	1.40	4.05	0.43	0.54	2.46	2.67	16.67	1.71	0.60	0.30	13.64	0.04	2296.36	1.06

Notes: n=# of observations; St. Dev.=Standard Deviation; Max=Maximum; Min.=Minimum; SQFT=Square Feet=above grade living area of the dwelling in 1000s of square feet;
Garage=area of the garage in 180s of square feet, approximately the number of standard cars that can fit in the garage; Acreage=total number of acres of the property; Sum.=Summation or Total;
NearWF=Near Twin Groves I & II=Near Wind Farm=1 if property located within 3 mile buffer of wind farm, 0 otherwise;
Blue Ridge CUSD 18; El Paso-Gridley CUSD 11; Gibson City-Melvin-Sibley CUSD 5; Heyworth CUSD 4; LeRoy CUSD 2; Lexington CUSD 7 (Reference Group); Normal CUSD 5; Prairie Central CUSD 8;
Ridgeview CUSD 19; Trivalley CUSD 3; School district dummy variables exclude properties near TG I and II; Stage 1=Before TG I and II (WF) Approval=01/01/2001 – 09/20/2005;
Stage 2=Post TG I and II (WF) Approval and during Construction=09/21/2005 – 02/01/2008; Stage 3=Twin Groves I and II Online, WF Operation=02/02/2008 – 12/01/2009.

Table C. 9. School District and Wind Farm 3-Stage Cross Tabulations

Wind Farm Stages		n	Year Built Mean	Year Built Median	Year Built Max	Year Built Min.	Year Built Std. Dev.	Fireplaces Sum.	RR Tracks Sum.	Lakefront Sum.	Cul-de-sac Sum.	Trees Sum.
Stage 1	Near WF	90	1929	1919	2001	1849	38	19	23	3	3	13
Stage 1	Trivalley	209	1979	1986	2004	1889	24	125	35	14	41	73
Stage 1	Lexington	173	1942	1961	2004	1824	45	54	36	2	17	21
Stage 1	LeRoy	281	1953	1969	2005	1849	44	77	18	0	35	6
Stage 1	El P-Gridley	111	1934	1940	2003	1869	38	23	22	0	0	2
Stage 1	Heyworth	302	1971	1982	2005	1869	33	119	52	1	26	71
Stage 1	Gibson City	305	1942	1950	2004	1883	31	34	60	0	4	2
Stage 1	NormalUnit 5	244	1969	1974	2003	1836	33	105	21	17	19	42
Stage 1	Ridgeview	134	1930	1913	2004	1858	42	31	46	0	23	6
Stage 1	Blue Ridge	38	1937	1925	1998	1889	36	5	19	0	0	0
Stage 1	PrairieCentral	149	1932	1935	2003	1859	42	23	46	0	0	1
Stage 1	All	2,036	1952	1963	2005	1824	40	615	378	37	168	237
Stage 2	Near WF	56	1924	1916	2006	1859	39	9	11	1	0	5
Stage 2	Trivalley	108	1977	1980	2005	1880	25	68	17	7	27	28
Stage 2	Lexington	98	1938	1958	2008	1859	46	21	12	0	8	7
Stage 2	LeRoy	142	1951	1963	2005	1849	43	33	17	0	13	2
Stage 2	El P-Gridley	70	1941	1952	2002	1859	39	11	14	0	0	2
Stage 2	Heyworth	145	1967	1978	2004	1859	35	46	24	3	14	33
Stage 2	Gibson City	158	1942	1950	2005	1860	32	15	41	0	4	1
Stage 2	NormalUnit 5	143	1966	1972	2003	1880	32	61	11	13	15	26
Stage 2	Ridgeview	78	1926	1907	2005	1869	43	17	31	0	8	3
Stage 2	Blue Ridge	22	1927	1910	1999	1884	35	2	9	0	0	0
Stage 2	PrairieCentral	101	1928	1916	2003	1859	41	16	30	0	0	0
Stage 2	All	1,121	1949	1960	2008	1849	41	299	217	24	89	107
Stage 3	Near WF	31	1927	1920	2004	1859	39	4	7	0	1	8
Stage 3	Trivalley	63	1980	1986	2004	1899	25	35	9	8	14	24
Stage 3	Lexington	81	1934	1940	2005	1869	45	25	18	0	10	9
Stage 3	LeRoy	96	1945	1960	2003	1867	40	23	12	0	11	1
Stage 3	El P-Gridley	48	1943	1953	2002	1869	42	10	11	0	0	0
Stage 3	Heyworth	112	1965	1978	2004	1879	35	36	20	1	4	26
Stage 3	Gibson City	67	1944	1953	2008	1890	32	10	15	0	1	1
Stage 3	NormalUnit 5	88	1967	1972	2003	1890	29	36	9	6	10	16
Stage 3	Ridgeview	33	1931	1910	2005	1869	41	3	9	0	6	0
Stage 3	Blue Ridge	11	1935	1919	1997	1879	41	0	6	0	0	0
Stage 3	PrairieCentral	64	1929	1929	2003	1869	40	6	20	0	0	0
Stage 3	All	694	1950	1961	2008	1859	40	188	136	15	57	85

All Stages	Near WF	177	1927	1919	2006	1849	39	32	41	4	4	26
All Stages	Trivalley	380	1979	1984	2005	1880	25	228	61	29	82	125
All Stages	Lexington	352	1939	1958	2008	1824	45	100	66	2	35	37
All Stages	LeRoy	519	1951	1964	2005	1849	43	133	47	0	59	9
All Stages	El P-Gridley	229	1938	1947	2003	1859	39	44	47	0	0	4
All Stages	Heyworth	559	1969	1979	2005	1859	34	201	96	5	44	130
All Stages	Gibson City	530	1942	1950	2008	1860	31	59	116	0	9	4
All Stages	NormalUnit 5	475	1968	1973	2003	1836	32	202	41	36	44	84
All Stages	Ridgeview	245	1929	1909	2005	1858	42	51	86	0	37	9
All Stages	Blue Ridge	71	1934	1919	1999	1879	36	7	34	0	0	0
All Stages	PrairieCentral	314	1930	1921	2003	1859	41	45	96	0	0	1
All Stages	All	3,851	1951	1962	2008	1824	41	1102	731	76	314	429

Notes: n=# of observations; Std. Dev.=Standard Deviation; Max=Maximum; Min.=Minimum; Sum.=Summation or Total; Year Built=the year the property was originally built; Fireplaces=# of fireplaces; RR Tracks=Railroad Tracks=1 if within 180 meters of railroad tracks, 0 otherwise; Lakefront=1 if within 70 meters of a lake, 0 otherwise; Cul-de-sac=1 if property located near a cul-de-sac, 0 otherwise; Near WF=Near Twin Groves I & II=Near Wind Farm=1 if property located within 3 mile buffer of wind farm, 0 otherwise; Trees=1 if within 180 meters of trees, 0 otherwise; Blue Ridge CUSD 18; El Paso-Gridley CUSD 11; Gibson City-Melvin-Sibley CUSD 5; Heyworth CUSD 4; LeRoy CUSD 2; Lexington CUSD 7 (Reference Group); Normal CUSD 5; Prairie Central CUSD 8; Ridgeview CUSD 19; Trivalley CUSD 3; School district dummy variables exclude properties near TG I and II; Stage 1=Before TG I and II (WF) Approval=01/01/2001 – 09/20/2005; Stage 2=Post TG I and II (WF) Approval and during Construction=09/21/2005 – 02/01/2008; Stage 3=Twin Groves I and II Online, WF Operation=02/02/2008 – 12/01/2009; All Stages=01/01/2001 – 12/01/2009.

Table C. 10. Township and Wind Farm 3-Stage Cross Tabulations

Wind Farm Stages		n	RealPrice Mean	RealPrice Median	RealPrice Max	RealPrice Min.	RealPrice Std. Dev.	ln(RealPrice) Mean	ln(RealPrice) Median	ln(RealPrice) Max	ln(RealPrice) Min.	ln(RealPrice) Std. Dev.
Stage 1	Near WF	90	108,168	94,112	344,704	31,318	51,475	11.49	11.45	12.75	10.35	0.47
Stage 1	Anchor	13	70,694	78,861	94,800	32,627	19,978	11.12	11.28	11.46	10.39	0.34
Stage 1	Bellflower	36	83,238	77,657	182,732	28,699	37,260	11.23	11.26	12.12	10.27	0.45
Stage 1	Blue Mound	26	92,375	79,696	158,492	29,135	38,564	11.34	11.29	11.97	10.28	0.44
Stage 1	Chenoa	133	91,211	83,878	251,792	29,149	40,691	11.32	11.34	12.44	10.28	0.46
Stage 1	Cropsey	9	89,420	63,684	203,965	44,079	56,202	11.26	11.06	12.23	10.69	0.54
Stage 1	Dix	20	70,648	69,893	119,886	35,263	20,264	11.13	11.16	11.69	10.47	0.29
Stage 1	Downs	72	140,607	160,813	230,802	37,572	46,515	11.78	11.99	12.35	10.53	0.41
Stage 1	Drummer	236	95,324	84,407	298,402	29,228	45,463	11.36	11.34	12.61	10.28	0.46
Stage 1	Empire	273	122,969	123,290	314,025	26,872	47,734	11.64	11.72	12.66	10.20	0.42
Stage 1	Gridley	111	106,534	95,985	270,973	26,837	46,917	11.48	11.47	12.51	10.20	0.45
Stage 1	Hudson	179	163,300	159,785	399,314	48,414	55,840	11.95	11.98	12.90	10.79	0.35
Stage 1	Lawndale	4	122,706	113,399	167,285	96,740	32,313	11.69	11.63	12.03	11.48	0.25
Stage 1	Lexington	161	126,712	116,257	360,089	36,881	49,402	11.68	11.66	12.79	10.52	0.38
Stage 1	Martin	91	100,539	98,778	230,266	26,837	44,500	11.41	11.50	12.35	10.20	0.49
Stage 1	Money Creek	32	228,021	219,968	388,113	87,404	90,458	12.25	12.30	12.87	11.38	0.43
Stage 1	Oldtown	142	214,888	199,895	396,875	29,769	80,024	12.20	12.21	12.89	10.30	0.43
Stage 1	Peach Orchard	29	68,570	71,100	165,865	28,259	32,360	11.03	11.17	12.02	10.25	0.46
Stage 1	Randolph	301	144,338	138,840	341,951	27,990	54,093	11.80	11.84	12.74	10.24	0.41
Stage 1	Sullivant	20	65,679	59,694	136,532	29,436	27,212	11.02	11.00	11.82	10.29	0.40
Stage 1	Towanda	45	132,656	136,051	234,312	34,162	49,333	11.71	11.82	12.36	10.44	0.44
Stage 1	West	6	144,835	150,770	164,977	120,148	19,629	11.88	11.92	12.01	11.70	0.14
Stage 1	Yates	7	99,089	91,921	189,149	48,856	53,345	11.39	11.43	12.15	10.80	0.51
Stage 1	All	2,036	127,593	116,665	399,314	26,837	63,194	11.63	11.67	12.90	10.20	0.51
Stage 2	Near WF	56	101,937	97,545	223,645	30,146	44,940	11.43	11.49	12.32	10.31	0.47
Stage 2	Anchor	7	63,622	61,666	100,486	37,180	21,902	11.01	11.03	11.52	10.52	0.35
Stage 2	Bellflower	21	73,464	71,843	174,445	30,154	34,838	11.10	11.18	12.07	10.31	0.47
Stage 2	Blue Mound	15	91,387	75,142	211,020	25,047	53,968	11.26	11.23	12.26	10.13	0.59
Stage 2	Chenoa	92	83,785	81,086	162,787	29,376	30,881	11.26	11.30	12.00	10.29	0.39
Stage 2	Cropsey	5	51,904	41,806	92,295	25,129	27,692	10.74	10.64	11.43	10.13	0.53
Stage 2	Dix	10	102,157	100,056	174,975	41,624	41,238	11.46	11.51	12.07	10.64	0.43
Stage 2	Downs	41	143,170	148,762	276,335	40,206	55,182	11.79	11.91	12.53	10.60	0.45
Stage 2	Drummer	132	105,127	99,688	261,152	27,496	51,716	11.44	11.51	12.47	10.22	0.52
Stage 2	Empire	136	122,077	117,451	395,688	36,580	51,758	11.64	11.67	12.89	10.51	0.39
Stage 2	Gridley	69	104,142	95,474	311,454	29,996	44,007	11.47	11.47	12.65	10.31	0.42
Stage 2	Hudson	98	165,741	154,766	391,432	31,354	74,378	11.93	11.95	12.88	10.35	0.43

Stage 2	Lawndale	3	125,319	133,609	150,230	92,119	29,930	11.72	11.80	11.92	11.43	0.26
Stage 2	Lexington	88	126,067	125,374	280,959	25,694	56,364	11.63	11.74	12.55	10.15	0.50
Stage 2	Martin	53	89,784	84,066	173,052	33,777	37,857	11.31	11.34	12.06	10.43	0.44
Stage 2	Money Creek	21	187,644	152,172	336,665	32,451	98,210	11.98	11.93	12.73	10.39	0.64
Stage 2	Oldtown	71	210,728	204,708	394,831	80,412	69,472	12.20	12.23	12.89	11.30	0.34
Stage 2	Peach Orchard	7	65,307	58,912	102,776	44,574	19,514	11.05	10.98	11.54	10.71	0.28
Stage 2	Randolph	145	140,011	132,581	333,001	39,940	57,011	11.77	11.80	12.72	10.60	0.41
Stage 2	Sullivant	9	84,446	80,388	168,884	33,949	50,232	11.18	11.30	12.04	10.43	0.62
Stage 2	Towanda	34	135,040	135,401	265,282	69,355	41,829	11.77	11.82	12.49	11.15	0.32
Stage 2	West	4	146,374	144,230	163,976	133,060	12,975	11.89	11.88	12.01	11.80	0.09
Stage 2	Yates	4	122,605	129,529	195,368	35,995	78,716	11.51	11.68	12.18	10.49	0.80
Stage 2	All	1,121	125,023	114,587	395,688	25,047	63,818	11.61	11.65	12.89	10.13	0.52
Stage 3	Near WF	31	116,814	124,342	211,550	30,000	42,814	11.59	11.73	12.26	10.31	0.45
Stage 3	Anchor	4	60,545	44,002	124,342	29,834	43,321	10.85	10.68	11.73	10.30	0.62
Stage 3	Bellflower	11	78,900	69,359	175,483	30,016	40,547	11.17	11.15	12.08	10.31	0.48
Stage 3	Blue Mound	2	66,387	66,387	84,045	48,729	24,972	11.07	11.07	11.34	10.79	0.39
Stage 3	Chenoa	57	82,208	75,579	180,000	29,936	36,300	11.22	11.23	12.10	10.31	0.44
Stage 3	Cropsey	1	83,508	83,508	83,508	83,508		11.33	11.33	11.33	11.33	
Stage 3	Dix	5	86,328	82,824	141,630	40,004	36,355	11.29	11.32	11.86	10.60	0.45
Stage 3	Downs	25	159,499	176,000	349,291	55,000	67,300	11.89	12.08	12.76	10.92	0.46
Stage 3	Drummer	51	118,351	102,282	283,900	35,097	62,871	11.55	11.54	12.56	10.47	0.52
Stage 3	Empire	94	120,811	110,029	287,793	35,669	48,488	11.62	11.61	12.57	10.48	0.40
Stage 3	Gridley	48	94,045	88,504	174,093	30,003	39,219	11.35	11.39	12.07	10.31	0.48
Stage 3	Hudson	59	144,695	136,000	308,349	60,006	52,381	11.82	11.82	12.64	11.00	0.37
Stage 3	Lawndale	4	122,875	127,577	155,583	80,764	37,855	11.68	11.73	11.96	11.30	0.32
Stage 3	Lexington	76	116,570	115,481	272,500	30,016	48,461	11.57	11.66	12.52	10.31	0.47
Stage 3	Martin	25	84,422	70,193	183,018	35,801	39,168	11.25	11.16	12.12	10.49	0.43
Stage 3	Money Creek	11	193,150	194,586	282,000	60,876	76,701	12.08	12.18	12.55	11.02	0.49
Stage 3	Oldtown	41	230,918	215,594	398,154	85,045	78,758	12.29	12.28	12.90	11.35	0.34
Stage 3	Peach Orchard	6	56,165	53,374	75,207	35,097	14,604	10.91	10.88	11.23	10.47	0.27
Stage 3	Randolph	112	137,532	125,407	319,321	28,579	57,555	11.74	11.74	12.67	10.26	0.46
Stage 3	Sullivant	5	79,902	65,180	120,012	34,003	38,009	11.19	11.09	11.70	10.43	0.53
Stage 3	Towanda	20	134,384	128,396	235,125	38,784	57,485	11.70	11.76	12.37	10.57	0.51
Stage 3	West	0										
Stage 3	Yates	6	42,524	39,989	66,500	25,932	16,355	10.60	10.56	11.11	10.16	0.39
Stage 3	All	694	124,831	114,834	398,154	25,932	63,536	11.60	11.65	12.90	10.16	0.53
All	Near WF	177	107,711	98,576	344,704	30,000	48,050	11.49	11.50	12.75	10.31	0.46
All	Anchor	24	66,940	67,364	124,342	29,834	24,425	11.04	11.11	11.73	10.30	0.39
All	Bellflower	68	79,518	73,940	182,732	28,699	36,768	11.18	11.21	12.12	10.27	0.46
All	Blue Mound	43	90,822	77,025	211,020	25,047	43,600	11.30	11.25	12.26	10.13	0.49
All	Chenoa	282	86,968	81,998	251,792	29,149	36,955	11.28	11.31	12.44	10.28	0.44
All	Cropsey	15	76,521	63,684	203,965	25,129	48,486	11.09	11.06	12.23	10.13	0.56
All	Dix	35	81,890	78,333	174,975	35,263	32,143	11.24	11.27	12.07	10.47	0.38

All	Downs	138	144,791	158,638	349,291	37,572	53,416	11.80	11.97	12.76	10.53	0.43
All	Drummer	419	101,215	89,915	298,402	27,496	50,332	11.41	11.41	12.61	10.22	0.49
All	Empire	503	122,325	119,983	395,688	26,872	48,901	11.64	11.70	12.89	10.20	0.41
All	Gridley	228	103,181	95,417	311,454	26,837	44,595	11.45	11.47	12.65	10.20	0.45
All	Hudson	336	160,745	153,766	399,314	31,354	61,562	11.92	11.94	12.90	10.35	0.38
All	Lawndale	11	123,480	125,599	167,285	80,764	30,392	11.70	11.74	12.03	11.30	0.25
All	Lexington	325	124,166	117,056	360,089	25,694	51,182	11.64	11.67	12.79	10.15	0.44
All	Martin	169	94,782	88,453	230,266	26,837	42,017	11.36	11.39	12.35	10.20	0.47
All	Money Creek	64	208,779	208,162	388,113	32,451	91,661	12.13	12.25	12.87	10.39	0.53
All	Old Town	254	216,313	203,908	398,154	29,769	77,003	12.21	12.23	12.90	10.30	0.39
All	Peach Orchard	42	66,254	60,556	165,865	28,259	28,561	11.02	11.01	12.02	10.25	0.41
All	Randolph	558	141,848	133,612	341,951	27,990	55,537	11.78	11.80	12.74	10.24	0.42
All	Sullivant	34	72,738	61,694	168,884	29,436	35,896	11.08	11.03	12.04	10.29	0.47
All	Towanda	99	133,824	135,107	265,282	34,162	48,205	11.73	11.81	12.49	10.44	0.41
All	West	10	145,451	147,059	164,977	120,148	16,456	11.88	11.90	12.01	11.70	0.12
All	Yates	17	84,658	60,074	195,368	25,932	58,561	11.14	11.00	12.18	10.16	0.66
All	All	3,851	126,347	115,390	399,314	25,047	63,435	11.62	11.66	12.90	10.13	0.51

Notes: n=# of observations; Std. Dev.=Standard Deviation; Max=Maximum; Min.=Minimum; ln=natural logarithm;

RealPrice=Real Price of Property in 2009 Q2 $; ln(RealPrice)=Natural Logarithm of the Real Price of Property in 2009 Q2 $, dependent variable;

Near WF=Near Twin Groves I & II=Near Wind Farm=1 if property located within 3 mile buffer of wind farm, 0 otherwise;

Township dummy variables exclude properties near TG I and II (WF); Stage 1=Before TG I and II (WF) Approval=01/01/2001 – 09/20/2005;

Stage 2=Post TG I and II (WF) Approval and during Construction=09/21/2005 – 02/01/2008; Stage 3=Twin Groves I and II Online, WF Operation=02/02/2008 – 12/01/2009.

Table C. 11. Township and Wind Farm 3-Stage Cross Tabulations

Wind Farm Stages		n	SQFT Mean	SQFT Median	SQFT Max	SQFT Min.	SQFT StDev.	Garage Mean	Garage Median	Garage Max	Garage StDev.	Acreage Mean	Acreage Median	Acreage Max	Acreage Min.	Acreage Sum.	Acreage StDev.
Stage 1	Near WF	90	1.50	1.36	3.90	0.58	0.62	1.29	0.00	8.00	1.79	1.51	0.56	9.70	0.11	135.97	2.16
Stage 1	Anchor	13	1.55	1.49	2.70	0.90	0.48	1.96	2.00	7.38	2.18	0.29	0.29	0.40	0.17	3.74	0.08
Stage 1	Bellflower	36	1.71	1.56	3.04	0.90	0.54	0.82	0.00	5.00	1.53	0.85	0.33	5.97	0.12	30.77	1.40
Stage 1	Blue Mound	26	1.27	1.17	1.81	0.76	0.34	3.12	2.93	10.27	2.84	0.51	0.28	2.33	0.11	13.25	0.56
Stage 1	Chenoa	133	1.49	1.42	2.89	0.79	0.45	2.08	2.26	10.00	1.75	0.39	0.29	5.79	0.10	51.36	0.61
Stage 1	Cropsey	9	1.51	1.39	2.21	0.72	0.51	0.69	0.00	2.22	1.04	1.27	0.34	5.42	0.23	11.42	1.79
Stage 1	Dix	20	1.18	1.14	1.80	0.78	0.24	1.70	1.73	5.20	1.58	0.49	0.28	2.00	0.13	9.73	0.47
Stage 1	Downs	72	1.39	1.36	2.14	0.67	0.36	2.61	2.76	6.58	1.51	0.47	0.36	2.75	0.10	33.59	0.52
Stage 1	Drummer	236	1.33	1.24	3.33	0.48	0.47	2.01	1.95	9.11	1.88	0.45	0.22	11.00	0.09	105.16	1.00
Stage 1	Empire	273	1.51	1.42	3.83	0.62	0.53	2.48	2.67	6.67	1.50	0.42	0.27	10.41	0.04	113.36	0.71
Stage 1	Gridley	111	1.52	1.39	3.23	0.76	0.53	1.99	1.96	6.73	1.36	0.60	0.28	6.18	0.10	66.64	1.07
Stage 1	Hudson	179	1.55	1.51	3.11	0.57	0.46	2.85	2.93	6.40	1.43	0.38	0.30	2.41	0.14	67.92	0.35
Stage 1	Lawndale	4	1.71	1.64	2.46	1.10	0.59	0.39	0.00	1.58	0.79	2.89	2.76	5.03	1.00	11.55	1.97
Stage 1	Lexington	161	1.46	1.29	3.87	0.60	0.57	2.27	2.43	6.76	1.66	0.49	0.28	12.92	0.09	78.67	1.06
Stage 1	Martin	91	1.45	1.40	2.61	0.77	0.42	2.43	2.78	6.36	1.66	0.59	0.33	9.49	0.08	53.42	1.12
Stage 1	Money Creek	32	1.96	1.95	3.52	0.86	0.76	3.35	3.67	6.84	1.76	1.22	0.63	13.64	0.20	39.16	2.32
Stage 1	Oldtown	142	1.98	1.96	4.05	0.88	0.71	3.04	3.20	8.60	1.73	0.94	0.67	5.23	0.17	133.98	0.89
Stage 1	Peach Orchard	29	1.30	1.17	2.59	0.72	0.49	2.38	2.44	9.33	2.34	0.81	0.34	7.02	0.17	23.59	1.53
Stage 1	Randolph	301	1.51	1.42	3.39	0.43	0.51	2.66	2.87	9.07	1.47	0.46	0.25	7.13	0.06	139.35	0.81
Stage 1	Sullivant	20	1.12	1.01	2.10	0.51	0.40	2.10	2.20	6.13	2.09	1.15	0.31	5.00	0.14	22.96	1.61
Stage 1	Towanda	45	1.54	1.59	2.19	0.72	0.39	3.46	3.20	8.53	1.85	0.52	0.47	1.60	0.15	23.33	0.34
Stage 1	West	6	1.75	1.81	2.06	1.25	0.29	1.81	1.17	4.28	2.11	1.81	1.61	3.13	1.03	10.86	0.80
Stage 1	Yates	7	1.69	1.23	3.54	1.08	0.90	2.45	2.02	5.07	2.01	1.22	1.10	3.46	0.17	8.55	1.05
Stage 1	All	2,036	1.51	1.41	4.05	0.43	0.54	2.39	2.67	10.27	1.73	0.58	0.30	13.64	0.04	1188.33	1.04
Stage 2	Near WF	56	1.62	1.58	3.90	0.72	0.64	1.74	1.66	9.50	1.93	1.81	0.55	12.73	0.11	101.26	2.60
Stage 2	Anchor	7	1.48	1.70	1.75	0.58	0.44	1.26	0.00	3.20	1.58	0.40	0.35	0.62	0.28	2.82	0.13
Stage 2	Bellflower	21	1.35	1.13	2.50	0.58	0.57	0.48	0.00	5.38	1.33	0.60	0.33	2.86	0.15	12.63	0.73
Stage 2	Blue Mound	15	1.29	1.39	2.00	0.64	0.41	3.55	3.20	9.77	2.31	0.54	0.28	2.36	0.14	8.15	0.64
Stage 2	Chenoa	92	1.40	1.25	2.95	0.69	0.50	2.06	2.04	6.24	1.63	0.34	0.28	2.41	0.14	31.04	0.29
Stage 2	Cropsey	5	1.31	1.06	2.02	0.90	0.51	1.03	0.00	2.93	1.43	0.53	0.30	1.14	0.30	2.64	0.37
Stage 2	Dix	10	1.58	1.30	3.49	0.78	0.80	3.37	3.02	6.67	1.91	0.86	0.50	3.09	0.25	8.62	0.94
Stage 2	Downs	41	1.41	1.36	3.15	0.70	0.52	2.48	2.67	8.86	1.79	0.42	0.25	2.57	0.15	17.34	0.49
Stage 2	Drummer	132	1.40	1.34	2.90	0.57	0.46	2.77	2.84	8.53	1.47	0.47	0.25	8.70	0.09	62.55	0.97
Stage 2	Empire	136	1.50	1.36	3.78	0.72	0.61	2.39	2.47	7.50	1.46	0.35	0.25	7.71	0.09	47.94	0.67
Stage 2	Gridley	69	1.47	1.36	3.63	0.76	0.55	2.20	2.44	6.67	1.58	0.42	0.28	3.07	0.10	29.23	0.55
Stage 2	Hudson	98	1.59	1.45	3.45	0.82	0.55	2.97	3.09	6.67	1.47	0.60	0.31	10.00	0.16	58.87	1.45

Stage 2	Lawndale	3	2.02	1.80	2.46	1.80	0.38	0.89	0.00	2.67	1.54	2.62	2.14	4.08	1.65	7.87	1.29
Stage 2	Lexington	88	1.54	1.43	3.19	0.72	0.58	2.79	3.17	11.20	1.84	0.41	0.27	3.30	0.09	36.09	0.48
Stage 2	Martin	53	1.43	1.41	2.52	0.69	0.42	2.32	2.57	8.00	1.84	0.32	0.26	1.20	0.11	17.17	0.21
Stage 2	Money Creek	21	1.65	1.49	3.20	0.67	0.68	2.99	3.29	6.40	1.66	1.15	0.76	5.02	0.26	24.12	1.07
Stage 2	Oldtown	71	1.94	1.94	3.31	0.64	0.61	2.83	3.06	6.11	1.36	1.00	0.68	5.01	0.19	71.02	1.04
Stage 2	Peach Orchard	7	1.57	1.27	2.42	1.17	0.56	2.76	2.67	5.33	1.78	0.33	0.33	0.52	0.26	2.33	0.09
Stage 2	Randolph	145	1.47	1.38	3.10	0.66	0.48	2.67	2.81	9.17	1.49	0.41	0.26	5.60	0.06	59.21	0.66
Stage 2	Sullivant	9	1.44	1.30	2.82	0.96	0.57	2.25	2.32	3.47	0.66	2.40	0.43	10.00	0.19	21.62	3.31
Stage 2	Towanda	34	1.42	1.37	3.20	0.71	0.53	2.84	2.89	6.67	1.49	0.67	0.43	4.86	0.13	22.78	0.99
Stage 2	West	4	1.82	1.76	2.18	1.59	0.26	1.07	0.00	4.28	2.14	3.30	3.01	6.17	1.03	13.21	2.16
Stage 2	Yates	4	2.33	2.10	3.60	1.51	1.01	1.93	1.73	4.27	2.26	1.66	1.29	3.49	0.58	6.65	1.39
Stage 2	All	1,121	1.51	1.40	3.90	0.57	0.56	2.50	2.68	11.20	1.65	0.59	0.30	12.73	0.06	665.16	1.10
Stage 3	Near WF	31	1.38	1.32	2.14	0.62	0.40	1.65	1.71	6.00	1.66	2.09	1.10	6.84	0.13	64.69	2.14
Stage 3	Anchor	4	1.29	1.30	1.58	0.97	0.25	3.09	4.00	4.36	2.08	0.34	0.36	0.37	0.26	1.34	0.05
Stage 3	Bellflower	11	1.44	1.39	2.45	0.93	0.40	0.85	0.00	4.36	1.39	0.42	0.33	1.36	0.16	4.63	0.35
Stage 3	Blue Mound	2	1.42	1.42	1.84	1.00	0.59	1.33	1.33	2.67	1.89	0.31	0.31	0.48	0.14	0.62	0.24
Stage 3	Chenoa	57	1.39	1.29	2.95	0.79	0.44	2.37	2.40	8.27	1.90	0.31	0.29	0.66	0.14	17.53	0.10
Stage 3	Cropsey	1	1.39	1.39	1.39	1.39		0.00	0.00	0.00		0.34	0.34	0.34	0.34	0.34	
Stage 3	Dix	5	1.29	1.22	1.74	0.78	0.36	2.41	2.44	4.00	1.70	1.12	0.33	4.35	0.25	5.59	1.81
Stage 3	Downs	25	1.47	1.48	2.84	0.73	0.43	2.50	2.67	4.98	1.27	0.61	0.36	2.84	0.17	15.18	0.75
Stage 3	Drummer	51	1.47	1.34	2.76	0.84	0.42	3.07	3.18	9.11	2.08	0.42	0.22	5.00	0.12	21.21	0.74
Stage 3	Empire	94	1.45	1.28	3.71	0.61	0.56	2.57	2.69	7.29	1.55	0.39	0.28	5.08	0.13	36.47	0.53
Stage 3	Gridley	48	1.47	1.40	2.54	0.78	0.41	2.54	2.67	6.67	1.43	0.36	0.29	1.82	0.10	17.19	0.28
Stage 3	Hudson	59	1.55	1.43	2.85	0.57	0.58	2.86	2.83	6.04	1.33	0.63	0.32	5.10	0.15	37.38	1.03
Stage 3	Lawndale	4	2.00	1.76	2.77	1.71	0.52	0.00	0.00	0.00	0.00	2.91	2.09	5.40	2.04	11.62	1.66
Stage 3	Lexington	76	1.48	1.37	2.41	0.56	0.46	2.26	2.61	6.00	1.45	0.41	0.29	2.81	0.08	31.37	0.44
Stage 3	Martin	25	1.40	1.35	2.36	0.93	0.37	2.44	2.93	4.00	1.18	0.35	0.32	1.33	0.16	8.80	0.23
Stage 3	Money Creek	11	1.77	1.54	2.67	1.12	0.57	3.18	3.07	10.00	2.83	0.99	0.69	3.35	0.30	10.85	0.83
Stage 3	Oldtown	41	1.88	1.73	3.01	1.15	0.55	2.96	3.18	6.27	1.84	1.28	0.76	5.27	0.20	52.60	1.25
Stage 3	Peach Orchard	6	1.60	1.53	2.37	1.10	0.50	2.75	2.52	4.98	1.24	1.55	0.41	5.00	0.24	9.29	2.00
Stage 3	Randolph	112	1.57	1.41	2.98	0.65	0.57	2.92	2.97	16.67	1.92	0.65	0.25	10.00	0.09	72.69	1.34
Stage 3	Sullivant	5	1.32	1.22	2.07	0.68	0.57	2.03	2.20	4.76	2.07	1.52	0.38	3.52	0.14	7.58	1.76
Stage 3	Towanda	20	1.40	1.31	2.24	0.72	0.41	3.30	3.31	7.79	2.23	0.63	0.40	1.86	0.19	12.53	0.55
Stage 3	West	0															
Stage 3	Yates	6	1.59	1.23	2.75	1.12	0.65	2.00	2.00	4.00	2.19	0.56	0.52	1.00	0.29	3.37	0.23
Stage 3	All	694	1.51	1.39	3.71	0.56	0.51	2.59	2.69	16.67	1.75	0.64	0.32	10.00	0.08	442.87	1.04
All	Near WF	177	1.52	1.40	3.90	0.58	0.60	1.49	0.00	9.50	1.81	1.71	0.61	12.73	0.11	301.92	2.30
All	Anchor	24	1.49	1.50	2.70	0.58	0.43	1.94	2.07	7.38	2.01	0.33	0.34	0.62	0.17	7.90	0.10
All	Bellflower	68	1.56	1.43	3.04	0.58	0.55	0.72	0.00	5.38	1.44	0.71	0.33	5.97	0.12	48.03	1.11
All	Blue Mound	43	1.28	1.17	2.00	0.64	0.37	3.18	2.93	10.27	2.62	0.51	0.28	2.36	0.11	22.02	0.57
All	Chenoa	282	1.44	1.38	2.95	0.69	0.46	2.13	2.13	10.00	1.74	0.35	0.29	5.79	0.10	99.93	0.45
All	Cropsey	15	1.43	1.39	2.21	0.72	0.48	0.76	0.00	2.93	1.13	0.96	0.34	5.42	0.23	14.40	1.42
All	Dix	35	1.31	1.20	3.49	0.78	0.50	2.28	2.13	6.67	1.80	0.68	0.30	4.35	0.13	23.94	0.90

All	Downs	138	1.41	1.39	3.15	0.67	0.42	2.55	2.69	8.86	1.55	0.48	0.36	2.84	0.10	66.11	0.56
All	Drummer	419	1.37	1.28	3.33	0.48	0.46	2.38	2.33	9.11	1.84	0.45	0.23	11.00	0.09	188.92	0.96
All	Empire	503	1.49	1.38	3.83	0.61	0.56	2.47	2.67	7.50	1.50	0.39	0.27	10.41	0.04	197.77	0.67
All	Gridley	228	1.49	1.38	3.63	0.76	0.51	2.17	2.19	6.73	1.46	0.50	0.28	6.18	0.10	113.06	0.82
All	Hudson	336	1.56	1.46	3.45	0.57	0.51	2.88	2.93	6.67	1.42	0.49	0.31	10.00	0.14	164.17	0.93
All	Lawndale	11	1.90	1.80	2.77	1.10	0.49	0.39	0.00	2.67	0.89	2.82	2.14	5.40	1.00	31.04	1.53
All	Lexington	325	1.49	1.35	3.87	0.56	0.55	2.41	2.67	11.20	1.68	0.45	0.28	12.92	0.08	146.13	0.81
All	Martin	169	1.43	1.40	2.61	0.69	0.41	2.40	2.67	8.00	1.65	0.47	0.32	9.49	0.08	79.39	0.84
All	Money Creek	64	1.83	1.74	3.52	0.67	0.71	3.20	3.36	10.00	1.92	1.16	0.68	13.64	0.20	74.13	1.77
All	Oldtown	254	1.96	1.89	4.05	0.64	0.66	2.97	3.17	8.60	1.65	1.01	0.69	5.27	0.17	257.60	1.00
All	Peach Orchard	42	1.39	1.20	2.59	0.72	0.51	2.50	2.52	9.33	2.10	0.84	0.34	7.02	0.17	35.21	1.48
All	Randolph	558	1.51	1.40	3.39	0.43	0.51	2.71	2.89	16.67	1.58	0.49	0.25	10.00	0.06	271.25	0.91
All	Sullivant	34	1.23	1.12	2.82	0.51	0.48	2.13	2.20	6.13	1.78	1.53	0.36	10.00	0.14	52.16	2.19
All	Towanda	99	1.47	1.44	3.20	0.71	0.45	3.21	3.18	8.53	1.82	0.59	0.47	4.86	0.13	58.64	0.67
All	West	10	1.78	1.81	2.18	1.25	0.26	1.52	0.00	4.28	2.04	2.41	2.03	6.17	1.03	24.07	1.58
All	Yates	17	1.80	1.36	3.60	1.08	0.85	2.17	2.02	5.07	2.01	1.09	0.58	3.49	0.17	18.57	1.00
All	All	3,851	1.51	1.40	4.05	0.43	0.54	2.46	2.67	16.67	1.71	0.60	0.30	13.64	0.04	2296.36	1.06

Notes: *n*=# of observations; StDev.=Standard Deviation; Max=Maximum; Min.=Minimum; SQFT=above grade living area of the dwelling in 1000s of square feet;
Garage=area of the garage in 180s of square feet, approximately the number of standard cars that can fit in the garage; Acreage=total number of acres of the property; Sum.=Summation or Total;
Near WF=Near Twin Groves I & II=Near Wind Farm=1 if property located within 3 mile buffer of wind farm, 0 otherwise;
Township dummy variables exclude properties near TG I and II; Stage 1=Before TG I and II (WF) Approval=01/01/2001 – 09/20/2005;
Stage 2=Post TG I and II (WF) Approval and during Construction=09/21/2005 – 02/01/2008; Stage 3=Twin Groves I and II Online, WF Operation=02/02/2008 – 12/01/2009.

Table C. 12. Township and Wind Farm 3-Stage Cross Tabulations

			Year Built	Year Built	Year Built	Year Built	Year Built	Fireplaces	RR Tracks	Lakefront	Cul-de-sac	Trees
Wind Farm Stages		*n*	Mean	Median	Max	Min.	Std. Dev.	Sum.	Sum.	Sum.	Sum.	Sum.
Stage 1	Near WF	90	1929	1919	2001	1849	38	19	23	3	3	13
Stage 1	Anchor	13	1913	1894	1973	1858	37	3	8	0	0	0
Stage 1	Bellflower	36	1940	1930	1998	1889	35	5	19	0	0	0
Stage 1	Blue Mound	26	1909	1897	2003	1879	31	3	10	0	0	0
Stage 1	Chenoa	133	1932	1935	2003	1859	43	22	41	0	0	0
Stage 1	Cropsey	9	1932	1921	2000	1871	39	0	4	0	0	1
Stage 1	Dix	20	1941	1955	1986	1900	30	0	1	0	0	0
Stage 1	Downs	72	1977	1999	2003	1867	33	25	19	0	14	9
Stage 1	Drummer	236	1943	1951	2004	1883	31	29	46	0	4	0
Stage 1	Empire	273	1954	1969	2005	1849	44	76	18	0	35	5
Stage 1	Gridley	111	1934	1940	2003	1869	38	23	22	0	0	2
Stage 1	Hudson	179	1972	1978	2003	1836	31	81	0	11	6	26
Stage 1	Lawndale	4	1922	1924	1930	1909	10	1	0	0	0	0
Stage 1	Lexington	161	1939	1958	2002	1824	44	48	36	1	17	16
Stage 1	Martin	91	1938	1920	2004	1874	44	24	28	0	23	6
Stage 1	Money Creek	32	1982	1988	2004	1875	22	18	1	5	7	21
Stage 1	Oldtown	142	1979	1981	2004	1899	22	101	16	14	27	64
Stage 1	Peach Orchard	29	1935	1930	1982	1900	29	2	13	0	0	1
Stage 1	Randolph	301	1971	1982	2005	1869	33	119	52	1	26	71
Stage 1	Sullivant	20	1934	1929	1978	1900	26	3	0	0	0	1
Stage 1	Towanda	45	1949	1971	2000	1883	36	12	20	2	6	0
Stage 1	West	6	1930	1906	1999	1891	46	0	0	0	0	1
Stage 1	Yates	7	1933	1940	1965	1896	25	1	1	0	0	0
Stage 1	All	2,036	1952	1963	2005	1824	40	615	378	37	168	237
Stage 2	Near WF	56	1924	1916	2006	1859	39	9	11	1	0	5
Stage 2	Anchor	7	1928	1890	2001	1879	52	2	5	0	0	0
Stage 2	Bellflower	21	1928	1910	1999	1884	35	2	9	0	0	0
Stage 2	Blue Mound	15	1920	1899	1994	1879	41	2	7	0	0	0
Stage 2	Chenoa	92	1929	1919	2003	1859	42	14	28	0	0	0
Stage 2	Cropsey	5	1924	1904	1958	1896	32	1	2	0	0	0
Stage 2	Dix	10	1945	1959	2000	1860	51	0	2	0	0	0
Stage 2	Downs	41	1971	1976	2005	1869	37	17	12	0	5	9
Stage 2	Drummer	132	1943	1951	2005	1880	31	15	36	0	4	1
Stage 2	Empire	136	1952	1964	2005	1849	43	30	17	0	13	2
Stage 2	Gridley	69	1940	1951	2002	1859	39	11	14	0	0	1
Stage 2	Hudson	98	1968	1974	2003	1880	32	47	0	9	9	20

Stage 2	Lawndale	3	1932	1910	1976	1909	38	1	0	0	0	0
Stage 2	Lexington	88	1935	1952	2003	1859	46	18	12	0	8	5
Stage 2	Martin	53	1927	1909	2005	1869	43	12	19	0	8	3
Stage 2	Money Creek	21	1975	1980	2008	1894	26	5	2	2	1	9
Stage 2	Oldtown	71	1979	1979	2004	1888	18	55	5	7	22	19
Stage 2	Peach Orchard	7	1941	1953	1960	1900	23	0	2	0	0	0
Stage 2	Randolph	145	1967	1978	2004	1859	35	46	24	3	14	33
Stage 2	Sullivant	9	1919	1910	1955	1900	21	0	1	0	0	0
Stage 2	Towanda	34	1955	1971	2000	1886	32	11	9	2	5	0
Stage 2	West	4	1917	1917	1933	1900	14	0	0	0	0	0
Stage 2	Yates	4	1911	1915	1920	1896	11	1	0	0	0	0
Stage 2	All	1,121	1949	1960	2008	1849	41	299	217	24	89	107
Stage 3	Near WF	31	1927	1920	2004	1859	39	4	7	0	1	8
Stage 3	Anchor	4	1945	1954	1964	1909	25	0	1	0	0	0
Stage 3	Bellflower	11	1935	1919	1997	1879	41	0	6	0	0	0
Stage 3	Blue Mound	2	1884	1884	1899	1869	21	0	0	0	0	0
Stage 3	Chenoa	57	1929	1921	2003	1869	41	6	16	0	0	0
Stage 3	Cropsey	1	1960	1960	1960	1960		0	0	0	0	0
Stage 3	Dix	5	1920	1907	1956	1890	29	0	1	0	0	0
Stage 3	Downs	25	1966	1997	2004	1899	41	5	8	0	2	4
Stage 3	Drummer	51	1951	1956	2008	1892	31	10	14	0	1	0
Stage 3	Empire	94	1946	1961	2003	1867	40	23	10	0	11	1
Stage 3	Gridley	48	1943	1953	2002	1869	42	10	11	0	0	0
Stage 3	Hudson	59	1970	1974	2003	1890	29	22	0	3	6	11
Stage 3	Lawndale	4	1904	1902	1910	1900	5	0	0	0	0	0
Stage 3	Lexington	76	1935	1954	2005	1869	46	24	18	0	10	8
Stage 3	Martin	25	1934	1914	2005	1880	43	3	8	0	6	0
Stage 3	Money Creek	11	1967	1981	2002	1895	37	9	1	1	1	6
Stage 3	Oldtown	41	1984	1981	2004	1960	11	31	3	8	12	20
Stage 3	Peach Orchard	6	1925	1920	1950	1900	20	0	0	0	0	1
Stage 3	Randolph	112	1965	1978	2004	1879	35	36	20	1	4	26
Stage 3	Sullivant	5	1919	1915	1955	1900	23	0	0	0	0	0
Stage 3	Towanda	20	1954	1970	1974	1901	27	5	8	2	3	0
Stage 3	West	0										
Stage 3	Yates	6	1931	1929	1995	1886	36	0	4	0	0	0
Stage 3	All	694	1950	1961	2008	1859	40	188	136	15	57	85
All Stages	Near WF	177	1927	1919	2006	1849	39	32	41	4	4	26
All Stages	Anchor	24	1923	1917	2001	1858	40	5	14	0	0	0
All Stages	Bellflower	68	1935	1924	1999	1879	36	7	34	0	0	0
All Stages	Blue Mound	43	1912	1899	2003	1869	35	5	17	0	0	0
All Stages	Chenoa	282	1930	1921	2003	1859	42	42	85	0	0	0
All Stages	Cropsey	15	1931	1921	2000	1871	35	1	6	0	0	1
All Stages	Dix	35	1939	1955	2000	1860	37	0	4	0	0	0

All Stages	Downs	138	1973	1999	2005	1867	36	47	39	0	21	22
All Stages	Drummer	419	1944	1951	2008	1880	31	54	96	0	9	1
All Stages	Empire	503	1952	1964	2005	1849	43	129	45	0	59	8
All Stages	Gridley	228	1938	1946	2003	1859	39	44	47	0	0	3
All Stages	Hudson	336	1971	1975	2003	1836	31	150	0	23	21	57
All Stages	Lawndale	11	1918	1910	1976	1900	22	2	0	0	0	0
All Stages	Lexington	325	1937	1956	2005	1824	45	90	66	1	35	29
All Stages	Martin	169	1934	1915	2005	1869	43	39	55	0	37	9
All Stages	Money Creek	64	1977	1986	2008	1875	26	32	4	8	9	36
All Stages	Oldtown	254	1980	1981	2004	1888	19	187	24	29	61	103
All Stages	Peach Orchard	42	1935	1934	1982	1900	27	2	15	0	0	2
All Stages	Randolph	558	1969	1979	2005	1859	34	201	96	5	44	130
All Stages	Sullivant	34	1928	1923	1978	1900	25	3	1	0	0	1
All Stages	Towanda	99	1952	1971	2000	1883	33	28	37	6	14	0
All Stages	West	10	1925	1911	1999	1891	36	0	0	0	0	1
All Stages	Yates	17	1927	1929	1995	1886	27	2	5	0	0	0
All Stages	All	3,851	1951	1962	2008	1824	41	1,102	731	76	314	429

Notes: *n*=# of observations; Std. Dev.=Standard Deviation; Max=Maximum; Min.=Minimum; Sum.=Summation or Total; Year Built=the year the property was originally built; Fireplaces=# of fireplaces; RR Tracks=Railroad Tracks=1 if within 180 meters of railroad tracks, 0 otherwise; Lakefront=1 if within 70 meters of a lake, 0 otherwise; Cul-de-sac=1 if property located near a cul-de-sac, 0 otherwise; Near WF=Near Twin Groves I & II=Near Wind Farm=1 if property located within 3 mile buffer of wind farm, 0 otherwise; Trees=1 if within 180 meters of trees, 0 otherwise; Township dummy variables exclude properties near TG I and II; Stage 1=Before TG I and II (WF) Approval=01/01/2001 – 09/20/2005; Stage 2=Post TG I and II (WF) Approval and during Construction=09/21/2005 – 02/01/2008; Stage 3=Twin Groves I and II Online, WF Operation=02/02/2008 – 12/01/2009; All Stages=01/01/2001 – 12/01/2009.

Appendix D. Introduction to Difference-in-Differences Estimators

This analysis utilizes a difference-in-differences estimator. In order to get a better understanding of how to interpret the results, this section goes through simplified examples that can be extended to most of the models estimated[137]. The estimated coefficients from the real estimation results (Appendix E) cannot be calculated exactly as indicated in this section because of the addition of various housing characteristics into the model which provides appropriate controls such that the wind farm impact on property values can be estimated more precisely (however, the estimated coefficients can be interpreted roughly the same).

1. Example: Two Wind Farm Development Stages

Consider the following equation:

$$\text{RealPrice} = \beta_0 + \delta_0 \text{wfoperation} + \gamma_0 \text{nearwf} + \delta_1 \text{wfoperation} * \text{nearwf} + \varepsilon \qquad \text{(D1)}$$

Where

- *RealPrice* is the selling price of properties adjusted for inflation;
- *wfoperation* is a dummy variable equal to 1 for properties that sold during the time period in which the wind farm was operational (and 0 otherwise);
- *nearwf* is a dummy variable equal to 1 for properties that sold near the wind farm area (and 0 otherwise);
- *wfoperation*nearwf* is a dummy variable equal to 1 for properties that sold that are located near the wind farm area during the time period in which the wind farm was operational (and 0 otherwise);
- ε is an error term[138];
- $\beta_0, \delta_0, \gamma_0, \delta_1$ represent parameters[139] to be estimated.

Eq. (D1) contains the "true" or "unknown" population parameters, while regression analysis involves estimating these "true" or "unknown" parameters by using a sample of data from the population[140]. The estimated[141] coefficients of Eq. (D1) can literally be calculated using simple averages[142].

$$\hat{\beta}_0 = \overline{\text{RealPrice}}_{\text{farwf,B4Operation}} \qquad \text{(D2)}$$

$$\hat{\delta}_0 = \left(\overline{\text{RealPrice}}_{\text{farwf,wfOperation}} - \overline{\text{RealPrice}}_{\text{farwf,B4Operation}}\right) \qquad \text{(D3)}$$

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[137] It can be extended to the rest of the models estimated except the separate stage estimations presented in Tables 14-16 from Section VI and Table E.3 of Appendix E.
[138] An error term contains unobserved factors that affect the dependent variable. It may also include measurement errors in the observed dependent or independent variables (Wooldridge, 2009).
[139] A parameter is an unknown value that describes a population relationship (Wooldridge, 2009).
[140] Using the sample of data collected from the population on particular variables of interest, one estimates the parameters of the model by regressing the dependent variable on the explanatory variables via Ordinary Least Squares (OLS) multiple linear regression analysis.
[141] The equation is estimated using Ordinary Least Squares (OLS) multiple linear regression analysis. OLS is a method for estimating the parameters of a multiple linear regression model. The ordinary least squares estimates are obtained by minimizing the sum of squared residuals (Wooldridge, 2009).
[142] The "mean" or "average" is defined as the sum of n numbers divided by n. The bar over a variable represents the average value.

$$\hat{\gamma}_0 = \left(\overline{\text{RealPrice}}_{\text{nearwf,B4Operation}} - \overline{\text{RealPrice}}_{\text{farwf,B4Operation}}\right) \quad \text{(D4)}$$

$$\hat{\delta}_1 = \left(\overline{\text{RealPrice}}_{\text{nearwf,wfOperation}} - \overline{\text{RealPrice}}_{\text{nearwf,B4Operation}}\right) - \left(\overline{\text{RealPrice}}_{\text{farwf,wfOperation}} - \overline{\text{RealPrice}}_{\text{farwf,B4Operation}}\right) \quad \text{(D5)}$$

Where[143]

- $\overline{RealPrice}_{farwf,B4Operation}$ is the real average price of properties that sold *far* from the wind farm during the time period *before* the wind farm was *operational.*
- $\overline{RealPrice}_{farwf,wfOperation}$ is the real average price of properties that sold *far* from the wind farm during the time period when the wind farm was *operational.*
- $\overline{RealPrice}_{nearwf,B4Operation}$ is the real average price of properties that sold *near* the wind farm during the time period *before* the wind farm was *operational.*
- $\overline{RealPrice}_{nearwf,wfOperation}$ is the real average price of properties that sold *near* the wind farm during the time period when the wind farm was *operational.*

The bar over *RealPrice* denotes the average and the subscript *B4Operation* denotes the time period before wind farm operation and the subscript *wfOperation* denotes the time period in which the wind farm was fully operational. The subscript *farwf* denotes properties that sold far away from the wind farm and the subscript *nearwf* denotes properties that sold near the wind farm. Thus, the estimated coefficients have the following interpretations:

- $\hat{\beta}_0$ the intercept represents the real average price of a home far from the wind farm prior to operation of the wind farm.
- $\hat{\delta}_0$ captures aggregate factors that affect the real prices of properties over time; it captures changes in the real value of properties far from the wind farm from the period before wind farm operations to the period when the wind farm was operational.
- $\hat{\gamma}_0$ measures the *location effect* that is *not* due to the presence of the wind farm. This takes into account any housing price differential between properties near the wind farm and far from the wind farm prior to wind farm operations.
- $\hat{\delta}_1$ the coefficient on the interaction term *wfoperation*nearwf* is the estimated coefficient of interest: it measures the change in real housing values due to the new wind farm, provided we assume that houses both near and far from the wind farm site did not appreciate at different rates for other reasons. Wind farm area stigma would occur if $\hat{\delta}_1$ is negative and statistically significant at conventional levels of significance[144].

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[143] Column (1) of Table D.1 of Appendix D contains the results of estimating Eq. (D1). The real average prices of properties that sold can be found in Table C.1 of Appendix C.

[144] Statistically significant at the 10% level means that, over many trials, one expects to *reject* the null hypothesis that the coefficient is zero, when it is in fact zero, one time out of ten (Malpezzi et al., 1980). Statistically significant at the 5% level means that, over many trials, one expects to *reject* the null hypothesis that the coefficient is zero, when it is in fact zero, one time out of twenty. Statistically significant at the 1% level means that, over many trials, one expects to *reject* the null hypothesis that the coefficient is zero, when it is in fact zero, one time out of one hundred. Small levels of statistical significance are evidence against the null hypothesis. The null hypothesis is that there is no significant relationship between the dependent variable and the independent variable; i.e., the coefficient is zero. Thus small levels of statistical significance are evidence against the null hypothesis, since they indicate that the outcome of the data occurs with small probability if the null hypothesis is true. An estimated coefficient that is statistically significant at the 1% level implies that it is statistically significant at the 5% and 10% level. However, the opposite is not necessarily true. The strongest level of statistical significance is reported throughout this report;

The results from OLS estimation of Eq. (D1) are presented in Column (1) of Table D.1 and in Eq. (D6). For those unfamiliar with difference-in-differences estimators or regression analysis, it would be a good idea to prove to yourself that the estimated coefficients in Eq. (D6) can be calculated using the averages of *RealPrice* presented in Eqs. (D2-D5). Real average property prices (the averages of *RealPrice*) can be found in Table C.1 of Appendix C; however, some are provided below for convenience.

$$\widehat{RealPrice} = 127{,}694 - 2{,}488\ wfoperation - 21{,}916\ nearwf + 13{,}524\ wfoperation * nearwf \qquad (D6)$$

$$\hat{\beta}_0 = \overline{RealPrice}_{farwf,B4Operation} = \$127{,}694$$

$$\hat{\delta}_0 = \left(\overline{RealPrice}_{farwf,wfOperation} - \overline{RealPrice}_{farwf,B4Operation}\right) = -\$2{,}488$$

$$\hat{\gamma}_0 = \left(\overline{RealPrice}_{nearwf,B4Operation} - \overline{RealPrice}_{farwf,B4Operation}\right) = -\$21{,}916$$

$$\hat{\delta}_1 = \left(\overline{RealPrice}_{nearwf,wfOperation} - \overline{RealPrice}_{nearwf,B4Operation}\right) - \left(\overline{RealPrice}_{farwf,wfOperation} - \overline{RealPrice}_{farwf,B4Operation}\right)$$

$$\hat{\delta}_1 = (\$116{,}814 - \$105{,}778) - (\$125{,}206 - \$127{,}694)$$

$$\hat{\delta}_1 = \$11{,}036 - (-\$2{,}488)$$

$$\hat{\delta}_1 = \$13{,}524$$

The real average price of a home far from the eventual wind farm site prior to operation of the wind farm was $127,694. Homes located far from the wind farm site have lost on average $2,488 in value since the wind farm began operating. Homes located near the wind farm were valued on average $21,916 less than homes far from the wind farm, before the wind farm began operating. Homes located near the wind farm had their values appreciate $13,524 more on average than homes located far from the wind farm, after the wind farm began operating. Only the coefficient of the intercept, *C* ($\hat{\beta}_0$) and *nearwf* ($\hat{\gamma}_0$) are statistically significant at conventional levels.

2. EXAMPLE: THREE WIND FARM DEVELOPMENT STAGES

The difference-in-differences estimator can be extended to take into account the different stages of the wind farm development. Consider the following equation:

$$RealPrice = \alpha_0 + \varphi_1 wfconstr + \varphi_2 wfoperation + \gamma_0 nearwf + \theta_1 wfconstr * nearwf + \theta_2 wfoperation * nearwf + \varepsilon \qquad (D7)$$

Where

- *RealPrice* is the selling prices of properties adjusted for inflation;
- *wfconstr* is a dummy variable equal to 1 for properties that sold during the time period after the wind farm was approved and during construction (and 0 otherwise);

e.g., 1% would be reported instead of reporting 1%, 5%, and 10%.

- *wfoperation* is a dummy variable equal to 1 for properties that sold during the time period that the wind farm was operational (and 0 otherwise);
- *nearwf* is a dummy variable equal to 1 for properties that sold near the wind farm area (and 0 otherwise);
- *wfconstr*nearwf* is a dummy variable equal to 1 for properties that sold that are located near the wind farm area during the time period after the wind farm was approved and during construction (and 0 otherwise);
- *wfoperation*nearwf* is a dummy variable equal to 1 for properties that sold that are located near the wind farm area during the time period in which the wind farm was operational (and 0 otherwise);
- ε is an error term;
- $\alpha_0, \varphi_1, \varphi_2, \gamma_0, \theta_1, \theta_2$ represent parameters to be estimated.

Again, Eq. (D7) contains the “true” or “unknown” population parameters, while regression analysis involves estimating these unknown parameters by using a sample of data from the population. The estimated coefficients of Eq. (D7) can literally be calculated using simple averages.

$$\hat{\alpha}_0 = \overline{\text{RealPrice}}_{\text{farwf,B4approv}} \quad \text{(D8)}$$

$$\hat{\varphi}_1 = \left(\overline{\text{RealPrice}}_{\text{farwf,wfconstr}} - \overline{\text{RealPrice}}_{\text{farwf,B4approv}}\right) \quad \text{(D9)}$$

$$\hat{\varphi}_2 = \left(\overline{\text{RealPrice}}_{\text{farwf,wfOperation}} - \overline{\text{RealPrice}}_{\text{farwf,B4approv}}\right) \quad \text{(D10)}$$

$$\hat{\gamma}_0 = \left(\overline{\text{RealPrice}}_{\text{nearwf,B4approv}} - \overline{\text{RealPrice}}_{\text{farwf,B4approv}}\right) \quad \text{(D11)}$$

$$\hat{\theta}_1 = \left(\overline{\text{RealPrice}}_{\text{nearwf,wfconstr}} - \overline{\text{RealPrice}}_{\text{nearwf,B4approv}}\right) - \left(\overline{\text{RealPrice}}_{\text{farwf,wfconstr}} - \overline{\text{RealPrice}}_{\text{farwf,B4approv}}\right) \quad \text{(D12)}$$

$$\hat{\theta}_2 = \left(\overline{\text{RealPrice}}_{\text{nearwf,wfOperation}} - \overline{\text{RealPrice}}_{\text{nearwf,B4approv}}\right) - \left(\overline{\text{RealPrice}}_{\text{farwf,wfOperation}} - \overline{\text{RealPrice}}_{\text{farwf,B4approv}}\right) \quad \text{(D13)}$$

Where[145]

- $\overline{RealPrice}_{farwf,B4approv}$ is the real average price of properties that sold *far* from the wind farm during the time period *before* the wind farm was *approved*[146].
- $\overline{RealPrice}_{farwf,wfconstr}$ is the real average price of properties that sold *far* from the wind farm during the time period *after* the wind farm was *approved* and during *construction.*
- $\overline{RealPrice}_{farwf,wfOperation}$ is the real average price of properties that sold *far* from the wind farm during the time period when the wind farm was *operational.*
- $\overline{RealPrice}_{nearwf,B4approv}$ is the real average price of properties that sold *near* the eventual wind farm location during the time period *before* the wind farm was *approved.*
- $\overline{RealPrice}_{nearwf,wfconstr}$ is the real average price of properties that sold *near* the wind farm during the time period *after* the wind farm was *approved* and during *construction.*
- $\overline{RealPrice}_{nearwf,wfOperation}$ is the real average price of properties that sold *near* the wind

[145] Column (2) of Table D.1 of Appendix D contains the results of estimating Eq. (D7). The real average prices of properties that sold can be found in Table C.4 of Appendix C.

[146] Before the wind farm (TG I and II) was approved by the McLean County Board.

farm during the time period when the wind farm was *operational*.

The bar over *RealPrice* denotes the average value of the real property prices. The subscript *farwf* denotes properties that sold far from the wind farm and the subscript *nearwf* denotes properties that sold near the wind farm. The subscript *B4approv* denotes the time period before the wind farm received approval from the McLean County Board (01/01/2001 – 09/20/2005). The subscript *wfconstr* denotes the time period after the wind farm received approval from the McLean County Board and during the construction stage of the wind farm project (09/21/2005 – 02/01/2008), and the subscript *wfOperation* denotes the time period in which the wind farm was fully operational (02/02/2008 – 12/01/2009).

The difference-in-differences estimators from Eq. (D7) include $\hat{\theta}_1$ and $\hat{\theta}_2$, Eqs. (D12-D13). $\hat{\theta}_1$ is an estimate of the difference over time in the average difference of real housing prices near the wind farm (*nearwf*) and farther away from the wind farm (*farwf*), and the difference over time is in relation to before wind farm approval *(B4approv)* and post wind farm approval and during the construction stage of the wind farm *(wfconstr)*. A negative and statistically significant $\hat{\theta}_1$ would provide support for *wind farm anticipation stigma theory.* Whereas $\hat{\theta}_2$ estimates the difference over time in the average difference of housing prices near the wind farm (*nearwf*) and farther away from the wind farm (*farwf*), and the difference over time is in relation to before wind farm approval *(B4approv)* and during wind farm operations *(wfOperation)*. A negative and statistically significant $\hat{\theta}_2$ would provide support for *wind farm area stigma theory.* The results from estimation of Eq. (D7) using Ordinary Least Squares are presented in Column (2) of Table D.1. For those unfamiliar with difference-in-differences estimators or regression analysis, it would be a good idea to prove to yourself that the estimated coefficients in Column (2) of Table D.1 can be calculated using the averages of *RealPrice* presented in Eqs. (D8-D13). The averages of *RealPrice* can be found in Table C.4.

$$\hat{\alpha}_0 = \overline{\text{RealPrice}}_{\text{farwf,B4approv}} = \$128{,}491$$

$$\hat{\varphi}_1 = \left(\overline{\text{RealPrice}}_{\text{farwf,wfconstr}} - \overline{\text{RealPrice}}_{\text{farwf,B4approv}}\right) = -\$2{,}254$$

$$\hat{\varphi}_2 = \left(\overline{\text{RealPrice}}_{\text{farwf,wfOperation}} - \overline{\text{RealPrice}}_{\text{farwf,B4approv}}\right) = -\$3{,}286$$

$$\hat{\gamma}_0 = \left(\overline{\text{RealPrice}}_{\text{nearwf,B4approv}} - \overline{\text{Real Price}}_{\text{farwf,B4approv}}\right) = -\$20{,}323$$

$$\hat{\theta}_1 = \left(\overline{\text{Real Price}}_{\text{nearwf,wfconstr}} - \overline{\text{Real Price}}_{\text{nearwf,B4approv}}\right) - \left(\overline{\text{Real Price}}_{\text{farwf,wfconstr}} - \overline{\text{Real Price}}_{\text{farwf,B4approv}}\right) = -\$3{,}977$$

$$\hat{\theta}_2 = \left(\overline{\text{Real Price}}_{\text{nearwf,wfOperation}} - \overline{\text{Real Price}}_{\text{nearwf,B4approv}}\right) - \left(\overline{\text{Real Price}}_{\text{farwf,wfOperation}} - \overline{\text{Real Price}}_{\text{farwf,B4approv}}\right) = \$11{,}931$$

The real average price of a home far from the wind farm prior to McLean County Board approval of the wind farm was \$128,491. Homes located far from the wind farm depreciated \$2,254 on average post approval and during construction of the wind farm as compared to home values before approval of the wind farm. Homes located far from the wind farm depreciated \$3,286 on average after the wind farm became operational as compared to home values before approval of the wind farm.

Before the wind farm was approved by the McLean County Board, homes located near the wind farm were valued on average \$20,323 less than homes located far from the wind farm. This estimate is statistically significant at the one percent level, thus we can strongly reject the hypothesis that the real average property value for homes near and far from the wind farm were the same before wind farm approval, and this demonstrates the *location effect* that is *not* due to the presence of the wind farm.

When comparing the appreciation in property values from the time period before approval of the wind farm to the time period after the wind farm was approved and during the construction stage of the wind farm project, the appreciation in property values was \$3,977 lower on average for properties near the wind farm when compared with properties far from the wind farm, *ceteris paribus.* When comparing the appreciation in property values from the time period before approval of the wind farm to the time period during wind farm operations, the appreciation in property values was $11,931 higher on average for properties near the wind farm when compared with properties far from the wind farm, *ceteris paribus.* Only the coefficient of the intercept, *C* ($\hat{\alpha}_0$) and *nearwf* ($\hat{\gamma}_0$) are statistically significant at conventional levels.

Table D. 1. Example Results: Two and Three Wind Farm Stages

Dependent Variable: RealPrice	2 stages		3 stages	
	(1)		(2)	
C (intercept)	127,694	***	128,491	***
	(1,164)		(1,441)	
Post Wind Farm Approval/Construction (wfconstr)			-2,254	
			(2,445)	
Wind Farm Operation (wfoperation)	-2,488		-3,286	
	(2,756)		(2,885)	
Near Wind Farm (nearwf)	-21,916	***	-20,323	***
	(4,208)		(5,589)	
Near Wind Farm, Post WF Approval/Construction (wfconstr*nearwf)			-3,977	
			(8,403)	
Near Wind Farm, WF Operation (wfoperation*nearwf)	13,524		11,931	
	(9,013)		(9,736)	
Adjusted R-squared	0.0038		0.0036	
Standard Error of Regression	63,314		63,321	
Log Likelihood	-48,038		-48,038	
F-statistic	6	***	4	***
Mean Real Property Price	126,347		126,347	
Std Dev. Real Property Price	63,435		63,435	
Akaike Information Criterion	24.95		24.95	
Schwarz Criterion	24.96		24.96	
Durbin-Watson Statistic	1.54		1.54	

***denotes significance at 1% level **denotes significance at 5% level *denotes significance at 10% level
Notes: White Heteroskedasticity-Consistent Standard Errors & Covariance are in parentheses (White, 1980). Estimation sample includes the period 01/01/2001 - 12/01/2009. *n*=3,851. The results from this estimation are not considered the "main" results of this study. This estimation is for demonstrative purposes only.

3. EXAMPLE: THREE WIND FARM DEVELOPMENT STAGES, TOWNSHIPS

Now moving on to a more complicated example that explicitly estimates the impact of the wind farm on property values over the different stages of wind farm development, in which the different stages are thought to roughly correspond to the different levels of risk as perceived by homebuyers. The following estimations directly compare changes in property values near the wind farm with changes in property values for each of the townships farther from the wind farm over time.

Consider the following equations:

$$\ln(\text{RealPrice}) = \omega_0 + \omega_1 \text{wfconstr} + \omega_2 \text{wfoperation} + \gamma_0 \text{nearwf} + \theta_1 \text{wfconstr} * \text{nearwf} + \psi_2 \text{wfoperation} * \text{nearwf} + \boldsymbol{\gamma}_i \mathbf{TWP}_i + \boldsymbol{\vartheta}_i \text{wfconstr} * \mathbf{TWP}_i + \boldsymbol{\psi}_i \text{wfoperation} * \mathbf{TWP}_i + \varepsilon \quad \text{(D14)}$$

$$\text{RealPrice} = \alpha_0 + \alpha_1 \text{wfconstr} + \alpha_2 \text{wfoperation} + \lambda_0 \text{nearwf} + \theta_1 \text{wfconstr} * \text{nearwf} + \phi_2 \text{wfoperation} * \text{nearwf} + \boldsymbol{\lambda}_i \mathbf{TWP}_i + \boldsymbol{\theta}_i \text{wfconstr} * \mathbf{TWP}_i + \boldsymbol{\phi}_i \text{wfoperation} * \mathbf{TWP}_i + \varepsilon \quad \text{(D15)}$$

Where

- *ln(RealPrice)* represents the natural logarithm of the selling prices of houses adjusted for inflation;
- *RealPrice* represents the selling prices of houses adjusted for inflation;
- *wfconstr* is a dummy variable equal to 1 for properties that sold during the time period after the wind farm was approved and during construction (and 0 otherwise);
- *wfoperation* is a dummy variable equal to 1 for properties that sold during the time period in which the wind farm was operational (and 0 otherwise);
- *nearwf* is a dummy variable equal to 1 for properties that sold near the wind farm area (and 0 otherwise);
- *wfconstr*nearwf* is a dummy variable equal to 1 for properties that sold that are located near the wind farm area during the time period after the wind farm was approved and during the construction period (and 0 otherwise);
- *wfoperation*nearwf* is a dummy variable equal to 1 for properties that sold that are located near the wind farm area during the time period in which the wind farm was operational (and 0 otherwise);
- TWP_i represents a vector of township *(twp-i)* dummy variables and the excluded township is *Lexington* township *(Lex)*. For each *township-i (twp-i)*, the dummy variable equals 1 for properties that sold that are located in that particular township *(twp-i)* far from the wind farm (and 0 otherwise), where *i* represents each of the following townships (*TWP*): *Anchor, Bellflower, Blue Mound, Chenoa, Cropsey, Dix, Downs, Drummer, Empire, Gridley, Hudson, Lawndale, Martin, Money Creek, Oldtown, Peach Orchard, Randolph, Sullivant, Towanda, West,* and *Yates.*
- *wfconstr** TWP_i is a dummy variable equal to 1 for properties that sold during the time period after the wind farm was approved and during construction that are located in *township-i (twp-i)* (and 0 otherwise);
- *wfoperation** TWP_i is a dummy variable equal to 1 for properties that sold during the time period in which the wind farm was operational that are located in *township-i (twp-i)* (and 0 otherwise);
- ε is an error term;
- the Greek letters represent parameters to be estimated.

The results of the OLS estimation of Eqs. (D14) and (D15) are presented in Table D.2, in Columns (1) and (2), respectively. Using the formulas listed in Eqs. (D16-D33), along with averages of *ln(RealPrice)* and *RealPrice* tabulated in Table C.10, and the estimated coefficients listed in Columns (1) and (2) of Table D.2, a verification can be made to ensure that the interpretation the author has given is indeed accurate.

a. THREE WIND FARM STAGES, TOWNSHIPS, LN(REALPRICE)

$$\ln(\text{RealPrice}) = \omega_0 + \omega_1\text{wfconstr} + \omega_2\text{wfoperation} + \gamma_0\text{nearwf} + \vartheta_1\text{wfconstr} * \text{nearwf} + \psi_2\text{wfoperation} * \text{nearwf} + \boldsymbol{\gamma}_i\mathbf{TWP}_i + \boldsymbol{\vartheta}_i\text{wfconstr} * \mathbf{TWP}_i + \boldsymbol{\psi}_i\text{wfoperation} * \mathbf{TWP}_i + \varepsilon \quad \text{(D14)}$$

Since the dependent variable, *ln(RealPrice),* is the natural logarithm of *RealPrice,* the estimated coefficients are in percentage (%) terms rather than dollar ($) terms. Also note that differencing the natural logarithm of a variable can be interpreted as the growth rate of a variable. The estimated coefficients of Eq. (D14) can literally be calculated using the formulas presented in Eqs. (D16-D24). Table C.10 of Appendix C contains the averages of *ln(RealPrice)* that you can use to make your calculations for Eqs. (D16-D24) and Column (1) of Table D.2 presents the OLS estimates of the regression coefficients, feel free to make comparisons between the two.

$$\hat{\omega}_0 = \overline{\ln\,(\text{RealPrice})}_{\text{Lex,B4approv}} \quad \text{(D16)}$$

$$\hat{\omega}_1 = \left(\overline{\ln\,(\text{RealPrice})}_{\text{Lex,wfconstr}} - \overline{\ln\,(\text{RealPrice})}_{\text{Lex,B4approv}}\right) \quad \text{(D17)}$$

$\hat{\omega}_1$ measures the appreciation in percentage terms of real property values in *Lexington* township from the time period before the wind farm was approved to the time period after the wind farm was approved and during the construction stage of the wind farm project.

$$\hat{\omega}_2 = \left(\overline{\ln\,(\text{RealPrice})}_{\text{Lex,wfOperation}} - \overline{\ln\,(\text{RealPrice})}_{\text{Lex,B4approv}}\right) \quad \text{(D18)}$$

$\hat{\omega}_2$ measures the appreciation in percentage terms of real property values in *Lexington* township from the time period before the wind farm was approved to the time period during wind farm operations.

$$\hat{\gamma}_0 = \left(\overline{\ln\,(\text{RealPrice})}_{\text{nearwf,B4approv}} - \overline{\ln\,(\text{RealPrice})}_{\text{Lex,B4approv}}\right) \quad \text{(D19)}$$

$\hat{\gamma}_0$ measures the *location effect* that is *neither* due to the approval of the wind farm *nor* the presence of the wind farm. It indicates the percentage difference in real property values on average that existed before approval of the wind farm for properties near the eventual wind farm site in comparison to properties located in *Lexington* township.

$\hat{\gamma}_0$=-18% or -0.1926 and is statistically significant at the 1% level. This indicates that before the wind farm was approved, properties located near the eventual wind farm location were valued 18% less on average than properties located in *Lexington* township, *ceteris paribus*.

$$\hat{\vartheta}_1 = \left(\overline{\ln(\text{RealPrice})}_{\text{nearwf,wfconstr}} - \overline{\ln(\text{RealPrice})}_{\text{nearwf,B4approv}}\right) - \left(\overline{\ln\,(\text{RealPrice})}_{\text{Lex,wfconstr}} - \overline{\ln\,(\text{RealPrice})}_{\text{Lex,B4approv}}\right) \quad \text{(D20)}$$

$\hat{\vartheta}_1$ measures whether the appreciation in percentage terms of real housing values near the wind farm is different from the appreciation in percentage terms of real housing values in *Lexington* township, where housing value appreciation is calculated from the time period prior to wind farm approval to the time period after the wind farm was approved and during construction. A negative and statistically significant $\hat{\vartheta}_1$ would indicate that the real value of properties near the wind farm appreciated less on average in percentage terms than the real value of properties in *Lexington* township, from the time period prior to wind farm approval to the time period after the wind farm was approved and during construction, and this would provide support for *wind farm anticipation stigma theory*.

$\hat{\vartheta}_1$=-1% or -0.0114 and is not statistically significant.

$$\hat{\psi}_2 = \left(\overline{\ln(\text{RealPrice})}_{\text{nearwf,wfOperation}} - \overline{\ln(\text{RealPrice})}_{\text{nearwf,B4approv}}\right) - \left(\overline{\ln(\text{RealPrice})}_{\text{Lex,wfOperation}} - \overline{\ln(\text{RealPrice})}_{\text{Lex,B4approv}}\right) \quad \text{(D21)}$$

$\hat{\psi}_2$ measures whether the appreciation in percentage terms of real housing values near the wind farm is different from the appreciation in percentage terms of real housing values in *Lexington* township, where housing value appreciation is calculated from the time period prior to wind farm approval to the time period during wind farm operations. A negative and statistically significant $\hat{\psi}_2$ would indicate that the real value of properties near the wind farm appreciated less on average in percentage terms than the real value of properties in *Lexington* township, from the time period prior to wind farm approval to the time period during wind farm operations. A negative and statistically significant $\hat{\psi}_2$ would provide evidence supporting *wind farm area stigma theory*.

$\hat{\psi}_2$=23% or 0.2104 and is statistically significant at the 10% level. This indicates that the real value of properties near the wind farm appreciated 23% more on average than the real value of properties in *Lexington* township, from the time period prior to wind farm approval to the time period during wind farm operations, *ceteris paribus*. This result provides evidence against wind farm area stigma theory.

$$\hat{\boldsymbol{\gamma}}_{\mathbf{i}} = \left(\overline{\ln(\text{RealPrice})}_{\text{twp-i,B4approv}} - \overline{\ln(\text{RealPrice})}_{\text{Lex,B4approv}}\right) \quad \text{(D22)}$$

$\hat{\gamma}_i$ indicates the percentage difference in real property values on average that properties in *township-i* sold for when compared to properties that sold in *Lexington* township before approval of the wind farm.

$$\hat{\boldsymbol{\vartheta}}_{\mathbf{i}} = \left(\overline{\ln(\text{RealPrice})}_{\text{twp-i,wfconstr}} - \overline{\ln(\text{RealPrice})}_{\text{twp-i,B4approv}}\right) - \left(\overline{\ln(\text{RealPrice})}_{\text{Lex,wfconstr}} - \overline{\ln(\text{RealPrice})}_{\text{Lex,B4approv}}\right) \quad \text{(D23)}$$

$\hat{\vartheta}_i$ measures whether the appreciation in real housing values in *township-i* is different from the appreciation in real housing values in *Lexington* township, where the appreciation in real housing values is in percentage terms and is calculated from the time period prior to wind farm approval to the time period after the wind farm was approved and during construction. A positive and statistically significant $\hat{\vartheta}_i$would indicate that the real value of properties located in *township-i* appreciated more on average in percentage terms than the real value of properties in *Lexington* township, from the time period prior to wind farm approval to the time period after the wind farm was approved and during construction.

$$\hat{\boldsymbol{\psi}}_{\mathbf{i}} = \left(\overline{\ln(\text{RealPrice})}_{\text{twp-i,wfOperation}} - \overline{\ln(\text{RealPrice})}_{\text{twp-i,B4approv}}\right) - \left(\overline{\ln(\text{RealPrice})}_{\text{Lex,wfOperation}} - \overline{\ln(\text{RealPrice})}_{\text{Lex,B4approv}}\right) \quad \text{(D24)}$$

$\hat{\psi}_i$ measures whether the appreciation in real housing values in *township-i* is different from the appreciation in real housing values in *Lexington* township, where the appreciation in real housing values in percentage terms is calculated from the time period prior to wind farm approval to the time period when the wind farm was operational. A positive and statistically significant $\hat{\psi}_i$ would indicate that the real value of properties in *township-i* appreciated more on average in percentage terms than the real value of properties in *Lexington* township, from the time period prior to wind farm approval to the time period when the wind farm was operational.

b. THREE WIND FARM STAGES, TOWNSHIPS, REALPRICE

$$\text{RealPrice} = \alpha_0 + \alpha_1 \text{wfconstr} + \alpha_2 \text{wfoperation} + \lambda_0 \text{nearwf} + \theta_1 \text{wfconstr} * \text{nearwf} + \phi_2 \text{wfoperation} * \text{nearwf} + \boldsymbol{\lambda_i} \mathbf{TWP_i} + \boldsymbol{\theta_i} \text{wfconstr} * \mathbf{TWP_i} + \boldsymbol{\phi_i} \text{wfoperation} * \mathbf{TWP_i} + \varepsilon \quad \text{(D15)}$$

The interpretation of the estimated coefficients of Eq. (D15) are analogous to those of Eq. (D14). The main difference is that the estimated coefficients are in dollar ($) terms rather than percentage (%) terms. The estimated coefficients of Eq. (D15) can literally be calculated using the formulas presented in Eqs. (D25-D33). Table C.10 of Appendix C contains the averages of *RealPrice* that you can use to make your calculations for Eqs. (D25-D33) and Column (2) of Table D.2 presents the OLS estimates of the regression coefficients, feel free to make comparisons between the two to ensure they are consistent.

$$\hat{\alpha}_0 = \overline{\text{RealPrice}}_{\text{Lex,B4approv}} \quad \text{(D25)}$$

$$\hat{\alpha}_1 = \left(\overline{\text{RealPrice}}_{\text{Lex,wfconstr}} - \overline{\text{RealPrice}}_{\text{Lex,B4approv}}\right) \quad \text{(D26)}$$

$$\hat{\alpha}_2 = \left(\overline{\text{RealPrice}}_{\text{Lex,wfOperation}} - \overline{\text{RealPrice}}_{\text{Lex,B4approv}}\right) \quad \text{(D27)}$$

$$\hat{\lambda}_0 = \left(\overline{\text{RealPrice}}_{\text{nearwf,B4approv}} - \overline{\text{RealPrice}}_{\text{Lex,B4approv}}\right) \quad \text{(D28)}$$

$$\hat{\theta}_1 = \left(\overline{\text{RealPrice}}_{\text{nearwf,wfconstr}} - \overline{\text{RealPrice}}_{\text{nearwf,B4approv}}\right) - \left(\overline{\text{RealPrice}}_{\text{Lex,wfconstr}} - \overline{\text{RealPrice}}_{\text{Lex,B4approv}}\right) \quad \text{(D29)}$$

$\hat{\theta}_1$ When comparing the appreciation in property values from the time period before approval of the wind farm to the time period after the wind farm was approved and during the construction stage of the wind farm project, the appreciation in property values was $\$\hat{\theta}_1$ different on average for properties near the wind farm when compared with properties in *Lexington* township, *ceteris paribus.*

$$\hat{\phi}_2 = \left(\overline{\text{RealPrice}}_{\text{nearwf,wfOperation}} - \overline{\text{RealPrice}}_{\text{nearwf,B4approv}}\right) - \left(\overline{\text{RealPrice}}_{\text{Lex,wfOperation}} - \overline{\text{RealPrice}}_{\text{Lex,B4approv}}\right) \quad \text{(D30)}$$

$\hat{\phi}_2$ When comparing the appreciation in property values from the time period before approval of the wind farm to the time period during wind farm operations, the appreciation in property values was $\$\hat{\phi}_2$ different on average for properties near the wind farm when compared with properties in *Lexington* township, *ceteris paribus.*

$$\hat{\boldsymbol{\lambda}}_{\mathbf{i}} = \left(\overline{\text{RealPrice}}_{\text{twp-i,B4approv}} - \overline{\text{RealPrice}}_{\text{Lex,B4approv}}\right) \quad \text{(D31)}$$

$$\hat{\boldsymbol{\theta}}_{\mathbf{i}} = \left(\overline{\text{RealPrice}}_{\text{twp-i,wfconstr}} - \overline{\text{RealPrice}}_{\text{twp-i,B4approv}}\right) - \left(\overline{\text{RealPrice}}_{\text{Lex,wfconstr}} - \overline{\text{RealPrice}}_{\text{Lex,B4approv}}\right) \quad \text{(D32)}$$

$$\hat{\boldsymbol{\phi}}_{\mathbf{i}} = \left(\overline{\text{RealPrice}}_{\text{twp-i,wfOperation}} - \overline{\text{RealPrice}}_{\text{twp-i,B4approv}}\right) - \left(\overline{\text{RealPrice}}_{\text{Lex,wfOperation}} - \overline{\text{RealPrice}}_{\text{Lex,B4approv}}\right) \quad \text{(D33)}$$

Table D. 2. Example Results: Three Wind Farm Stages, Townships

Dependent Variable:		ln(RealPrice)			RealPrice		
		(1)	Std. Error†		(2)	Std. Error†	
C (Intercept)		11.6787	(0.030)	***	126,681	(3,863)	***
Post WF Approval/Construction (wfconstr)	-4%	-0.0439	(0.059)		-557	(6,907)	
Wind Farm Operation (wfoperation)	-11%	-0.1111	(0.062)	*	-10,111	(6,779)	
Near Wind Farm (nearwf)	-18%	-0.1926	(0.058)	***	-18,513	(6,675)	***
Near Wind Farm, Post WF Approval/Construction (wfconstr*nearwf)	-1%	-0.0114	(0.099)		-5,675	(10,648)	
Near Wind Farm, WF Operation (wfoperation*nearwf)	23%	0.2104	(0.112)	*	18,756	(11,568)	
Anchor Township	-43%	-0.5600	(0.097)	***	-55,987	(6,615)	***
Anchor Township, Post WF Approval/Construction (wfconstr*Anchor)	-6%	-0.0664	(0.166)		-6,516	(11,676)	
Anchor Township, Wind Farm Operation (wfoperation*Anchor)	-15%	-0.1576	(0.294)		-38	(20,807)	
Bellflower Township	-36%	-0.4459	(0.081)	***	-43,443	(7,285)	***
Bellflower Township, Post WF Approval/Construction (wfconstr*Bellflower)	-8%	-0.0879	(0.139)		-9,218	(11,911)	
Bellflower Township, Wind Farm Operation (wfoperation*Bellflower)	5%	0.0486	(0.169)		5,772	(14,913)	
Blue Mound Township	-28%	-0.3344	(0.091)	***	-34,306	(8,420)	***
Blue Mound Township, Post WF Approval/Construction (wfconstr*Blue Mound)	-4%	-0.0364	(0.181)		-431	(16,974)	
Blue Mound Township, Wind Farm Operation (wfoperation*Blue Mound)	-15%	-0.1667	(0.221)		-15,878	(16,143)	
Chenoa Township	-30%	-0.3580	(0.050)	***	-35,470	(5,244)	***
Chenoa Township, Post WF Approval/Construction (wfconstr*Chenoa)	-1%	-0.0133	(0.082)		-6,869	(8,409)	
Chenoa Township, Wind Farm Operation (wfoperation*Chenoa)	1%	0.0142	(0.094)		1,108	(9,036)	
Cropsey Township	-34%	-0.4199	(0.173)	**	-37,261	(18,232)	**
Cropsey Township, Post WF Approval/Construction (wfconstr*Cropsey)	-38%	-0.4705	(0.280)	*	-36,959	(22,137)	*
Cropsey Township, Wind Farm Operation (wfoperation*Cropsey)	20%	0.1853	(0.181)		4,199	(19,064)	
Dix Township	-42%	-0.5525	(0.070)	***	-56,033	(5,897)	***
Dix Township, Post WF Approval/Construction (wfconstr*Dix)	45%	0.3744	(0.156)	**	32,066	(14,944)	**
Dix Township, Wind Farm Operation (wfoperation*Dix)	32%	0.2741	(0.203)		25,791	(16,764)	
Downs Township	11%	0.1038	(0.057)	*	13,926	(6,714)	**
Downs Township, Post WF Approval/Construction (wfconstr*Downs)	5%	0.0475	(0.103)		3,120	(12,312)	
Downs Township, Wind Farm Operation (wfoperation*Downs)	24%	0.2144	(0.120)	*	29,003	(15,910)	
Drummer Township	-27%	-0.3198	(0.042)	***	-31,357	(4,878)	***
Drummer Township, Post WF Approval/Construction (wfconstr*Drummer)	13%	0.1222	(0.080)		10,359	(8,777)	
Drummer Township, Wind Farm Operation (wfoperation*Drummer)	35%	0.3035	(0.100)	***	33,138	(11,496)	***
Empire Township	-4%	-0.0396	(0.039)		-3,712	(4,836)	
Empire Township, Post WF Approval/Construction (wfconstr*Empire)	4%	0.0405	(0.072)		-335	(8,721)	
Empire Township, Wind Farm Operation (wfoperation*Empire)	10%	0.0965	(0.079)		7,953	(8,922)	
Gridley Township	-18%	-0.1985	(0.052)	***	-20,146	(5,909)	***
Gridley Township, Post WF Approval/Construction (wfconstr*Gridley)	3%	0.0330	(0.089)		-1,836	(9,790)	
Gridley Township, Wind Farm Operation (wfoperation*Gridley)	-2%	-0.0185	(0.102)		-2,378	(9,894)	
Hudson Township	31%	0.2666	(0.040)	***	36,619	(5,705)	***
Hudson Township, Post WF Approval/Construction (wfconstr*Hudson)	3%	0.0273	(0.078)		2,998	(11,054)	
Hudson Township, Wind Farm Operation (wfoperation*Hudson)	-2%	-0.0165	(0.082)		-8,494	(10,493)	
Lawndale Township	1%	0.0145	(0.113)		-3,975	(14,634)	
Lawndale Township, Post WF Approval/Construction (wfconstr*Lawndale)	7%	0.0687	(0.174)		3,170	(21,202)	
Lawndale Township, Wind Farm Operation (wfoperation*Lawndale)	10%	0.0986	(0.189)		10,280	(22,774)	
Martin Township	-24%	-0.2686	(0.059)	***	-26,142	(6,068)	***
Martin Township, Post WF Approval and Construction (wfconstr*Martin)	-5%	-0.0512	(0.099)		-10,198	(9,829)	
Martin Township, Wind Farm Operation (wfoperation*Martin)	-5%	-0.0479	(0.117)		-6,006	(11,305)	
Money Creek Township	77%	0.5734	(0.082)	***	101,341	(16,341)	***
Money Creek, Post WF Approval/Construction (wfconstr*Money Creek)	-21%	-0.2330	(0.168)		-39,820	(27,294)	
Money Creek Township, Wind Farm Operation (wfoperation*Money Creek)	-6%	-0.0634	(0.173)		-24,761	(28,158)	
Oldtown Township	68%	0.5189	(0.047)	***	88,207	(7,778)	***
Oldtown Township, Post WF Approval/Construction (wfconstr*Oldtown)	5%	0.0491	(0.080)		-3,603	(12,707)	
Oldtown Township, Wind Farm Operation (wfoperation*Oldtown)	23%	0.2072	(0.089)	**	26,141	(15,548)	*
Peach Orchard Township	-48%	-0.6448	(0.090)	***	-58,111	(7,100)	***
Peach Orchard, Post WF Approval/Construction (wfconstr*Peach Orchard)	6%	0.0622	(0.142)		-2,706	(11,430)	
Peach Orchard Township, Wind Farm Operation (wfoperation*Peach Orchard)	-2%	-0.0166	(0.147)		-2,294	(10,563)	
Randolph Township	13%	0.1254	(0.038)	***	17,657	(4,978)	***
Randolph Township, Post WF Approval/Construction (wfconstr*Randolph)	1%	0.0088	(0.072)		-3,770	(8,956)	
Randolph Township, Wind Farm Operation (wfoperation*Randolph)	4%	0.0428	(0.079)		3,305	(9,255)	
Sullivant Township	-48%	-0.6621	(0.092)	***	-61,002	(7,122)	***
Sullivant Township, Post WF Approval/Construction (wfconstr*Sullivant)	23%	0.2063	(0.222)		19,324	(18,361)	
Sullivant Township, Wind Farm Operation (wfoperation*Sullivant)	32%	0.2799	(0.238)		24,335	(17,804)	
Towanda Township	3%	0.0339	(0.072)		5,975	(8,291)	
Towanda Township, Post WF Approval/Construction (wfconstr*Towanda)	10%	0.0977	(0.103)		2,940	(12,343)	
Towanda Township, Wind Farm Operation (wfoperation*Towanda)	10%	0.0992	(0.144)		11,839	(16,109)	
West Township	25%	0.2206	(0.046)	***	18,992	(6,020)	***
Yates Township	-25%	-0.2917	(0.184)		-27,592	(19,224)	

Yates Township, Post WF Approval/Construction (wfconstr*Yates)	18%	0.1649	(0.399)		24,073	(39,808)	
Yates Township, Wind Farm Operation (wfoperation*Yates)	-49%	-0.6800	(0.241)	***	-46,454	(20,938)	**
Adjusted R-squared		0.2892			0.3089		
Standard Error of Regression		0.4332			52735		
Sum Squared Residuals		710.10			1.05E+13		
Log Likelihood		-2208.93			-47,303		
F-statistic		24.74	***		27.07	***	
Mean Dependent Variable		11.62			126,347		
Standard Deviation Dependent Variable		0.51			63,435		
Akaike Information Criterion		1.18			24.60		
Schwarz Criterion		1.29			24.71		
Durbin-Watson Statistic		1.99			1.98		

***denotes significance at 1% level **denotes significance at 5% level *denotes significance at 10% level

Notes: Estimation sample includes the period 01/01/2001 - 12/01/2009. *n*=3,851. %=[e^{coeff}-1]*100.

Base Groups: Before Wind Farm Approval (01/01/2001 - 09/20/2005); Lexington township.

†White Heteroskedasticity-Consistent Standard Errors & Covariance are in parentheses (White, 1980). The results from this estimation are not considered the "main" results of this study. This estimation is for demonstrative purposes only.

APPENDIX E. FULL ESTIMATION RESULTS

Table E. 1. Full Estimation Results: Two and Three Wind Farm Stages

Dependent Variable: ln(Real Property Price)												
	XY		SD		TWP		XY		SD		TWP	
	2 WF stages				*2 WF stages*		*3 WF stages*				*3 WF stages*	
	(12.1)		(12.2)		(12.3)		(13.1)		(13.2)		(13.3)	
Square Feet *(1000s)*	0.339	***	0.341	***	0.338	***	0.339	***	0.340	***	0.338	***
Garage	0.026	***	0.026	***	0.025	***	0.026	***	0.025	***	0.025	***
Acre *(tenths)*	0.021	***	0.022	***	0.024	***	0.021	***	0.022	***	0.025	***
Acres	0.073	***	0.074	***	0.077	***	0.073	***	0.074	***	0.077	***
Age *(decades)*	-0.072	***	-0.072	***	-0.070	***	-0.072	***	-0.073	***	-0.071	***
Age^2	0.002	***	0.002	***	0.002	***	0.002	***	0.003	***	0.002	***
Fireplaces *(number)*	0.083	***	0.085	***	0.081	***	0.083	***	0.084	***	0.080	***
Railroad Tracks	-0.100	***	-0.086	***	-0.077	***	-0.100	***	-0.088	***	-0.078	***
Lakefront	0.261	***	0.235	***	0.228	***	0.260	***	0.234	***	0.227	***
Cul-de-sac	0.031	**	0.039	***	0.040	***	0.030	**	0.036	***	0.038	***
Trees	0.035	**	0.026	*	0.023		0.034	**	0.025	*	0.022	
C *(Intercept)*	262.841	***	11.310	***	11.317	***	261.787	***	11.339	***	11.334	***
Post WF Approval and Construction							0.011		-0.075	**	-0.050	
Wind Farm Operation	-0.014		-0.034		-0.064		-0.010		-0.061		-0.081	*
X	-1.6E-3	***					-1.6E-3	***				
Y	-7.1E-4	***					-7.1E-4	***				
XY	3.8E-9	***					3.8E-09	***				
X^2	1.5E-9	***					1.53E-9	***				
Y^2	2.7E-10	**					2.7E-10	**				
X^2Y^2	-9E-21	***					-9E-21	***				
Near Wind Farm	-0.126	***	-0.204	***	-0.221	***	-0.079	**	-0.191	***	-0.199	***
Near Wind Farm, Post WF Approval/Construction							-0.124	**	-0.029		-0.055	
Near Wind Farm, WF Operation	0.158	***	0.202	***	0.231	***	0.111	*	0.189	**	0.208	***
Blue Ridge CUSD 18			-0.361	***					-0.406	***		
Blue Ridge CUSD 18, Post WF Approval and Construction									0.126			
Blue Ridge CUSD 18, Wind Farm Operation			0.076						0.122			
El Paso-Gridley CUSD 11			-0.139	***					-0.167	***		
El Paso-Gridley CUSD 11, Post WF Approval and Construction									0.078			
El Paso-Gridley CUSD 11, Wind Farm Operation			-0.096						-0.068			
Gibson City CUSD 5			-0.239	***					-0.287	***		
Gibson City CUSD 5, Post WF Approval and Construction									0.140	***		
Gibson City CUSD 5, WF Operation			0.096						0.146	**		
Heyworth CUSD 4			-0.006						-0.038			
Heyworth CUSD 4, Post WF Approval and Construction									0.089	**		
Heyworth CUSD 4, Wind Farm Operation			-0.011						0.021			
LeRoy CUSD 2			-0.077	***					-0.122	***		
LeRoy CUSD 2, Post WF Approval and Construction									0.127	***		
LeRoy CUSD 2, Wind Farm Operation			0.101	**					0.146	***		
Normal CUSD 5			0.065	***					0.038			
Normal CUSD 5, Post WF Approval and Construction									0.075			
Normal CUSD 5, Wind Farm Operation			-0.026						0.002			
Prairie Central CUSD 8			-0.280	***					-0.299	***		
Prairie Central CUSD 8, Post WF Approval and Construction									0.053			
Prairie Central CUSD 8, Wind Farm Operation			-0.048						-0.030			
Ridgeview CUSD 19			-0.232	***					-0.244	***		

Ridgeview CUSD 19, Post WF Approval and Construction					0.035			
Ridgeview CUSD 19, Wind Farm Operation	-0.096				-0.084			
Trivalley CUSD 3	0.045	*			0.004			
Trivalley CUSD 3, Post WF Approval and Construction					0.116	***		
Trivalley CUSD 3, Wind Farm Operation	0.120	**			0.161	***		
Anchor Township			-0.455	***			-0.418	***
Anchor Township, Post WF Approval and Construction							-0.105	
Anchor Township, Wind Farm Operation			-0.185				-0.222	
Bellflower Township			-0.420	***			-0.464	***
Bellflower Township, Post WF Approval and Construction							0.121	
Bellflower Township, Wind Farm Operation			0.145				0.189	
Blue Mound Township			-0.166	***			-0.138	**
Blue Mound Township, Post WF Approval and Construction							-0.074	
Blue Mound Township, Wind Farm Operation			-0.108				-0.137	
Chenoa Township			-0.283	***			-0.300	***
Chenoa Township, Post WF Approval and Construction							0.049	
Chenoa Township, Wind Farm Operation			0.032				0.049	
Cropsey Township			-0.474	***			-0.355	***
Cropsey Township, Post WF Approval and Construction							-0.331	**
Cropsey Township, Wind Farm Operation			0.283	***			0.164	*
Dix Township			-0.356	***			-0.400	***
Dix Township, Post WF Approval and Construction							0.129	
Dix Township, Wind Farm Operation			0.205				0.249	*
Downs Township			-0.012				-0.049	
Downs Township, Post WF Approval and Construction							0.106	*
Downs Township, Wind Farm Operation			0.204	***			0.241	***
Drummer Township			-0.201	***			-0.236	***
Drummer Township, Post WF Approval and Construction							0.099	*
Drummer Township, Wind Farm Operation			0.158	**			0.193	***
Empire Township			-0.095	***			-0.128	***
Empire Township, Post WF Approval and Construction							0.096	**
Empire Township, Wind Farm Operation			0.120	**			0.153	***
Gridley Township			-0.154	***			-0.173	***
Gridley Township, Post WF Approval and Construction							0.053	
Gridley Township, Wind Farm Operation			-0.066				-0.048	
Hudson Township			0.060	***			0.053	*
Hudson Township, Post WF Approval and Construction							0.019	
Hudson Township, Wind Farm Operation			-0.019				-0.012	
Lawndale Township			-0.116	***			-0.098	*
Lawndale Township, Post WF Approval and Construction							-0.034	
Lawndale Township, Wind Farm Operation			0.121				0.103	
Martin Township			-0.249	***			-0.266	***
Martin Township, Post WF Approval and Construction							0.049	
Martin Township, Wind Farm Operation			-0.008				0.010	
Money Creek Township			0.030				0.033	
Money Creek Township, Post WF Approval and Construction							-0.002	
Money Creek Township, Wind Farm Operation			0.086				0.083	
Oldtown Township			0.054	**			0.024	
Oldtown Township, Post WF Approval and Construction							0.087	*
Oldtown Township, Wind Farm Operation			0.142	***			0.172	***
Peach Orchard Township			-0.525	***			-0.529	***
Peach Orchard Township, Post WF Approval and Construction							-0.018	
Peach Orchard Township, Wind Farm Operation			-0.178				-0.175	
Randolph Township			-0.018				-0.040	
Randolph Township, Post WF Approval and Construction							0.063	
Randolph Township, Wind Farm Operation			0.018				0.040	
Sullivant Township			-0.495	***			-0.528	***

Sullivant Township, Post WF Approval and Construction											0.101	
Sullivant Township, Wind Farm Operation					0.218	*					0.252	*
Towanda Township					-0.012						-0.059	
Towanda Township, Post WF Approval and Construction											0.117	*
Towanda Township, Wind Farm Operation					0.084						0.132	
West Township					0.123						0.125	*
Yates Township					-0.335	***					-0.322	***
Yates Township, Post WF Approval and Construction											-0.035	
Yates Township, Wind Farm Operation					-0.617	***					-0.630	***
n	3,851		3,851		3,851		3,851		3,851		3,851	
Adjusted R-squared	0.6634		0.6648		0.6777		0.6637		0.6655		0.6780	
Standard Error of Regression	0.2981		0.2975		0.2917		0.2980		0.2972		0.2916	
Sum Squared Residuals	340.36		337.93		322.92		339.84		336.23		320.74	
Log Likelihood	-792.9		-779.1		-691.6		-789.99		-769.4		-678.6	
F-statistic	380.40	***	239.57	***	148.20	***	346.43	***	179.12	***	106.29	***
Mean ln(Real Property Price)	11.62		11.62		11.62		11.62		11.62		11.62	
Std Deviation ln(RealPrice)	0.51		0.51		0.51		0.51		0.51		0.51	
Akaike Information Criterion	0.42		0.42		0.39		0.42		0.42		0.39	
Schwarz Criterion	0.46		0.48		0.48		0.46		0.49		0.52	
Durbin-Watson Statistic	1.90		1.95		1.97		1.91		1.95		1.97	

***denotes significance at 1% level **denotes significance at 5% level *denotes significance at 10% level

Notes: White Heteroskedasticity-Consistent Standard Errors & Covariance are used in determining statistical significance (White, 1980).
Base Groups: (12.1) Before Wind Farm Operation (01/01/2001 - 02/01/2008); Far from the wind farm;
(12.2) Before Wind Farm Operation (01/01/2001 - 02/01/2008); Lexington CUSD 7;
(12.3) Before Wind Farm Operation (01/01/2001 - 02/01/2008); Lexington township;
(13.1) Before Wind Farm Approval (01/01/2001 - 09/20/2005); Far from the wind farm;
(13.2) Before Wind Farm Approval (01/01/2001 - 09/20/2005); Lexington CUSD 7;
(13.3) Before Wind Farm Approval (01/01/2001 - 09/20/2005); Lexington Township.

Table E. 2. Full Estimation Results: Separate Wind Farm Stages, {X,Y}-Coordinates

Dependent Variable: ln(Real Property Price)									
	$[e^{coeff}-1]*100$	Stage 1		$[e^{coeff}-1]*100$	Stage 2		$[e^{coeff}-1]*100$	Stage 3	
		(14.1)			(14.2)			(14.3)	
Square Feet *(1000s)*	40.49%	0.340	***	43.88%	0.364	***	33.41%	0.288	***
		(0.015)			(0.020)			(0.031)	
Garage	2.78%	0.027	***	2.79%	0.028	***	2.22%	0.022	***
		(0.005)			(0.007)			(0.008)	
Acre *(tenths)*	2.48%	0.025	***	1.80%	0.018	***	1.62%	0.016	**
		(0.004)			(0.006)			(0.008)	
Acres	7.16%	0.069	***	7.14%	0.069	***	9.75%	0.093	***
		(0.010)			(0.013)			(0.015)	
Age *(decades)*	-6.56%	-0.068	***	-7.25%	-0.075	***	-9.66%	-0.102	***
		(0.007)			(0.010)			(0.015)	
Age^2	0.24%	0.002	***	0.23%	0.002	***	0.43%	0.004	***
		(0.000)			(0.001)			(0.001)	
Fireplaces *(number)*	6.90%	0.067	***	5.94%	0.058	***	17.29%	0.159	***
		(0.016)			(0.023)			(0.025)	
Railroad Tracks	-11.15%	-0.118	***	-6.83%	-0.071	***	-9.87%	-0.104	***
		(0.020)			(0.026)			(0.037)	
Lakefront	42.08%	0.351	***	29.33%	0.257	***	4.65%	0.045	
		(0.074)			(0.100)			(0.088)	
Cul-de-sac	2.34%	0.023		6.14%	0.060	**	1.47%	0.015	
		(0.019)			(0.027)			(0.035)	
Trees	4.15%	0.041	**	3.16%	0.031		1.38%	0.014	
		(0.019)			(0.030)			(0.033)	
C *(Intercept)*		250.698	***		281.035	**		326.052	*
		(81.204)			(121.094)			(171.067)	
Near Wind Farm	-5.82%	-0.060	*	-16.19%	-0.177	***	-7.71%	-0.080	
		(0.037)			(0.052)			(0.072)	
X		-0.002	***	-0.16%	-0.002	***	-0.20%	-0.002	**
		(0.000)			(0.001)			(0.001)	
Y		-0.001	***	-0.08%	-0.001	**	-0.09%	-0.001	*
		(0.0003)			(0.000)			(0.001)	
XY		4E-09	***		4E-09	***		5E-09	**
		(0.000)			(0.000)			(0.000)	
X^2		1E-09	***		2E-09	***		2E-09	**
		(0.000)			(0.000)			(0.000)	
Y^2		2E-10			4E-10	*		3E-10	
		(0.000)			(0.000)			(0.000)	
X^2Y^2		-8E-21	***		-9E-21	***		-1E-20	**
		(0.000)			(0.000)			(0.000)	
n		2,036			1,121			694	
Estimation Time Period		1/1/01 - 9/20/05			9/21/05 - 2/1/08			2/2/08 - 12/1/09	
Adjusted R-squared		0.6846			0.6684			0.6183	
Standard Error of Regression		0.2856			0.2970			0.3248	
Sum Squared Residuals		164.51			97.23			71.19	
Log Likelihood		-327.92			-220.24			-194.60	
F-statistic		246.42	***		126.43	***		63.36	***
Mean ln(Real Property Price)		11.63			11.61			11.60	
Std Deviation ln(Real Price)		0.51			0.52			0.53	
Durbin-Watson Statistic		1.93			1.97			1.83	

***denotes significance at 1% level **denotes significance at 5% level *denotes significance at 10% level

Notes: White Heteroskedasticity-Consistent Standard Errors & Covariance are in parentheses (White, 1980).

Base Group: Far from the wind farm.

Table E. 3. Full Separate Wind Farm Stage Estimation Results: School Districts

Dependent Variable: ln(Real Property Price)									
	$[e^{coeff}-1]*100$	Stage 1		$[e^{coeff}-1]*100$	Stage 2		$[e^{coeff}-1]*100$	Stage 3	
		(15.1)			(15.2)			(15.3)	
Square Feet *(1000s)*	41.32%	0.346	***	42.88%	0.357	***	33.65%	0.290	***
		(0.015)			(0.020)			(0.031)	
Garage	2.72%	0.027	***	2.61%	0.026	***	2.18%	0.022	***
		(0.005)			(0.007)			(0.008)	
Acre *(tenths)*	2.63%	0.026	***	1.86%	0.018	***	1.41%	0.014	*
		(0.004)			(0.006)			(0.008)	
Acres	7.48%	0.072	***	7.19%	0.069	***	9.24%	0.088	***
		(0.010)			(0.013)			(0.015)	
Age *(decades)*	-6.44%	-0.067	***	-7.28%	-0.076	***	-9.90%	-0.104	***
		(0.007)			(0.010)			(0.015)	
Age^2	0.24%	0.002	***	0.25%	0.002	***	0.45%	0.004	***
		(0.000)			(0.001)			(0.001)	
Fireplaces *(number)*	7.21%	0.070	***	6.38%	0.062	***	16.86%	0.156	***
		(0.016)			(0.023)			(0.025)	
Railroad Tracks	-10.32%	-0.109	***	-5.39%	-0.055	**	-7.93%	-0.083	**
		(0.020)			(0.025)			(0.037)	
Lakefront	39.33%	0.332	***	26.04%	0.231	**	1.69%	0.017	
		(0.074)			(0.097)			(0.085)	
Cul-de-sac	3.01%	0.030		6.23%	0.060	**	3.13%	0.031	
		(0.019)			(0.027)			(0.032)	
Trees	3.30%	0.032	*	3.33%	0.033		-0.78%	-0.008	
		(0.020)			(0.030)			(0.034)	
C *(Intercept)*		11.299	***		11.274	***		11.453	***
		(0.037)			(0.057)			(0.085)	
Near Wind Farm	-17.74%	-0.195	***	-19.14%	-0.212	***	-1.30%	-0.013	
		(0.042)			(0.060)			(0.080)	
Ridgeview CUSD 19	-21.76%	-0.245	***	-19.13%	-0.212	***	-26.85%	-0.313	***
		(0.034)			(0.049)			(0.076)	
Trivalley CUSD 3	0.70%	0.007		11.26%	0.107	***	18.89%	0.173	***
		(0.030)			(0.041)			(0.051)	
Gibson City CUSD 5	-25.08%	-0.289	***	-14.28%	-0.154	***	-11.95%	-0.127	**
		(0.029)			(0.044)			(0.060)	
LeRoy CUSD 2	-11.39%	-0.121	***	-0.06%	-0.001		3.07%	0.030	
		(0.026)			(0.039)			(0.047)	
Normal CUSD 5	3.63%	0.036		11.36%	0.108	***	4.73%	0.046	
		(0.026)			(0.039)			(0.049)	
Blue Ridge CUSD 18	-33.15%	-0.403	***	-24.63%	-0.283	***	-23.37%	-0.266	*
		(0.071)			(0.101)			(0.140)	
El Paso-Gridley CUSD 11	-15.77%	-0.172	***	-8.81%	-0.092	**	-20.54%	-0.230	***
		(0.033)			(0.046)			(0.065)	
Prairie Central CUSD 8	-26.00%	-0.301	***	-21.72%	-0.245	***	-26.52%	-0.308	***
		(0.034)			(0.048)			(0.067)	
Heyworth CUSD 4	-2.72%	-0.028		4.01%	0.039		-2.34%	-0.024	
		(0.024)			(0.039)			(0.048)	
n		2,036			1,121			694	
Estimation Sample Time Period		1/1/01 - 9/20/05			9/21/05 - 2/1/08			2/2/08-12/1/09	
Adjusted R-squared		0.6821			0.6702			0.6195	
Standard Error of Regression		0.2867			0.2962			0.3243	
Sum Squared Residuals		165.59			96.42			70.66	
Log Likelihood		-334.58			-215.60			-191.97	
F-statistic		208.90	***		109.40	***		54.72	***
Mean ln(Real Property Price)		11.63			11.61			11.60	

Standard Deviation ln(Real Price)	0.51	0.52	0.53
Akaike Information Criterion	0.35	0.42	0.62
Schwarz Criterion	0.41	0.52	0.76
Durbin-Watson Statistic	1.96	2.01	1.90

***denotes significance at 1% level **denotes significance at 5% level *denotes significance at 10% level

Notes: White Heteroskedasticity-Consistent Standard Errors & Covariance are in parentheses (White, 1980).

Base Group: Lexington CUSD 7.

Table E. 4. Full Separate Wind Farm Stage Estimation Results: Townships

Dependent Variable: ln(Real Property Price)									
	$[e^{coeff}-1]*100$	Stage 1		$[e^{coeff}-1]*100$	Stage 2		$[e^{coeff}-1]*100$	Stage 3	
		(16.1)			(16.2)			(16.3)	
Square Feet *(1000s)*	40.80%	0.342	***	42.77%	0.356	***	33.99%	0.293	***
		(0.015)			(0.020)			(0.030)	
Garage	2.77%	0.027	***	2.44%	0.024	***	2.12%	0.021	***
		(0.005)			(0.007)			(0.008)	
Acre *(tenths)*	2.80%	0.028	***	2.10%	0.021	***	2.06%	0.020	***
		(0.004)			(0.006)			(0.008)	
Acres	7.73%	0.074	***	7.30%	0.070	***	9.82%	0.094	***
		(0.011)			(0.014)			(0.015)	
Age *(decades)*	-6.27%	-0.065	***	-7.23%	-0.075	***	-9.29%	-0.097	***
		(0.007)			(0.010)			(0.015)	
Age^2	0.22%	0.002	***	0.24%	0.002	***	0.41%	0.004	***
		(0.001)			(0.001)			(0.001)	
Fireplaces *(number)*	7.04%	0.068	***	6.07%	0.059	***	15.00%	0.140	***
		(0.015)			(0.023)			(0.025)	
Railroad Tracks	-8.94%	-0.094	***	-4.60%	-0.047	*	-8.38%	-0.088	**
		(0.020)			(0.025)			(0.037)	
Lakefront	38.03%	0.322	***	26.81%	0.238	**	-0.63%	-0.006	
		(0.074)			(0.100)			(0.083)	
Cul-de-sac	3.87%	0.038	*	5.63%	0.055	**	2.14%	0.021	
		(0.020)			(0.027)			(0.032)	
Trees	2.75%	0.027		3.44%	0.034		-0.51%	-0.005	
		(0.021)			(0.031)			(0.034)	
C *(Intercept)*		11.296	***		11.301	***		11.404	***
		(0.039)			(0.059)			(0.086)	
Near Wind Farm	-18.24%	-0.201	***	-21.63%	-0.244	***	-0.79%	-0.008	
		(0.042)			(0.059)			(0.081)	
Chenoa Township	-26.14%	-0.303	***	-22.15%	-0.250	***	-21.22%	-0.239	***
		(0.036)			(0.048)			(0.066)	
Cropsey Township	-29.60%	-0.351	***	-49.46%	-0.682	***	-15.83%	-0.172	***
		(0.087)			(0.114)			(0.048)	
Dix Township	-33.26%	-0.404	***	-23.97%	-0.274	***	-12.99%	-0.139	
		(0.065)			(0.078)			(0.118)	
Downs Township	-3.40%	-0.035		4.07%	0.040		19.75%	0.180	**
		(0.037)			(0.050)			(0.075)	
Gridley Township	-16.14%	-0.176	***	-11.53%	-0.123	***	-19.48%	-0.217	***
		(0.034)			(0.046)			(0.066)	
Hudson Township	5.56%	0.054	**	6.92%	0.067		4.11%	0.040	
		(0.027)			(0.042)			(0.052)	
Lawndale Township	-9.54%	-0.100	*	-11.84%	-0.126	**	-0.48%	-0.005	
		(0.060)			(0.060)			(0.270)	
Money Creek Township	2.50%	0.025		1.91%	0.019		13.00%	0.122	

		(0.055)			(0.114)			(0.081)	
Peach Orchard Township	-41.08%	-0.529	***	-42.61%	-0.555	***	-49.08%	-0.675	***
		(0.065)			(0.100)			(0.124)	
Randolph Township	-2.93%	-0.030		1.04%	0.010		-0.54%	-0.005	
		(0.025)			(0.038)			(0.050)	
Sullivant Township	-41.22%	-0.531	***	-33.64%	-0.410	***	-24.06%	-0.275	***
		(0.087)			(0.139)			(0.106)	
West Township	11.94%	0.113		17.23%	0.159	**	No Obs	No Obs	
		(0.116)			(0.072)				
Yates Township	-27.58%	-0.323	***	-29.10%	-0.344	*	-59.38%	-0.901	***
		(0.085)			(0.203)			(0.170)	
Anchor Township	-34.44%	-0.422	***	-41.13%	-0.530	***	-45.51%	-0.607	**
		(0.084)			(0.105)			(0.255)	
Bellflower Township	-36.79%	-0.459	***	-29.20%	-0.345	***	-22.72%	-0.258	*
		(0.066)			(0.101)			(0.140)	
Blue Mound Township	-13.91%	-0.150	**	-18.87%	-0.209	**	-23.63%	-0.270	***
		(0.065)			(0.102)			(0.081)	
Drummer Township	-21.03%	-0.236	***	-13.22%	-0.142	***	-3.11%	-0.032	
		(0.031)			(0.044)			(0.064)	
Empire Township	-11.87%	-0.126	***	-3.73%	-0.038		2.95%	0.029	
		(0.026)			(0.038)			(0.048)	
Martin Township	-23.37%	-0.266	***	-19.71%	-0.220	***	-21.59%	-0.243	***
		(0.038)			(0.053)			(0.079)	
Oldtown Township	2.28%	0.023		10.54%	0.100	**	24.65%	0.220	***
		(0.034)			(0.044)			(0.053)	
Towanda Township	-6.20%	-0.064		5.73%	0.056		11.31%	0.107	
		(0.055)			(0.043)			(0.090)	
n		2,036			1,121			694	
Time Period		1/1/01 - 9/20/05			9/21/05 - 2/1/08			2/2/08 - 12/1/09	
Adjusted R-squared		0.6923			0.6786			0.6418	
Standard Error of Regression		0.2821			0.2924			0.3146	
Sum Squared Residuals		159.29			92.96			65.42	
Log Likelihood		-295.10			-195.08			-165.26	
F-statistic		139.77	***		72.66	***		39.80	***
Mean ln(Real Property Price)		11.63			11.61			11.60	
Std Dev ln(RealPrice)		0.51			0.52			0.53	
Akaike Information Criterion		0.32			0.41			0.57	
Schwarz Criterion		0.42			0.56			0.79	
Durbin-Watson Statistic		1.98			2.02			1.93	

***denotes significance at 1% level **denotes significance at 5% level *denotes significance at 10% level
Notes: White Heteroskedasticity-Consistent Standard Errors & Covariance are in parentheses (White, 1980). No Obs=No Observations.
Base Group: Lexington Township.

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