**Supplemental Materials—Spatial discontinuities in support for hydraulic fracturing: searching for a “Goldilocks Zone”**

**Methods S1:** Well proximity and density estimation

Survey respondent location was reported at the ZIP code level, which were then associated with ZIP Code Tabulation Areas (ZCTAS). The spatial extent of ZCTAs varies substantially across the U.S. Some ZCTAs have relatively high population density and a small spatial extent; others have a large spatial extent with low population density; and still others have a large spatial extent with a mix between high and low population densities, often reflecting a combination of both urban and rural areas. To deal with this heterogeneity, we used a method that weights each ZTCA spatially. Following the approach described in Boudet et al. (2018), we assumed that survey respondents are sampled as-if-random from the population of their ZCTA. Applying a population weighted estimate of the earth (SEDAC: Gridded Population of the World v4) at approximately 1 km grid cells, or 30 arc-seconds, we used this as a basis to estimate average nearest well distance for respondents within their respective ZTCA.

First, we measured the distance of each 30 arc-second cell for the contiguous U.S. to the nearest well that began active production within 1 year, and then 2 years, of each survey wave administration period. Next, we took the distance-to-well value associated with that cell and multiplied it by the population value for that cell. Then, we collected all the cells within the ZTCA, summed them and divided by the total population of that ZTCA. This generated an average distance-to-well measurement based on the distribution of the population within the ZTCA. Each respondent from a corresponding ZTCA was then assigned this distance-to-well measurement. Compared to methods that simply use the centroid, or spatial center, of ZCTAs to measure nearest distance, this approach accounts for *where* people are located *within* the ZCTA—particularly relevant for ZCTAs with an irregular shape or a population dense area (such as a major metropolitan center). For this reason, and in the absence of a better respondent geolocation measure, we apply this population-weighted ZCTA method to estimate respondent well proximity. For more information on this approach, see Boudet et al. (2018).

To measure the impact of development intensity we used a measure of well location density generated through kernel density estimation. Wells selected for kernel density estimation began production within one year of survey administration. First, using the well data furnished by Drillinginfo™ (Table S1), kernel density surfaces of well point data were generated for search radii of 20km, 50km, and 100km using a quartic kernel function (Silverman 2018). Next, the kernel density surface was spatially weighted using an approach similar to that described in the previous paragraph. Lastly, these kernel density measures were then applied in binary logistic multilevel regression analysis. Results from models that include well density estimates are presented in Table S6.

**Table S1**: Information about primary datasets used in this study, adapted from Boudet et al. (2018).

| **Dataset** | **Description** |
| --- | --- |
| University of Texas at Austin Energy Poll | Hydraulic fracturing familiarity and opinions, demographics, and respondent ZIP code were collected by the UT Austin Energy Poll in 11 survey waves administered from March 2012 through March 2017, which updates the 9 survey waves applied in Boudet et al. (2018). Each wave represents a new cross-section of the U.S. population. Participants were recruited by the Internet survey company Toluna ([www.toluna-group.com](http://www.toluna-group.com)), which provided de-identified data to the University of Texas at Austin. |
| Drillinginfo™ | Drillinginfo is an energy data analytics company that offers subscription services to the oil and gas industry. Using Drillinginfo Desktop, a product that tracks information about oil and gas wells in the contiguous U.S., wells drilled directionally and/or horizontally with first production dates between 1/1/1990 – 4/1/2017 were queried and formed into a dataset. Directional and/or horizontal drilling techniques were used as a proxy for unconventional oil and gas wells. This dataset contains information on the geocoordinates for each well and additional well information. See Boudet et al. (2018) for more detail. |
| ZIP Code Tabulation Areas (ZCTA) | U.S. Census Cartographic Boundary Shapefiles provided by the U.S. Census Bureau. |
| ZCTA to County Relationship File | The ZCTA to County Relationship File, provided by the U.S. Census Bureau, was utilized to associate ZIP code geographies with county geographies (FIPS). |
| Gridded Population of the World (GPW), v4 | Estimates of global population distributions provided by NASA’s Socioeconomic Data and Application Center (SEDAC). |
| 2012 North American Industry Classification System | *Mining, quarrying, and oil and gas extraction sector* (NAICS: 21) employment information, reported at the county-level, provided by U.S. Census Bureau. |
| 2013 Rural-Urban Continuum Codes | Rural-Urban Continuum Codes, ranked from one to nine, developed by the Economic Research Service (ERS) |

**Table S2:** Description and summary statistics of relevant variables (information updated from Boudet et al. 2018).

| **Variable** | **Measurement** | **Source** | **Descriptive Statistics** |
| --- | --- | --- | --- |
| ***Proximity and density variables*** | | | |
| Distance to nearest well (km), 1 year interval | Distance from population weighted respondent ZIP Code Tabulation Area to nearest well that began active production within 1 year of survey wave administration period. | UT Energy Poll, Gridded Population of the World (GPW), v4, Drillinginfo | Mean = 243.50 km  SD = 215.62  n = 22751 |
| Distance to nearest well (km), 2 year interval | Distance from population weighted respondent ZIP Code Tabulation Area to nearest well that began active production within 2 years of survey wave administration period. | UT Energy Poll, Gridded Population of the World (GPW), v4, Drillinginfo | Mean = 225.01 km  SD = 215.62  n = 22751 |
| Well density | Kernel density estimation was used to create surfaces with bandwidths of 20km, 50km, and 100km, population weighted by respondent ZIP Code Tabulation Area. | UT Energy Poll, Gridded Population of the World (GPW), v4, Drillinginfo | **Well density 20km**  Mean = 0.398  SD = 5.49  **Well density 50km**  Mean = 0.446  SD = 4.63  **Well density 100km**  Mean = 0.458  SD = 4.17  n = 22751 |
| ***Demographic/individual-level variables*** | | | |
| Gender | Are you…  0 = Female; 1 = Male | UT Energy Poll | *Male* = 47.3%  *Female* = 52.7%  n = 23154 |
| Age | Into which of the following age groups do you fall?  1 = Under 18 years (exit survey); 2 = 18-24; 3 = 25-29; 4 = 30-34; 5 = 35-39; 6 = 40-44; 7= 45-49, 8 = 50-54; 9 = 55-59, 10 = 60-64; 11 =65-74; 12 = 75 or over | UT Energy Poll | Mean = 5.80  SD = 3.12  n = 23154 |
| Education | What is the last grade of school that you completed?  1 = Grade school or less [Grade 1-8] , 2 = Some high school [Grade 9-11]; 3 = Graduated high school [Grade 12]; 4 = Vocational school/Technical school; 5 = Some college – 2 years or less; 6 = Some college – more than 2 years; 7 = graduated college; 8 = Post-graduate work without a degree; 9 = Post-graduate degree [e.g. MA, MBA, LLD, PhD] | UT Energy Poll | ***Recoded as:***  *Less than 4 year degree* (1,2,3,4,5,6 → 0) = 58.8%  *4 year degree or higher* (7,8,9 → 1) = 41.2%  SD = 0.492  n = 23154 |
| Income | Which of the following income groups includes your TOTAL FAMILY INCOME in [insert previous year] before taxes?  1 = Less than $20,000 ; 2 = $20,000 to less than $30,000; 3 = $30,000 to less than $40,000 ; 4 = $40,000 to less than $50,000; 5 = $50,000 to less than $75,000 ; 6 = 75,000 to less than $100,000 ; 7 = $100,000 to less than $200,000 ; 8 = $200,00 or more | UT Energy Poll | Mean = 3.987  SD = 2.04  n = 23154 |
| Race | What is your racial or ethnic heritage?  1 = African American or Black; 2 = American Indian or Alaska Native; 3 = Asian; 4 = Native Hawaiian or Pacific Islander; 5 = White; 6 = Other | UT Energy Poll | ***Recoded as:***  *Nonwhite* (1,2,3,4,6 → 0) = 18.9%  *White* (5 → 1) = 80.1%  n= 23154 |
| Political affiliation | Generally speaking, which of the following best describes your political affiliation?  1= Strong Democrat; 2 = Democrat; 3 = Somewhat/Lean Democrat; 4 = Strictly Independent; 5= Somewhat/Lean Republican; 6 = Republican; 7 = Strong Republican ; 8 = Other; 9 = Prefer not to answer; 10 = Libertarian | UT Energy Poll | ***Recoded as:***  *Democrat* (1,2,3) = 42.4%  *Republican* (5,6,7) = 30.82%  *Libertarian* (10) = 4.45%  *Independent/other* (4,8) = 22.33%  n= 21540 |
| Metro area | 1= Counties in metro areas of 1 million population or more  2= Counties in metro areas of 250,000 to 1 million population  3= Counties in metro areas of fewer than 250,000 population  4= Urban population of 20,000 or more, adjacent to a metro area  5= Urban population of 20,000 of more, not adjacent to a metro area  6= Urban population of 2,500 to 19,999, adjacent to a metro area  7= Urban population of 2,500 to 19,999, not adjacent to a metro area  8= Completely rural or less than 2,500 urban population, adjacent to a metro area  9= Completely rural or less than 2,500 urban population, not adjacent to a metro area | 2013 Rural-Urban Continuum Codes | *Metro* (1,2,3→0) = 86.6%  *Nonmetro* (4,5,6,7,8,9→1) = 13.4%  n= 23154 |
| ***Contextual variables applied in analysis*** | | | |
| Survey wave | Each wave corresponds to a bi-annual survey administration period, 2012-2017 | UT Energy Poll | n = 11 |
| County | U.S. county identification (FIPS) | U.S. Census Bureau | n = 1521 |
| ZCTA | ZIP Code Tabulation Areas | U.S. Census Bureau | n = 5420 |
| State | Contiguous U.S. states and Washington, D.C. | U.S. Census Bureau | n = 49 |
| ***Dependent variable*** | | | |
| Opposition/support for hydraulic fracturing (ordinal) | Based on what you know or have heard, please indicate the degree to which you support or oppose the use of hydraulic fracturing in the extraction of fossil fuels.  1 = Strongly oppose; 2 = Somewhat oppose; 3 = Neither support nor oppose; 4 = Somewhat support; 5 = Strongly support; 6 = Don’t know | UT Energy Poll | *Strongly oppose (1) = 25.6%*  *Somewhat oppose (2) = 18.8%*  *Neither support nor oppose (3) = 14.3%*  *Somewhat support (4) =21.6%*  *Strongly support (5) = 19.5%*  n = 9828 |
| Support for hydraulic fracturing (binary) | Based on what you know or have heard, please indicate the degree to which you support or oppose the use of hydraulic fracturing in the extraction of fossil fuels.  1 = Strongly oppose; 2 = Somewhat oppose; 3 = Neither support nor oppose; 4 = Somewhat support; 5 = Strongly support; 6 = Don’t know | UT Energy Poll | ***Recoded as:***  *Do not support* (1,2,3 -> 0) = 59.0%  *Support* (4,5 ->1) = 41.0%  n = 9828 |

**References:**

Boudet, Hilary S., Chad M. Zanocco, Peter D. Howe, and Christopher E. Clarke. 2018. “The Effect of Geographic Proximity to Unconventional Oil and Gas Development on Public Support for Hydraulic Fracturing.” *Risk Analysis* 38 (9): 1871–90. <https://doi.org/10.1111/risa.12989>.

Silverman, B. W. 2018. “Density Estimation for Statistics and Data Analysis.” Routledge. <https://doi.org/10.1201/9781315140919>.

**Table S3:** Binary logistic multilevel model results for support for “hydraulic fracturing” using three threshold measures, <115km, 115-305km, and >305km for wells that began production within 1 year of survey administration. These results generated Figure 1 (Right) in the main text.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Model 1** | | **Model 2** | | **Model 3** | |
|  | <115km threshold | | 115-305km threshold | | >305km threshold | |
| **Fixed effects:** | Estimate | Pr(>|z|) | Estimate | Pr(>|z|) | Estimate | Pr(>|z|) |
| (Intercept) | -1.88495 | < 2e-16 \*\*\* | -1.81479 | < 2e-16 \*\*\* | -1.82259 | < 2e-16 \*\*\* |
| Age | 0.025492 | 0.00752 \*\* | 0.02454 | 0.00989 \*\* | 0.020796 | 0.0292 \* |
| Male | 0.779254 | < 2e-16 \*\*\* | 0.778295 | < 2e-16 \*\*\* | 0.781631 | < 2e-16 \*\*\* |
| White | -0.13465 | 0.11966 | -0.10801 | 0.21158 | -0.09011 | 0.2988 |
| 4 year degree | 0.034142 | 0.5677 | 0.03323 | 0.57733 | 0.026587 | 0.6566 |
| Income | 0.129224 | < 2e-16 \*\*\* | 0.132111 | < 2e-16 \*\*\* | 0.12285 | 3.53e-16 \*\*\* |
| Democrat1 | -0.60716 | 9.41e-16 \*\*\* | -0.59535 | 2.81e-15 \*\*\* | -0.59562 | 3.26e-15 \*\*\* |
| Republican1 | 1.465758 | < 2e-16 \*\*\* | 1.468526 | < 2e-16 \*\*\* | 1.487105 | < 2e-16 \*\*\* |
| Libertarian1 | 0.773106 | 1.99e-09 \*\*\* | 0.768572 | 2.25e-09 \*\*\* | 0.796614 | 6.70e-10 \*\*\* |
| Nonmetro area | -0.1781 | 0.04198 \* | -0.15059 | 0.08539 . | -0.15624 | 0.0744 . |
| <115km threshold | 0.180005 | 0.01036 \* |  |  |  |  |
| 115-305km threshold |  |  | -0.15298 | 0.02199 \* |  |  |
| >305km threshold |  |  |  |  | -0.00146 | 0.9849 |
| **Random effects:** |  |  |  |  |  |  |
| **Groups** | Variance | Std. Dev. | Variance | Std. Dev. | Variance | Std. Dev. |
| ZTCA | 0.869646 | 0.93255 | 0.84548 | 0.9195 | 0.864331 | 0.92969 |
| County | 0.018609 | 0.13641 | 0.02389 | 0.15458 | 0.027303 | 0.16524 |
| State | 0.010538 | 0.10266 | 0.01531 | 0.12372 | 0.013532 | 0.11633 |
| Survey wave | 0.004695 | 0.06852 | 0.00447 | 0.06686 | 0.006429 | 0.08018 |
| AIC | 10605 | | 10606 | | 10610.3 | |
| BIC | 10711.7 | | 10712.7 | | 10717 | |
| Number of observations: 9076 | | | | | | |
| Groups: ZTCA, 5420; county, 1521; state, 49; survey wave, 11 | | | | | | |

\*p<.05, \*\*p<.01, \*\*\*p<.001 are corresponding significance levels

1Political affiliation reference category is Independent/other

**Table S4:** Binary logistic multilevel model results for support for “hydraulic fracturing” using different formulations of distance measures for wells that began production within 1 year of survey administration. Model 1 uses a continuous distance-to-nearest well measurement. Model 2 uses the log transform of the distance-to-nearest well measurement. Model 3 uses the <115km threshold and interacts it with the distance measurement. Model 4 considers a logged transform of the distance-to-nearest well measurement, squared. Without taking the log transform, a quadratic specification of the distance-to-nearest well measurement did not result in model convergence because the scale of the variable was too large.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Model 1** | | **Model 2** | | **Model 3** | | **Model 4** | |
| Fixed effects: | Estimate | Pr(>|z|) | Estimate | Pr(>|z|) | Estimate | Pr(>|z|) | Estimate | Pr(>|z|) |
| (Intercept) | -1.7902364 | < 2e-16 \*\*\* | -1.50524 | 1.20e-14 \*\*\* | -1.7653499 | < 2e-16 \*\*\* | -1.517916 | 1.06e-10 \*\*\* |
| Age | 0.0254101 | 0.00781 \*\* | 0.02521 | 0.00828 \*\* | 0.0217679 | 0.0220 \* | 0.021704 | 0.0220 \* |
| Male | 0.7695404 | < 2e-16 \*\*\* | 0.75202 | < 2e-16 \*\*\* | 0.7917619 | < 2e-16 \*\*\* | 0.740547 | < 2e-16 \*\*\* |
| White | -0.1103412 | 0.20337 | -0.05701 | 0.51188 | -0.0905376 | 0.2948 | -0.109554 | 0.2032 |
| 4 year degree | 0.0439365 | 0.46272 | 0.03553 | 0.55268 | 0.0491158 | 0.4096 | 0.031037 | 0.6013 |
| Income | 0.1285063 | < 2e-16 \*\*\* | 0.12864 | < 2e-16 \*\*\* | 0.1257182 | < 2e-16 \*\*\* | 0.125772 | < 2e-16 \*\*\* |
| Democrat1 | -0.6061101 | 1.16e-15 \*\*\* | -0.59378 | 4.14e-15 \*\*\* | -0.5838992 | 8.70e-15 \*\*\* | -0.630401 | < 2e-16 \*\*\* |
| Republican1 | 1.4689618 | < 2e-16 \*\*\* | 1.46942 | < 2e-16 \*\*\* | 1.4632938 | < 2e-16 \*\*\* | 1.438855 | < 2e-16 \*\*\* |
| Libertarian1 | 0.7840495 | 1.27e-09 \*\*\* | 0.80886 | 3.89e-10 \*\*\* | 0.8137641 | 2.64e-10 \*\*\* | 0.738371 | 7.93e-09 \*\*\* |
| Nonmetro area | -0.1526097 | 0.08102 . | -0.16479 | 0.06063 . | -0.1300352 | 0.1349 | -0.205753 | 0.0178 \* |
| Distance-to-well (km) | -0.0002606 | 0.11439 |  |  |  |  |  |  |
| Logged distance-to-well (km) |  |  | -0.07651 | 0.00617 \*\* |  |  | 0.47058 | 0.559 |
| Distance X >115km |  |  |  |  | -0.0003368 | 0.0526 . |  |  |
| Distance X <115km |  |  |  |  | -0.0011321 | 0.3574 |  |  |
| logged (Distance X Distance) |  |  |  |  |  |  | -0.260971 | 0.5032 |
| **Random effects:** |  |  |  |  |  |  |  |  |
| **Groups** | Variance | Std. Dev. | Variance | Std. Dev. | Variance | Std. Dev. | Variance | Std. Dev. |
| ZTCA | 0.874965 | 0.9354 | 0.87206 | 0.93384 | 0.847586 | 0.92064 | 0.84219 | 0.91771 |
| County | 0.024844 | 0.15762 | 0.030045 | 0.17334 | 0.025303 | 0.15907 | 0.01284 | 0.11331 |
| State | 0.010663 | 0.10326 | 0.012127 | 0.11012 | 0.008703 | 0.09329 | 0.009373 | 0.09681 |
| Survey wave | 0.004738 | 0.06883 | 0.004412 | 0.06642 | 0.004351 | 0.06596 | 0.003644 | 0.06036 |
| AIC | 10607.8 | | 10603.2 | | 10610.3 | | 10605.9 | |
| BIC | 10714.5 | | 10709.9 | | 10724.1 | | 10719.7 | |
| Number of observations: 9076 | | | | | | | | |
| Groups: ZTCA, 5420; county, 1521; state, 49; survey wave, 11 | | | | | | | | |

\*p<.05, \*\*p<.01, \*\*\*p<.001 are corresponding significance levels

1Political affiliation reference category is Independent/other

**Table S5:** Binary logistic multilevel model results for support for “hydraulic fracturing” using interaction terms and distance measures for wells that began production within 1 year of survey administration. In Model 1, employment in the extractive sector is modeled alongside nonmetro and the <115km threshold. In Model 2, employment in the extractive sector is interacted with the distance threshold. In Model 3, nonmetro area is interacted with the distance threshold. In Model 4, political affiliation (Republican, Democrat, and Libertarian) is interacted with the distance threshold.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Model 1** | | **Model 2** | | **Model 3** | | **Model 4** | |
| Fixed effects: | Estimate | Pr(>|z|) | Estimate | Pr(>|z|) | Estimate | Pr(>|z|) | Estimate | Pr(>|z|) |
| (Intercept) | -1.915765 | < 2e-16 \*\*\* | -1.872392 | < 2e-16 \*\*\* | -1.87247 | < 2e-16 \*\*\* | -1.866038 | < 2e-16 \*\*\* |
| Age | 0.024391 | 0.0106 \* | 0.022055 | 0.0208 \* | 0.02181 | 0.0221 \* | 0.019113 | 0.0445 \* |
| Male | 0.772958 | < 2e-16 \*\*\* | 0.771825 | < 2e-16 \*\*\* | 0.809 | < 2e-16 \*\*\* | 0.779338 | < 2e-16 \*\*\* |
| White | -0.077756 | 0.3695 | -0.087157 | 0.3141 | -0.09872 | 0.2542 | -0.098524 | 0.2545 |
| 4 year degree | 0.012586 | 0.8331 | 0.024837 | 0.6774 | 0.02672 | 0.6546 | 0.03582 | 0.548 |
| Income | 0.132008 | < 2e-16 \*\*\* | 0.127657 | < 2e-16 \*\*\* | 0.12418 | < 2e-16 \*\*\* | 0.126263 | < 2e-16 \*\*\* |
| Democrat1 | -0.613335 | 4.8e-16 \*\*\* | -0.618489 | 2.79e-16 \*\*\* | -0.59997 | 1.95e-15 \*\*\* | -0.623396 | 2.16e-11 \*\*\* |
| Republican1 | 1.45219 | < 2e-16 \*\*\* | 1.459755 | < 2e-16 \*\*\* | 1.45834 | < 2e-16 \*\*\* | 1.477228 | < 2e-16 \*\*\* |
| Libertarian1 | 0.749435 | 5.8e-09 \*\*\* | 0.778143 | 1.52e-09 \*\*\* | 0.79616 | 6.75e-10 \*\*\* | 0.899512 | 1.18e-08 \*\*\* |
| Nonmetro area | -0.178401 | 0.0435 \* | -0.195175 | 0.0274 \* | -0.15161 | 0.178 | -0.174257 | 0.0463 \* |
| <115km threshold | 0.151335 | 0.0341 \* | -3.81974 | 0.3172 | 0.15011 | 0.0479 \* | 0.195898 | 0.1229 |
| Employment in extractive sector | -0.504786 | 0.7273 | 0.161773 | 0.0230 \* |  |  |  |  |
| <115km threshold X Employment in extractive sector |  |  | 3.824053 | 0.3533 |  |  |  |  |
| <115km threshold X nonmetro |  |  |  |  | -0.05776 | 0.7378 |  |  |
| <115km threshold X Democrat |  |  |  |  |  |  | 0.02866 | 0.8529 |
| <115km threshold X Republican |  |  |  |  |  |  | -0.04633 | 0.7658 |
| <115km threshold X Libertarian |  |  |  |  |  |  | -0.424464 | 0.1138 |
| **Random effects:** |  |  |  |  |  |  |  |  |
| **Groups** | Variance | Std. Dev. | Variance | Std. Dev. | Variance | Std. Dev. | Variance | Std. Dev. |
| ZTCA | 0.8665 | 0.93086 | 0.865643 | 0.9304 | 0.864855 | 0.92998 | 0.849284 | 0.92157 |
| County | 0.018876 | 0.13739 | 0.021512 | 0.14667 | 0.023031 | 0.15176 | 0.026778 | 0.16364 |
| State | 0.010291 | 0.10144 | 0.007476 | 0.08646 | 0.009079 | 0.09528 | 0.008543 | 0.09243 |
| Survey wave | 0.004398 | 0.06632 | 0.003503 | 0.05919 | 0.007864 | 0.08868 | 0.003535 | 0.05945 |
| AIC | 10607 | | 10608 | | 10607.4 | | 10607.5 | |
| BIC | 10720.8 | | 10728.9 | | 10721.3 | | 10735.5 | |
| Number of observations: 9076 | | | | | | | | |
| Groups: ZTCA, 5420; county, 1521; state, 49; survey wave, 11 | | | | | | | | |

\*p<.05, \*\*p<.01, \*\*\*p<.001 are corresponding significance levels

1Political affiliation reference category is Independent/other

**Table S6:** Binary logistic multilevel model results for support for “hydraulic fracturing” using kernel density for wells at three bandwidths: 20km, 50km, and 100km.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Model 1** | | **Model 2** | | **Model 3** | |
| Fixed effects: | Estimate | Pr(>|z|) | Estimate | Pr(>|z|) | Estimate | Pr(>|z|) |
| (Intercept) | -13.428 | < 2e-16 \*\*\* | -1.7617388 | < 2e-16 \*\*\* | -1.8856013 | < 2e-16 \*\*\* |
| Age | 2.355 | 0.0185 \* | 0.022528 | 0.0173 \* | 0.0257466 | 0.00712 \*\* |
| Male | 13.081 | < 2e-16 \*\*\* | 0.7681456 | < 2e-16 \*\*\* | 0.7895903 | < 2e-16 \*\*\* |
| White | -0.73 | 0.4652 | -0.1142546 | 0.1842 | -0.0864889 | 0.31976 |
| 4 year degree | 0.122 | 0.9026 | 0.0122054 | 0.8371 | 0.0358732 | 0.54932 |
| Income | 8.811 | < 2e-16 \*\*\* | 0.1248195 | < 2e-16 \*\*\* | 0.1279548 | < 2e-16 \*\*\* |
| Democrat1 | -8.187 | 2.68e-16 \*\*\* | -0.6399167 | < 2e-16 \*\*\* | -0.5995058 | 2.47e-15 \*\*\* |
| Republican1 | 18.135 | < 2e-16 \*\*\* | 1.4247557 | < 2e-16 \*\*\* | 1.4763739 | < 2e-16 \*\*\* |
| Libertarian1 | 5.927 | 3.09e-09 \*\*\* | 0.7167693 | 2.06e-08 \*\*\* | 0.7687788 | 2.74e-09 \*\*\* |
| Nonmetro area | -1.657 | 0.0974 . | -0.1958121 | 0.0243 \* | -0.1505967 | 0.08774 . |
| Well density 20km | -0.64 | 0.5219 |  |  |  |  |
| Well density 50km |  |  | -0.0003907 | 0.9459 |  |  |
| Well density 100km |  |  |  |  | -0.0002493 | 0.975 |
| **Random effects:** |  |  |  |  |  |  |
| **Groups** | Variance | Std. Dev. | Variance | Std. Dev. | Variance | Std. Dev. |
| ZTCA | 0.844883 | 0.91918 | 0.827741 | 0.9098 | 0.873816 | 0.93478 |
| County | 0.016676 | 0.12914 | 0.020796 | 0.14421 | 0.032181 | 0.17939 |
| State | 0.012014 | 0.10961 | 0.012117 | 0.11008 | 0.012375 | 0.11124 |
| Survey wave | 0.004438 | 0.06662 | 0.005393 | 0.07344 | 0.006418 | 0.08011 |
| AIC | 10610.9 | | 10611.8 | | 10610.1 | |
| BIC | 10717.6 | | 10718.5 | | 10716.8 | |
| Number of observations: 9076 | | | | | | |
| Groups: ZTCA, 5420; county, 1521; state, 49; survey wave, 11 | | | | | | |

\*p<.05, \*\*p<.01, \*\*\*p<.001 are corresponding significance levels

1Political affiliation reference category is Independent/other

**Table S7:** Linear multilevel model results for “hydraulic fracturing” opinion on a five-point ordinal scale from “strongly oppose” to “strongly support” using three threshold measures, <115km, 115-305km, and >305km for wells that began production within 1 year of survey administration. For this alternative model formulation, the sign and magnitude for distance thresholds are consistent with Table S3 and Figure 1 (Right) in the main text.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Model 1** | | **Model 2** | | **Model 3** | |
|  | <115km threshold | | 115-305km threshold | | >305km threshold | |
| **Fixed effects:** | Estimate | Pr(>|z|) | Estimate | Pr(>|z|) | Estimate | Pr(>|z|) |
| (Intercept) | 2.16E+00 | < 2e-16 \*\*\* | 2.23E+00 | < 2e-16 \*\*\* | 2.19E+00 | < 2e-16 \*\*\* |
| Age | 1.09E-02 | 0.02186 \* | 1.08E-02 | 0.02424 \* | 1.07E-02 | 0.02497 \* |
| Male | 4.41E-01 | < 2e-16 \*\*\* | 4.41E-01 | < 2e-16 \*\*\* | 4.42E-01 | < 2e-16 \*\*\* |
| White | -1.41E-01 | 0.00119 \*\* | -1.42E-01 | 0.00113 \*\* | -1.40E-01 | 0.00134 \*\* |
| 4 year degree | -5.77E-03 | 0.8482 | -5.09E-03 | 0.86595 | -7.34E-03 | 0.80774 |
| Income | 8.03E-02 | < 2e-16 \*\*\* | 8.02E-02 | < 2e-16 \*\*\* | 7.97E-02 | < 2e-16 \*\*\* |
| Democrat1 | -3.61E-01 | < 2e-16 \*\*\* | -3.60E-01 | < 2e-16 \*\*\* | -3.61E-01 | < 2e-16 \*\*\* |
| Republican1 | 9.26E-01 | < 2e-16 \*\*\* | 9.28E-01 | < 2e-16 \*\*\* | 9.27E-01 | < 2e-16 \*\*\* |
| Libertarian1 | 4.74E-01 | 2.6e-12 \*\*\* | 4.74E-01 | 2.47e-12 \*\*\* | 4.73E-01 | 2.72e-12 \*\*\* |
| Nonmetro area | -8.90E-02 | 0.05233 . | -8.99E-02 | 0.05048 . | -8.11E-02 | 0.07709 . |
| <115km threshold | 1.08E-01 | 0.00675 \*\* |  |  |  |  |
| 115-305km threshold |  |  | -8.62E-02 | 0.01560 \* |  |  |
| >305km threshold |  |  |  |  | 1.95E-03 | 0.96312 |
| **Random effects:** |  |  |  |  |  |  |
| **Groups** | Variance | Std. Dev. | Variance | Std. Dev. | Variance | Std. Dev. |
| ZTCA | 0.435048 | 0.65958 | 0.434741 | 0.65935 | 0.43443 | 0.65911 |
| County | 0.009902 | 0.09951 | 0.010062 | 0.10031 | 0.010244 | 0.10121 |
| State | 0.006658 | 0.08159 | 0.007836 | 0.08852 | 0.008428 | 0.09181 |
| Survey wave | 0.004502 | 0.0671 | 0.005001 | 0.07072 | 0.005058 | 0.07112 |
| AIC | 30593.6 | | 30595.3 | | 30600.8 | |
| BIC | 30707.38 | | 30709.1 | | 30714.63 | |
| Number of observations: 9076 | | | | | | |
| Groups: ZTCA, 5420; county, 1521; state, 49; survey wave, 11 | | | | | | |

\*p<.05, \*\*p<.01, \*\*\*p<.001 are corresponding significance levels

1Political affiliation reference category is Independent/other

**Table S8:** Ordinal logistic multilevel model results for “hydraulic fracturing” opinion on a five-point ordinal scale from “strongly oppose” to “strongly support” using three thresholds measures, <115km, 115-305km, and >305km for wells that began production within 1 year of survey administration. For our distance thresholds, the sign and magnitude are consistent with Table S3 and Figure 1 (Right) in the main text. We present results from binary logistic multilevel models in the main text, instead of this ordinal logistic multilevel model specification, due to a violation of the proportional odds assumption.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Model 1** | | **Model 2** | | **Model 3** | |
|  | <115km threshold | | 115-305km threshold | | >305km threshold | |
| **Fixed effects:** | Estimate | Pr(>|z|) | Estimate | Pr(>|z|) | Estimate | Pr(>|z|) |
| (Intercept) | --- | --- | --- | --- | 2.19E+00 | < 2e-16 \*\*\* |
| Age | 0.020644 | 0.006860 \*\* | 0.020309 | 0.007809 \*\* | 0.020297 | 0.007841 \*\* |
| Male | 0.714008 | < 2e-16 \*\*\* | 0.71384 | < 2e-16 \*\*\* | 0.713616 | < 2e-16 \*\*\* |
| White | -0.233181 | 0.000725 \*\*\* | -0.234675 | 0.000676 \*\*\* | -0.230663 | 0.000829 \*\*\* |
| 4 year degree | -0.001764 | 0.970717 | -0.000908 | 0.984926 | -0.004888 | 0.918951 |
| Income | 0.126975 | < 2e-16 \*\*\* | 0.126708 | < 2e-16 \*\*\* | 0.125646 | < 2e-16 \*\*\* |
| Democrat1 | -0.547136 | < 2e-16 \*\*\* | -0.545496 | < 2e-16 \*\*\* | -0.546192 | < 2e-16 \*\*\* |
| Republican1 | 1.431597 | < 2e-16 \*\*\* | 1.434438 | < 2e-16 \*\*\* | 1.432779 | < 2e-16 \*\*\* |
| Libertarian1 | 0.74591 | 9.6e-12 \*\*\* | 0.748147 | 8.31e-12 \*\*\* | 0.744083 | 1.05e-11 \*\*\* |
| Nonmetro area | -0.154941 | 0.031610 \* | -0.156746 | 0.030257 \* | -0.139941 | 0.052124 . |
| <115km threshold | 0.192631 | 0.001638 \*\* |  |  |  |  |
| 115-305km threshold |  |  | -8.62E-02 | 0.01560 \* |  |  |
| >305km threshold |  |  |  |  | -0.01275 | 0.849225 |
| **Random effects:** |  |  |  |  |  |  |
| **Groups** | Variance | Std. Dev. | Variance | Std. Dev. | Variance | Std. Dev. |
| ZTCA | 0.83173 | 0.912 | 0.434741 | 0.65935 | 0.82927 | 0.9106 |
| County | 0.02428 | 0.1558 | 0.010062 | 0.10031 | 0.02518 | 0.1587 |
| State | 0.01456 | 0.1207 | 0.007836 | 0.08852 | 0.01927 | 0.1388 |
| Survey wave | 0.01236 | 0.1112 | 0.005001 | 0.07072 | 0.01389 | 0.1179 |
| AIC | 26627.1 | | 26630.0 | | 26636.71 | |
| BIC | 26755.1 | | 26758.1 | | 26764.8 | |
| Number of observations: 9076 | | | | | | |
| Groups: ZTCA, 5420; county, 1521; state, 49; survey wave, 11 | | | | | | |

\*p<.05, \*\*p<.01, \*\*\*p<.001 are corresponding significance levels

1Political affiliation reference category is Independent/other

**Table S9:** Binary logistic multilevel model results for support for “hydraulic fracturing” using three thresholds measures for <115km, 115-305km, and >305km for wells that began production within ***2 years*** of survey administration. For our distance thresholds, the sign and magnitude are consistent with Table S3 and Figure 1 (Right) in the main text.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Model 1** | | **Model 2** | | **Model 3** | |
|  | <115km threshold | | 115-305km threshold | | >305km threshold | |
| **Fixed effects:** | Estimate | Pr(>|z|) | Estimate | Pr(>|z|) | Estimate | Pr(>|z|) |
| (Intercept) | -1.91839 | < 2e-16 \*\*\* | -1.761845 | < 2e-16 \*\*\* | -1.869292 | < 2e-16 \*\*\* |
| Age | 0.02457 | 0.00985 \*\* | 0.019914 | 0.0368 \* | 0.023469 | 0.0141 \* |
| Male | 0.77465 | < 2e-16 \*\*\* | 0.782545 | < 2e-16 \*\*\* | 0.766003 | < 2e-16 \*\*\* |
| White | -0.0731 | 0.39832 | -0.103697 | 0.2321 | -0.074484 | 0.3918 |
| 4 year degree | 0.01957 | 0.74282 | 0.036825 | 0.5383 | 0.039586 | 0.509 |
| Income | 0.12932 | < 2e-16 \*\*\* | 0.12474 | < 2e-16 \*\*\* | 0.125909 | < 2e-16 \*\*\* |
| Democrat1 | -0.61039 | 6.01e-16 \*\*\* | -0.598643 | 2.45e-15 \*\*\* | -0.600784 | 2.28e-15 \*\*\* |
| Republican1 | 1.46052 | < 2e-16 \*\*\* | 1.483151 | < 2e-16 \*\*\* | 1.488126 | < 2e-16 \*\*\* |
| Libertarian1 | 0.77234 | 1.89e-09 \*\*\* | 0.778822 | 1.57e-09 \*\*\* | 0.80687 | 4.55e-10 \*\*\* |
| Nonmetro area | -0.16423 | 0.05989 . | -0.156716 | 0.0750 . | -0.170152 | 0.0524 . |
| <115km threshold, 2 year | 0.13178 | 0.05241 . |  |  |  |  |
| 115-305km threshold, 2 year |  |  | -0.141526 | 0.0373 \* |  |  |
| >305km threshold, 2 year |  |  |  |  | 0.013139 | 0.8689 |
| **Random effects:** |  |  |  |  |  |  |
| **Groups** | Variance | Std. Dev. | Variance | Std. Dev. | Variance | Std. Dev. |
| ZTCA | 0.855082 | 0.92471 | 0.870076 | 0.93278 | 0.886185 | 0.94137 |
| County | 0.02121 | 0.14564 | 0.023739 | 0.15407 | 0.02213 | 0.14876 |
| State | 0.007523 | 0.08674 | 0.015808 | 0.12573 | 0.011271 | 0.10617 |
| Survey wave | 0.004188 | 0.06472 | 0.006181 | 0.07862 | 0.007347 | 0.08572 |
| AIC | 10714.0 | | 10607.2 | | 10610.3 | |
| BIC | 10714.0 | | 10713.9 | | 10717.0 | |
| Number of observations: 9076 | | | | | | |
| Groups: ZTCA, 5420; county, 1521; state, 49; survey wave, 11 | | | | | | |

\*p<.05, \*\*p<.01, \*\*\*p<.001 are corresponding significance levels

1Political affiliation reference category is Independent/other

**Figure S1:** Frequency distribution of opposition/support for “hydraulic fracturing” (ordinal) dependent variable.



**Figure S2:** Frequency distribution of support for “hydraulic fracturing” (binary) dependent variable.



**Figure S3:** Plot ofbest linear unbiased prediction (BLUP) estimates for survey wave random effect from Model 1 in Table S3. This plot of random effects suggests that there are no clearly identifiable temporal patterns in our analysis. Two out of eleven estimates for survey wave administration period were outside the 95% confidence interval (3/2013 and 3/2017).

