

Geographic Dispersion of Economic Shocks: Evidence from the Fracking Revolution Online Appendix

James Feyrer and Erin T. Mansur and Bruce Sacerdote*

November 29, 2016

Appendix - For Online Publication

A1 Robustness Checks

A1.1 Non-Overlapping 100-Mile Commuting Areas

Our distance regressions result in county data being included multiple times in the regression as we aggregate around counties over distance. This aggregation method may cause spatial correlation and could affect estimates of spillovers. In our main results we cluster by time to deal with the spatial correlation that results from this aggregation method. Traditional methods of measuring spillovers aggregate units of observation with each region being aggregated into a single unit of observation. Our commuting zone and state results follow this methodology.

Our results suggest that commuting areas of 100 miles account for the overall spillovers better than the smaller standard commuting zones. We test whether our estimates of spillovers are influenced by our aggregation method by creating a new set of 100 mile commuting areas that do not overlap.

First we choose a random county and group all other counties within 100 miles in an artificial commuting area. We continue choosing random counties, forming new commuting areas when the chosen county is at least 100 miles from an existing commuting area (measured county centroid to county centroid). Figure A6 shows one result of this random process. The country is essentially cut in as many places as possible by random, 100-mile

*Feyrer: Department of Economics - Dartmouth College, 6106 Rockefeller Hall, Dartmouth College, Hanover NH 03755, james.feyrer@dartmouth.edu. Mansur: Tuck School of Business - Dartmouth College and NBER, 100 Tuck Hall, Dartmouth College, Hanover NH 03755, erin.t.mansur@tuck.dartmouth.edu. Sacerdote: Department of Economics - Dartmouth College and NBER, 6106 Rockefeller Hall, Dartmouth College, Hanover NH 03755, bruce.sacerdote@dartmouth.edu.

radius circles. We aggregate all the counties in each of these circles and perform our standard commuting zone analysis. Because this method randomly leaves out counties for any given partition (on average it captures a little over half of the counties) and each partition is random, the results from any given run of this method will be noisy. We therefore bootstrap 1000 replications of this method and look at the distribution of estimates.

Table A2 reports the results for the four measures of income from Table 1: BLS wages, IRS AGI, IRS wages, and IRS other income. For comparison, the table also shows the paper’s main results. For the 1000 bootstrap replications, we report the mean and the confidence interval spanning the 5% to 95% range. The mean of the non-overlapping commuting area draws is within 5% of the main results on average. IRS wages are higher while IRS other income is lower, but overall we find that the non-overlapping method provides similar estimates to our main specification. As expected, the draws are noisy. The bootstrap estimates are based on an average of 77 areas. Nonetheless, the confidence interval excludes zero.

A1.2 Wells versus Production

Our preferred specifications use the new value of oil and gas production per capita on the right hand side. There are several alternative measures of fracking activity that were also considered. The value of production is a combination of the number of wells, the average production of each well, and the price of oil and gas during the production period. Because we include time effects in all regressions, changes in oil and gas prices play a minor role.

In Table A6, we consider whether the number of wells that began producing that year has predictive power independent of new production because the process suggests a fixed labor cost to creating a well regardless of the well’s productivity. This did not turn out to be the case. In regressions including both the value of production and well data, we find that production data have greater predictive power. Part of the explanation may be that productive wells are re-fracked more often and involve more trucking and more extensive horizontal drilling. It may also be that the willingness to invest in new wells is proportional to the expected production from these wells, leading to a strong correlation between the costs of opening a well and the value of new production. Because the well and production data are highly correlated with each other it is not possible to separate out the effects.

A1.3 Oil versus Gas

It is possible that new oil drilling and new gas drilling have different impacts. For example, natural gas is almost always transported by pipeline while oil may be shipped by rail or truck. The point estimates when we estimate new oil extraction and new gas production separately suggest that oil has a larger impact on wages than natural gas (\$260,000 in wages per million for oil production versus \$180,000 for gas production for our preferred specification of county plus 100 miles using instrumental variables), but that these differences are not statistically significant (Table A7).

Figure A4 shows the results split by oil and gas at varying distances from the county centroid. Between 0 and 100 miles the impact of natural gas and oil are very similar. The impact of oil flattens out at distances larger than 100 miles while natural gas continues to have marginal effect out to 200 miles, though the standard errors are quite large.

A1.4 Rising versus Falling Fossil Fuel Prices

Oil prices have played a role in the timing of the fracking boom, with high prices between 2005 and 2008, followed by a collapse during the Great Recession. We may worry that our results are being driven by periods of high oil prices in ways not captured by time dummies. We therefore split our sample by periods of rising and falling prices. Oil and natural gas prices generally move together, but there are a few periods where they diverge. We therefore split the sample based on whether a county sees rising or falling prices for the dominant fuel in that county. Both the rising and falling price samples include all the non-producing counties as a control group. Table A8 shows our main results for each of these samples. The results do not seem to be affected by the direction of prices.

A1.5 More Recent Data

Our analysis has focused on the period 2005-2012 due to availability of the IRS data. The BLS data is available through 2014. Table A9 presents our results for this extended sample using the BLS data. Adding these additional data increases the magnitude of our coefficients in our preferred IV specification.

In order to explore this further we split the sample into three periods. The first period, 2005 to 2008, includes the early years of the fracking boom but does not include the Great Recession. The second period, 2009 to 2011 is during the Great Recession and ends with our IRS sample. For the final period, 2012 to 2014, we only have BLS data. This is a period with falling unemployment and a more mature fracking industry. Tables A10 and A11 present the OLS and IV results across these three time periods. The second period has the largest effects and the tightest standard errors, suggesting that the period during the Great Recession is providing a lot of the identification. IV results are extremely noisy for the 2012-2014 period.

A2 Additional Figures

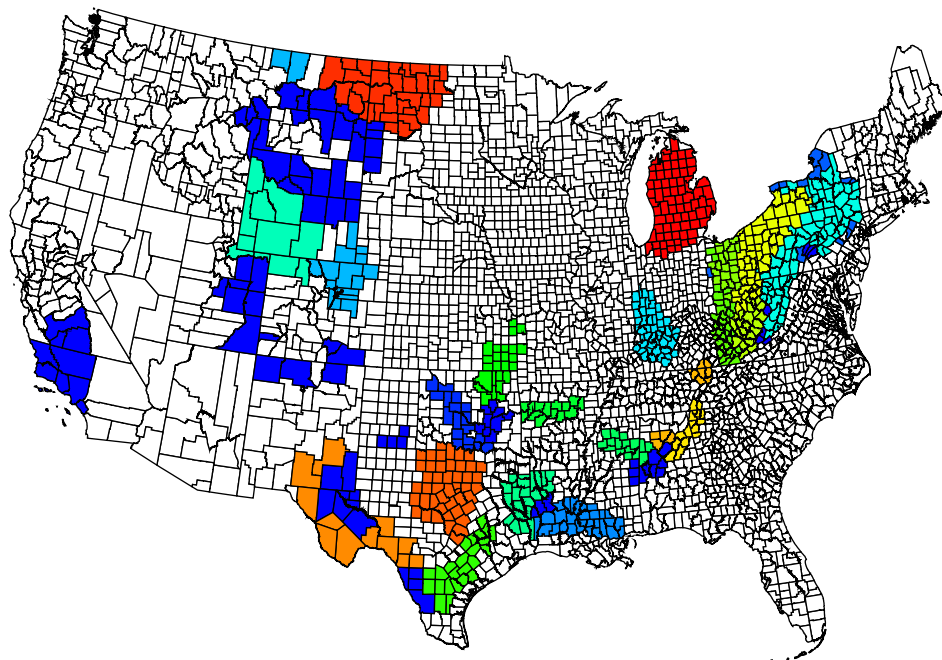


Figure A1: Shale Plays

Note: See text for details. Source: EIA “Major Tight Oil and Shale Gas Plays in Lower 48 States”.

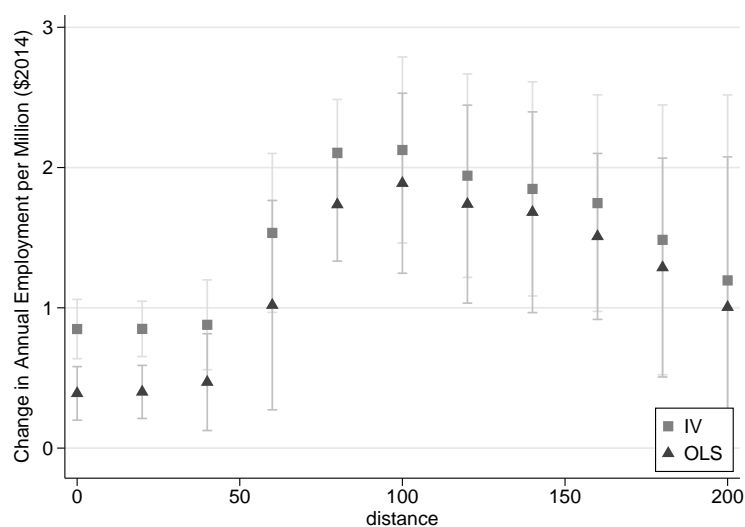


Figure A2: Employment Effects Including Neighbors within a Given Distance

Note: We regress the one-year change in employment per capita against the total value of new production aggregated within circles of various radii around county centroids. We control for county and year fixed effects and a single lag of production. Standard errors are clustered by county and year, error bars show the 95 percent confidence interval.

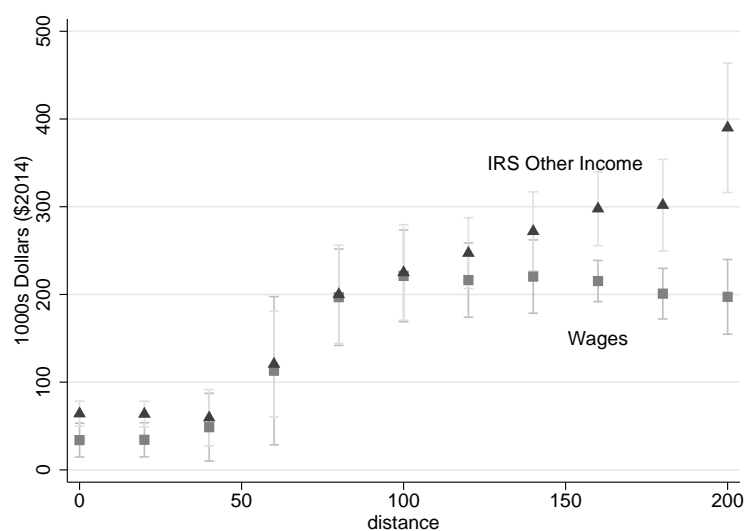


Figure A3: Wage Income and Other Income Effects within a Given Distance (OLS)

Note: We regress the one-year change in employment per capita against the total value of new production aggregated within circles of various radii around county centroids. We control for county and year fixed effects and a single lag of production. Standard errors are clustered by county and year, error bars show the 95 percent confidence interval.

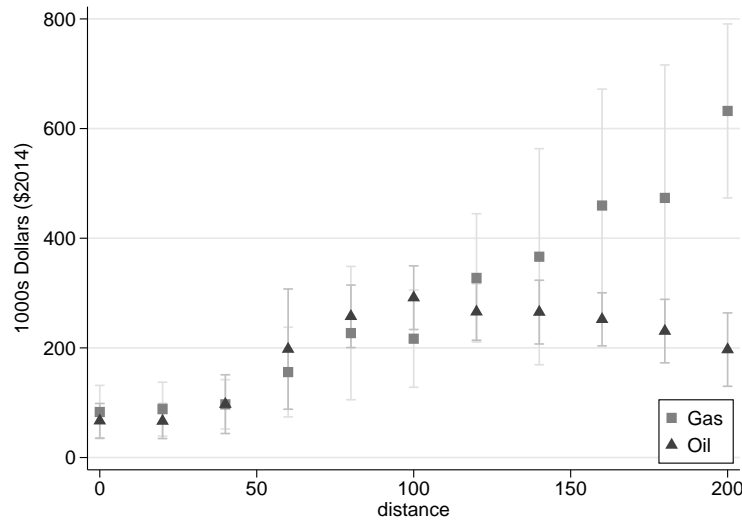


Figure A4: Wage Income Effects within a Given Distance by Fuel Type

Note: We regress the one-year change in annual income per capita against the total value of new production aggregated within circles of various radii around county centroids. We control for county and year fixed effects and a single lag of production. Standard errors are clustered by county and year, error bars show the 95 percent confidence interval.

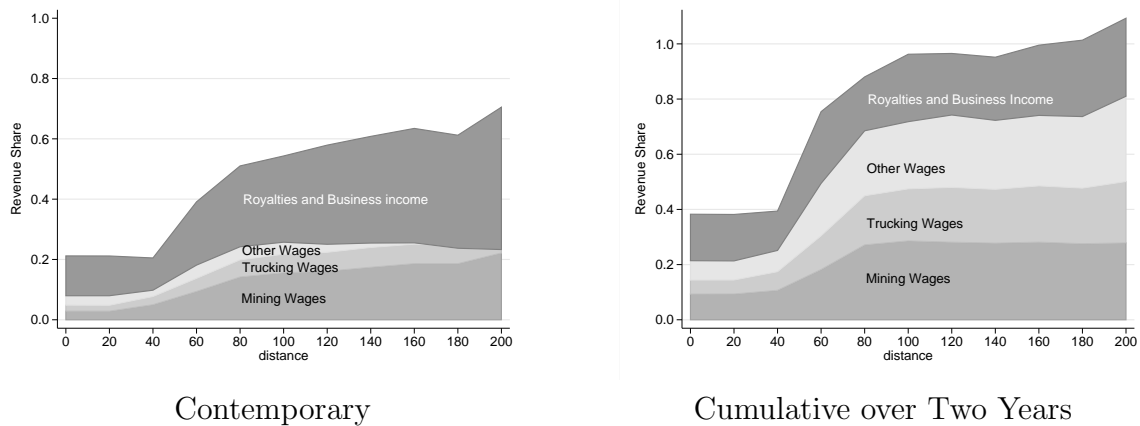


Figure A5: Cumulative Effects Over Time for One-Lag Regressions

Note: The left panel decomposes the contemporary income gains from new production combining the IRS and BLS income results over various distances. The right panel sums the effect over two years using the estimates from our main results. See text for details.

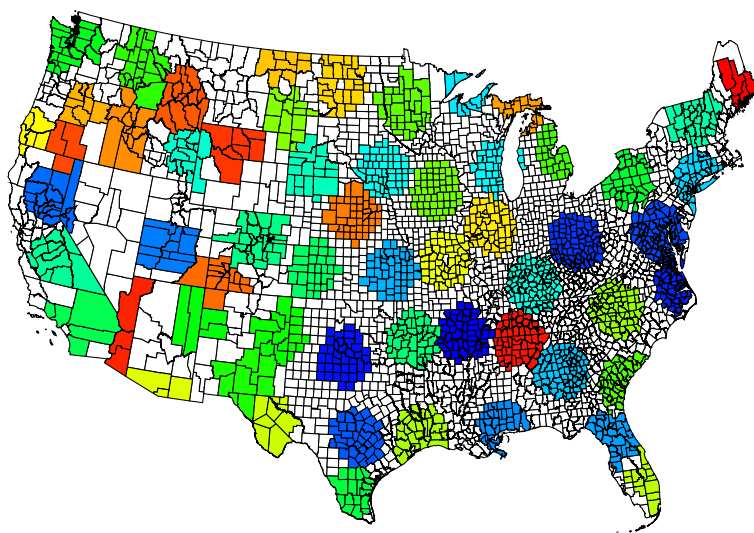


Figure A6: Map of Non-Overlapping 100-Mile Commuting Areas

Note: The figure shows one set of draws of random non-overlapping 100 mile commuting areas. The areas in Hawaii and Alaska are not shown but are in all estimates.

A3 Additional Tables

Table A1: Comparison of Historic Population and Income by Group

Panel A: Summary Statistics for 2004 by Group				
Group	Observations	Population	Income (millions)	Wage Rate
1	2,113	42,609 (126,956)	\$1,680 (6,540)	\$38,310 (12,762)
2	827	35,118 (175,911)	\$1,300 (7,820)	\$39,576 (12,828)
3	116	54,576 (182,231)	\$2,450 (9,560)	\$38,885 (12,963)
4	23	67,572 (143,066)	\$2,570 (5,930)	\$41,417 (14,152)

Panel B: T-Statistics of Differences in Means across Groups

Population	2	3	4
1	-1.29	0.96	0.92
2		1.11	0.87
3			0.31
Income	2	3	4
1	-1.35	1.19	0.64
2		1.44	0.77
3			0.05
Wage Rate	2	3	4
1	2.42	0.47	1.14
2		-0.54	0.66
3			0.82

Notes: Panel A reports the sample mean by group. Standard deviations are shown in parentheses. Groups are defined as follows: group 1 is the control group without any drilling; group 2 is early drillers starting in 2005 or 2006; group 3 is mid adopters starting in 2007-2010; and group 4 is late adopters starting in 2011 or 2012. Panel B shows the t-statistics of the differences between means for each pair of groups.

Table A2: Non-Overlapping 100-Mile Commuting Areas
 Dependent Variable: One-Year Change in Wages and Salaries per Capita
 Main Independent Variable: Oil and Natural Gas Value (\$Millions)
 from Wells Opened in Current Year Per Capita

	(1) BLS Wages	(2) IRS AGI	(3) IRS Wages	(4) IRS Other Inc
Panel A: Main IV results				
County +100 miles	257,252*** (20,455)	417,275*** (38,174)	129,926*** (13,915)	285,999*** (30,632)
Panel B: Bootstrapped results				
County +100 miles	268,876 [80,171; 535,630]	384,048 [163,367; 731,282]	156,150 [80,692; 298,555]	231,431 [49,377; 469,039]

*** p<0.01, ** p<0.05, * p<0.10

Notes: Panel A repeats main IV results from Table 1. Panel B shows the mean and the 5% to 95% range of 1000 bootstrap replications. See Section A1.1 of the appendix for a description of the methodology.

Table A3: Jackknifed Effects

Dependent Variable: One-Year Change in Wages and Salaries per Capita
 Main Independent Variable: Oil and Natural Gas Value (\$Millions)
 from Wells Opened in Current Year Per Capita

	(1) BLS Wages	(2) IRS AGI	(3) IRS Wages	(4) IRS Other Inc
Panel A: Omit Own County				
County	87,629*** (9,254)	191,190*** (28,240)	45,633*** (6,127)	142,431*** (28,143)
Commuting Zone	118,915*** (19,542)	214,357*** (31,315)	78,888*** (15,113)	139,766*** (27,698)
County +100 miles	260,736*** (20,608)	428,309*** (42,071)	132,684*** (14,255)	294,523*** (33,182)
State	300,459*** (78,311)	606,608*** (85,129)	162,120 (117,382)	433,794*** (131,964)
Panel B: Omit Counties Within 50 miles				
County	115,387*** (27,554)	229,008*** (61,636)	54,964*** (9,635)	169,030*** (52,836)
Commuting Zone	149,248*** (52,294)	244,465*** (45,848)	91,731*** (20,527)	157,115*** (37,285)
County +100 miles	262,291*** (18,372)	463,052*** (55,852)	137,476*** (16,482)	322,347*** (41,278)
State	280,750*** (76,742)	664,154*** (111,590)	139,634 (112,877)	473,835*** (96,152)
*** p<0.01, ** p<0.05, * p<0.10				

Notes: See Table 1.

Table A4: Instrumental Variables First Stage Results
 Dependent Variable: Oil and Natural Gas Value (\$Millions)
 from Wells Opened in Current Year Per Capita
 Main Independent Variable: Instrumented Oil and Natural Gas Value (\$Millions)

	(1)	(2)	(3)	(4)	(5)
	Main Sample	All Years	Pre-Recession	Recession	Post-Recession
County	1.57*** (0.53) [10.06]	1.09* (0.64) [9.630]	1.00** (0.49) [4.111]	3.63*** (0.40) [82.19]	1.20** (0.56) [5.774]
County +100 miles	2.72*** (0.55) [24.48]	1.58 (0.96) [15.13]	1.52*** (0.39) [15.79]	3.87*** (0.14) [735.2]	0.68* (0.39) [3.779]
Commuting Zone	3.00*** (0.59) [25.81]				
State	2.40** (1.05) [5.264]	1.79*** (0.67) [8.812]	2.01*** (0.51) [15.67]	4.10*** (0.25) [414.8]	-2.39*** (0.39) [441.6]

*** p<0.01, ** p<0.05, * p<0.10

Notes: First-stage regressions for Tables 1 and A11. See text for a description of the instruments. Standard errors are two-way clustered by geography and year. F-Stats are in brackets.

Table A5: Effects of Fracking on Employment by Industry

Dependent Variable: One-Year Change in Employment per Capita

Main Independent Variable: Oil and Natural Gas Value (\$Millions)
from Wells Opened in Current Year Per Capita

	(1) Total	(2) Mining	(3) Transport	(4) Construct	(5) Manufact	(6) Ed & Health	(7) Govern	(8) Other Serv
Panel A: OLS								
County	0.39*** (0.10)	0.20*** (0.02)	0.11*** (0.03)	0.05** (0.02)	-0.03 (0.03)	-0.04 (0.04)	0.05** (0.02)	0.05 (0.07)
County +100 miles	1.89*** (0.32)	1.11*** (0.17)	0.52*** (0.08)	0.31*** (0.06)	-0.31*** (0.10)	-0.05* (0.03)	0.09 (0.11)	0.21*** (0.04)
State	1.32*** (0.31)	1.44*** (0.21)	0.42*** (0.10)	0.49* (0.26)	-0.56*** (0.14)	0.07 (0.07)	-0.65* (0.37)	0.12 (0.25)
Panel B: IV								
County	0.85*** (0.11)	0.29* (0.16)	0.24*** (0.06)	0.12** (0.05)	-0.10 (0.07)	0.03 (0.03)	0.10*** (0.02)	0.17 (0.24)
County +100 miles	2.13*** (0.33)	1.39*** (0.14)	0.60*** (0.08)	0.43*** (0.06)	-0.35*** (0.09)	-0.07* (0.04)	0.00 (0.08)	0.13* (0.07)
State	2.21** (1.07)	1.77*** (0.12)	0.60*** (0.12)	0.87 (0.62)	-0.75*** (0.15)	0.02 (0.11)	-0.58 (0.57)	0.29 (0.36)
*** p<0.01, ** p<0.05, * p<0.10								

Notes: Each coefficient represents a separate regression with standard errors in parentheses. The county and county +100 miles regressions have 21,546 observations and standard errors are clustered by county and year. These counties are included in the state aggregates. The state regressions have 357 observations and standard errors are clustered by area and year.

Table A6: Effects of Wells Versus Value of Production
 Dependent Variable: One-Year Change in Wages and Salaries per Capita

	1	2	3
Value of Production	33,957*** (9,655)		33,972*** (10,248)
Value of Production = L,	4,718 (10,496)		3,437 (10,185)
Number of Wells		67,090*** (20,793)	372 (14,912)
Number of Wells = L,		29,868 (21,185)	9,213 (11,817)

*** p<0.01, ** p<0.05, * p<0.10

Notes: Production is the total value of oil and natural gas (\$Millions) from wells opened in the current year per capita. Wells is the number of these wells per capita. Standard errors, clustered by state-year, are in parentheses. There are 21,546 observations in each regression.

Table A7: Effects of Fracking on Income by Fuel Type
 Dependent Variable: One-Year Change in Wages and Salaries per Capita
 Main Independent Variable: Oil or Natural Gas Value (\$Millions)
 from Wells Opened in Current Year Per Capita

	(1) BLS Wages	(2) IRS AGI	(3) IRS Wages	(4) IRS Other Inc
Panel A: Oil (OLS)				
County	28,775** (12,179)	83,474*** (14,518)	15,197*** (4,809)	68,822*** (9,784)
County +100 miles	240,822*** (36,894)	333,046*** (40,781)	81,951*** (14,475)	256,435*** (36,451)
State	153,498*** (38,326)	347,509*** (92,253)	-86,445 (65,435)	442,842*** (100,550)
Panel B: Gas (OLS)				
County	39,456*** (12,188)	93,152*** (22,537)	24,915** (9,959)	66,169*** (13,048)
County +100 miles	218,707*** (57,242)	377,844*** (80,907)	159,922*** (29,745)	222,056*** (54,000)
State	446,895*** (35,720)	281,372 (195,146)	275,472*** (98,334)	-9,163 (151,120)
Panel C: Oil (IV)				
County	67,101*** (15,771)	141,884*** (21,230)	37,237*** (7,382)	105,641*** (16,951)
County +100 miles	291,567*** (29,038)	422,760*** (43,004)	118,314*** (24,248)	313,641*** (36,212)
State	97,708*** (32,109)	499,036 (608,985)	-128,512 (115,031)	628,294 (485,346)
Panel D: Gas (IV)				
County	83,072*** (24,283)	253,513*** (14,711)	53,736*** (14,627)	186,526*** (59,805)
County +100 miles	216,750*** (44,307)	531,377*** (98,386)	193,129*** (33,173)	323,945*** (71,612)
State	570,888*** (63,988)	594,452*** (65,007)	396,575*** (27,425)	202,556* (106,798)
*** p<0.01, ** p<0.05, * p<0.10				

Notes: See Table 1.

Table A8: Effects on Income by Direction of Price Shock

Dependent Variable: One-Year Change in Wages and Salaries per Capita
 Main Independent Variable: Oil and Natural Gas Value (\$Millions)
 from Wells Opened in Current Year Per Capita

	(1) BLS Wages	(2) IRS AGI	(3) IRS Wages	(4) IRS Other Inc
Panel A: Rising Prices (OLS)				
County	18,440** (7,660)	61,683*** (16,402)	12,825*** (2,564)	49,098*** (14,068)
County +100 miles	195,423*** (37,569)	259,629*** (36,177)	71,420*** (14,020)	198,120*** (36,446)
State	147,310 (151,724)	-114,768 (264,157)	-114,521 (190,935)	-32,661 (181,850)
Panel B: Falling Prices (OLS)				
County	46,512*** (9,505)	92,621*** (10,493)	19,946*** (5,948)	72,616*** (7,234)
County +100 miles	215,058*** (25,927)	353,144*** (24,674)	105,942*** (8,594)	245,587*** (20,039)
State	252,545*** (59,768)	864,367*** (117,006)	102,658** (45,196)	778,803*** (123,675)
Panel C: Rising Prices (IV)				
County	38,695 (27,190)	223,780** (89,511)	37,359*** (13,505)	181,188** (78,273)
County +100 miles	219,697*** (43,518)	425,128*** (54,355)	96,320*** (24,201)	336,227*** (46,749)
State	78,583 (69,901)	27,982 (305,646)	-225,095 (182,925)	73,321 (297,212)
Panel D: Falling Prices (IV)				
County	81,438*** (13,001)	170,245*** (40,974)	43,419*** (10,451)	124,323*** (30,972)
County +100 miles	230,421*** (29,247)	400,645*** (32,005)	119,388*** (16,389)	278,811*** (26,040)
State	309,298* (170,115)	964,606*** (91,198)	147,157 (121,939)	823,447*** (136,683)

*** p<0.01, ** p<0.05, * p<0.10

Notes: Each coefficient represents a separate regression with standard errors in parentheses. AGI is adjusted gross income. Standard errors are clustered by area and year.

Table A9: Effects of Fracking on Wages and Salaries by Industry: Full Sample

Dependent Variable: One-Year Change in Wages and Salaries per Capita

Main Independent Variable: Oil and Natural Gas Value (\$Millions)

from Wells Opened in Current Year Per Capita

	(1) Total	(2) Mining	(3) Transport	(4) Construct	(5) Manufact	(6) Ed & Health	(7) Govern	(8) Other Serv
Panel A: OLS								
County	27,345*** (7,205)	12,927*** (2,577)	6,827*** (2,222)	4,110*** (1,592)	-649 (1,028)	-832 (1,116)	2,665*** (746)	2,665*** (746)
County +100 miles	185,129*** (61,236)	101,781*** (29,420)	48,655*** (15,932)	21,963*** (7,694)	-10,111** (4,557)	450 (708)	13,945 (9,307)	8,445 (6,071)
State	220,949*** (85,100)	137,122*** (21,203)	69,665** (31,914)	53,010*** (18,212)	-25,929 (17,216)	16,488** (7,085)	-40,176 (32,403)	10,770 (21,903)
Panel B: IV								
County	79,955*** (14,408)	27,365* (14,234)	21,110*** (7,061)	8,130** (3,589)	-3,028 (3,182)	1,268* (720)	6,952*** (1,972)	18,158 (11,570)
County +100 miles	344,966*** (91,144)	177,865*** (25,571)	85,628*** (26,338)	44,281*** (9,608)	-9,797 (6,699)	1,644 (1,425)	24,671 (16,116)	20,673 (12,612)
State	430,044*** (122,313)	219,549*** (16,539)	97,503*** (33,294)	95,408*** (17,010)	-26,549 (20,061)	26,527*** (8,887)	-22,587 (47,883)	40,193* (23,072)

*** p<0.01, ** p<0.05, * p<0.10

Notes: Each coefficient represents a separate regression with standard errors in parentheses. AGI is adjusted gross income. The county and county +100 miles regressions have 21,546 observations and standard errors are clustered by county and year. The state regressions have 357 observations and standard errors are clustered by state and year.

Table A10: Effects on Income by Period (OLS)

Dependent Variable: One-Year Change in Wages and Salaries per Capita
Main Independent Variable: Oil and Natural Gas Value (\$Millions)
from Wells Opened in Current Year Per Capita

	(1) BLS Wages	(2) IRS AGI	(3) IRS Wages	(4) IRS Other Inc
Panel A: Years 2005 to 2008				
County	11,636*** (3,079)	44,906*** (6,575)	7,470*** (1,458)	37,807*** (5,347)
County +100 miles	110,142*** (12,079)	236,237*** (25,097)	83,461*** (12,974)	153,258*** (20,922)
State	261,055*** (66,764)	448,601** (204,811)	251,194*** (49,732)	171,507 (170,081)
Panel B: Years 2009 to 2011				
County	57,190*** (9,429)	115,945*** (19,863)	25,314*** (5,101)	91,085*** (18,650)
County +100 miles	266,150*** (13,974)	366,360*** (20,343)	95,173*** (13,520)	275,086*** (15,220)
State	139,269*** (47,528)	420,441*** (148,312)	-29,958 (51,761)	420,418*** (106,705)
Panel C: Years 2012 to 2014				
County	9,389* (5,390)			
County +100 miles	157,240** (61,265)			
State	52,522 (71,596)			
*** p<0.01, ** p<0.05, * p<0.10				

Notes: Each coefficient represents a separate regression. AGI is adjusted gross income. County +100 miles includes all economic activity from counties within 100 miles radius. Standard errors, clustered by state-year (or state), are in parentheses. There are 12,324, 9,239, and 9,237 (204, 153, and 153) observations for Panels A, B, and C, respectively. The county sample excludes counties with 446 or fewer employees in 2004 (2 percent of all counties).

Table A11: Effects on Income by Period (IV)

Dependent Variable: One-Year Change in Wages and Salaries per Capita
 Main Independent Variable: Oil and Natural Gas Value (\$Millions)
 from Wells Opened in Current Year Per Capita

	(1) BLS Wages	(2) IRS AGI	(3) IRS Wages	(4) IRS Other Inc
Panel A: Years 2005 to 2008				
County	30,314* (16,811)	235,815* (132,174)	6,399 (11,212)	232,977* (136,338)
County +100 miles	104,148* (56,027)	220,555 (331,267)	144,285* (77,775)	69,005 (285,963)
State	480,311* (251,678)	175,806 (449,014)	108,254 (171,493)	99,552 (464,549)
Panel B: Years 2009 to 2011				
County	86,979*** (6,639)	129,277*** (19,734)	37,120*** (5,255)	93,508*** (18,266)
County +100 miles	285,555*** (13,453)	386,268*** (14,166)	110,554*** (14,066)	279,544*** (18,899)
State	129,052* (65,989)	300,075 (284,029)	-481 (85,525)	299,187*** (110,082)
Panel C: Years 2012 to 2014				
County	154,318 (113,811)			
County +100 miles	-44,611,953 (1349510505)			
State	280,231 (332,827)			
*** p<0.01, ** p<0.05, * p<0.10				

Notes: Each coefficient represents a separate regression. AGI is adjusted gross income. County +100 miles includes all economic activity from counties within 100 miles radius. Standard errors, clustered by state-year (or state), are in parentheses. There are 12,324, 9,239, and 9,237 (204, 153, and 153) observations for Panels A, B, and C, respectively. The county sample excludes counties with 446 or fewer employees in 2004 (2 percent of all counties).

Table A12: Effects on Wages by Population Size
 Dependent Variable: One-Year Change in Wages and Salaries per Capita
 Main Independent Variable: Oil and Natural Gas Value (\$Millions)
 from Wells Opened in Current Year Per Capita

	(1) OLS Income	(2) IV Income	(3) OLS Employment	(4) IV Employment
Population: 447 to 2265	37,991*** (7,834)	68,115*** (9,878)	0.47*** (0.09)	0.84*** (0.10)
Pop: 2268 to 4546	30,660*** (8,667)	57,729*** (7,522)	0.39*** (0.10)	0.66*** (0.10)
Pop: 4558 to 8354	20,697*** (2,934)	147,979 (279,855)	0.34*** (0.05)	1.68 (3.01)
Pop: 8368 to 15807	253,695*** (93,466)	323,412*** (96,930)	2.75*** (0.86)	3.76*** (0.68)
Pop: 15827 to 41586	104,046 (64,609)	525,302*** (132,240)	1.44** (0.68)	6.57*** (1.85)
Pop: 42006 to 4043854	305,123*** (100,695)	307,098** (125,773)	3.93*** (1.43)	3.84* (2.09)
*** p<0.01, ** p<0.05, * p<0.10				

Notes: Each coefficient represents a separate regression. Standard errors clustered by county and year are in parentheses. There are 24,624 observations in each regression.

Table A13: Impulse Response Functions of Fracking on Income

Dependent Variable: One-Year Change in Income per Capita
Main Independent Variable: Oil and Natural Gas Value (\$Millions)
from Wells Opened in Current Year Per Capita

	(1) BLS Wages	(2) IRS AGI	(3) IRS Wages	(4) IRS Other Inc
New Value Per Capita	267,026*** (22,745)	430,434*** (48,089)	134,553*** (13,652)	299,164*** (38,952)
Lag 1	-22,905 (30,041)	-417,488*** (46,330)	-82,170*** (14,183)	-322,980*** (42,257)
Lag 2	-71,046* (42,704)	-85,351 (78,247)	-38,240*** (11,310)	-72,685 (76,192)
L0+L1	244122 (29977)	12946 (32476)	52383 (8530)	-23816 (34315)
L0+L1+L2	173076 (32146)	-72405 (59520)	14143 (11955)	-96500 (58992)

*** p<0.01, ** p<0.05, * p<0.10

Notes: This table reports results for the county +100 miles IV regressions that have 18,468 observations and standard errors clustered by county and year.

Table A14: Impulse Response Function of Fracking on Income by Industry

Dependent Variable: One-Year Change in Wages and Salaries per Capita

Main Independent Variable: Oil and Natural Gas Value (\$Millions)

from Wells Opened in Current Year Per Capita

	(1) Total	(2) Mining	(3) Transport	(4) Construct	(5) Manufact	(6) Ed & Health	(7) Govern	(8) Other Serv
New Value Per Capita	267,026*** (22,745)	163,767*** (11,509)	64,463*** (7,650)	36,916*** (3,919)	-16,463*** (3,314)	670 (1,717)	12,776* (7,527)	4,897** (1,956)
Lag 1	-22,905 (30,041)	-80,827*** (14,033)	5,005 (8,726)	-2,607 (5,038)	22,849*** (5,271)	-354 (2,408)	26,133* (13,416)	6,897** (3,255)
Lag 2	-71,046* (42,704)	-55,789*** (20,884)	-25,863 (16,597)	-2,232 (6,554)	2,983 (4,998)	3,970 (3,039)	-13,593* (8,121)	19,477*** (5,473)
L0+L1	244122 (29977)	82939 (13586)	69467 (10450)	34309 (4889)	6386 (3998)	316.9 (1322)	38909 (8044)	11794 (2355)
L0+L1+L2	173076 (32146)	27150 (13076)	43604 (10174)	32077 (6463)	9369 (3950)	4287 (2422)	25316 (5542)	31272 (4420)

*** p<0.01, ** p<0.05, * p<0.10

Table A15: Impulse Response Function of Fracking on Employment by Industry

Dependent Variable: One-Year Change in Employment per Capita
Main Independent Variable: Oil and Natural Gas Value (\$Millions)
from Wells Opened in Current Year Per Capita

	(1) Total	(2) Mining	(3) Transport	(4) Construct	(5) Manufact	(6) Ed & Health	(7) Govern	(8) Other Serv
New Value Per Capita	2.18*** (0.40)	1.49*** (0.14)	0.64*** (0.07)	0.45*** (0.06)	-0.39*** (0.09)	-0.10*** (0.04)	0.02 (0.10)	0.08* (0.04)
Lag 1	0.53 (0.51)	-0.75*** (0.14)	0.31*** (0.10)	-0.01 (0.06)	0.41*** (0.11)	0.05 (0.06)	0.53*** (0.15)	-0.01 (0.08)
Lag 2	-0.44 (0.49)	-0.61*** (0.21)	-0.31*** (0.11)	-0.13 (0.10)	0.24*** (0.08)	0.14* (0.08)	-0.14* (0.07)	0.38*** (0.11)
L0+L1	2.709 (0.299)	0.737 (0.0862)	0.952 (0.0780)	0.435 (0.0680)	0.0137 (0.0690)	-0.0486 (0.0379)	0.549 (0.0783)	0.0703 (0.0429)
L0+L1+L2	2.273 (0.433)	0.126 (0.159)	0.637 (0.0979)	0.302 (0.0988)	0.250 (0.0831)	0.0949 (0.0610)	0.411 (0.0688)	0.451 (0.0845)

*** p<0.01, ** p<0.05, * p<0.10