Learning to Lease

Understanding Information Asymmetry in Natural Gas Leasing
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RESOURCES FOR THE FUTURE

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Motivation & research questions

Mineral leasing is a very “information-constrained” environment

- Mineral owners often do not have as much information as extraction firms
- It is unclear how serious of an issue this is
- …and, it is unclear what types of policies are most effective in providing useful information

Focusing on Marcellus region:

1. How do demographic and socioeconomic characteristics of “property” owners correlate with likelihood of signing a “good” lease?
    - A “good” lease provides good economic terms and environmental protection to mineral owners
    - Surface vs. mineral-rights owners

2. Do mineral-rights owners trade off economic benefits for environmental protection?

3. How does information about historical production, environmental violations, and exposure to leasing spread throughout communities?

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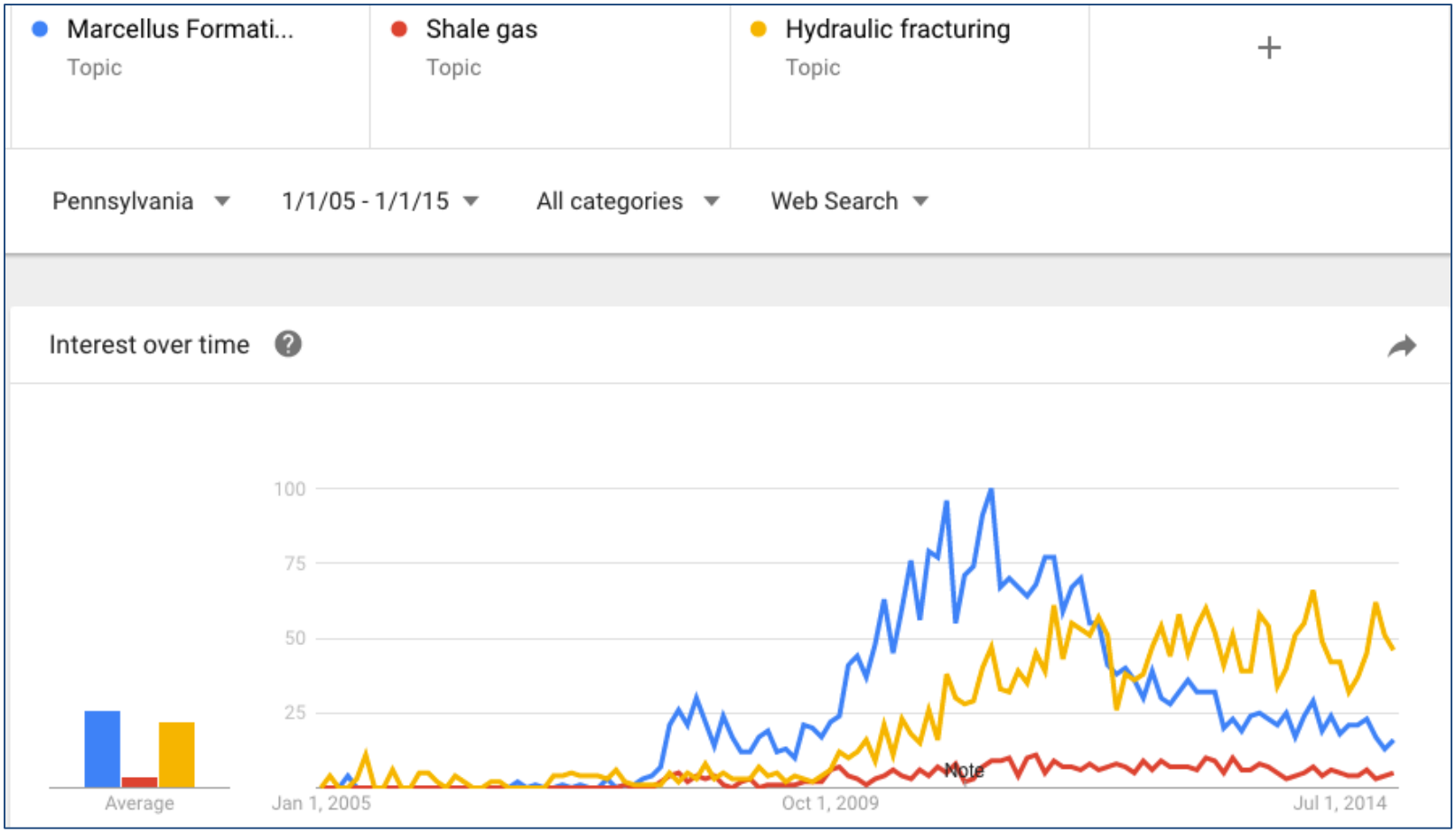
Pennsylvania's public interest in fracking

Google trends results for "Marcellus Formation," "Shale gas," and "Hydraulic fracturing" in PA over time



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What is a natural gas lease?

- Mineral rights owner leases all oil, gas, and constituents underneath surface, rights to explore for and develop oil and gas, using surface as necessary

- Specifies:
    - Royalty rate and bonus payment
    - Term of lease
    - Primary and auxiliary clauses, which can:
        - Provide additional environmental protection (water damage remediation, water testing, disposal and injection well limitations)
        - Protect from surface damage (non-surface leases, location approval, pipeline restrictions, crop damage)
        - Protect interest of extraction firms (no forfeiture, pooling and unitization, underground storage)
- Clauses we explore:
    - Surface water damage compensation
    - Disposal and injection well ban, storage ban
    - Coalbed methane ban
    - Pugh clause
    - Surface use ban, location approval

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Related findings from recent economics research

Brown, Fitzgerald, Weber – U.S.

- $39B in royalty payments in 2014 (Brown et al., 2016)
- Limited “pass-through” of resource abundance into royalty rates
- Mineral owners have little success in negotiating better economic terms

Vissing and Timmins - Tarrant County, TX

- Black & Hispanic populations receive lower quality leases (Vissing, 2015).
- Higher income & education related to more protective clauses.
- Poor English-speaking related to fewer protective clauses.
- More lease protections leads to fewer future violations (Timmins and Vissing 2017).

Our contribution:

- Unclear whether these findings translate to the Marcellus region
- How much do mineral owners need to “give up” economic benefits for additional environmental protection?
- Channels of information dissemination within communities?

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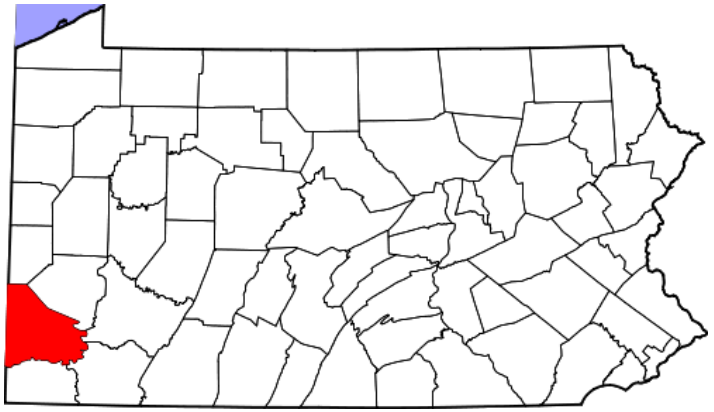
Our approach

We obtained 335 leases in Washington Co. from two sources, signed prior to 2016:

Morascyzk & Polochak
Attorneys at Law

LANDEX/Washington County
Recorder of Deeds



Source: https://en.wikipedia.org/wiki/Washington_County,_Pennsylvania

- Hand-coded lease terms, auxiliary clauses, firm information, etc., into quantitative variables
- Matched individual leases with publicly available property records and 2011 ACS information at block-group level
- Incorporated information from PA Dept. of Environmental Protection on natural gas extraction and violations

- Econometric analysis to establish relationships among economic and non-economic factors for lease quality

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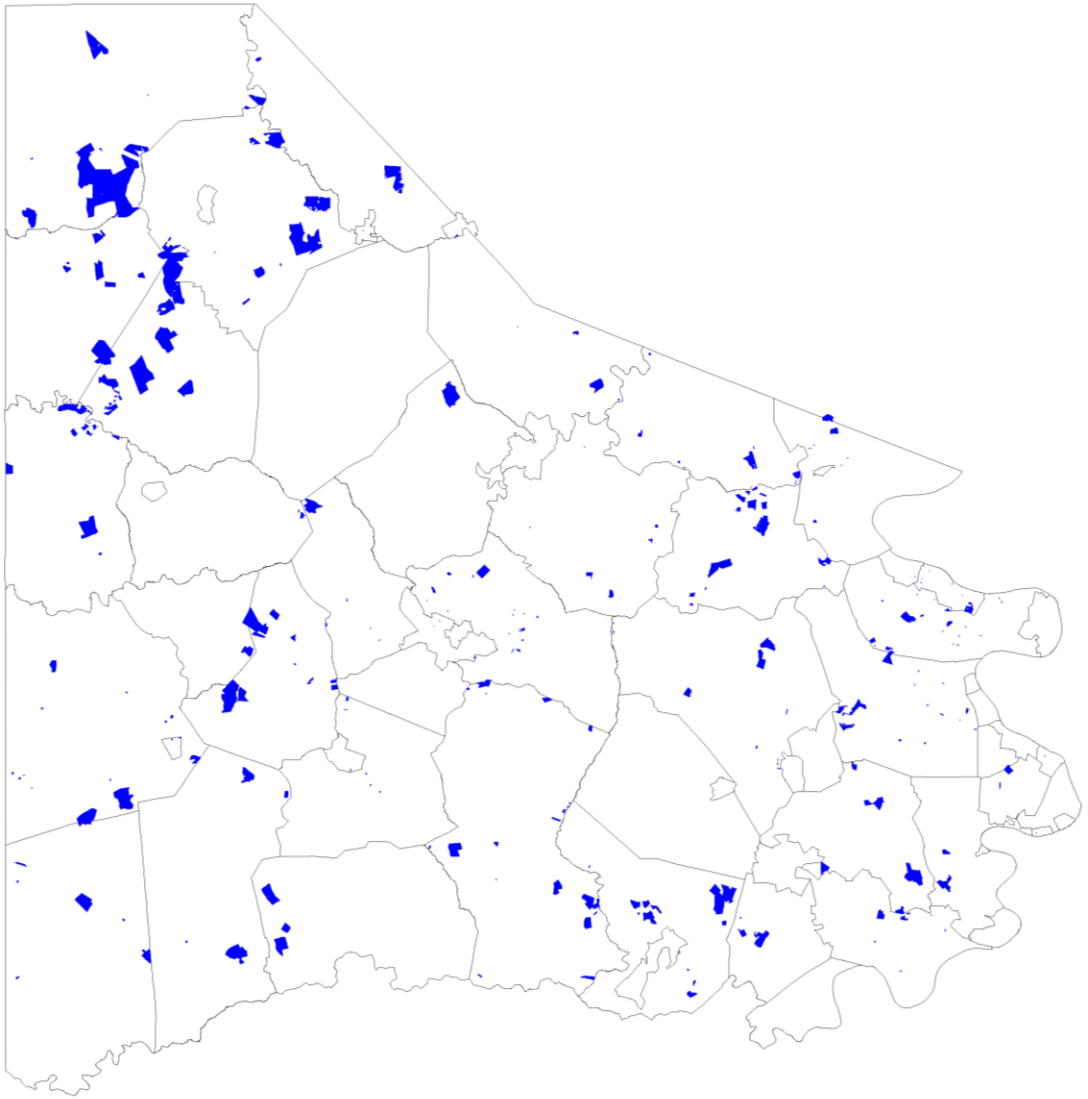
Lease Sample

- 335 leases covering 606 Parcels
- 70% Signed in 2009-10
- Mean Royalty Rate: 15.7%
- 85.3% Have addendum clauses



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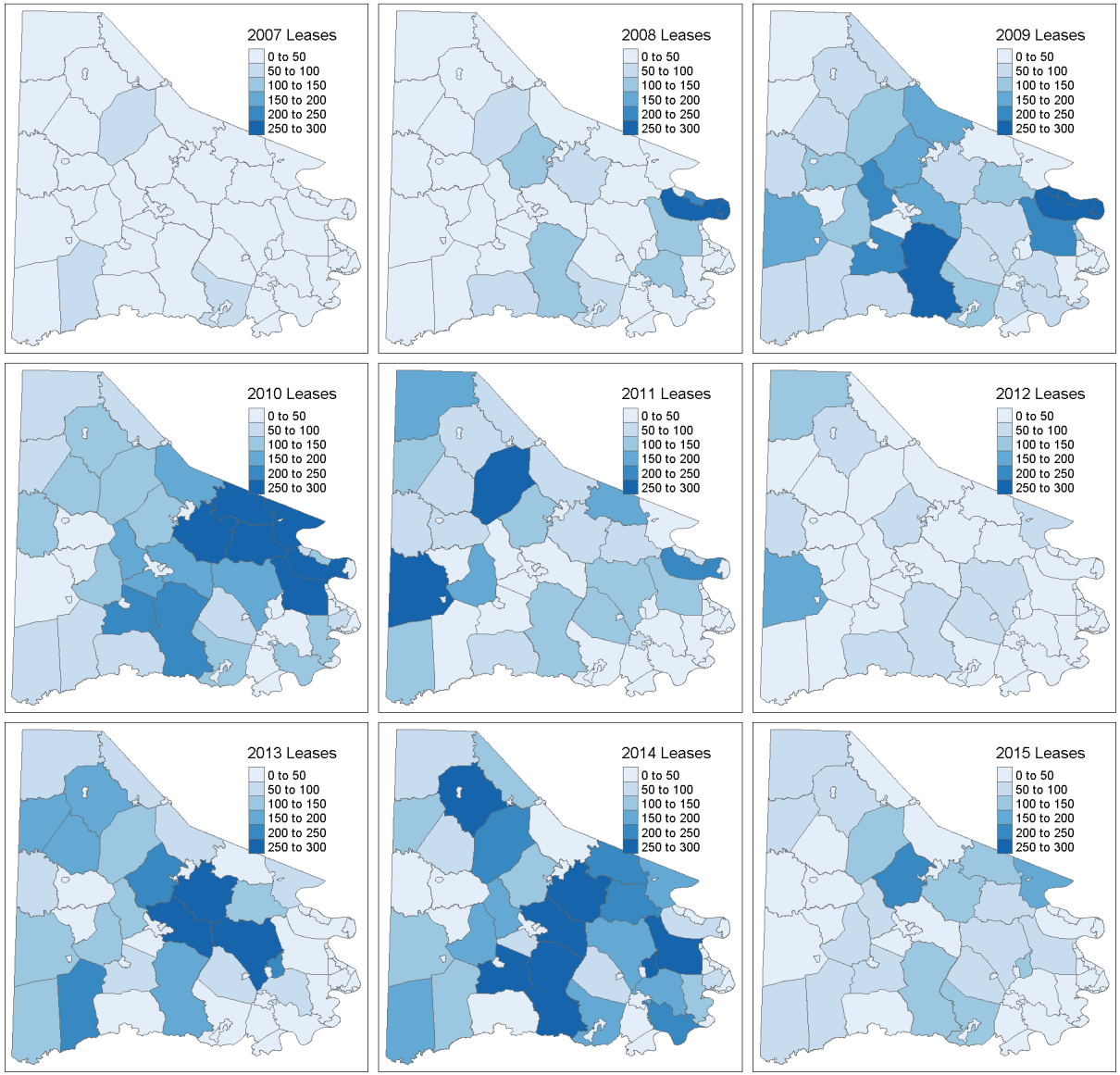
Leasing activity in Washington County, PA

Number of natural gas leases signed each year, by municipality, in Washington County

(Source: Drilling Info, LANDEX, Washington County Recorder's Office)



Results

Summary demographics for Washington County, PA:

- 93.4% White, 3.3% Black, 1.1% Hispanic, 2.2% Other Minority
  - White: 67.3 - 100%
  - Black: 0 – 21.5%
  - Hispanic: 0 - 9.0%
  - All Minority, Non-Hispanic: 0 – 32.7%
- Median household income: $47,823
  - Range: $31,250 – $161,484 (Census block groups)
- Education:
  - 91% high school graduate
  - 27.1% bachelor's or higher

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Socioeconomics and lease quality

Do demographic and socioeconomic characteristics of "property" owners correlate with likelihood of signing a good lease?

			Presence of clauses:			
	Royalty rate	Any addendum?	Water quality?	Surface protection?	Favorable to producer?	Legal protection?
HH Income	0.022*	0.008	-0.001	-0.006	-0.004	-0.012
	(0.013)	(0.0	(0.0	(0.017)	(0.017)	(0.016)
% Less Than HS	0.097***	0.073*	0.097***	0.058	0.045	0.048
	(0.032)	(0.038)	(0.028)	(0.043)	(0.040)	(0.040)
% College+	0.007	0.030	0.013	0.010	0.015	0.018
	(0.017)	(0.0	(0.0	(0.0	(0.0	(0.022)
% Minority	0.003	-0.039	0.041	-0.067	-0.053	0.072*
	(0.036)	(0.040)	(0.038)	(0.050)	(0.049)	(0.043)
% Hispanic	0.062	0.0	(0.0	(0.0	(0.0	-0.131*
	(0.059)	(0.068)	(0.050)	(0.073)	(0.073)	(0.071)
Acreage	-0.000	-0.003	0.000	-0.003	0.001	-0.002
	(0.001)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)
Joint estate	-0.507**	0.161	0.419*	0.183	0.274	0.493
	(0.250)	(0.297)	(0.218)	(0.358)	(0.354)	(0.300)
Observations	286	270	258	215	212	246
Model	OLS	Probit	Probit	Probit	Probit	Probit
Mean	15.70	0.86	0.40	0.93	0.93	0.87

All models include year and company fixed effects and controls for residential and agricultural land. Marginal effects evaluated at sample mean are shown for probit models. at Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

General idea:

We attempt to explain changes in dependent variables with variation in our explanatory variables of interest.

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Socioeconomics and lease quality

Do demographic and socioeconomic characteristics of "property" owners correlate with likelihood of signing a good lease?

- Overall, we **do not** find a systematic relationship between lease quality and socioeconomic characteristics of mineral rights owners
    - Regions with lower education levels receive higher quality leases (i.e., larger royalty rates + more protective clauses)
- We do find important differences between joint surface-mineral owners:
    - Joint estates receive *lower* royalty rates, on average
    - Joint estates are more likely to possess protective water quality clauses

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Economic-environmental trade offs

Do mineral owners trade off economic benefits for environmental protection?

			Joint Estates Only	Pre-2009	Post-2009
	Royalty rate		Royalty rate	Royalty rate	Royalty rate
Post-boom (>=2009)	6.039***		-0.636		
	(1.130)		(0.693)		
Joint estate?	-0.847***			0.224	-0.611*
	(0.238)			(0.419)	(0.349)
Clause: Surface protection	-0.316***		-0.307**	-0.275	-0.201
	(0.101)		(0.141)	(0.218)	(0.166)
Clause: Water quality protection	0.334**		0.182	0.203	0.514**
	(0.131)		(0.170)	(0.219)	(0.201)
Clause: Favorable to producer	-0.914***		-0.886***	-0.866**	-0.633**
	(0.193)		(0.217)	(0.350)	(0.272)
Clause: Legal protection	0.406*		0.580**	-0.143	0.495*
	(0.220)		(0.269)	(0.498)	(0.257)
Observations	224		172	88	136
R-squared	0.600		0.641	0.725	0.715

All models include year and company fixed effects, controls for residential and agricultural land, controls for natural gas prices (Henry Hub), and demographic controls. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

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Economic-environmental trade offs

Do mineral owners trade off economic benefits for environmental protection?

Additional Results:

			Pre-2009	Post-2009
	Royalty rate		Royalty rate	Royalty rate
Post-boom (>=2009)	4.265***			
	(0.690)			
Joint estate?	-0.674**		0.182	-0.492
	(0.271)		(0.527)	(0.367)
Add'l clause: Water damage compensation	0.733***		0.220	0.678*
	(0.265)		(0.505)	(0.344)
Add'l clause: Disposal & injection well prohibited	0.700*		0.286	0.828
	(0.390)		(1.015)	(0.556)
Add'l clause: Coalbed methane prohibited	0.074		0.626	1.146**
	(0.341)		(0.759)	(0.517)
Add'l clause: Underground gas storage prohibited	1.279***		0.725	0.526
	(0.288)		(0.459)	(0.338)
Observations	224		88	136
R-squared	0.591		0.707	0.730

All models include year and company fixed effects, controls for residential and agricultural land, controls for natural gas prices (Henry Hub), and demographic controls. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

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Economic-environmental trade offs

Do mineral owners trade off economic benefits for environmental protection?

- Overall, we do not find that mineral owners "give up" better economic terms for additional protective clauses
    - This implies property owners can get a high-quality lease on all dimensions without sacrificing benefits
    - Alternatively, mineral owners without good information may receive poor-quality leases
- Initial leases had poorer terms for the mineral owner, but lease quality has improved drastically over short period of time
- Joint estates receive lower royalty rates

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Diffusion of information

How does information about historical production, environmental violations, and lease exposure and quality spread throughout communities?

	Royalty rate	Count of water quality clauses	Count of surface protection clauses	Count of legal protection clauses	Count of favorable to producer clauses
Joint estate?	-0.679**	0.124	-0.056	0.110	-0.162
	(0.271)	(0.146)	(0.216)	(0.118)	(0.150)
Lagged NG production	0.353**	0.002	-0.038	0.061	-0.056
	(0.176)	(0.056)	(0.067)	(0.042)	(0.057)
Lagged violations	-0.083	0.190**	0.109	-0.017	-0.034
	(0.195)	(0.078)	(0.090)	(0.021)	(0.024)
Lagged water violations	-0.031	-0.541***			
	(0.437)	(0.171)			
Lagged surface/land violations			-0.108		
			(0.125)		
Cumulative no. of leases signed	-0.001	-0.000	-0.000	-0.000	-0.000
	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Cumulative water quality clauses	-0.030	-0.044*			
	(0.101)	(0.024)			
Cumulative surface protection clauses	-0.097		0.029***		
	(0.100)		(0.011)		
Cumulative legal protection clauses	0.051			-0.015	
	(0.239)			(0.018)	
Cumulative favorable to producer	0.073				-0.009*
	(0.081)				(0.005)
Observations	203	203	203	203	203
R-squared	0.802	0.547	0.568	0.537	0.716

All models include year, township, and company fixed effects, controls for residential and agricultural land, controls for natural gas prices (Henry Hub), and demographic controls. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Diffusion of information

How does information about historical production, environmental violations, and lease exposure and quality spread throughout communities?

	Royalty rate	Count of water quality clauses	Count of surface protection clauses	Count of legal protection clauses	Count of favorable to producer clauses
Joint estate?	-0.679**	0.124	-0.056	0.110	-0.162
	(0.271)	(0.146)	(0.216)	(0.118)	(0.150)
Lagged NG production	0.353**	0.002	-0.038	0.061	-0.056
	(0.176)	(0.056)	(0.067)	(0.042)	(0.057)
Lagged violations	-0.083	0.190**	0.109	-0.017	-0.034
	(0.195)	(0.078)	(0.090)	(0.021)	(0.024)
Lagged water violations	-0.031	-0.541***			
	(0.437)	(0.171)			
Lagged surface/land violations			-0.108		
			(0.125)		
Cumulative no. of leases signed	-0.001	-0.000	-0.000	-0.000	-0.000
	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Cumulative water quality clauses	-0.030	-0.044*			
	(0.101)	(0.024)			
Cumulative surface protection clauses	-0.097		0.029***		
	(0.100)		(0.011)		
Cumulative legal protection clauses	0.051			-0.015	
	(0.239)			(0.018)	
Cumulative favorable to producer	0.073				-0.009*
	(0.081)				(0.005)
Observations	203	203	203	203	203
R-squared	0.802	0.547	0.568	0.537	0.716

All models include year, township, and company fixed effects, controls for residential and agricultural land, controls for natural gas prices (Henry Hub), and demographic controls. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Preliminary results; please do not cite

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Diffusion of information

How does information about historical production, environmental violations, and lease exposure and quality spread throughout communities?

- Lagged production within a township increases the royalty rate received by mineral owners
- Reported violations increase the number of water quality clauses (but no other clauses)
    - Although, water-specific violations *reduce* the number of water quality clauses
- Overall leasing activity does (and clause-specific activity) within a township (e.g., learning from your neighbors) does not appreciably alter the likelihood of successfully negotiating a quality lease

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Summary and implications

Results are mixed:

- In our sample, high-quality leases appear to be well-distributed across socioeconomic groups
    - Joint vs. split estates matter more than income/education/race
- We do not find that mineral owners “give up” better economic terms for additional protective clauses
    - This implies property owners can get a high-quality lease on all dimensions without sacrifice, if provided with the “right” information
    - Alternatively, those with the “wrong” information may receive poor quality leases
- Leases have increased in quality over time, but difficult to pin down what is driving it
- Greater production generates higher royalty rates, and violations generally increase adoption of protective water quality clauses

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Thank you

Working paper coming soon!

(Special thanks to Chuck Mason, Alan Krupnick, Zhongmin Wang, & Kristin Hayes)

RESOURCES FOR THE FUTURE