



The Shale Tipping Point: The Relationship of Drilling to Crime, Traffic Fatalities, STDs, and Rents in Pennsylvania, West Virginia, and Ohio

Abridged Version

**Multi-State Shale Research Collaborative
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See <http://www.multistateshale.org/shale-tipping-point> for the full report and http://keystoneresearch.org/MSSRC/tech_app for the online technical appendix.

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Executive Summary

How does hydrofracking affect the rural communities at the epicenter of drilling activity? A rich body of literature and lore from the Mountain West exists: of boomtowns, bar fights, rising rents and rising crime that accompanied oil and gas development in Wyoming and Colorado in the 1980s and 1990s, and more recently in North Dakota shale oil fields.

Considerable prior evidence shows that shale development has produced some of the same impacts in Pennsylvania. Academic researchers, advocacy groups such as Food and Water Watch, and the Multi-State Shale Research Collaborative's own case studies of two high-intensity Pennsylvania drilling counties (Greene and Tioga) document traffic increases, road damage, rising rents, and growing demands on police and other first responders. (For complete references, see the full Shale Tipping Point research report, online at <http://www.multistateshale.org/shale-tipping-point>).

These impacts are in addition to the environmental and public health impacts associated with hydrofracking, ranging from incidence of childhood asthma in Texas to water contamination in Pennsylvania to seismic activity in Ohio and more recently in Oklahoma.

In many states, drilling activity is regulated by state officials, leaving local officials to manage the consequences. A better understanding of what impacts are likely to occur and when to expect them can help local governments and residents anticipate and plan for--or take steps to avoid--the negative community consequences of shale development.

In this report, the Multi-State Shale Research Collaborative examined potential shale-related impacts, that have been identified in our prior work and that of others, to determine at what point the effects become evident. We looked at three states (Pennsylvania, Ohio, and West Virginia) and divided counties in those states into three levels of drilling activity – low, moderate and high – to better understand the relationship between the density of drilling and the severity of impacts. We used non-drilling rural and non-drilling urban counties as control groups. Our analysis looked at crime, traffic fatalities, sexually transmitted diseases and housing, and found evidence of impacts in each area in high-drilling communities. We relied, of necessity, on county-level (and, in the case of housing, multi-county) data, although the impact of drilling is often localized within counties. As a result of this mismatch between the geography of drilling's impact and our data sources, the impacts on crime, traffic fatalities, STDs, and rents are likely to be underestimated.

Our research confirmed community impacts in six high-drilling Pennsylvania counties. We found a statistical relationship between well density and increases in crime, rents, traffic fatalities and STDs. Increases also were apparent in medium- and low-drilling counties in many cases, but do not ordinarily register as "statistically significant." It is reasonable to expect that, if the pace of drilling increases in low- and medium-drilling counties, impacts will grow to match those in high-drilling counties.

Our research includes findings in the following areas:

- Employment: Drilling has had a only a limited impact on employment in the three states, particularly when measured as a share of total employment. The bulk of the employment gains were in the six high-drilling counties and those were modest. Total growth in mining and natural resources employment in the three states from 2005 to 2012 was just over 25,000 jobs, or .22% of all employment.

- Population: We found no evidence of significant population growth in any of the states resulting from drilling.
- Crime: Violent crime increased 17.7% and property crime 10.8% in the six high-drilling counties, compared to no statistically significant increases in medium- and low-drilling counties.
- Traffic fatalities: Between 2005 and 2010, traffic fatalities involving trucks in the six high-drilling counties increased by a statistically significant 27.8%, compared to 2000 to 2005.
- STDs: Since 2005, rates of chlamydia infection across all the drilling counties increased 24% to 27%, compared to non-drilling counties.
- Housing: Rents in the regions with high-drilling counties all increased from 2005 to 2012 with the biggest increases in median (10.2%) and high-end (12.3%) rents.

In human terms, in the high-drilling countries, about 130 more violent crimes, 819 more property crimes and 160 more cases of chlamydia occurred each year by 2012 compared to 2005 (i.e., before the increase in drilling). Residents, most of whom gain no benefit from the gas industry, also bear the risk of higher fatalities from traffic accidents involving trucks and of higher rents. Local governments must pay for additional first responders and staff to address rising crime, traffic fatalities, and STDs.

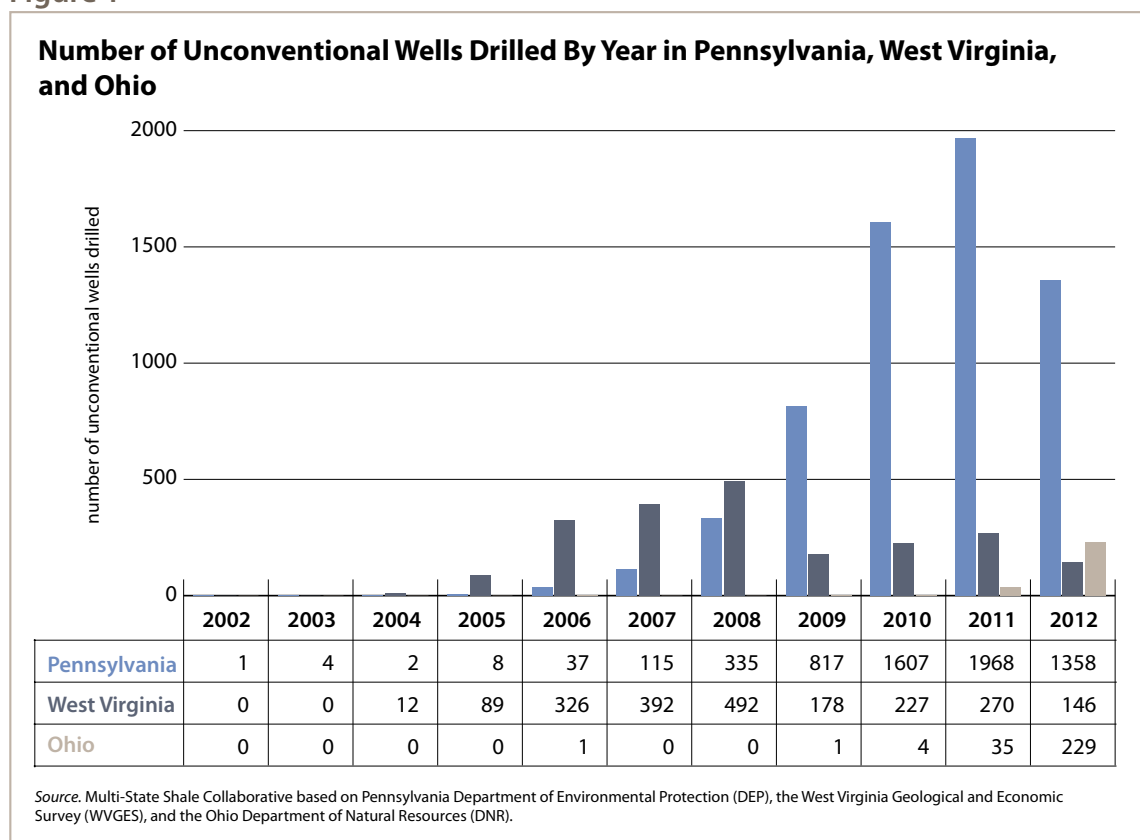
This analysis offers clear evidence that a high concentration of drilling over a relatively short period of time is a recipe for significant, multiple impacts. Trends that are apparent in Pennsylvania are absent in West Virginia, perhaps as a result of slower and less concentrated drilling development, and are hinted at in Ohio, where drilling accelerated in 2012, the final year of our analysis. Local and state governments may be able to avoid or mitigate the most severe impacts by better controlling the pace of drilling, perhaps with county rig limits, or longer and more thorough permit and water review processes. States should enact severance taxes to help ensure that the industry, not taxpayers, foots the bill for impacts.

Drilling, Employment, and Population Trends

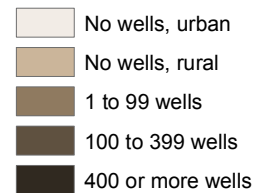
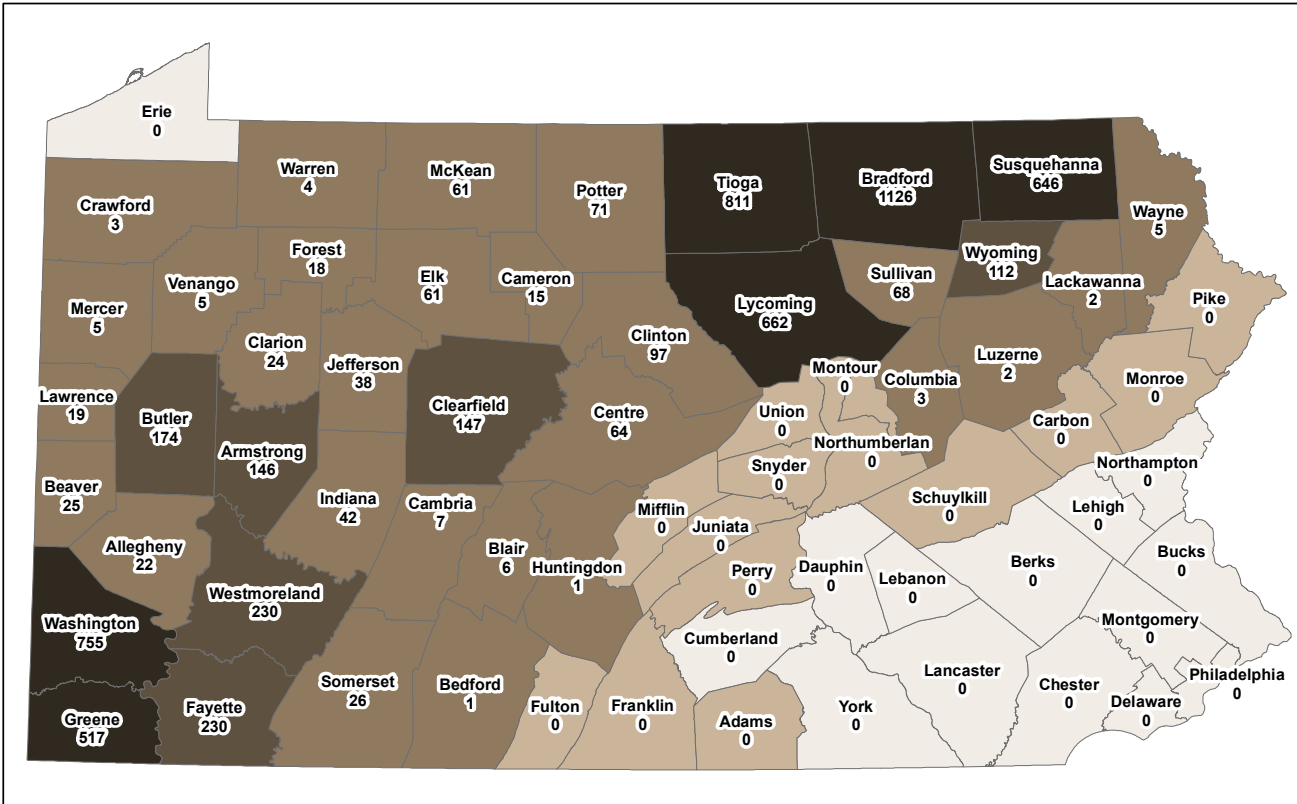
Since 2002, 8,654 wells have been drilled in 102 counties in Pennsylvania, West Virginia, and Ohio. Figure 1 shows the number of **hydraulic fracking – or “unconventional” – wells drilled** by year and state in Pennsylvania, Ohio, and West Virginia. Pennsylvania accounts for four-fifths (72%) of the wells drilled across the three states since 2002. Although drilling started in earnest first in West Virginia, at its peak in 2008 it was only one-quarter the peak drilling level in Pennsylvania. Significant drilling activity in Ohio did not begin until 2012, the final year of this study, when it accounted for just over 10% of the wells drilled in that year.

Six “high-activity” Pennsylvania counties – the darkest counties on Map 1 – account for more than half (52%) of the wells drilled across all 210 counties in the three states. In each of the high-drilling counties, at least 517 wells have been drilled since 2002. In no other county in the three states have more than 230 wells been drilled.

Figure 1



Map 1



Source. Multi-State Shale Collaborative.

Seventeen other counties (10 in West Virginia, six in Pennsylvania, and one in Ohio) account for 30% of the wells drilled from 2002 to 2012.

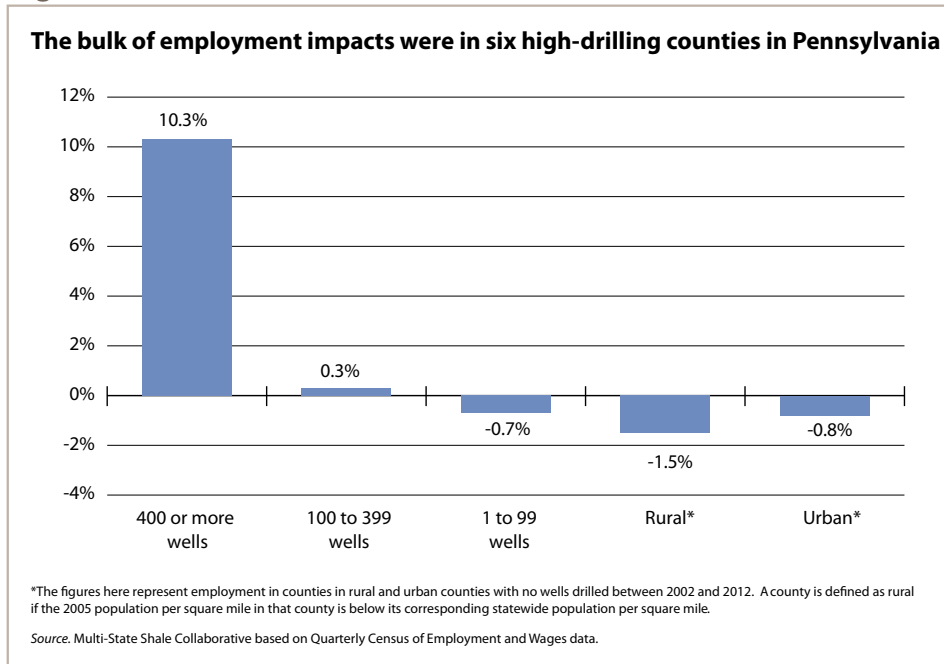
For the purpose of our analysis, we grouped 102 counties by number of wells, based on the pattern of drilling in each of the states, in order to assess whether the concentration of wells was related to the incidence of social and human service impacts. We defined high-drilling counties as those with at least 400 wells (six counties), medium-drilling counties as those with 100-399 wells (17 counties) and low-drilling counties as those with fewer than 100 wells (79 counties).

Drilling has had a modest impact on **employment** in Pennsylvania, West Virginia, and Ohio, particularly when measured as a share of total employment (Mauro et al, 2013). The bulk of employment impacts are found in the six high-drilling counties. Drilling-related jobs – measured at the county level using a broad aggregate of extractive industries called “mining and natural resources employment” – rose by 138% (7,121 jobs) from 2005 to 2012, while total employment (across all industries) grew by 10.3% (or 18,932 jobs). Total employment in the three states was 11.3 million in 2012, and total growth of mining and natural resources employment in these three states from 2005 to 2012 was just over 25,000, or 0.22% of all employment.

In the 17 medium-drilling counties, drilling-related employment grew by 8% (1,126 jobs) from 2005 to 2012, and total employment actually fell.

Figure 2 shows the total employment change from 2005 to 2012 in the six Pennsylvania high-drilling counties as compared to four other groups of Pennsylvania counties.

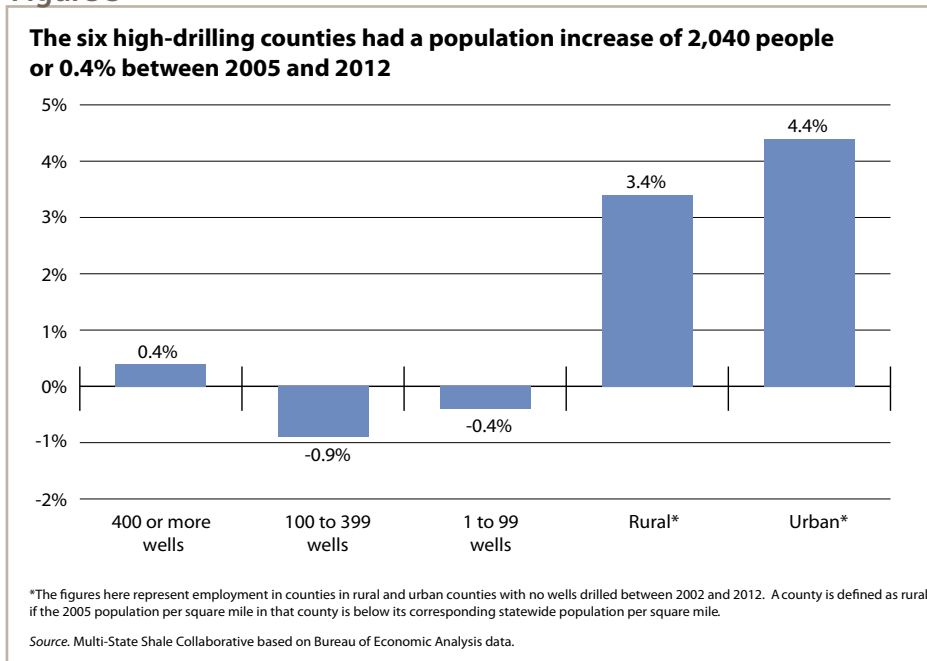
Figure 2



While Carroll County, Ohio has had only 112 wells drilled, drilling only started in 2011, and nearly 100 (94) of these wells were drilled in 2012. Carroll's recent uptick in drilling resembles the six Pennsylvania high-drilling counties.

Little evidence exists of significant **population growth** resulting from drilling in Pennsylvania, West Virginia, and Ohio. The six high-drilling counties in Pennsylvania had a population increase of 2,040 people, or 0.4%, between 2005 and 2012. Figure 3 shows that non-drilling Pennsylvania counties (both rural and urban) saw larger population increases than drilling counties, although it is of note that in the six high-drilling counties the population was declining prior to the start of drilling (1998 to 2005).

Figure 3



In West Virginia and Ohio, non-drilling counties (rural and urban) also experienced more population growth than drilling counties from 2005 to 2012.

One challenge in analyzing population trends is that county-level population data may not quickly or accurately capture population shifts that result from out-of-state workers who still consider their primary residence to be in their home state. The construction sector is important in terms of employment in shale development, and it is not uncommon for construction workers, especially in rural areas, to travel long distances for work. Even so, while population changes may be understated in high-drilling counties, evidence of large population effects is weak.

Crime

As noted, natural resource extraction booms tend to lead to an influx of out-of-state workers, including transient young men making higher-than-average wages. With this influx and the extraction activity, local traffic increases, area bars and restaurants fill up, and small town life changes. Numerous studies have found that with this influx comes an increase in crime.

For example, Headwaters Economics (2013, p. 13) found that counties in the American West that derive more of their income from oil and gas extraction for a longer period of time experienced higher violent and property crime rates than other counties. Murray and Ooms (2008) documented increases in crime during the height of gas extraction in Denton and Wise counties in Texas, and in Faulkner and White counties in Arkansas. In Sublette County, Wyoming, Jacquet (2005) found that arrests grew faster than the population between 1995 and 2004 and showed links between the growth in gas drilling and the growth in crime rate.

Headwaters Economics (2009) found a sharp increase in crime in Sweetwater County, Wyoming, that coincided with a boom in oil and gas extraction. Drug-related arrests increased from 90 in 2002 to 450 in 2006.

In Williston, North Dakota, there has been an increase in reported rape (about one complaint each week, most often date rape, say local police). They rarely received these types of complaints before the gas boom (Ellis 2011).

In Pennsylvania, the influx of well-paid young men who work in (or are connected to) the gas industry has led to reports of increases in drunk driving, assaults, domestic disturbances and prostitution (Levy 2011).

The Multi-State Shale Research Collaborative case study of Greene County, PA, found that arrests and calls to police increased during the height of the gas boom (Herzenberg, Polson, and Price 2014). Police in Cumberland Township, a center of heavy drilling, reported that calls doubled between 2008 and 2011. Arrests in Cumberland Township rose for DUIs, theft, bar fights, assaults, and prostitution.

In Tioga County, PA, drilling was associated with increases in crime and increased demands on emergency service personnel. More crime has meant higher costs to the county as the number of new criminal cases jumped 25% between 2010 and 2011.

Mansfield and Wellsboro, Tioga County's two population hubs, also saw calls to police and arrests increase with the gas boom. Between 2009 and 2011, calls to the Mansfield Police Department tripled.

Wellsboro saw a spike in traffic and other citations. Misdemeanor arrests rose by 82% from 2009 to 2011. One Tioga County resource organization for sexual assault victims reported seeing a rise in the number of sexual assaults (some with the use of date rape drugs) and women seeking domestic violence services during the height of the boom (Ward, Polson, Price 2014).

In Wetzel County, West Virginia, interviewees did not report increases in crime or 911 calls. The Sheriff’s office did note a slight increase in DUI arrests and an increase in traffic citations. County commissioners reported complaints from citizens about traffic problems and hazardous driving by trucking companies. Vehicle accidents increased from 194 in 2007 to 310 in 2012 (O’Leary 2014).

Interviewees in Ohio reported a quadrupling of calls to the sheriff between 2011 and 2013; that, plus a doubling of traffic accidents primarily involving heavy trucks, had reportedly increased the workload for the sheriff’s office (Woodrum 2014).

In this report, we used county-level crime data to more rigorously examine changes in crime by county in Pennsylvania, West Virginia, and Ohio. Since drilling usually concentrates in parts of counties, the reliance on county data may understate drilling’s impacts.

Violent crime: In analysis looking across three states, we observed a statistically significant increase in violent crime of 17.7% in the six high-drilling counties in Pennsylvania between 2005 and 2012. (Figure 4).

Figure 4

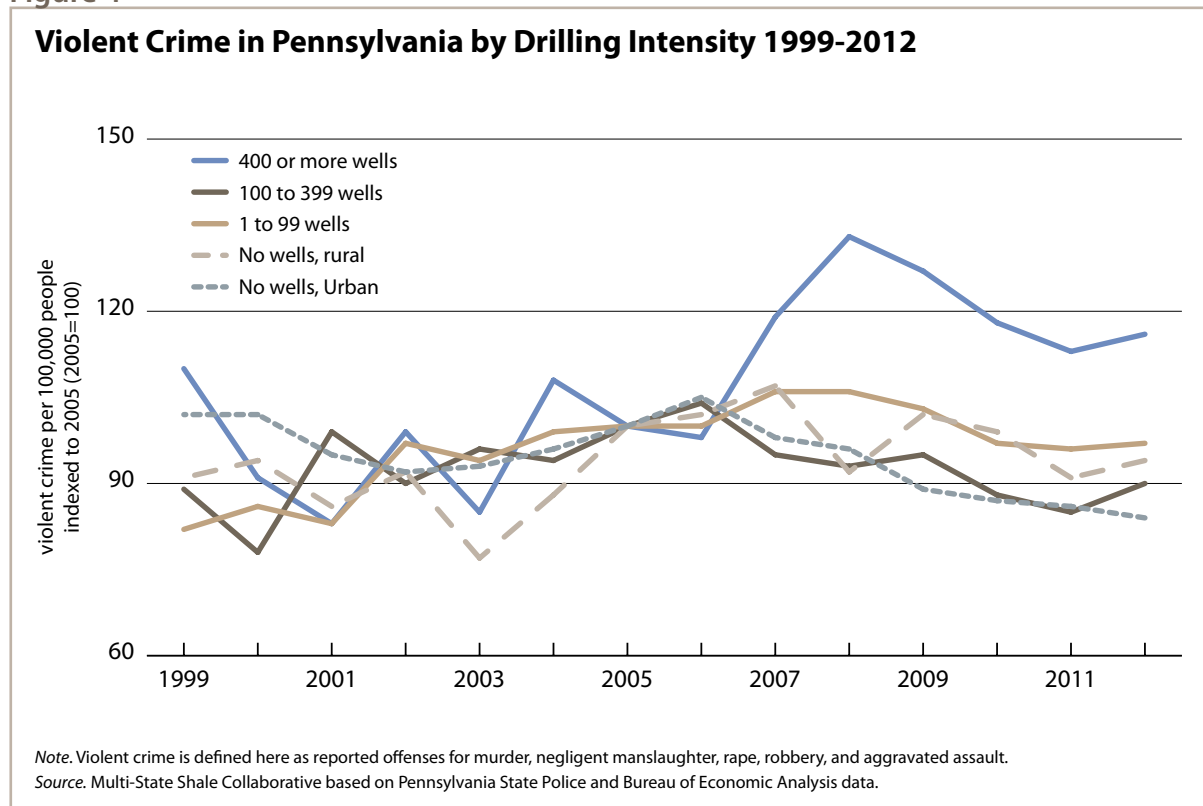
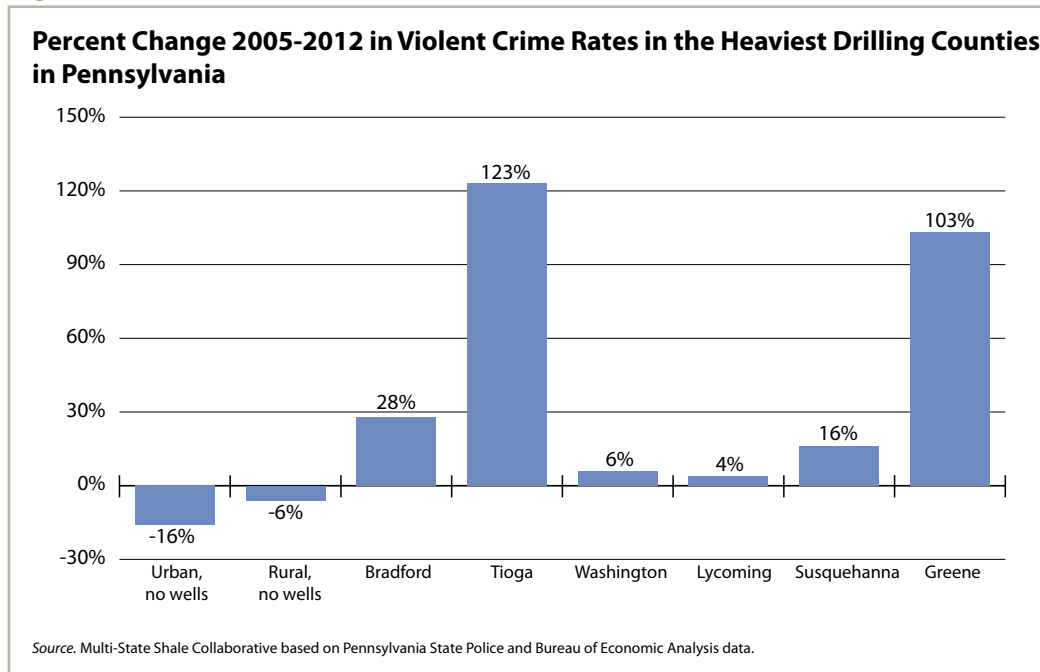


Figure 5



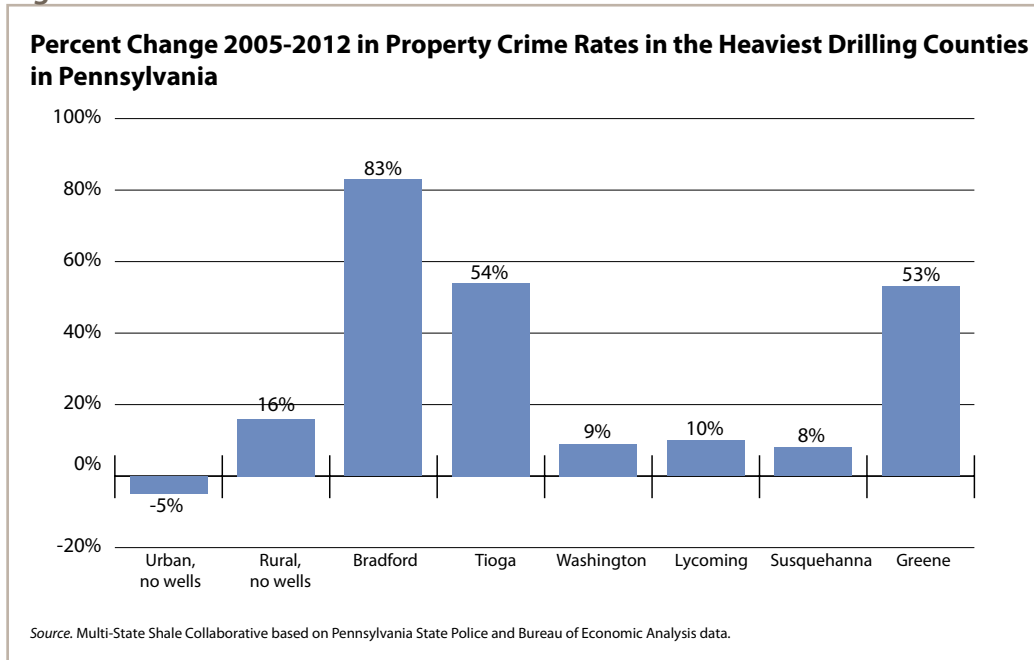
This increase corresponds to about 130 more violent crimes annually in these six counties above the 737 violent crimes reported in 2005. During this same period, the violent crime rate was down in both urban and rural communities without wells drilled.

Property Crime. In our statistical analysis looking across all three states, we observed an increase in property crime of 10.8% in the high-drilling counties in Pennsylvania. This corresponds to 819 more property crimes annually over and above the 7,587 property crimes reported in 2005. For the most part, we did not observe a statistically significant increase in violent and property crime in moderate- and low-drilling counties in West Virginia, Pennsylvania and Ohio.¹ Rural Pennsylvania counties without wells drilled, on the other hand, experienced a property-crime rate increase slightly below those of heavy-drilling counties.

The most abrupt increases in property crimes occurred in the two highest-drilling counties, Bradford and Tioga, with increases of 83% and 54% respectively, and in Greene County, with a 53% increase in property crime (Figure 6).

¹ We did, however, observe a statistically significant increase in violent crime in low-drilling counties.

Figure 6



Drug and alcohol crime. Between 2005 and 2012 in Pennsylvania, drug abuse rates rose 48% in the highest-drilling counties, or about 600 more cases per year (Figure 7). No other county category saw drug abuse increases of more than about half this amount.

Figure 7

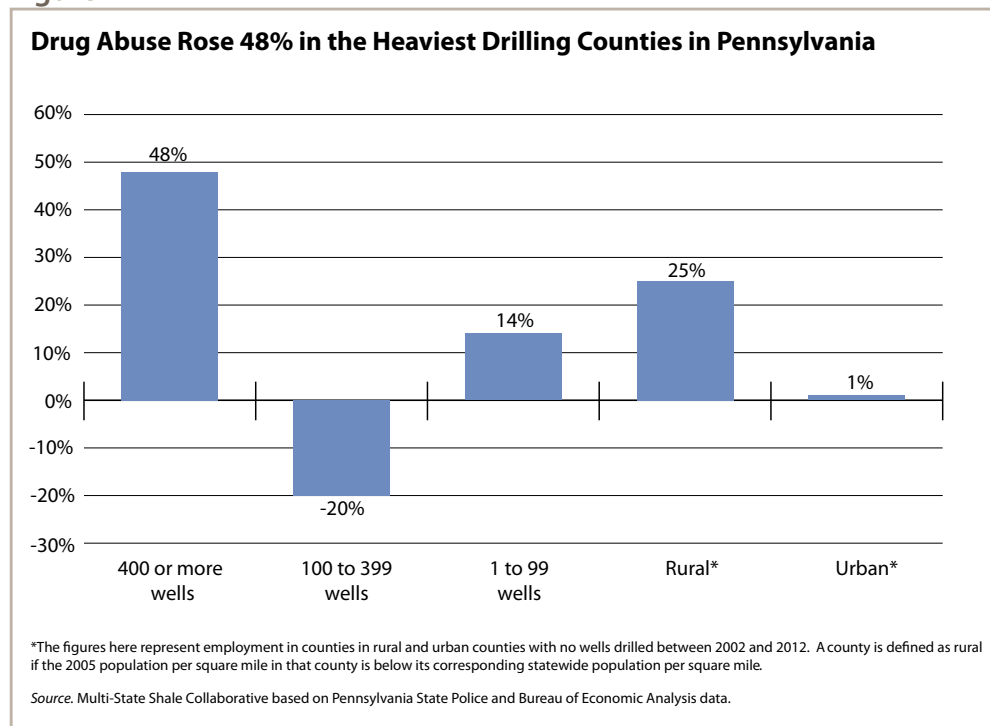
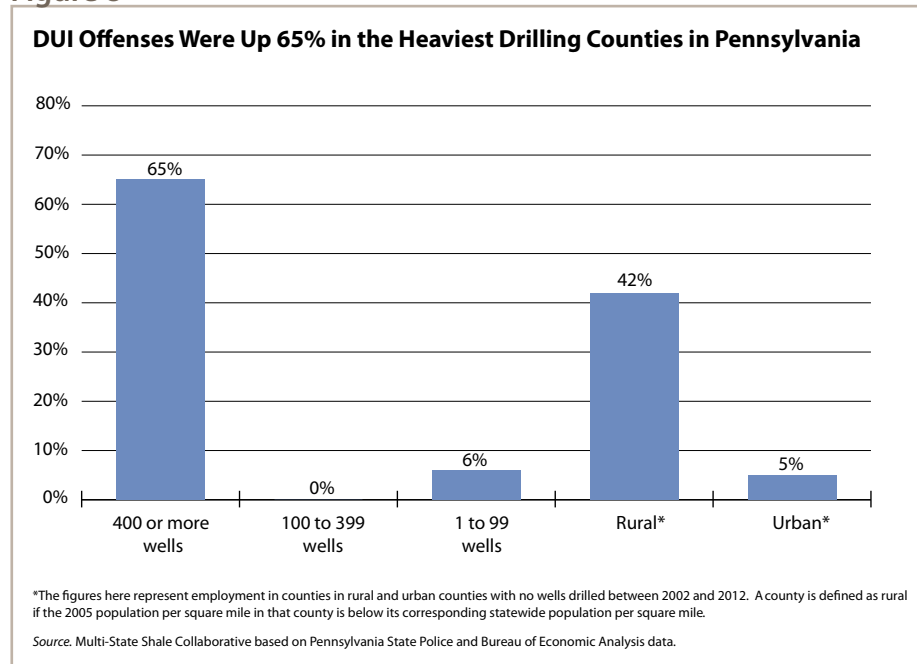


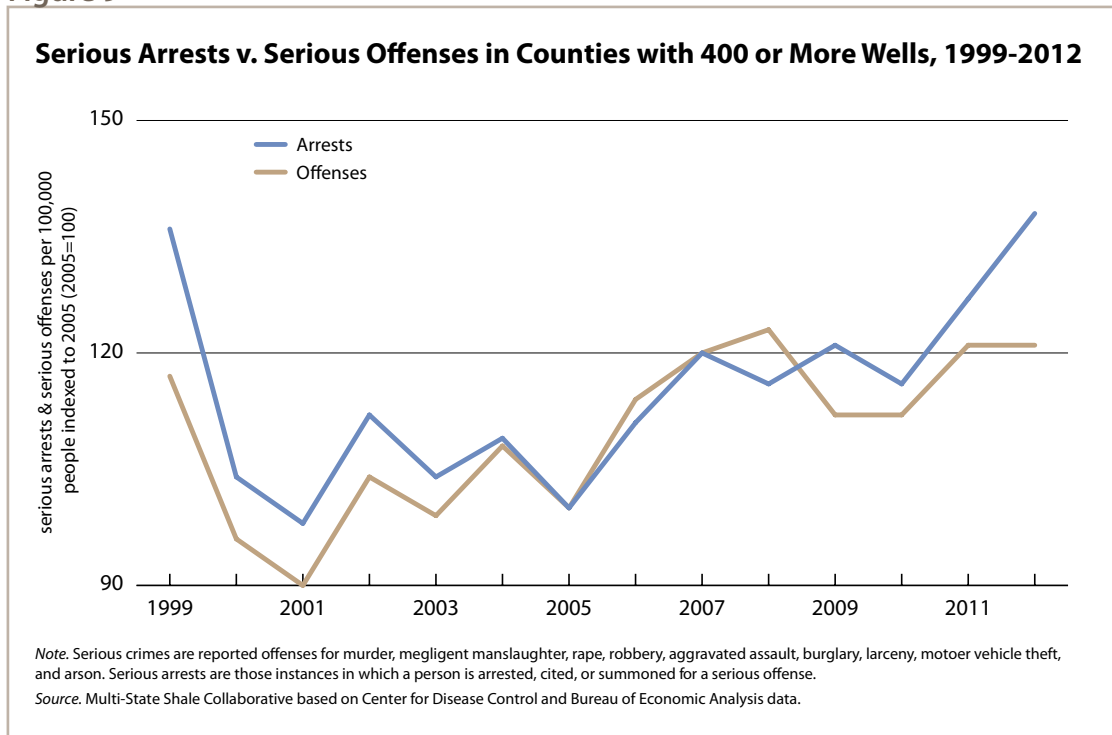
Figure 8



From 2005 to 2012, DUI offenses were up 65% in high-drilling counties, compared to 42% in rural counties without drilling (Figure 8). The gap between the 65% and 42% increase amounts to an additional 400 cases per year across the six high-drilling counties. Drug abuse and DUI offenses did not increase substantially, and in some cases fell in moderate- and low-drilling counties.

Arrest Data. The Pennsylvania State Police track data on arrests as well as reported offenses. Data on “serious arrests” – the sum of arrests for violent and property crimes - corroborate the violent and property crime statistics (Figure 9). The increase in arrests was primarily for aggravated assault and larceny-theft.

Figure 9



In West Virginia, crime data reveal no clear relationship between increased drilling and crime rates. In Ohio, in the one medium-drilling county - Carroll – property and violent crime have increased since drilling began in 2011 (we examine the change from 2009 to 2012). Ohio violent and property crime rates also rose in areas with no drilling since 2009 (by 8% and 5% respectively) so it is too early to know whether drilling contributed in a causal way to the uptick in Carroll.

Sexually Transmitted Diseases

Sexually transmitted disease rates have increased in some areas where gas workers, mostly young men, enter a new town en masse to work in the gas (or related) industries. Food and Water Watch found that in Pennsylvania, the average number of cases of sexually transmitted diseases was 62 percent higher in high-drilling counties than in counties with no drilling (Food and Water Watch 2013). In Bradford County (which is the highest number of wells in the three-state region) the Troy Community Hospital reported an increase in STDs connected to the growth of the industry (Covey 2011). A spike in sexually transmitted diseases has also been reported in high-drilling areas in other states, including Carrizzo Springs, Texas; Mesa County, Colorado; and McKenzie County, North Dakota (Vaughan 2012; Redifer et al 2007; Eligon 2013). Chlamydia rates doubled between 2010 and 2011 in McKenzie County, North Dakota (Eligon 2013).

In our case studies of high-drilling counties, Pennsylvania's Soldiers and Sailors Memorial Hospital in Tioga County attributed an increase in sexually transmitted diseases to increased drilling and a rise in the number of out-of-state workers (Ward, Polson, and Price 2014). Other interviewees in case study

research did not report increases in STDs.

In this report we examined STD trends statistically, relying again on county-level data.

Since 2005, there has been a statistically significant increase of 24% to 27% in rates of infection for chlamydia across all categories of drilling counties (high-, medium- and low-) compared to non-drilling counties. (Figure 10) We also observed an increase in gonorrhea infection rates in high- and medium-drilling counties, but the difference with non-drilling counties was not statistically significant (Figure 11). There is no clear relationship between rates of infection for chlamydia and gonorrhea and drilling activity in West Virginia.

Figure 10

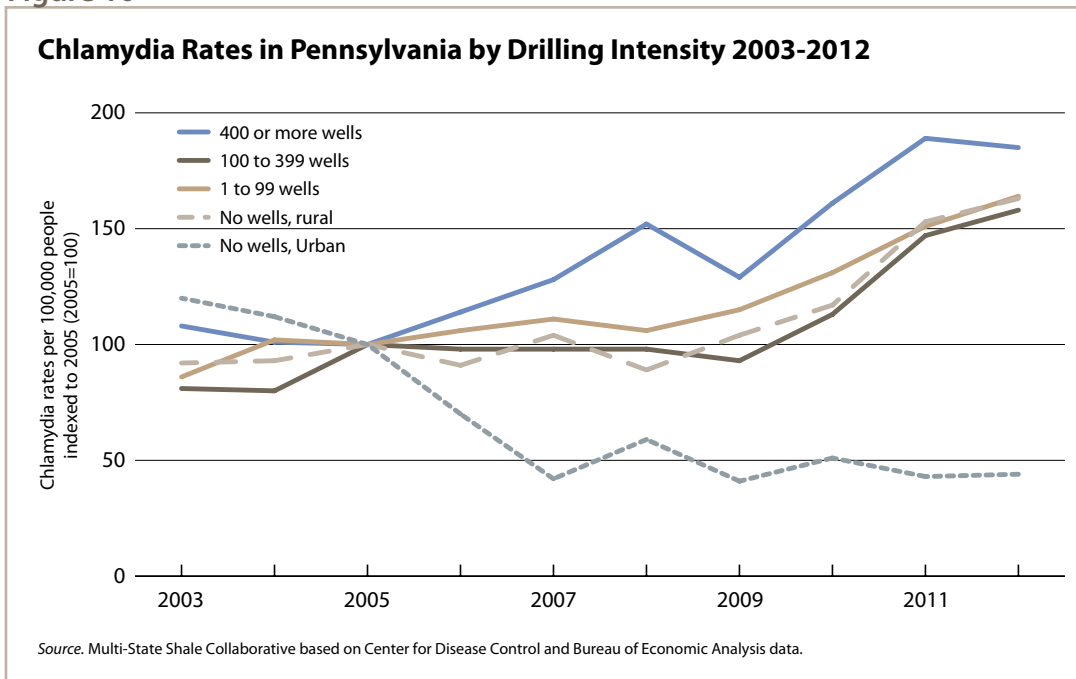
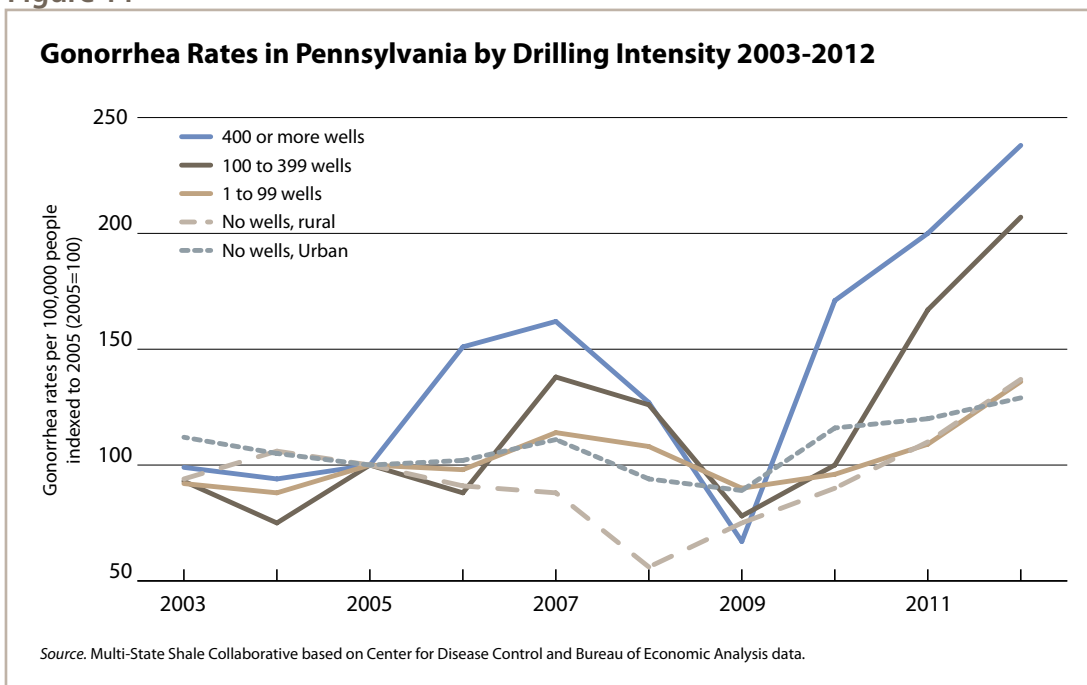


Figure 11



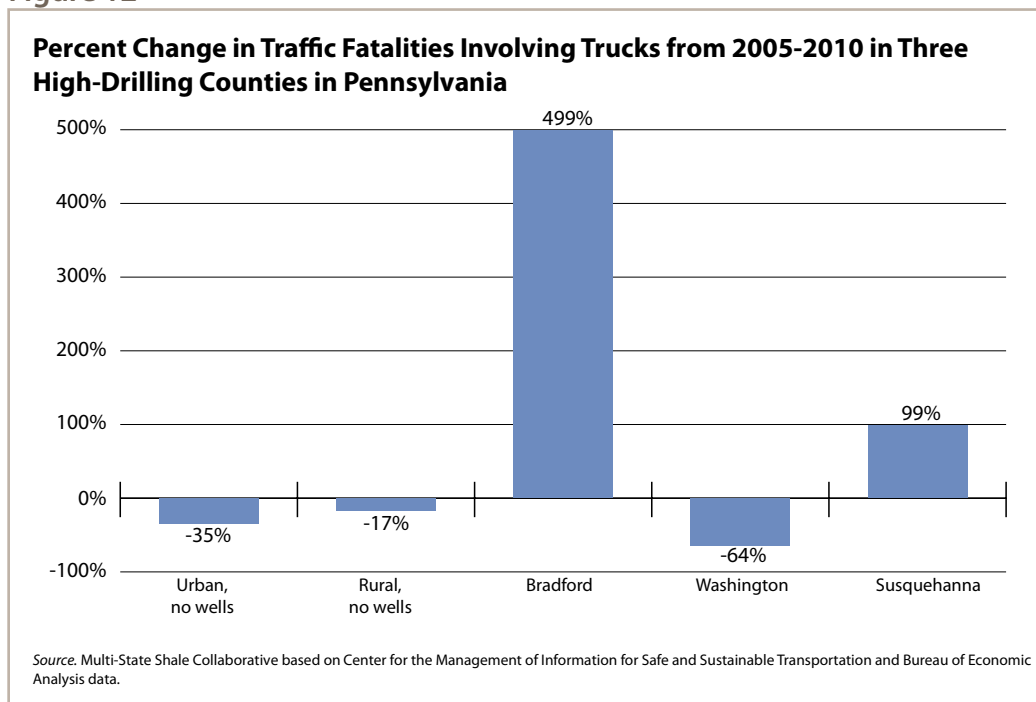
Motor Vehicle Fatalities

Traffic fatalities involving trucks in the six high-drilling counties increased by a statistically significant 27.8% from 2005 to 2012 compared to 2000 to 2005.

Looking at all traffic fatalities, not just those involving trucks, Pennsylvania's six high-drilling counties had about 37 more traffic fatalities in 2012 than if the number of fatal accidents had followed the statewide trend. Although overall traffic fatality rates increased in the high-drilling counties, the difference with other groups of counties was not statistically significant.

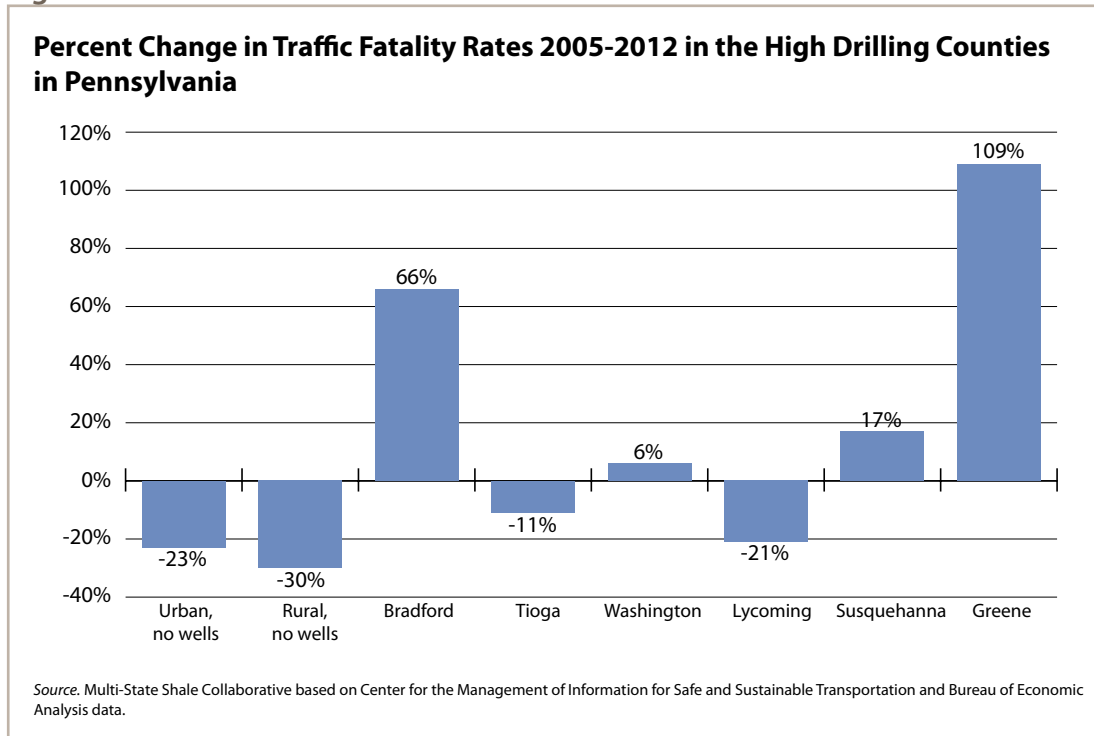
We observed no increase in truck-involved or overall motor vehicle fatalities in medium-drilling counties in West Virginia, Pennsylvania and Ohio.²

Figure 12



² We did observe a decline of 11% in motor vehicle fatalities overall in low-drilling counties.

Figure 13



Rents

Multi-State Shale Research Collaborative case studies of four drilling counties released in spring 2014 revealed findings consistent with other research on housing impacts of booms in extractive industries. Out-of-state drilling industry workers created increased demand for temporary housing in Carroll County, Ohio, and in Greene and Tioga counties in Pennsylvania (Woodrum 2014; Herzenberg, Polson, and Price, 2014; Ward, Polson, and Price, 2014). Existing hotels filled up and new hotels were added or planned. Tioga and Greene counties each built two new hotels (Coolidge 2011; Herzenberg, Polson, and Price 2014). Wetzel County, West Virginia, experienced a 700% increase in collections from a New Martinsville hotel room occupancy tax (O’Leary 2014).

In Tioga, Greene, and Carroll counties, empty lots were being turned into RV sites, sometimes without adequate connections to water, sewer, or electrical systems (Woodrum 2014, Herzenberg, Polson, and Price, 2014; Ward, Polson, and Price, 2014).

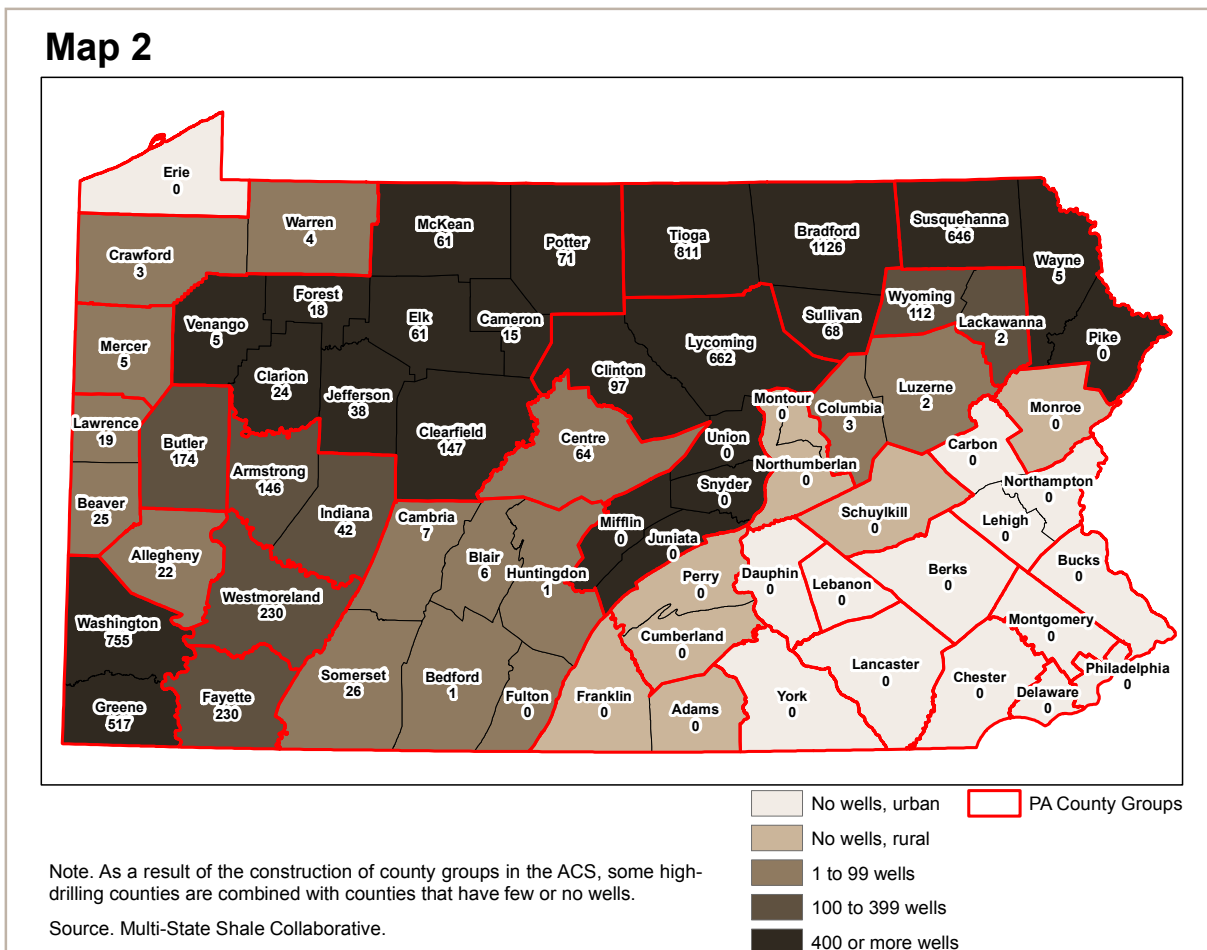
Large housing stipends for oil and gas workers and limited supplies of housing translated into a doubling, tripling, or even quadrupling of rental rates, according to local interviews (Woodrum 2014). In Tioga, classified ads in the Wellsboro Gazette documented a doubling or tripling of rents for comparable housing between 2007-08 and 2012 (Ward, Polson, and Price, 2014).

Rising rents created a shortage of affordable housing in Carroll County (Voinovich School and COHHIO 2013). In Greene County, increased demand exacerbated a pre-existing shortage of affordable housing (Herzenberg, Polson, and Price, 2014). Some residents had to move out of the county or live in substandard housing that lacked running water. Some landlords rented unlivable properties for high prices.

Sources in Tioga, Greene, and Carroll counties all reported increased homelessness (Woodrum 2014, Herzenberg, Polson, and Price, 2014; Ward, Polson, and Price, 2014). The Tioga County Department of Human Services reported a four- to five-fold increase in households seeking help with housing (after it started tracking this number in August, 2008) (Ward, Polson, and Price, 2014). Tioga also reported a four-fold increase in the share of Head Start families who were homeless (from 6% in 2010-11 to 24% in 2012-13). Similarly, Greene County saw a jump in the number of children in foster care because of “inadequate housing,” from 12 in 2008-09 to 36 in 2012-13.

In Greene County, a local domestic violence organization reported that some clients found it more difficult to leave abusive situations because of the lack of affordable housing (Herzenberg, Polson, and Price 2014).

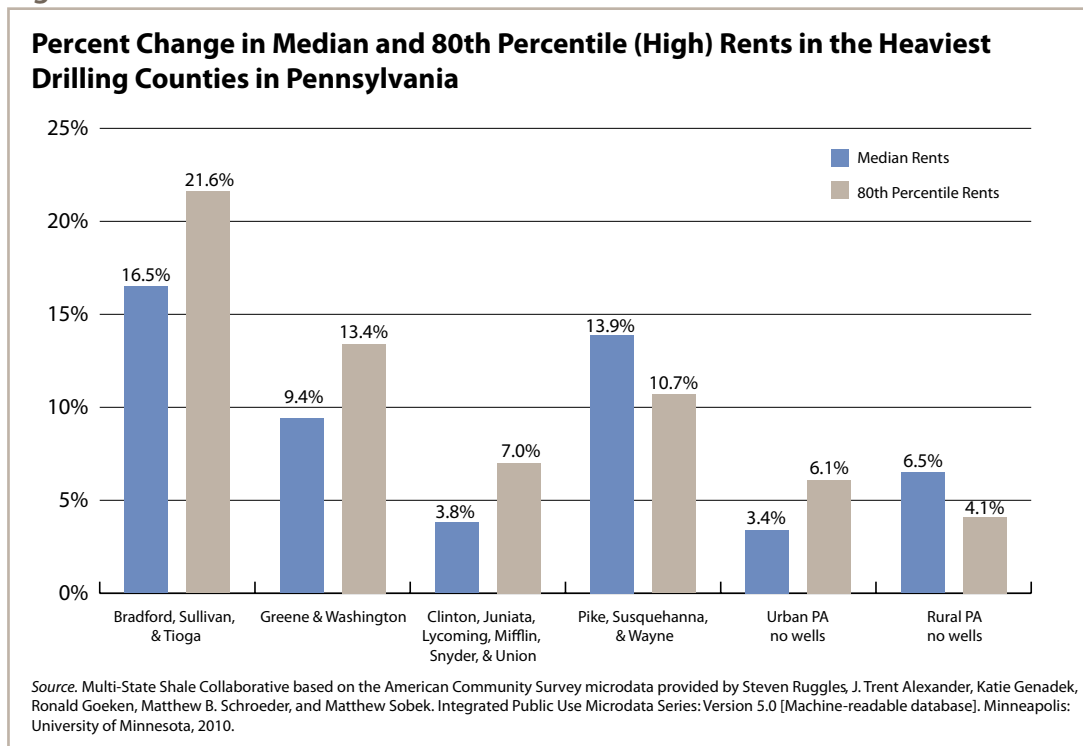
Exploring housing issues statistically is hampered by the fact that the American Community Survey (the primary source on rents) combines counties into multi-county areas that usually include high-drilling counties and counties with less or no drilling. In Map 2, the red lines show the county groupings for which data are reported in Pennsylvania. Four of the six Pennsylvania high-drilling counties are combined with low- or no-drilling counties, making it difficult to isolate changes where drilling is concentrated. Even the grouping of Washington and Greene counties, which are both high-drilling, prevents us from exploring statistically the impacts in Greene alone. Washington County is a highly populated urban region, which means that drilling demand is less likely to lead to large shifts in the overall housing market.



Despite these severe data limitations, considering the multi-county regions that include high-drilling counties as a group, median, low (20th percentile) and high (80th percentile) rents all increased from 2005 to 2012 by statistically significant amounts of 10.2%, 7.6% and 12.3%, respectively.

Figure 14 shows separately the change in median and high rents for four regions that include one or more high-drilling counties and also include no-drilling rural areas. The figure shows clearly that rents have increased much more in regions that include high-drilling counties, especially at the 80th percentile. In Ohio, low and median rents were up 3.2% and 1.7%, respectively, in Carroll (112 wells drilled) and Stark (7 wells drilled) counties.

Figure 14



Conclusion: Modest Job Gain but Also Community Impacts

What is the takeaway from our analysis of data on community impacts of drilling and our prior case studies?

Both our case studies and our statistical analysis of employment revealed modest employment and income benefits of shale development in high-drilling counties, especially in Greene County, Pennsylvania.

This report reveals the other side of the coin: The high-drilling counties, measured by number of wells, also experienced negative community impacts, such as higher rates of crime, STDs, and traffic fatalities, and less affordable housing.

Our findings are consistent with the qualitative picture of drilling impacts from case studies in Wyoming and other drilling states. High levels of drilling lead to an increase in employment, some of it as a result of an influx of transient out-of-state workers making higher-than-average wages. Drilling activity itself, out-of-state workers, and the increase in income and valuable (and portable) equipment and materials on drilling sites, contribute to increases in crime, traffic accidents, STD rate, and rents. Some of these impacts may have been mitigated in the Marcellus and Utica Shale regions by the lack of apparent increase in overall population; this may reflect, in addition to data limitations, the fact that rural drilling counties in Pennsylvania, West Virginia, and Ohio are more densely populated than parts of the west. As a result, drilling counties in the east may have more pre-existing infrastructure and social services than their counterparts in Wyoming and North Dakota.

Summing up, our research indicates that Marcellus and Utica Shale communities in which the scale of shale development is sufficient to move the needle on total employment and income are also communities likely to be faced with social challenges as a result of the drilling intensity. Communities with shale deposits where drilling has not yet occurred should understand this trade-off so that they can weigh their options in an informed way and prepare for the social impacts if drilling does expand to them.