Spatial discontinuities in support for hydraulic fracturing

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Background

- Recent growth in unconventional oil and natural gas development (UOGD) through the use of directional drilling and hydraulic fracturing (or 'fracking') has transformed the U.S. energy landscape (EIA, 2016).
- Fracking is a set of well stimulation and completion techniques that involves the high pressure injection of fluids to extract oil and gas from shale rock formations.
- The expansion of fracking in the past decade has substantially increased domestic energy production (EIA, 2016) and generated considerable public debate over its potential impacts.
- Negative potential environmental impacts include ground water contamination, air pollution, and increased seismic activity (Jackson et al., 2014).
- Positive potential impacts include increased employment, lower energy prices for electricity generation and heating, and stimulation of local economic growth (Jackson et al., 2014; Jacquet & Stedman, 2014).

Motivation for research

- Familiarity and opinions about hydraulic fracturing are influenced by proximity to unconventional oil and gas wells (Boudet et al., 2017).
- Prior research has considered proximity primarily as a continuous concept, however, we consider potential nonlinearities and discontinuities in the relationship between proximity and opinion.

Well and opinion data

Opinion data

- We utilized nationally representative surveys from University of Texas at Austin Energy Poll comprising 11 survey waves conducted between 2012 and 2017 (n=9,076).
- Key survey items included demographics, political affiliation, familiarity with and support for "hydraulic fracturing", and respondent ZIP code.

Unconventional oil/gas well data

- High resolution location of horizontal and directionally drilled wells were provided by Drillinginfo.

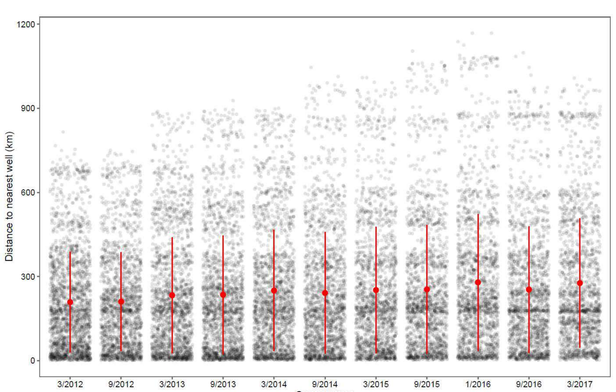

Figure 1: Distance of respondents to nearest well that began active production within one year of survey administration

Methods

- Distance-to-nearest well measurements (km) that began active production within 1 year of survey administration were estimated for each respondent (Figure 1).
- We applied logistic multilevel regression analysis using survey wave administration period (11 waves), ZIP code, county, and state as random intercepts.
- The dependent variable of interest was support for hydraulic fracturing (1=support; 0=do not support or neither).
- Individual-level fixed effects variables included in the model specification were political affiliation (democrat, republican, libertarian, independent/other), gender (male vs. female), education (bachelor's or higher vs. other), income, age, and a measure of proximity to the nearest unconventional oil and gas development that began active production within one year of survey administration.
- We tested 50 different models each with 50 different binary variables indicating whether the respondent was located within a threshold distance of a newly active well. Distances varied between 10km and 500km at 10km intervals.
- For example, if the distance-to-well threshold was 100km and a respondent was 71km from a well, they received a value of 1. Another respondent who was 111km from a well received a value of 0.
- We tested additional threshold distances to capture potential nonlinearities and considered interactions between thresholds and the rural/urban classification of the respondent's county.

Findings

- Political affiliation, sex, education and income were significant across all 50 model specifications. Republicans, libertarians, those who were older, and those with higher incomes were more likely to support hydraulic fracturing, while democrats and females were less likely to support.
- Those proximal to UOGD were more supportive. This pattern was true for threshold variables between 20km-90km and 110km (p<.05).
- For threshold distance variables further away than 110km, we found no significant relationship to support, but predicted coefficients display a downward trend that increased at 300km (Figure 5).
- Based on the coefficient patterns of these threshold variables, we tested two additional thresholds: 90km-300km and 300km or greater.
- Respondents located 90km or closer to a newly active well were more likely to support hydraulic fracturing (p<.01).
- Respondents located within 90-300km of a well are less likely to support hydraulic fracturing (p<.05).
- For respondents located greater than 300km from a well, this measure is not significantly related to support (Figure 6).
- Figure 4 gives a visual representation of the spatial extent of these thresholds on a nationwide map.
- Modeled interactions between these thresholds and rural/urban county classifications were not significant, indicating that population dense areas are not driving these threshold patterns.

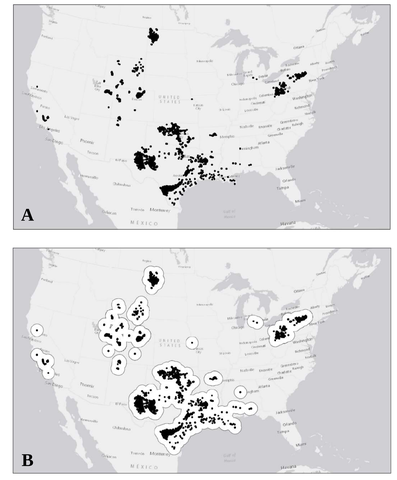

Figure 3: A, locations of wells that began active production in 2016. B, 90km thresholds drawn around each newly active well in 2016.

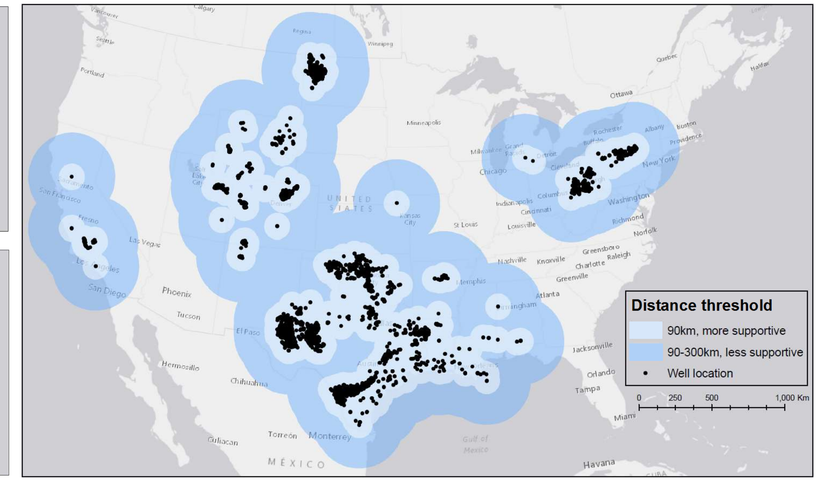

Figure 4: Distance thresholds drawn around wells that were newly active in 2016. The light-colored buffer corresponds to a 90km distance threshold, which contains respondents who were on average more supportive of hydraulic fracturing compared to those outside this threshold. The darker-colored threshold corresponds to a 90-300km distance-to-nearest well, with respondents in this threshold being less supportive of hydraulic fracturing than those inside or outside of this threshold.

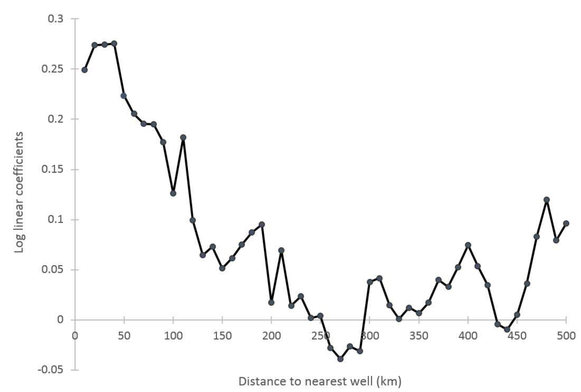

Figure 5. Plotted threshold distance variables from 50 model results (10km – 500km at 10km intervals). Threshold variables between 20km-90km and 110km are statistically significant at p<0.05.

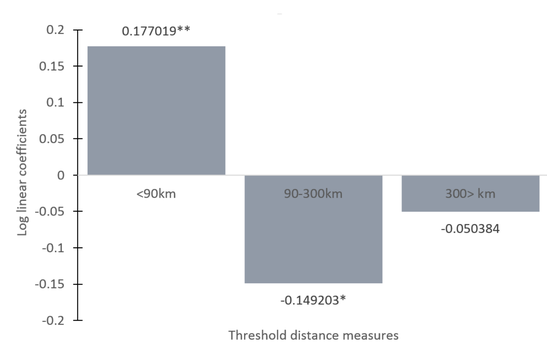

Figure 6: Log linear coefficients from three model specification with "less than 90 km", "90 to 300 km", and "300 km or greater" all modeled separately; *p<.05, **p<.01.

Conclusions

- We find that the relationship between distance to UOGD and opinion has nonlinear features.
- Our analysis suggests that those within 90km of a newly active well were more supportive of hydraulic fracturing, 90km-300km were less supportive, and for those greater than 300km there was no effect.
- One potential explanation for these findings is that high density population areas are driving these threshold bands. However, when we test for urban influence on thresholds we find no significant relationships.
- Another potential explanation is that these findings are capturing unexplored or poorly understood social-psychological processes related to proximity to UOGD. These threshold effects could parallel a "Goldilocks Zone" of support identified in recent case study research (Junod et al., 2017) on a national scale.
- We recommend that scholars conducting public opinion research about energy development consider spatial discontinuities measures and explore interactions between these measures and key variables of interest.

References

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