Disamenity or Premium:

Do Electricity Transmission Lines Affect Farmland Values and Housing Prices Differently?

Qinan Lu, Ph.D. Candidate, University of Wisconsin–Madison

Nieyan Cheng, Assistant Professor, China University of Petroleum - Beijing

Wendong Zhang*, Assistant Professor, Dyson School of Applied Economics and Management, Cornell University; Associate Professor, Iowa State University (On leave)

Pengfei Liu, Assistant Professor, University of Rhode Island

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Dyson
Cornell
SC Johnson College of Business

Motivations

Growing construction of electricity transmission lines (TMLs) due to:

- **Commitment to achieving carbon neutrality by 2035 in the USA.**

  "*Upgrade our power infrastructure……to achieve a zero-emissions future." (White House Fact Sheet: The Bipartisan Infrastructure Deal)*

- **Rising transmission demand of electricity generated from renewable energy transported across the whole country.**

  "The Bipartisan Infrastructure Deal's more than $65 billion investment includes the largest investment in clean energy transmission and grid in American history. It will upgrade our power infrastructure, by building thousands of miles of new, resilient transmission lines to facilitate the expansion of renewables and clean energy, while lowering costs." (White House Fact Sheet: The Bipartisan Infrastructure Deal)

- **Needs to improve and modernize rural electric infrastructure under the challenge of climate change.**

  "USDA Invests $598 Million……will bring affordable electric power to rural residents, tribal communities, community facilities, schools and medical institutions……to improve quality of life and support good-paying jobs, transition to a clean energy economy." (USDA Press 2021)

Motivations

Would the growing investment in renewable energy and the rise of electronic cars challenge the conventional wisdom of disamenity effect from the literature?

- TMLs could bring positive option values due to their locational premium for wind and solar energy infrastructure
- TMLs could facilitate adoption of precision agriculture equipment
- TMLs could be a catalyst for broadband expansion
- TMLs could enhance quality of life (telemedicine, zoom, WFH)
- TMLs allow electric car charging for rural residents

Preview

Research Question

- How do TMLs impact nearby farmland prices and housing property values in the era of renewable energy? Disamenity or premium?

Data

- Farmland: *FarmlandFinder*.
- House: Zillow/ZTRAX.
- TMLs location: US Energy Information Administration.
- Wind Speed: National Renewable Energy Laboratory

Method

- Hedonic pricing model

Results

- Premium: Farmland value decreases 0.99% every 1000 meters away from the TMLs.
- Disamenity: House price increases 0.63% every 1000 meters away from the TMLs.
- Locating in high-wind areas brings more option values for farmlands, but not for houses.

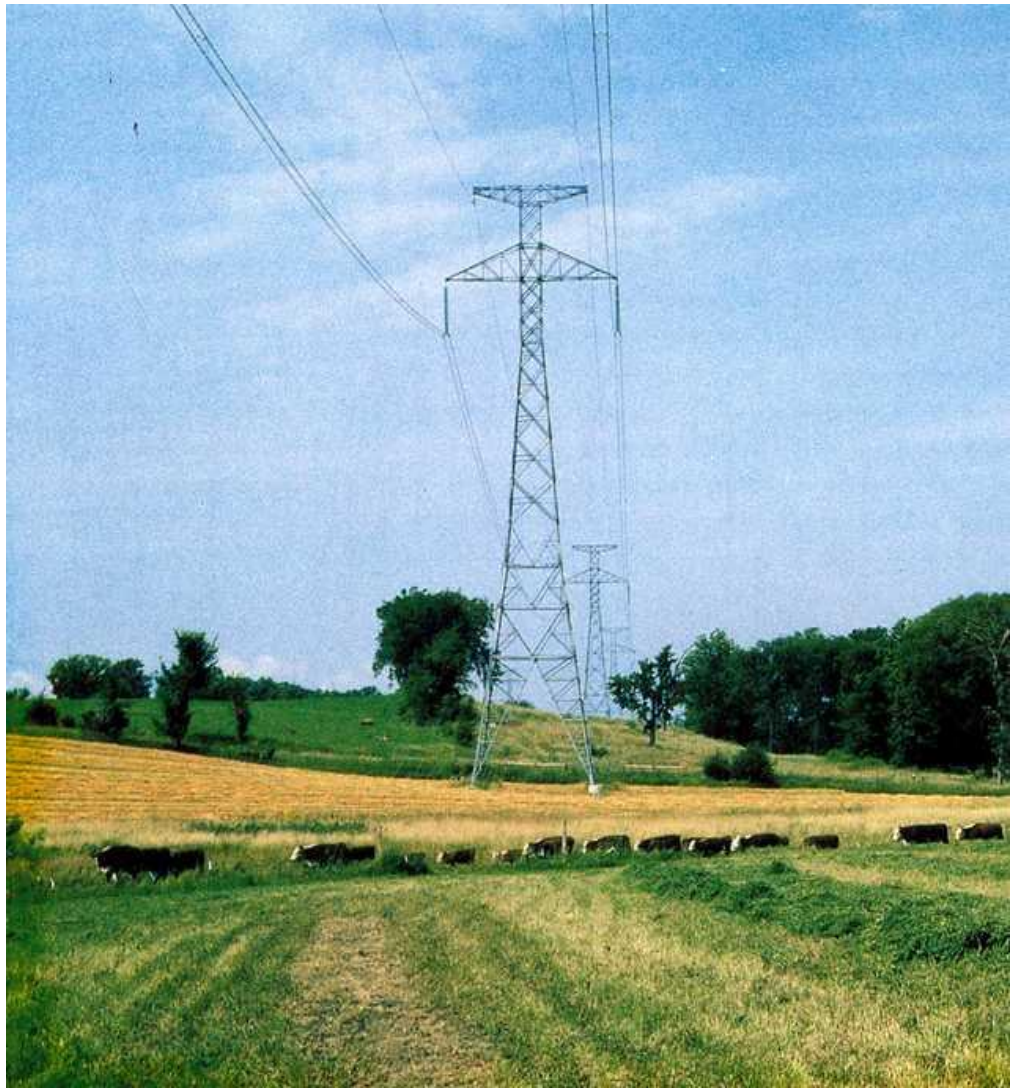
Previous Literature

TMLs and farmland values

- One paper found that the overhead TMLs depressed nearby farmland values in Italy (Sardaro et al., 2018)
- Some literature found that the TMLs does not find significant effects of TMLs on farmland values. (Brown, 1976; Jackson, 2010)
- A recent study shows that proximity to TMLs for farmland parcels could be positively valued AFTER construction of utility-scale solar facilities (Abashidze and Taylor, 2022)

TMLs and housing prices

- A bunch of literature has explored the adverse effects of electric transmission lines on housing property values due to:
  - Health risk and safety hazards (Priestley and Evans, 1990)
  - Visual aesthetics deterioration (Hamilton and Schwann, 1995; Des Rosiers, 2002; Chalmers, 2009)
  - Culture (Jackson, 2010)



Source: MINN Post (2020)
https://www.minnpost.com/mnopedia/2020/02/in-the-1970s-some-minnesota-farmers-were-very-upset-about-a-plan-to-route-power-lines-across-their-fields/

Source: Green Tech Media (2020)
https://www.greentechmedia.com/articles/read/midwest-grid-operators-seek-to-unlock-clean-energy-transmission-on-the-seam

Source: University of Nebraska-Lincoln (2017)
https://cropwatch.unl.edu/2017/look-avoid-power-line-deaths-harvest

Data

Farmland values

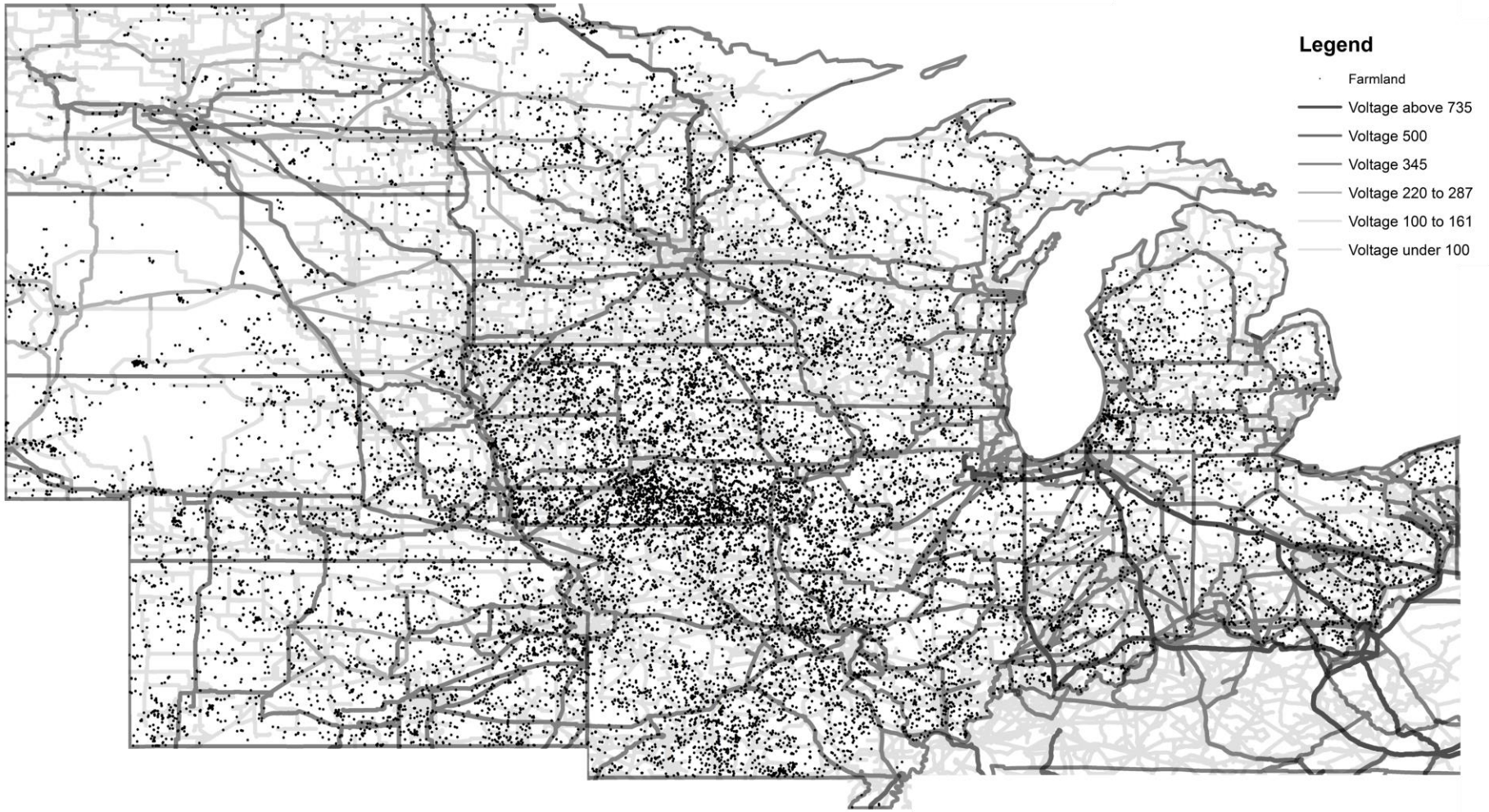
- Restricted-access farmland transaction data obtained from *FarmlandFinder* (now acquired by Growers Edge and rebranded as Range.ag https://app.range.ag/)
- 23,829 actual sales of farmland parcels via farmland auctions or listings from 2017 to 2020
- Detailed information including farmland centroid location, acreage and transaction date.
- Covered states include Iowa, Illinois, Kansas, Minnesota, Wisconsin, Missouri, Nebraska, South Dakota, North Dakota, Ohio, and Michigan.

TMLs data

- Calculate the distance from the farmland circumference to the nearest TMLs.
- Identify whether there is/are TML(s) going across farmlands.
- Identify the number of TMLs within the half-mile/one-mile of the farmland circumference.

Data – Farmland values

23,000+ farmland transactions via auctions or listings 2017-2020;
12 Midwestern states (Corn Belt, Great Plains, Lake States)



Data – ZTRAX Housing Prices

Housing prices

- Single family housing sales from 2015 to 2020 from ZTRAX/Zillow housing database.
- 919,521 transactions in 6 states with detailed information: sales amount, house characteristics, single-family, arm-length transaction and so on.
- Covered states include Iowa, Illinois, Kansas, Minnesota, Missouri and Nebraska.
- Only keep arm's length transactions
- Use inflation-adjusted transaction prices in 2000 dollars using Federal Home Finance Agency (FHFA) state-quarter price index
- Drop observations with prices lower than $1000

Proximity to TMLs

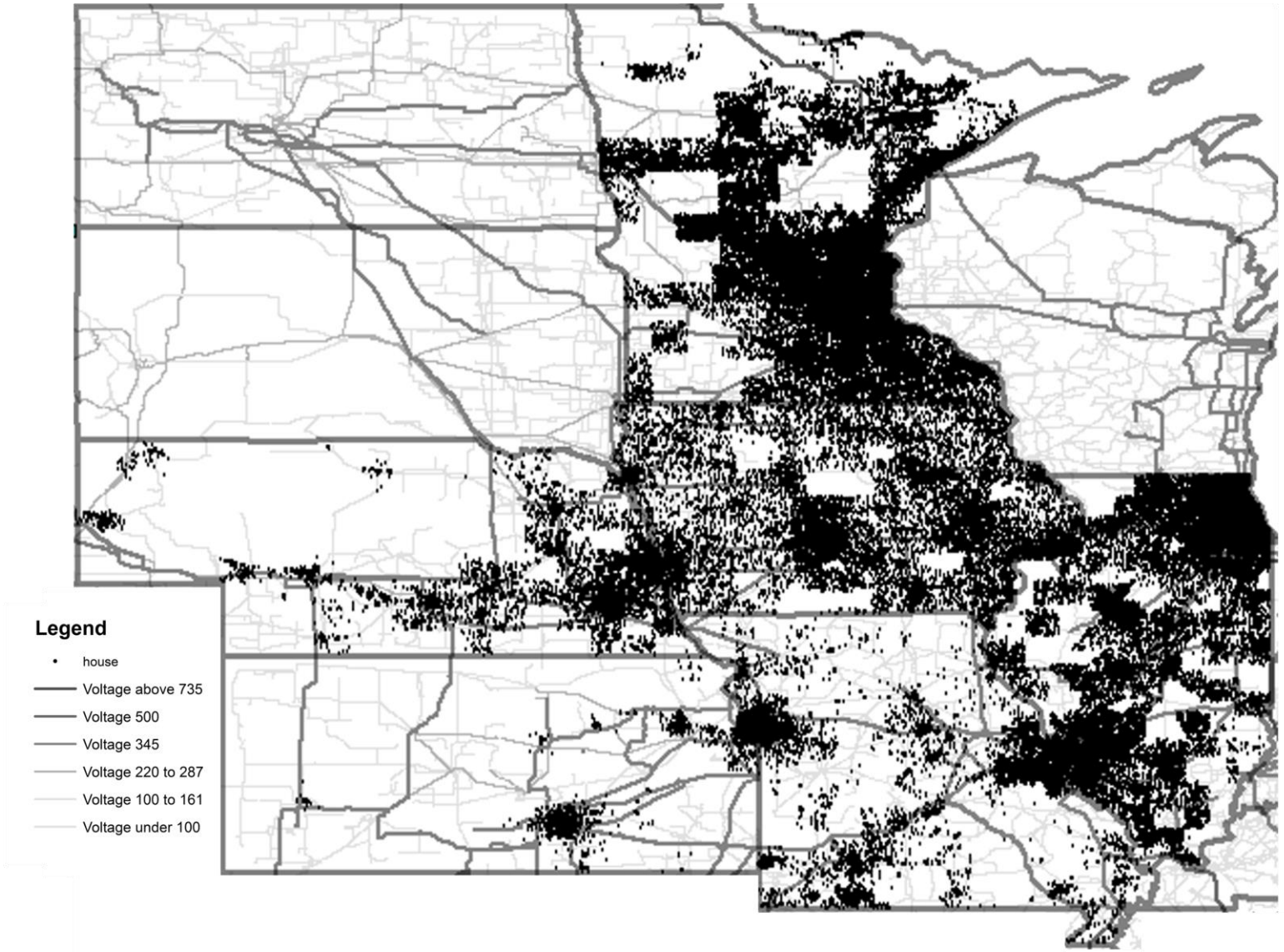
- Calculate the distance from the house to the nearby TMLs in ten miles.

Data – ZTRAX Housing Prices

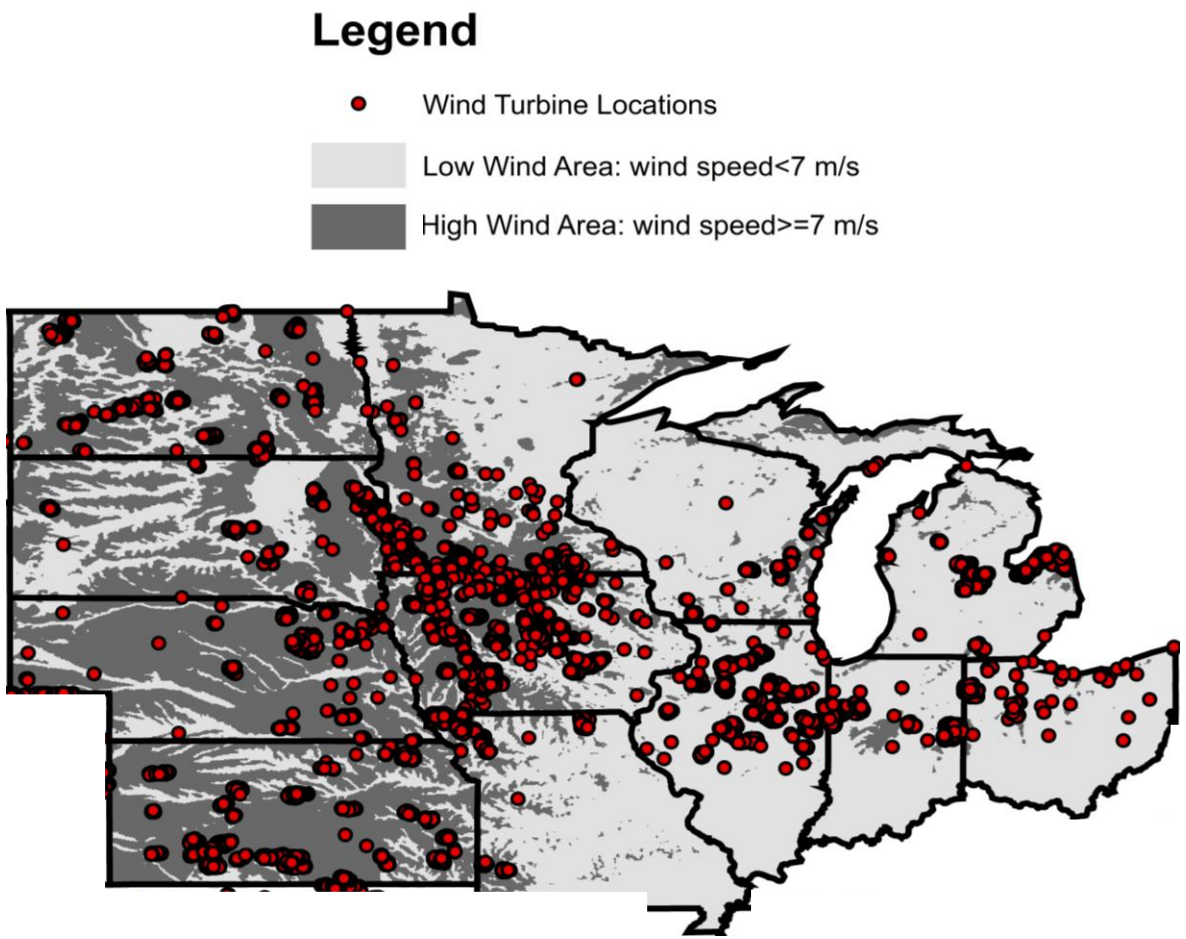
Nearly 1 million housing sales in 6 states

Within 10 miles of TMLs

2015-2019



Data



Wind Speed

- 10-year average nationwide wind speed data at 80-meter altitude
- The cutoff of high and low wind speed is 7 meters per second in the baseline analysis

Method

Baseline Model

$$\log(Y_{it,p}) = \alpha_0 + \alpha_1 line_{it,p} + X_{it,p}\gamma + \delta_{c,p} + \phi_{t,p} + \epsilon_{it,p};\ \ p = f, h$$

- p: f stands for; h represents housing.
- $Y_{it,p}$: either farmland i value or house i price at sale time t.
- $line_{it,p}$: distance from farmland i or house i to the nearby TMLs at time t .
- $X_{it,p}$: a set of control variables for farmland or house i.
- $\delta_{c,p}$: county fixed effect for farmland, and census tract fixed effect for housing prices
- $\phi_{t,p}$: time fixed effect. (year FE for farmland values; year-quarter FE for housing prices)

Interaction with wind resources

$$\log(Y_{it,p}) = \beta_0 + \beta_1 DL_{\mathrm{it},p} + \beta_2 HW_{\mathrm{it},p} + \beta_3 DL_{\mathrm{it},p} \times HW_{\mathrm{it},p} + Z_{it,p}\eta + \lambda_{c,p} + \psi_{t,p} + \upsilon_{it,p};\quad p = f, h$$

- $DL_{\mathrm{it},p}$: dummy variable that equals 1 if farmland or house i is close to a TML at time t (<= 800 meters in the baseline analysis) and 0 otherwise.
- $HW_{\mathrm{it},p}$: equals 1 if the farmland or house i is in a high-wind area at time t, and 0 otherwise.

Results: Baseline

	Farmland Values	
Dependent variable		log o
All samples	(1)	
Distance to TMLs	-0.0099***	(0.0008
Gross acres	-0.0565***	(0.0070)
Gross acres^2	0.0005***	(0.0002)
Land percentage tillable	0.2131***	(0.0127)
Average NCCPI for agriculture	0.8483***	(0.0306)
% of prime farmland	0.0440**	(0.0180)
Soil texture: % of clay	0.3476***	(0.1016)
Soil texture: % of silt	-0.1447	(0.1183)
Soil texture: % of loam	-0.0193	(0.0178)
Average land slope	0.0025***	(0.0006)
Population in urban areas	0.0070***	(0.0004)
Distance to highway	-0.1330***	(0.0118)
Distance to railway	-0.0583***	(0.0047)
Distance to waterbody	0.0905***	(0.0151)
Distance to biodiesel	-0.0184***	(0.0008)
Distance to grain warehouse	-0.0427***	(0.0035)
County FE		Yes
Year FE		Yes
No. of obs.		18,580
Adj. R-sq		0.423

Premium:
Farmland value decreases by 0.99% every one kilometer further away from the TMLs.

Disamenity:
Housing price increases 0.63% every one kilometer away from the TMLs.

	Housing Prices	
Dependent variable	log of price	
All samples		
Distance to TMLs	0063**	(0.0027)
Age	-0.0041***	(0.0003)
Age^2	-0.0000***	(0.0000)
No. of stories	0.0271*	(0.0139)
No. of total rooms	0.0279***	(0.0035)
No. of total bedrooms	0.0222**	(0.0102)
No. of full bath	0.1578***	(0.0045)
Census tract FE	Yes	
Year-quarter FE	Yes	
No. of obs.	1,254,611	
Adj. R-sq	0.459	

Results – Heterogeneity by urban/rural areas

Urban + rural samples

- TMLs bring option values for farmland in both urban and rural areas.
  - But coefficients of TMLs in the rural has a slightly larger magnitude
- TMLs negatively affect house prices in urban areas but have a null effect on rural houses.

	Farmland Values		Housing Prices	
Dependent variable	log of price			
Sample	Urban	Rural	Urban	Rural
	(1)	(2)	(3)	(4)
Distance to TMLs	-0.0071***	-0.0079***	0.0129**	0.0010
	(0.0023)	(0.0019)	(0.0055)	(0.0031)
Controls for farmland	Yes	Yes		
FE for farmland	Yes	Yes		
Controls for house			Yes	Yes
FE for house			Yes	Yes
No. of obs.	9,380	9,200	1,046,036	208,286
Adj. R-sq	0.425	0.416	0.503	0.278

Results – Alternative measures for TMLs

- Whether or the number of TMLs across farmland negatively impacts farmland values, though not statistically significant
- Number of TMLs nearby significantly increase farmland sale prices

- One more TMLs decreases house price by 0.5% in pooled samples
- Adding the distance variable doesn't alter the impact of the number of TMLs

Variables	Farmland Values			
Dependent variable				log of price
All samples	(1)	(2)	(3)	(4)
Whether TMLs across farmland	-0.007			
	(0.016)			
Number of TMLs across farmland		-0.001		
		(0.010)		
Number of TMLs within 0.8 km			0.028***	
			(0.005)	
Number of TMLs within 1.6 km				0.026***
				(0.004)
Controls for farmland	Yes	Yes	Yes	Yes
FE for farmland	Yes	Yes	Yes	Yes
Controls for house				
FE for house				
No. of obs.	18,580	18,580	18,580	18,580
Adj. R-sq	0.433	0.433	0.434	0.435

Results – Synergy with wind energy potential

- Both being close to TMLs and with high wind resources increases farmland values by **6.5%(=4.9%-3.2%+4.8%)**.
- Abashidze and Taylor (2022) also found **TMLs interact with solar farms to create premium** on farmland values
- Being in low or high wind areas doesn't impact the effect of the distance of TMLs to house prices.

	Farmland Values	Housing Prices
Dependent variable	log of price	
All samples	(1)	(2)
If close to TMLs	0.049***	-0.0797
	(0.013)	(0.0632)
Whether be close TML × high wind	0.048*	-0.1007
	(0.026)	(0.1067)
If located at high wind areas	-0.032***	0.0010
	(0.011)	(0.0149)
Controls for farmland	Yes	
FE for farmland	Yes	
Controls for house		Yes
FE for house		Yes
No. of obs.	18,580	1,254,611
Adj. R-sq	0.424	0.459

Robustness checks for farmland value regressions

Different Regions & Subsamples based on voltage of TMLs

	Regions			Voltage	
Dependent variable					
Subsample	I-states	Lake states	Great plains	≤150V	>150V
	(1)	(2)	(3)	(10)	(11)
Distance to TMLs	-0.0031*	-0.0069**	-0.0163***	-0.0139***	-0.0061***
	(0.0016)	(0.0027)	(0.0023)	(0.0019)	(0.0020)
Controls for Farmland	Yes	Yes	Yes	Yes	Yes
FE for Farmland	Yes	Yes	Yes	Yes	Yes
Adj. R-sq	0.389	0.525	0.393	0.429	0.434
No. of Observations	6,909	5,417	6,254	10,397	8,183

- For farmland values, different regions also show the premiums of TMLs, with larger effects in the Great Plains. The housing price disamenities are strongest in Lakes states
- The premium of higher voltage TMLs is smaller, possibly due to counteracting effects of visual disamenity. But it is not large enough to offset all the premium

Conclusions

- Our study shows new evidence on the differential impact of TMLs on property values, which partially reverses previous findings in the literature.
- We reconfirm the disamentity effects of TMLs- conventional wisdom in the literature- on housing property values, especially on urban housing properties.
- Different from the null or disamenity effects of TMLs on farmland values in the literature, we find that proximity to TMLs positively increase farmland values, especially for farmland with abundant wind resources.
- Implication for the siting of TMLs.

Questions?

Wendong Zhang
wendongz@cornell.edu

https://wendongzhang.weebly.com/

Dyson
Cornell
SC Johnson College of Business