



Exaggerating the Employment Impacts of Shale Drilling: How and Why

**Multi-State Shale Research Collaborative
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I. Introduction and Overview

Over the last five years, firms with an economic interest in the expansion of drilling in the Marcellus and Utica shale formations — and their allies, supporters, and trade associations — have used a variety of tools and techniques to exaggerate the employment impacts of shale drilling. These strategies have ranged from the use of inappropriate measures, such as data on new hires, to represent job growth to the misleading attribution of all jobs in “ancillary” industries to the shale industry.

A review of statements by representatives of shale drilling firms and their allies makes the motivation for this exaggeration clear — to preclude, or at least to minimize, taxation, regulation, and even careful examination of shale drilling.

An explicit example of this “defense by exaggeration” strategy occurred on July 19, 2012, at a Harrisburg press conference during which the Pennsylvania Chamber of Business and Industry joined the U.S. Chamber of Commerce for the launch of its “Shale Works for US” campaign.

At this event, Karen Harbert, the president and CEO of The Institute for 21st Century Energy, the energy policy arm of the U.S. Chamber of Commerce, said the goal of “Shale Works for US” was to make sure that lawmakers “don’t squander or obstruct this opportunity” and to “ensure no hindrance or regulatory barriers” to natural gas drilling.¹

As reported in The Patriot-News of Harrisburg, the Chamber’s employment claims exceeded those reported by the Pennsylvania Department of Labor and Industry, whose Secretary shared the stage with Harbert that day. In its release, the Chamber stated that shale gas production “created over 300,000 new jobs in the last two years,” while the most recent Department of Labor and Industry data at the time indicated that, between the 4th quarter of 2008 and 4th quarter 2011, the industry created a total of 18,007 jobs in “core” Marcellus industries, with an additional 5,611 jobs added in “ancillary” industries.²

The Department of Labor and Industry explained the discrepancy by stating that the U.S. Chamber’s figures “relied on a two-year-old industry-funded Penn State study that focused on projected jobs”³ and that the Labor and Industry figures, 23,618 jobs, were the “most current, real jobs numbers as they pertain to Marcellus Shale.”

Based on the questioning it received at and after the July 19, 2012, press conference, the U.S. Chamber itself issued a revised press release⁴ that changed the 300,000 jobs “created” to 180,000 jobs “supported” by natural gas.⁵ The U.S. Chamber did not explain the basis for (or the source of) this revised claim.⁶

1 Gilliland, Donald, “US Chamber of Commerce launches pro-gas campaign with inaccurate jobs numbers,” *Harrisburg Patriot-News*, July 19, 2012, http://www.pennlive.com/midstate/index.ssf/2012/07/us_chamber_of_commerce_launche.html.

2 Figures in this sentence come from Gilliland, Donald, “US Chamber of Commerce launches pro-gas campaign with inaccurate jobs numbers,” July 19, 2012, http://www.pennlive.com/midstate/index.ssf/2012/07/us_chamber_of_commerce_launche.html. As explained in the body of this report, even the 5,611 additional ancillary jobs do not measure drilling-related employment created.

3 The exaggerations embodied in this industry-funded study are examined in a later section of this report.

4 *U.S. Chamber’s Energy Institute Launches “Shale Works for US” campaign in Pennsylvania*, July 19, 2012, <http://www.energyxxi.org/us-chamber%E2%80%99s-energy-institute-launches-%E2%80%9Cshale-works-us%E2%80%9D-campaign-pennsylvania>

5 Gilliland, Donald, “US Chamber of Commerce launches pro-gas campaign with inaccurate jobs numbers,” July 19, 2012, http://www.pennlive.com/midstate/index.ssf/2012/07/us_chamber_of_commerce_launche.html.

6 “Pennsylvania is already a leader in shale gas production which, by 2012, supported 180,000 jobs and will generate over \$2.5 billion in state and local tax revenues.” U.S. Chamber’s Energy Institute Launches “Shale Works for US” campaign in Pennsylvania,

The press conference in Pennsylvania's Capitol could have occurred in any state experiencing a shale boom. Industry officials make claims about the economic benefits of hydrofracking that are intended to impress — but overstate job growth, which remains small relative to overall state employment, and fail to mention the costs imposed by drilling on communities, local governments, and the environment.⁷

An accurate assessment of the short- and long-term impacts of shale development is necessary to adequately prepare drilling communities for the emergence of the industry, to estimate negative externalities associated with this industry (such as road damage, water treatment, and habitat loss), and to recover the costs of these externalities.

That accurate assessment must include defensible estimates of the number of jobs created in the industry, the wages associated with those jobs, the distribution of those jobs between in-state and out-of-state workers, and the relationship to total state employment.

To answer those questions, the Multi-State Shale Research Collaborative has examined employment in the Marcellus and Utica Shale in six states: Maryland, New York, Ohio, Pennsylvania, Virginia, and West Virginia. Our findings include:

- New York, Ohio, Pennsylvania, and West Virginia have a long history of gas and oil production and a core of extraction-related jobs created well before the emergence of hydrofracking. Together, Ohio, Pennsylvania, and West Virginia had 38% of all producing wells in the country in 1990 and 32% in 2000.
- Some counties with a long history of mineral extraction have experienced a shift in employment from coal to shale extraction.⁸
- Natural gas development has advanced quickly in the Marcellus Shale bringing with it some economic benefit to counties with significant drilling activity. Those impacts helped to insulate those counties from the worst effects of the Great Recession but had little overall impact on the state economy in any state studied.
- Job growth in the industry has been greatest (as a share of total employment) in West Virginia, but shale-related employment is less than 1% of total West Virginia employment and less than half a percent of total employment in all the other states.
- Region-wide, shale-related employment accounts for nearly 33,000 jobs, one out of every 794 jobs. The education and health sectors, by contrast, account for 4.5 million jobs in the region, one out of every 6 jobs.
- Between 2005 and 2012, less than four new shale-related jobs have been created for each new well. This figure stands in sharp contrast to the claims in some industry-financed studies, which have included estimates as high as 31 for the number of jobs created per well drilled.⁹

July 19, 2012, <http://www.energyxxi.org/us-chamber%E2%80%99s-energy-institute-launches-%E2%80%9Cshale-works-us%E2%80%9D-campaign-pennsylvania>

7 Tom Feran, "Ohio Oil and Gas Association touts 40,000 new Ohio jobs, Truth-O-Meter Says: Pants on Fire," Cleveland Plain Dealer, April 29, 2013, <http://www.politifact.com/ohio/statements/2013/apr/29/ohio-oil-and-gas-association/ohio-oil-and-gas-association-touts-40000-new-ohio-/>; Whitney Burdette, "Natural Gas Industry Creates Jobs in West Virginia, Pennsylvania, The (Charleston) State Journal (published online by Energy Speaks), June 17, 2011, <http://justbeneaththesurfacewv.com/post/Natural-Gas-Industry-Creates-Jobs-in-West-Virginia-Pennsylvania.aspx>; Friends of Natural Gas NY, "Jobs," Friends of Natural Gas NY.com, 2011, <http://www.friendsofnaturalgasny.com/why-natural-gas/jobs/>.

8 Amanda Weinstein and Mark Partridge, The Economic Value of Shale Natural Gas in Ohio, The Ohio State University Swank Program, December 2011, http://aede.osu.edu/sites/aede/files/publication_files/Economic%20Value%20of%20Shale%20FINAL%20Dec%202011.pdf

9 Timothy Considine, Robert Watson, and Nicholas Considine, The Economic Opportunities of Shale Energy Development, The Manhattan Institute, May 2011, http://www.manhattan-institute.org/pdf/eper_09.pdf

- Employment estimates have been overstated, and the industry and its boosters have used inappropriate employment numbers, including equating new hires with new jobs and using ancillary job figures that largely have nothing to do with drilling, even after the flaws in those numbers have been brought to their attention.
- In addition, industry-funded studies, including those by Dr. Timothy Conside and co-authors, have substantially overstated the total jobs impact of the shale industry. With the passage of several years since the earliest Conside studies, we now know that actual Pennsylvania job growth has been much less than his initial estimates for 2011 and 2012.
- Finally, employment gains in some counties have already been reversed as drilling activity, which is highly sensitive to commodity prices, shifted to more lucrative oil shale fields in Ohio and North Dakota. In fact, shale-related employment across the six-state Marcellus/Utica region fell over the past 12 months for which data exist, from the 1st quarter of 2012 to the 1st quarter of 2013.

Some residents of shale drilling counties have, it should be acknowledged, benefited from the emergence of the industry, particularly during the depths of the recession.

It is also true that Ohio, Pennsylvania, and West Virginia have long histories with coal and oil “resource curses,” which have provided wealth for a few but left a legacy of environmental degradation and poverty in their wake. The decline of shale employment in Pennsylvania in the 12 months ending in the 4th quarter of 2012 is a reminder that resource extraction has rarely proved a reliable route to sustainable regional prosperity. Policymakers in shale-rich regions should view employment projections with caution and recognize that even robust gains can be quickly reversed.

II. Development of the Marcellus and Utica Shale Formations

The Geography of the Marcellus and Utica Shale

Over the last decade, the production of fossil fuel from the shale formations underlying much of the United States has become both economically and technologically viable. Gas and oil are produced through wells that extend horizontally through shale layers using an extractive process known as hydraulic fracturing, or hydrofracking. Since 2005, the share of the nation’s gas supply produced from shale has increased dramatically. According to the U.S. Energy Information Administration (EIA), shale gas became in 2011 the single largest source of natural gas produced in the United States.¹⁰

Shale development is occurring in two geographic formations in the Northeast, the Marcellus Shale and Utica Shale.

The Marcellus Shale extends from New York through Pennsylvania, Eastern Ohio, the tail of Maryland, West Virginia, and into Virginia’s western border.

The Utica Shale underlies the Marcellus Shale in most of its range and extends north under Lake Ontario and further west into central Ohio and beneath Lake Erie.

¹⁰ U.S. Energy Information Administration (EIA), *Annual Energy Outlook 2013*, Natural Gas from Executive Summary, Figure 91, May 2, 2013, http://www.eia.gov/forecasts/aeo/source_natural_gas_all.cfm#shale_gasa.

The size of the recoverable reserves in the Marcellus Shale is large, although estimates have varied. The most recent estimates from the U.S. Geological Survey (USGS) put it at 84 trillion cubic feet of recoverable gas, a revision downward from earlier estimates.¹¹

States in the Marcellus region have responded differently to the discovery of this resource.

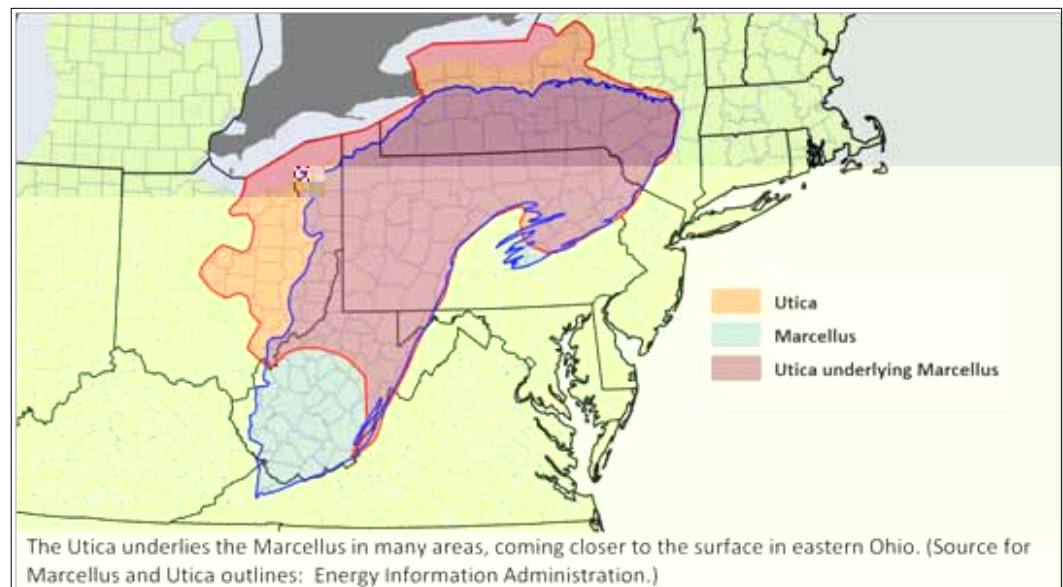
Pennsylvania, West Virginia, and later Ohio have allowed rapid development of the drilling industry, while New York and Maryland have restricted development in order to assess potential impacts and review the adequacy of existing regulatory structures. The U.S. Forest Service is studying the impact of drilling in the George Washington National Forest, which overlays Virginia's share of the shale, and is considering a ban.

The volume of gas produced in the Marcellus Shale has grown significantly, accounting for more than one-quarter of shale gas production in the United States in 2012.¹²

Gas wells in Northeastern Pennsylvania produce methane, which is usually referred to as natural gas or "dry gas." This type of gas can be added into the nation's pipeline system with little processing. In other areas – Eastern Ohio, Southwestern Pennsylvania, and parts of West Virginia – the methane extracted includes other related hydrocarbons known as natural gas liquids (NGL): propane, butane, ethane, and natural gasoline.¹³ This mixture is often called "wet gas" and needs additional processing before use. At present, NGL products command a much higher price than methane, making wet gas wells more profitable than traditional dry gas wells.

The Utica Shale contains both natural gas and shale oil. A 2012 USGS study estimates the Utica Shale could contain 38 billion cubic feet of recoverable natural gas, 940 million barrels of unconventional oil, and 208 million barrels of natural gas liquids.¹⁴

Shale development in Eastern Ohio has focused principally on shale oil in the Utica. There is little development at the moment of the Utica natural gas resources.



11 U.S. Geological Survey, "USGS Releases First Assessment of Shale Gas Resources in Utica Shale: 38 trillion cubic feet," October 4, 2012, <http://www.usgs.gov/newsroom/article.asp?ID=3419&from=rss#.Ud3IkDvkv5x>.

12 U.S. Energy Information Administration, *What is shale gas and why is it important?* December 5, 2012, http://www.eia.gov/energy_in_brief/article/about_shale_gas.cfm.

13 U.S. Energy Information Administration, "Today in Energy: What are natural gas liquids and how are they used?" April 20, 2012, <http://www.eia.gov/todayinenergy/detail.cfm?id=5930>.

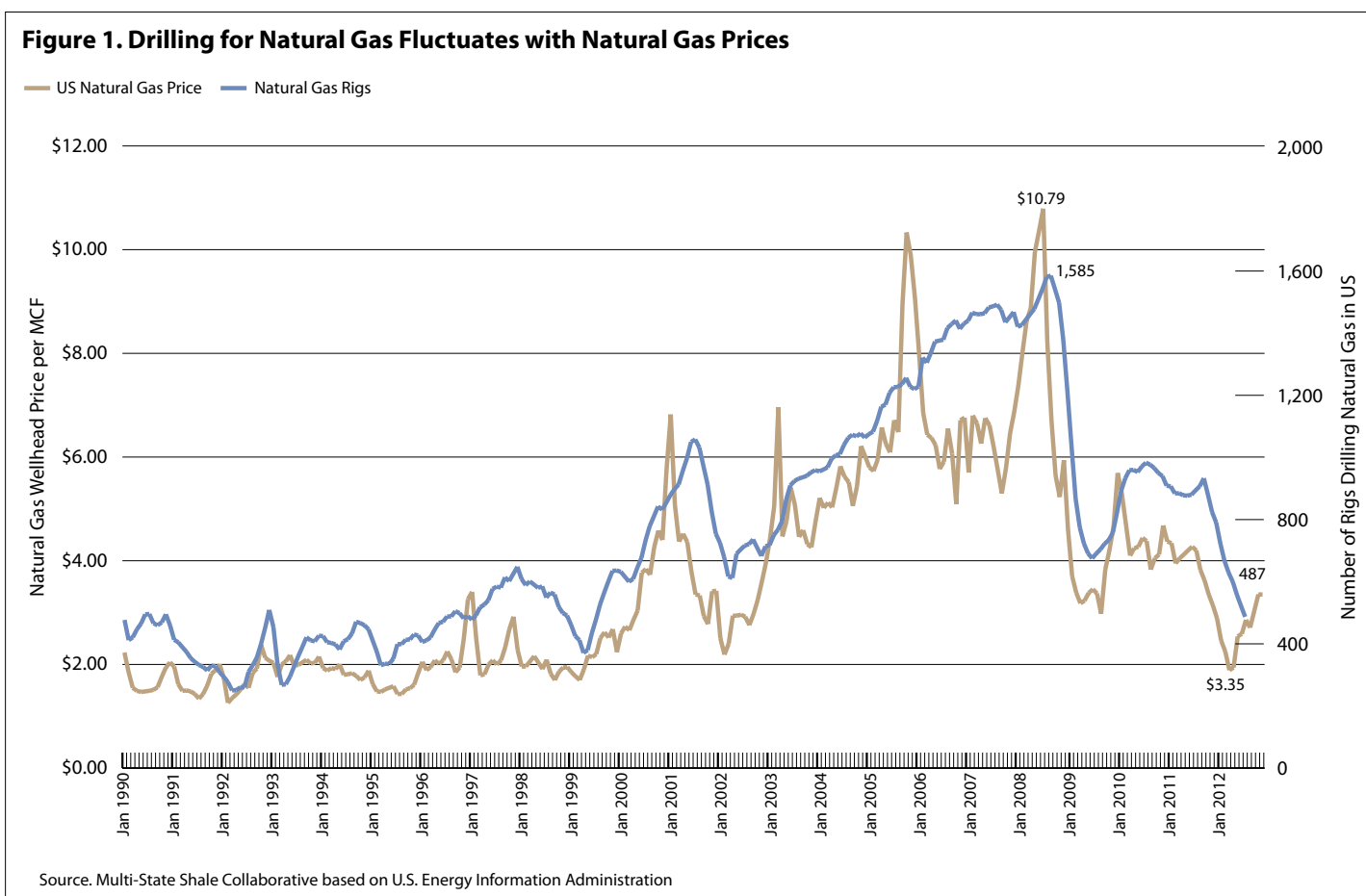
14 U.S. Geological Survey, "USGS Releases First Assessment of Shale Gas Resources in Utica Shale: 38 trillion cubic feet," October 4, 2012, <http://www.usgs.gov/newsroom/article.asp?ID=3419&from=rss#.Ud3IkDvkv5x>.

Extraction Activity Highly Sensitive to Price

Natural gas development in the six Marcellus Shale states was fueled by high commodity prices from 2000 to 2008. As prices have declined, gas drilling activity has slowed while development of higher-priced oil has accelerated.

Natural gas prices began to increase in the early 2000s, with the price at the wellhead increasing from \$2.19 in 1999 to \$7.33 per thousand cubic feet (MCF) of natural gas in 2005. (See Figure 1.) Natural gas prices peaked at \$10.79 per MCF in July 2008.¹⁵

An oversupply of natural gas and falling demand due to the Great Recession contributed to a swift decline in the wellhead price of gas to below \$3 per MCF in September 2009. From 2010 to 2012, the wellhead price averaged \$3.70 per MCF,¹⁶ and the U.S. Energy Information Administration (EIA) estimates that gas prices will remain below \$5 per MCF through 2025.¹⁷



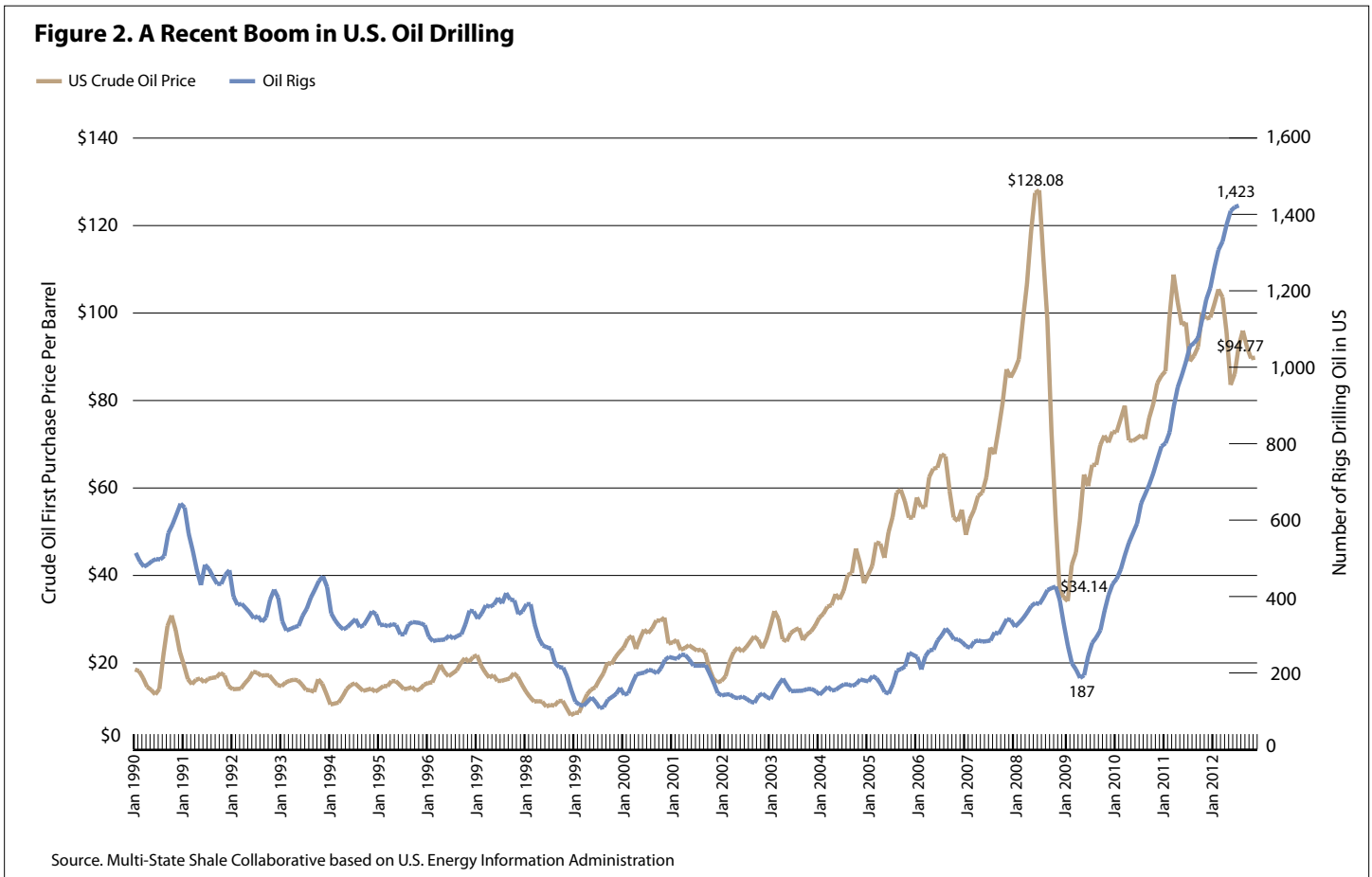
¹⁵ Average U.S. wellhead prices reported by the U.S. Energy Information Administration (EIA), June 28, 2013 <http://www.eia.gov/dnav/ng/hist/n9190us3M.htm>.

¹⁶ U.S. Energy Information Administration, June 28, 2013 <http://tonto.eia.gov/dnav/ng/hist/n9190us3m.htm>.

¹⁷ EIA *Annual Energy Outlook, 2013*, April 2013 <http://www.eia.gov/oaia/aeo/tablebrowser/#release=AEO2013&subject=0-AEO2013&table=13-AEO2013®ion=0-0&cases=ref2013-d102312a> Forecast of Henry Hub spot price (often used as a standard for U.S. natural gas production prices) of \$4.87 per million BTUs (or approximately \$4.98 per MCF) in 2025.

As gas prices increased nationally, the number of active natural gas rigs in the United States grew from 559 in September 1999 to a peak of 1,585 rigs in September 2008 when the wellhead price was \$6.71 and had already begun to fall.¹⁸ As prices continued to drop, the number of operating gas rigs fell by two-thirds from the peak.

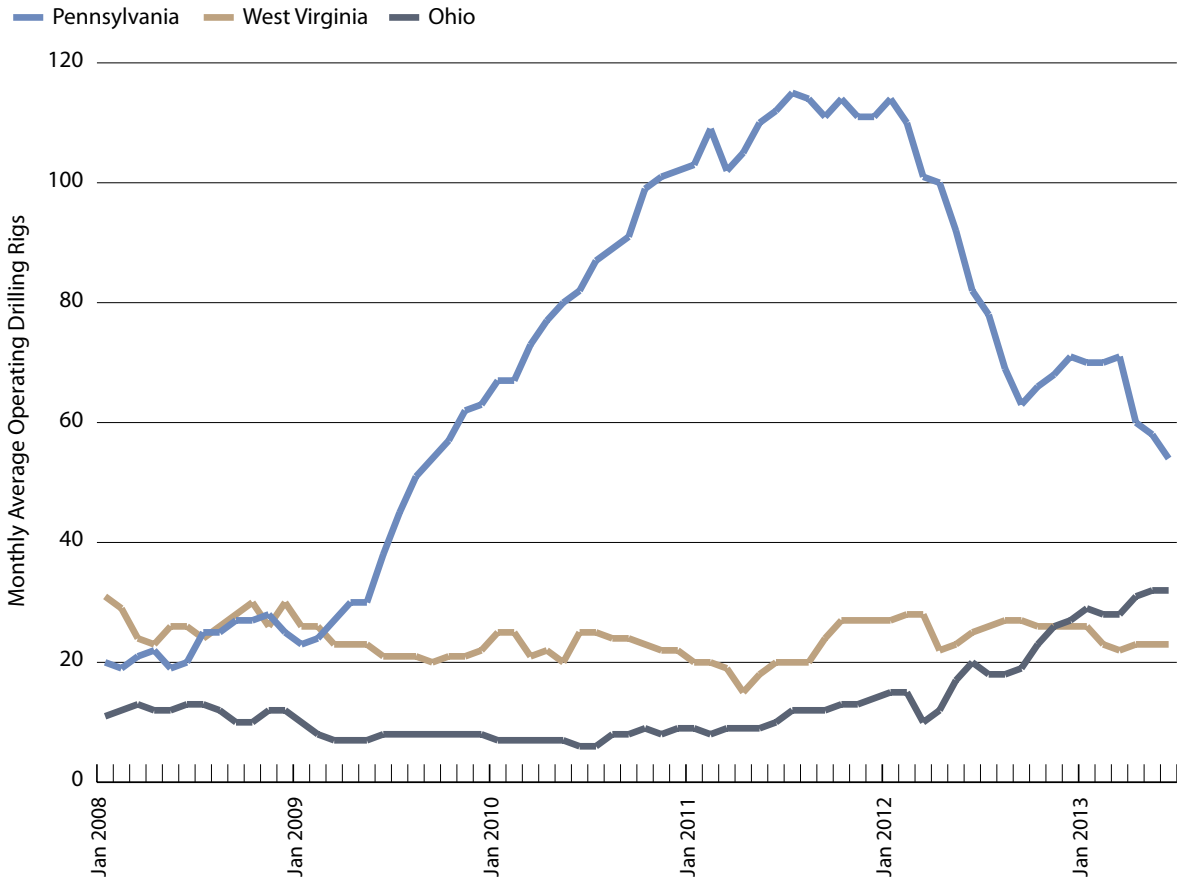
Beginning in 2005, shale oil production began to gain ground in Texas and North Dakota. In mid-2009, as gas prices dropped and oil prices began to rebound from the recession, drill rigs were increasingly deployed for oil rather than gas production. The number of operating oil rigs increased from fewer than 200 in 2009 to more than 1,400 in mid-2012.



In September 2013, there were 52 rigs in Pennsylvania, down from a peak of 115 in July 2011, 36 rigs in West Virginia, and 35 rigs in Ohio. (See Figure 3.) Drilling activity has shifted within Pennsylvania, as companies moved first from the Northeastern “dry gas” sites to the more liquid-rich Southwest and finally to Ohio and other areas with shale oil production beginning in 2012.

18 U.S. Energy Information Administration, U.S. Natural Gas Rotary Rigs in Operation, May 31, 2013 http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=E_ERTRRG_XR0_NUS_C&f=M. Oil and gas activity can be tracked worldwide through information on the location of operating drill rigs, which is published weekly by the rig servicing company Baker Hughes.

Figure 3. A Shift in Drilling from Pennsylvania to Ohio



Source. Multi-State Shale Collaborative based on Baker Hughes North American Rig Count

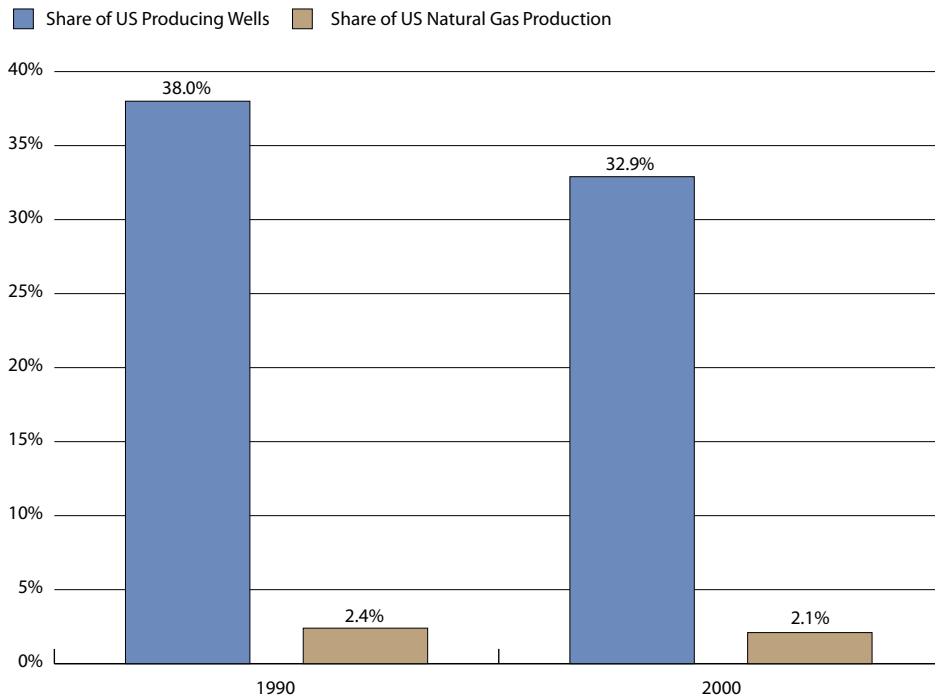
Shale States Have a Long History of Oil and Gas Extraction

Ohio, Pennsylvania, and West Virginia have a long history of mineral extraction. The first commercial oil well was developed in Titusville, Pennsylvania, in 1859, and within that year, production of oil and gas for sale began in both Ohio and West Virginia.¹⁹ The first oil well was developed in New York in 1865.

The natural gas industry in all three states has consisted of large numbers of low-producing – or “stripper” – wells that gather natural gas from deposits close to the surface.

¹⁹ See the following sources on the history of oil and gas extraction in Ohio, Pennsylvania, and West Virginia: <http://www.wvgs.wvnet.edu/www/geology/geoldvog.htm> and www.dnr.state.oh.us/portals/10/pdf/pg01.pdf. U.S. Energy Information Administration, “Producing Natural Gas Wells”

Figure 4. Prior to Shale, Ohio, Pennsylvania, and West Virginia Had Many Low-Producing Wells



Source: Multi-State Shale Collaborative based on U.S. Energy Information Administration

Together, the three states had 38% of all producing wells in 1990 and almost one-third of producing wells in 2000. The states' share of the U.S. total natural gas production was much smaller – less than 3% of the total in both 1990 and 2000. (See Figure 4.)²⁰

Shale Gas Development in the Region

There has been significant new gas development activity in the Marcellus region between 2002 and 2013 when more than 6,200 new wells were constructed in Pennsylvania and more than 2,000 new producing wells were developed in West Virginia. (See Table 1.) Ohio has also embraced the industry, but development there started later and has been concentrated on Utica oil rather than Marcellus gas. By the end of 2012, fewer than 300 shale wells had been drilled in Ohio.

In New York, a handful of wells were drilled in the Marcellus in 2006,²¹ but development halted when the state implemented a temporary moratorium on new permits.²² In 2011, Maryland also imposed a moratorium, and Governor Martin O'Malley created the Marcellus Shale Safe Drilling Initiative via executive order to study the issue.²³

²⁰ U.S. Energy Information Administration, "Producing Natural Gas Wells" (http://www.eia.gov/dnav/ng/ng_prod_wells_s1_a.htm) and "Marketed Production" (http://www.eia.gov/dnav/ng/ng_prod_whv_a_EPG0_VGM_mmcfa.htm).

²¹ New York Department of Environmental Conservation (DEC) indicates 12 wells were producing natural gas from its state's share of the Marcellus Shale in 2009, <http://www.dec.ny.gov/energy/46381.html>.

²² <http://www.governor.ny.gov/archive/paterson/executiveorders/EO41.html>.

²³ <http://www.governor.maryland.gov/executiveorders/01.01.2011.11.pdf>

Table 1.
Number of shale wells drilled since, 2002 to 2012

| Year | Maryland | New York | Ohio | Penn- sylvania | Virginia | West Virginia | Regional Total |
|--|----------|----------|------|-------------------|----------|------------------|-------------------|
| 2002 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 2003 | 0 | 1 | 0 | 4 | 0 | 0 | 5 |
| 2004 | 0 | 0 | 0 | 2 | 0 | 12 | 14 |
| 2005 | 0 | 1 | 0 | 8 | 0 | 89 | 98 |
| 2006 | 0 | 6 | 1 | 37 | 0 | 326 | 370 |
| 2007 | 0 | 6 | 0 | 115 | 2 | 392 | 515 |
| 2008 | 0 | 5 | 0 | 335 | 20 | 492 | 852 |
| 2009 | 0 | 1 | 1 | 817 | 20 | 178 | 1,017 |
| 2010 | 0 | 2 | 4 | 1,607 | 24 | 227 | 1,864 |
| 2011 | 0 | 0 | 35 | 1,968 | 23 | 270 | 2,296 |
| 2012 | 0 | 0 | 229 | 1,358 | 4 | 146 | 1,737 |
| Total Wells Drilled 2002 to 2004 | 0 | 1 | 0 | 7 | 0 | 12 | 20 |
| Total Wells Drilled 2005 to 2012 | 0 | 21 | 270 | 6,245 | 93 | 2,120 | 8,749 |

Source. Multi-State Shale Collaborative based on drilling data reported by the Maryland Department of Environment, New York Department of Environmental Conservation, Ohio Department of Natural Resources, Pennsylvania Department of Environmental Protection, Virginia Department of Mines Minerals and Energy, and the West Virginia Geological and Economic Survey.

Like New York and Maryland, Virginia has approached shale development cautiously. Rockingham County has rejected a drilling permit application, and the U.S. Forest Service is considering a drilling ban in the George Washington National Forest, which provides water to the Washington D.C. metropolitan area.²⁴ According to Virginia oil and gas regulators, only one company has expressed interest in developing natural gas from the Marcellus Shale in the state, and as of mid-2013, no development has yet taken place.²⁵ Only 93 horizontal wells had been drilled in Virginia through the end of 2012.

Drilling Trends in Ohio, Pennsylvania, and West Virginia

Three of the six Marcellus and Utica states — Pennsylvania, West Virginia, and Ohio — have hosted significant hydrofracking in recent years. The following charts detail the number of drilling permits issued for unconventional shale wells each year, the number of wells drilled, or “spud”, that year, the number of new producing wells,²⁶ and the number of operating rigs.

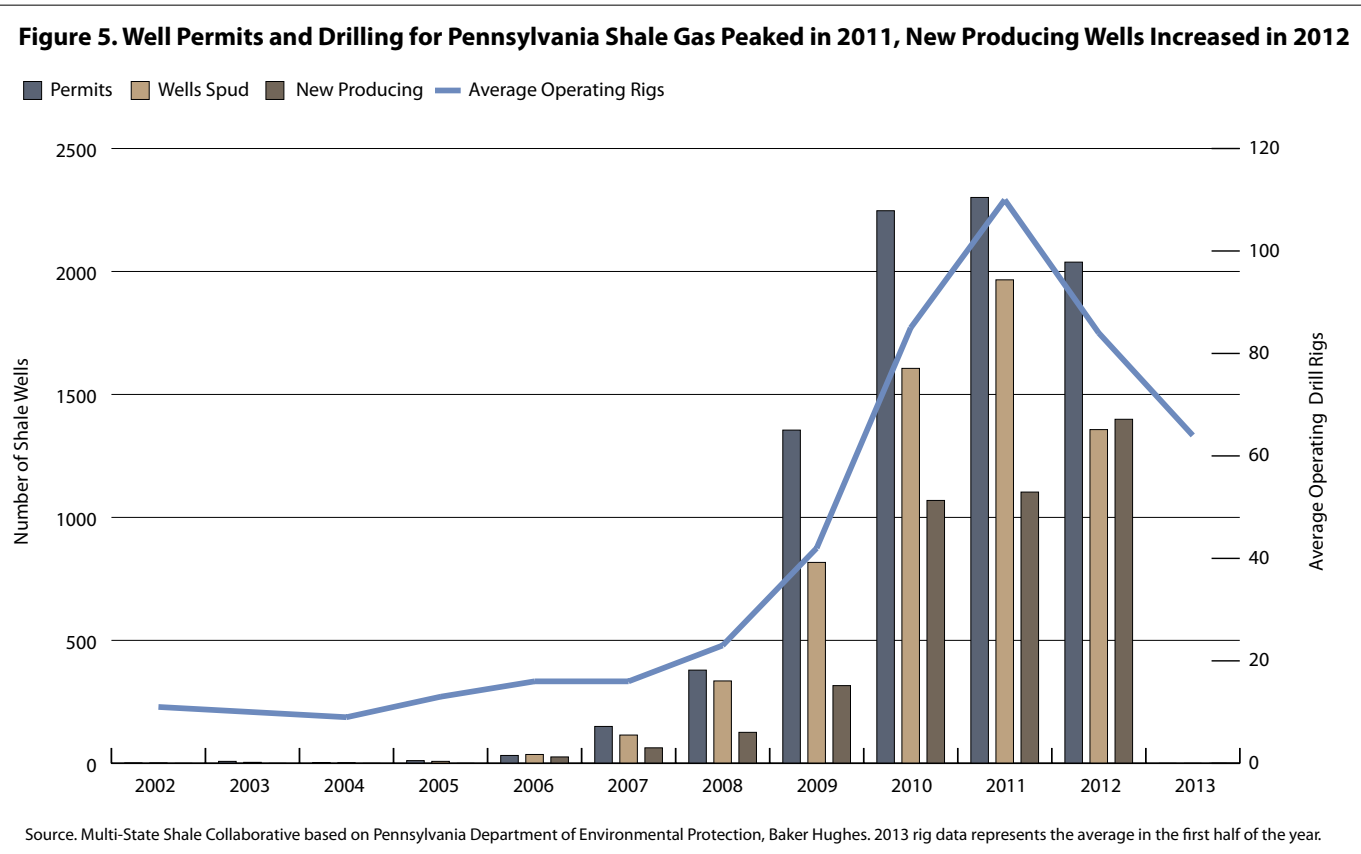
Pennsylvania has the highest number of wells in the region with more than 1,500 new wells spud in 2010 and

24 Darryl Fears, “U.S. Forest Service set to decide on Fracking in George Washington National Forest, Washington Post, September 7, 2013, http://articles.washingtonpost.com/2013-09-07/national/41854799_1_george-washington-national-forest-hydraulic-fracturing-drinking-water.

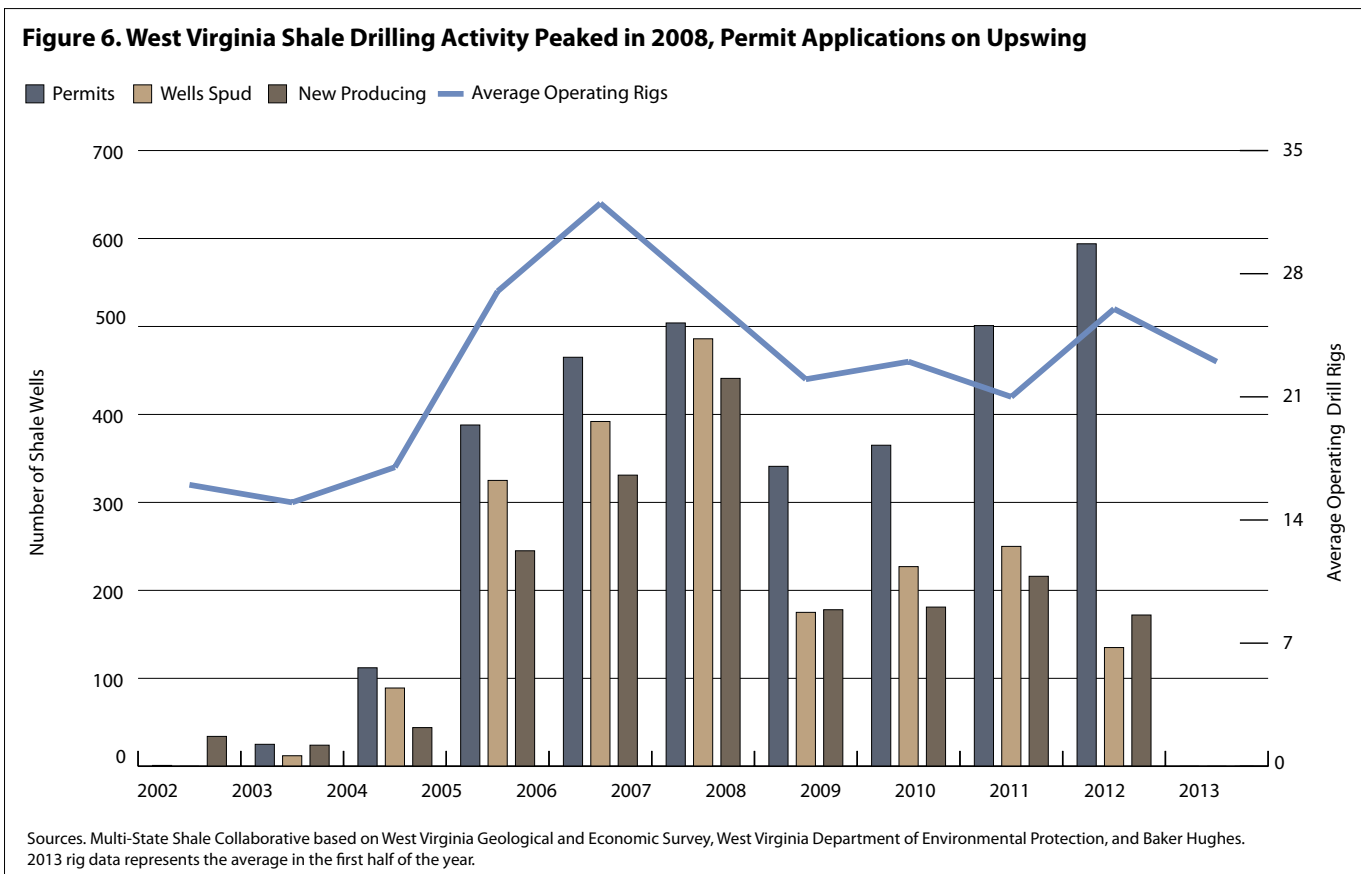
25 Virginia Department of Mines Minerals and Energy, <http://www.dmme.virginia.gov/dgo/HydraulicFracturing.shtml>

26 This number is slightly lower than and lags “wells spud” because production occurs after drilling and not all wells spud produce gas right away, due largely to a lack of local pipeline infrastructure.

2011, the peak of activity. (See Figure 5.) Although permit activity continued at a high level in 2011 and 2012, well spuds and active rigs have declined, with the number of rigs falling almost in half between 2011 and 2013.

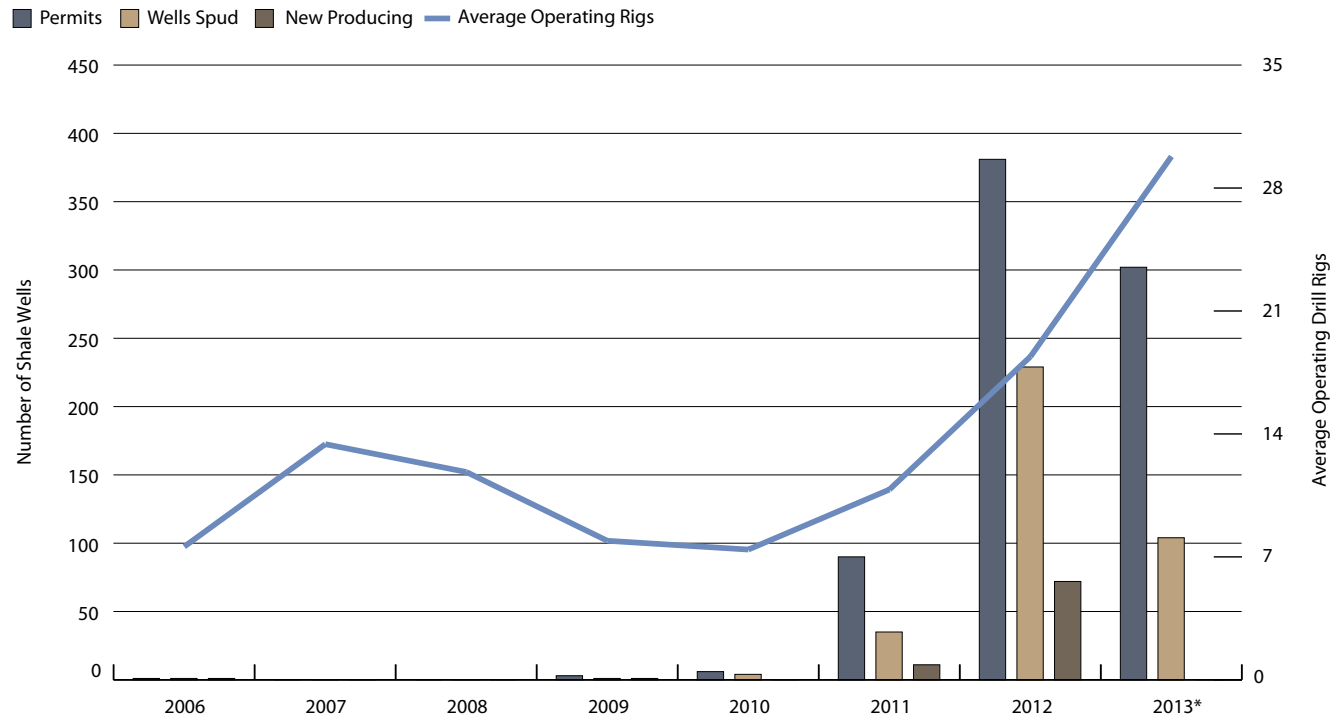


In West Virginia, shale development began in earnest in 2006. (See Figure 6.) Activity dropped in 2009 as gas prices fell nationally, but the number of new permits issued has been on the rise since 2009.



Shale development began later in Ohio and is still relatively small, with 84 producing oil and gas wells in 2012. (See Figure 7.) However, activity measured by growth in the number of rigs in the state is on the rise, reflecting higher oil prices and the movement of rigs from Marcellus gas plays in Pennsylvania and West Virginia to oil plays in Ohio.

Figure 7. Ohio Shale Activity Ramping Up, Few Producing Wells through 2012



Sources: Multi-State Shale Collaborative based on Ohio Department of Natural Resources, Baker Hughes. 2013 permit and well data as of July 12, 2013 operating rigs is the over the first half of the year.

III. Employment in Shale Gas Extraction and Support Activities

The simplest measure of the employment impact of shale drilling is the number of jobs directly engaged in or supporting gas extraction. Using official government databases in each of the six states of the Marcellus and Utica shale region, and at the county level, we are able to estimate employment in “Shale Gas Extraction and Support Activities” as a share of total employment and the impact of shale-related employment growth on overall employment. (See Box 1 for a full explanation of how we estimate the employment numbers.) In both the county and state analyses, we use data from the Quarterly Census of Employment and Wages (QCEW).²⁷

²⁷ The QCEW is a federal-state cooperative program that is based largely on the quarterly Unemployment Insurance (UI) reports filed by employers with their State Employment Security Agencies (SESAs). These reports include information on the employment and wages of workers covered by UI based on location of employment. “Major exclusions from UI coverage include self-employed workers, most agricultural workers on small farms, all members of the Armed Forces, elected officials in most states, most employees of railroads, some domestic workers, most student workers at schools, and employees of certain small nonprofit organizations.” U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages, Frequently Asked Questions, <http://www.bls.gov/cew/cewfaq.htm#Q14>.

Box 1. How Employment in ‘Shale Gas Extraction and Support Activities’ Is Calculated

The BLS uses the North American Industrial Classification System, or NAICS, to report employment for different industries. At the state and especially the county level, government statistical agencies do not publicly disclose data for an industry in a geographic area when there are a very small number of firms or when one employer accounts for a large share of employment. To create consistent state-level data, we had to rely on data for NAICS industries that are disclosed for all six states. Similarly, to create consistent county-level data, we had to use NAICS industries disclosed for most counties within the six states.

State employment estimates. Employment most directly associated with shale development falls largely into five detailed (six-digit) NAICS industries. (Table A1 displays the relationship of these narrow industries to more aggregated super-sectors.)²⁸

- Crude Petroleum & Natural Gas Extraction (NAICS 211111)
- Natural Gas Liquid Extraction (NAICS 211112)
- Drilling Oil & Gas Wells (NAICS 213111)
- Support Activities for Oil & Gas Operations (NAICS 213112)
- Oil & Gas Pipeline & Related Structures Construction (NAICS 237120)

The first two of these industries make up the more aggregated Oil and Gas Extraction super-sector (NAICS 211), which is reported for all six states. The last of the five bulleted industries above (NAICS 237120) is also reported for all six states. The two NAICS industries that begin with “213” (bullets three and four) fall within NAICS 213 (“Support Activities for Mining”), which is also reported for all six states. Thus, we add NAICS 213 to NAICS 211 and NAICS 237120 to create an industry aggregate that we call “Oil and Gas Extraction and Support Activities.”²⁹ This aggregate includes extraction of oil from shale; conventional oil and gas extraction and support activities, and the support activities for mining described in the previous footnote.

To estimate the share of the state-level employment aggregate related to shale gas extraction, we rely on two assumptions. First, shale development did not begin in earnest prior to 2005. Therefore, we attribute employment in our aggregate prior to 2005 to oil and conventional gas extraction plus support activities for other mining rather than to shale development. Second, we assume that all growth in these categories after 2005 is attributable to shale and that employment in conventional gas and oil remained constant. With this assumption, the increase in employment in the aggregate of industries since 2005 becomes our estimate of employment in “Shale Gas Extraction and Support Activities.”³⁰ Figure 8 displays visually the method we use to estimate state-level Shale Gas Extraction

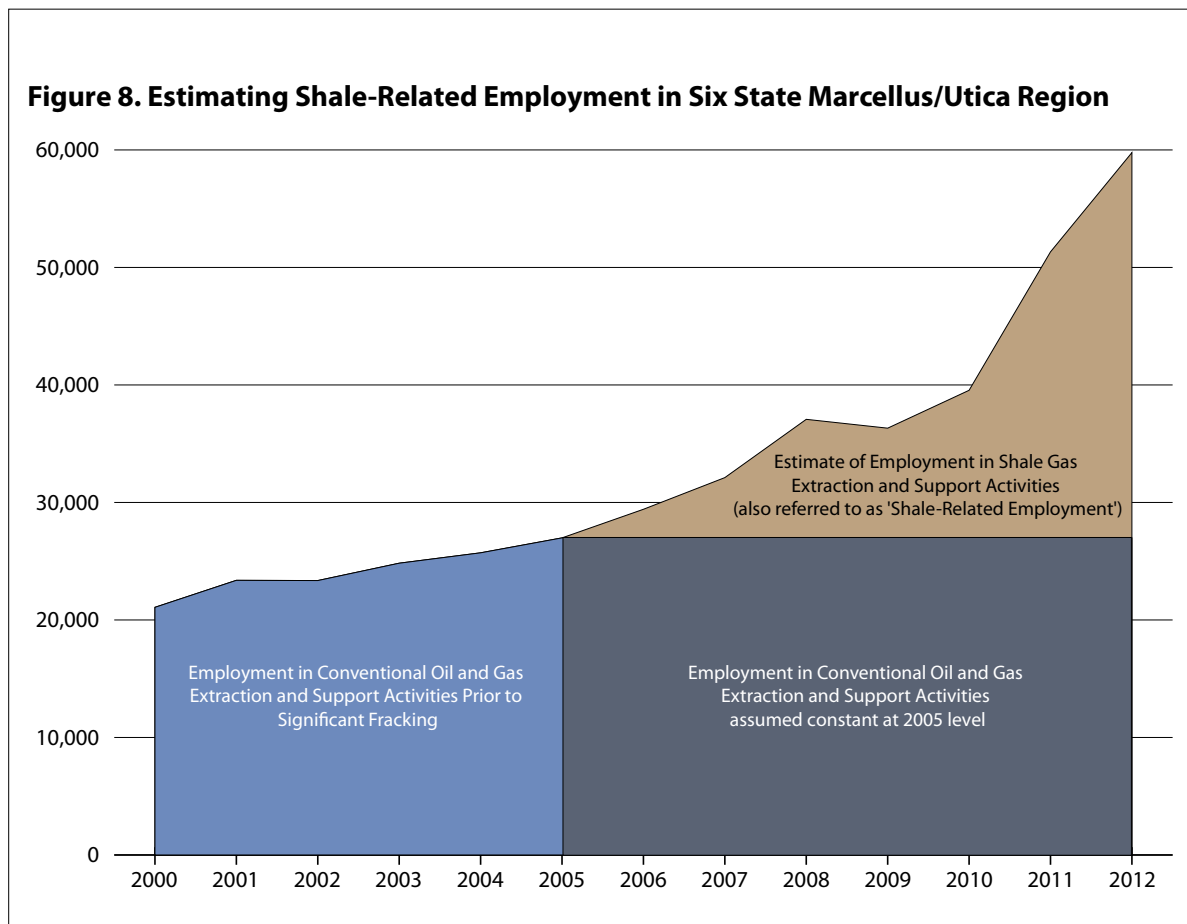
cont.

28 Another detailed industry – NAICS 486210, Pipeline Transportation of Natural Gas – would ideally be included in our employment aggregate for shale-related employment. While reported for Pennsylvania and the United States, however, this is not reported separately for the other states.

29 As well as NAIC 213111 and 213113, NAICS 213 includes three other detailed industries unrelated to shale extraction: Support Activities for Coal Mining (213113); Support Activities for Metal Mining (213114) and Support Activities for Nonmetallic Mining Except Fuels (213115). This compounds the challenge that already exists because even the most detailed industries consist of more than shale-related employment. For a full description of each industry, see the Bureau of Labor Statistics for Oil and Gas Extraction (<http://www.bls.gov/iag/tgs/iag211.htm>) and for Support Activities for Mining (<http://www.bls.gov/iag/tgs/iag213.htm>), and the Census Bureau for Oil & Gas Pipeline & Related Structures Construction (<http://www.census.gov/econ/industry/def/d237120.htm>).

30 Employment in oil and conventional gas extraction and support activities – i.e., in these six detailed industries – was relatively stable from 1990 to 2005. See Table 2.

and Support Activities,³¹ which we also label shale-related employment³² for short.



County employment estimates. The challenges of analyzing shale-related employment multiply at the county level because less data are publicly disclosed by the BLS. To minimize this challenge, we examine trends in employment at the county level using a broad industry – the super-sector Natural Resources and Mining, which includes Oil and Gas Extraction but also Mining and Logging.³³ Of course, by using a broader super-sector, we unavoidably include more non-shale industries, confounding shale-related county employment trends with employment trends in other sectors such as coal extraction. A further challenge by comparison with our more precise state-level estimates is that the NAICS industry Oil & Gas Pipeline & Related Structures Construction, which falls outside Natural Resources and Mining, is not disclosed at the county level and is therefore excluded from our county analysis.³⁴

31 In most of its reports, the Department of Labor and Industry calculates recent increases in employment in these six industries, recognizing that the base of employment that existed prior to shale drilling is not shale jobs. The precise number of years for which the Department calculates the change in employment varies, although usually the initially year is later than 2005. This means that the changes in employment computed by the Department are lower than our estimate for Shale-Related Employment.

32 In Pennsylvania, the five bulleted six-digit NAICS industries on the previous page and the additional six-digit shale-related industry in footnote 25 (NAICS 486210, Pipeline Transportation of Natural Gas) are each publicly available. The labor market information agency of the Pennsylvania Department of Labor and Industry, The Center for Workforce Information and Analysis (CWIA), uses recent increases in employment in these six industries to measure what we call Shale-Related Employment. For Pennsylvania, employment in the CWIA aggregate of six six-digit industries increased by 22,735 jobs from 2005 to 2012. Using the aggregate of NAICS codes used to measure state shale employment in this report (see Table 3), employment increased by 22,441 from 2005 to 2012.

33 For a full description of the characteristics Mining and Natural Resources see the Bureau of Labor Statistics <http://www.bls.gov/iag/tgs/iag10.htm>

34 At the state level, oil & gas pipeline & related structures construction accounted for 28% of the job gains we attribute to shale extraction.

Shale-related Employment Across the Six States

From 1990 to 2005, employment in Oil and Gas Extraction and Support Activities in the six-state region ranged from 20,000 to 30,000, making clear that these states had significant employment in other forms of natural resource extraction that predated hydrofracking. (See Table 2. As explained in Box 1, we estimate employment in Shale Gas Extraction and Support Activities, or shale-related employment, as the increase in employment since 2005 in Oil and Gas Extraction and Support Activities. This increase in each state is shown at the bottom of the table.)

Since 2005, shale-related employment in the United States has increased by more than 283,000 jobs. Over the same period, employment in this aggregate grew by 22,441 jobs in Pennsylvania, 6,022 jobs in West Virginia, 2,791 jobs in Ohio, 563 jobs in Virginia, 324 jobs in Maryland, and 648 jobs in New York.

| Year | U.S. | Maryland | New York | Ohio | Penn- sylvania | Virginia | West Virginia | Regional Total | Rest of US |
|--------------------------------|---------|----------|----------|-------|-------------------|----------|------------------|-------------------|------------|
| 1990 | 449,938 | 838 | 3,696 | 8,872 | 8,234 | 2,249 | 5,459 | 29,348 | 420,590 |
| 1991 | 442,014 | 763 | 3,223 | 8,228 | 7,443 | 2,343 | 5,223 | 27,223 | 414,791 |
| 1992 | 398,654 | 762 | 2,610 | 7,116 | 7,115 | 2,150 | 5,200 | 24,953 | 373,701 |
| 1993 | 385,550 | 826 | 2,388 | 6,856 | 6,425 | 2,348 | 5,128 | 23,971 | 361,579 |
| 1994 | 384,652 | 833 | 2,351 | 6,620 | 6,482 | 2,598 | 5,344 | 24,228 | 360,424 |
| 1995 | 376,133 | 866 | 2,161 | 6,691 | 5,592 | 2,466 | 4,707 | 22,483 | 353,650 |
| 1996 | 378,538 | 882 | 2,333 | 6,702 | 5,381 | 2,523 | 4,562 | 22,383 | 356,155 |
| 1997 | 397,497 | 841 | 2,276 | 6,168 | 5,489 | 2,814 | 4,560 | 22,148 | 375,349 |
| 1998 | 399,228 | 859 | 2,222 | 6,200 | 5,553 | 2,368 | 5,251 | 22,453 | 376,775 |
| 1999 | 352,509 | 919 | 2,307 | 6,125 | 5,348 | 2,148 | 4,881 | 21,728 | 330,781 |
| 2000 | 360,452 | 665 | 2,270 | 6,098 | 5,504 | 2,190 | 4,349 | 21,076 | 339,376 |
| 2001 | 391,330 | 667 | 2,697 | 6,228 | 6,043 | 2,773 | 4,965 | 23,373 | 367,957 |
| 2002 | 372,137 | 715 | 2,550 | 6,095 | 6,086 | 2,667 | 5,240 | 23,353 | 348,784 |
| 2003 | 372,411 | 887 | 2,389 | 6,467 | 6,309 | 3,025 | 5,753 | 24,830 | 347,581 |
| 2004 | 385,040 | 972 | 2,122 | 6,538 | 6,712 | 2,932 | 6,438 | 25,714 | 359,326 |
| 2005 | 420,921 | 1,120 | 1,989 | 6,181 | 7,415 | 3,155 | 7,125 | 26,985 | 393,936 |
| 2006 | 480,734 | 1,211 | 2,194 | 6,316 | 7,871 | 3,833 | 7,994 | 29,419 | 451,315 |
| 2007 | 537,439 | 1,227 | 2,422 | 6,886 | 8,949 | 3,676 | 8,955 | 32,115 | 505,324 |
| 2008 | 601,224 | 1,628 | 3,821 | 7,571 | 10,017 | 4,038 | 9,999 | 37,074 | 564,150 |
| 2009 | 532,811 | 1,759 | 2,690 | 8,518 | 10,915 | 3,558 | 8,882 | 36,322 | 496,489 |
| 2010 | 540,172 | 1,119 | 2,588 | 6,910 | 16,095 | 3,579 | 9,254 | 39,545 | 500,627 |
| 2011 | 622,746 | 1,272 | 2,684 | 7,663 | 24,823 | 3,940 | 10,944 | 51,326 | 571,420 |
| 2012 | 704,076 | 1,444 | 2,637 | 8,972 | 29,856 | 3,718 | 13,147 | 59,774 | 644,302 |
| Change from 2005 to 2012 | 283,155 | 324 | 648 | 2,791 | 22,441 | 563 | 6,022 | 32,789 | 250,366 |

Note. F Employment each year consists of the aggregate of employment in Oil and Gas Extraction (NAICS 211), Support Activities for Mining (NAICS 213), and Oil & Gas Pipeline & Related Structures Construction (NAICS 237120)

Source. Multi-State Shale Collaborative based on Quarterly Census of Employment and Wages data

Table 3 combines information presented in Table 1 on the number of wells drilled with data on shale-related employment in each of the Marcellus and Utica states. We find that Pennsylvania accounted for 71% of the wells drilled in the region over the period and 68% of the shale-related employment increase. West Virginia accounted for 24% of all wells drilled over the period and 18% of the shale-related employment increase. Ohio accounted for 10% of the wells drilled and 8.5% of the shale-related employment increase. Virginia accounted for 6% of wells drilled and less than 2% of the shale-related employment increase.

In the region as a whole, shale-related employment grew by almost 33,000 jobs as 8,750 wells were drilled. An estimated 3.7 jobs were created for every well drilled in the region. This figure stands in sharp contrast to the claims in industry-financed studies, which included estimates as high as 31 jobs created per well drilled.³⁵

| Table 3. | | | | | | | |
|--|----------|----------|-------|--------------|----------|---------------|----------------|
| Comparing wells drilled to estimated change in shale-related employment, 2005 to 2012 | | | | | | | |
| Year | Maryland | New York | Ohio | Pennsylvania | Virginia | West Virginia | Regional Total |
| Estimated Employment Increase | 324 | 648 | 2,791 | 22,441 | 563 | 6,022 | 32,789 |
| Share of Employment Increase | 1.0% | 2.0% | 8.5% | 68.4% | 1.7% | 18.4% | 100% |
| Total Wells Drilled 2005 to 2012 | 0 | 21 | 270 | 6,245 | 93 | 2,120 | 8,749 |
| Share of Wells Drilled 2005 to 2012 | 0.0% | 0.2% | 3.1% | 71.4% | 1.1% | 24.2% | 100% |

Source. Multi-State Shale Research Collaborative calculations based on drilling data reported by the Maryland Department of Environment, New York Department of Environmental Conservation, Ohio Department of Natural Resources, Pennsylvania Department of Environmental Protection, Virginia Department of Mines Minerals and Energy, and the West Virginia Geological and Economic Survey and employment data from the Quarterly Census of Employment and Wages

Employment growth in Shale Gas Extraction and Support Activities has been strong in percentage terms since 2005 but represents only a small slice of total statewide employment. (See Table 4 and Figures 9 to 11.) In West Virginia, Shale Gas Extraction and Support Activities accounted for one out of every 118 jobs in the state in 2012 – 0.8%. In Pennsylvania, shale-related employment accounted for one out of every 249 jobs. In Ohio, shale-related employment accounted for one out of every 1,809 jobs. In the region as a whole, shale-related employment accounted for nearly 33,000 jobs, one out of every 794 jobs. By contrast, the education and health sectors account for 4.5 million jobs in the region, one out of every six jobs. The manufacturing sector still accounts for more than 2 million jobs in the region, 63 times as much as shale gas extraction and support activity.³⁶

35 Timothy Considine, Robert Watson, and Nicholas Considine, The Economic Opportunities of Shale Energy Development, The Manhattan Institute, May 2011, http://www.manhattan-institute.org/pdf/eper_09.pdf

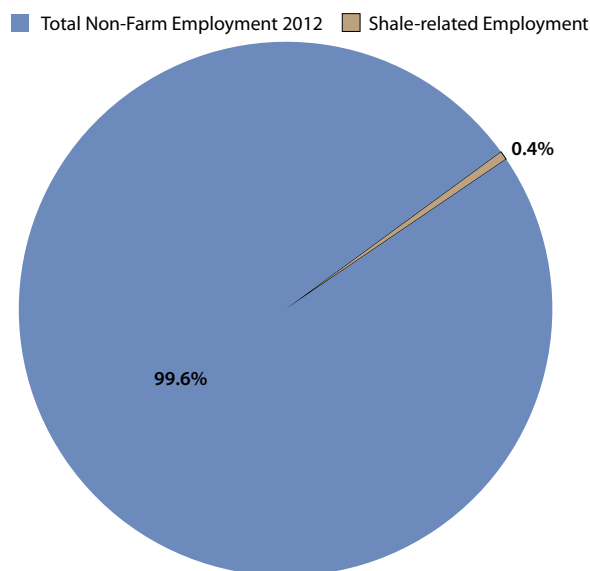
36 Employment statistics for other sectors in the previous two sentences are online at <http://www.bls.gov/news.release/laus.t05.htm>.

Table 4.**Shale-related employment as a share of total covered employment**

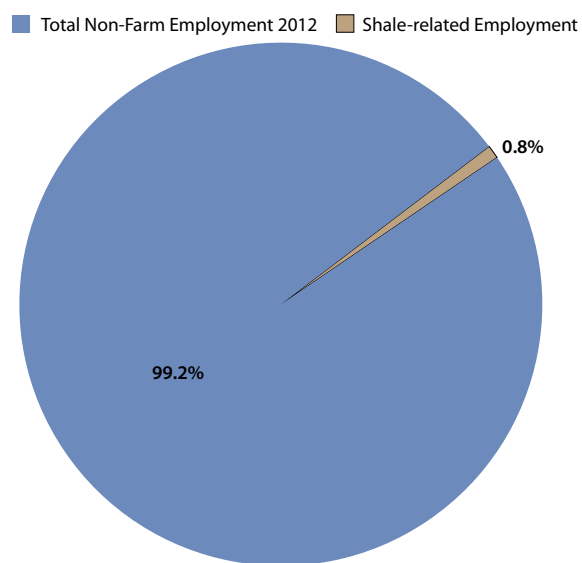
| Year | shale-related employment | total covered employment 2012 | Shale-related employment / total covered employment 2012 |
|----------------|--------------------------|-------------------------------|--|
| U.S. | 283,155 | 131,696,378 | 0.22% |
| Maryland | 324 | 2,511,669 | 0.01% |
| New York | 648 | 8,563,125 | 0.01% |
| Ohio | 2,791 | 5,048,166 | 0.06% |
| Pennsylvania | 22,441 | 5,578,414 | 0.40% |
| Virginia | 563 | 3,619,176 | 0.02% |
| West Virginia | 6,022 | 710,590 | 0.85% |
| Regional Total | 32,789 | 26,031,140 | 0.13% |
| Rest of US | 250,366 | 105,665,238 | 0.24% |

Note. Shale-related employment is defined here as the change between 2005 and 2012 in the sum of employment in Oil and Gas Extraction (211), Support Activities for Mining (213), and Oil & Gas Pipeline & Related Structures Construction (237120)

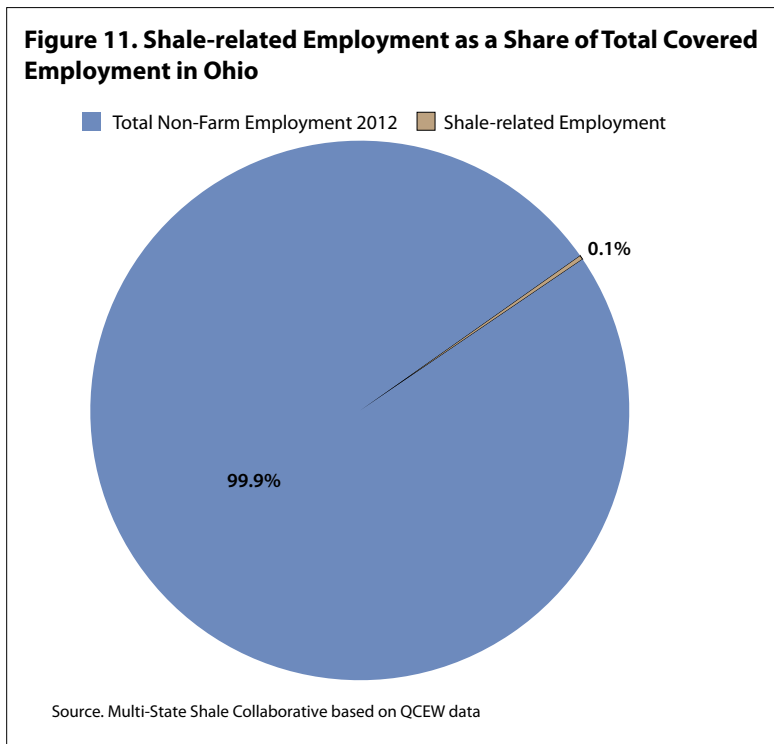
Source. Multi-State Shale Collaborative based on Quarterly Census of Employment and Wages data

Figure 9. Shale-related Employment as a Share of Total Covered Employment in Pennsylvania

Source. Multi-State Shale Collaborative based on QCEW data

Figure 10. Shale-related Employment as a Share of Total Covered Employment in West Virginia

Source. Multi-State Shale Collaborative based on QCEW data



Shale-related employment, while growing rapidly, accounts for a small slice of overall in employment growth in the region. For the six Marcellus-Utica Shale states, we find that shale-related employment increases job growth in West Virginia and Pennsylvania by a small amount: 0.5% in Pennsylvania versus 0.1% without shale-related employment, and 2.2% in West Virginia versus 1.3% without shale jobs. (See Figure 12, Table 5, and Table A2 in the Appendix.³⁷) Across the six states, the three states in which there was essentially no drilling — New York, Virginia, and Maryland — ranked first, third, and fourth, respectively, for job growth even when shale-related jobs are included. By contrast, the three states with the most drilling — West Virginia, Pennsylvania, and Ohio — ranked second, fifth, and sixth, respectively, for job growth in the region.

While shale-related employment growth has made a positive contribution to job growth in the region, the contribution was small. Shale development is not the primary driver in any of the state economies profiled here.

Table 5.

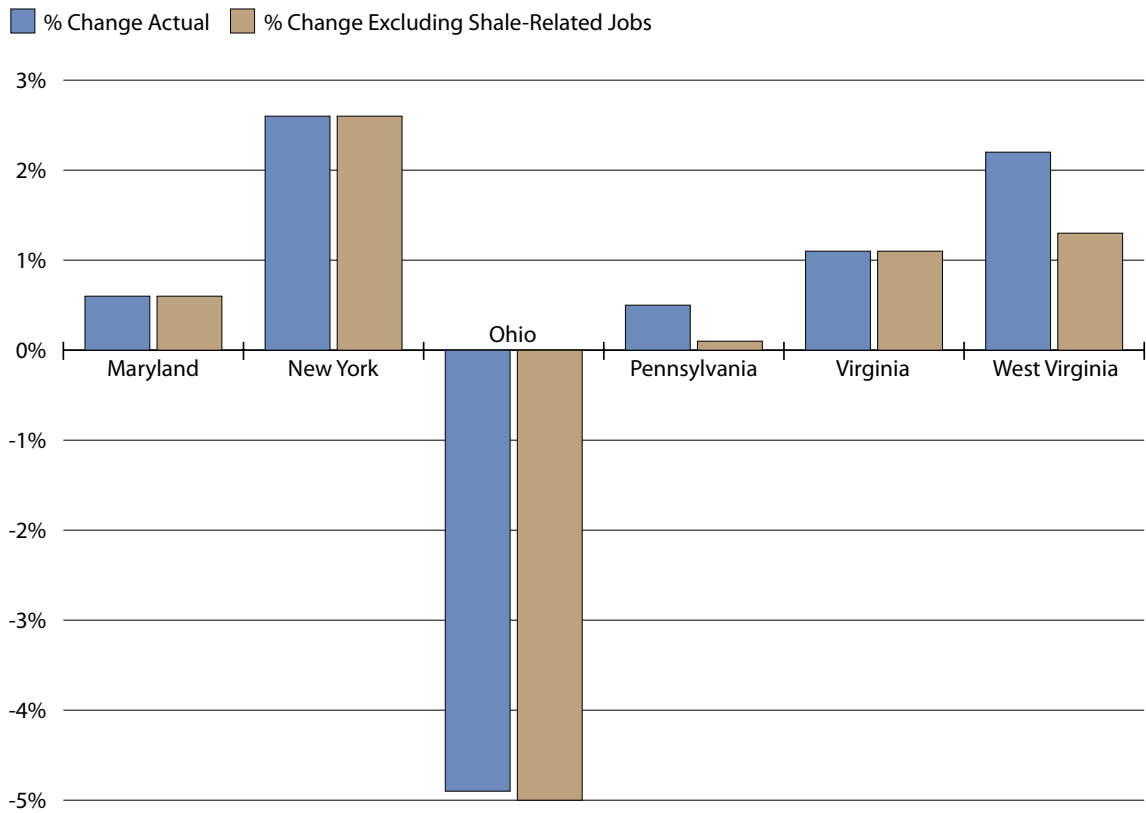
State Job Growth Ranking With and Without Shale Jobs, 2005 to 2012 (out of 43 states for which shale-related employment data exist)

| | Actual Job Growth Ranking | Job Growth Ranking Excluding Shale Jobs |
|---------------|---------------------------|---|
| Maryland | 20 | 19 |
| New York | 12 | 12 |
| Ohio | 40 | 40 |
| Pennsylvania | 21 | 23 |
| Virginia | 18 | 16 |
| West Virginia | 13 | 14 |

Source. Multi-State Shale Collaborative based on QCEW data

³⁷ The state job-growth rankings are out of 43 states for which we have a complete shale-related employment series. Some shale employment data is suppressed in the other seven states.

Figure 12. Growth in Shale Jobs Makes Little Difference to State Job Growth, 2005-12



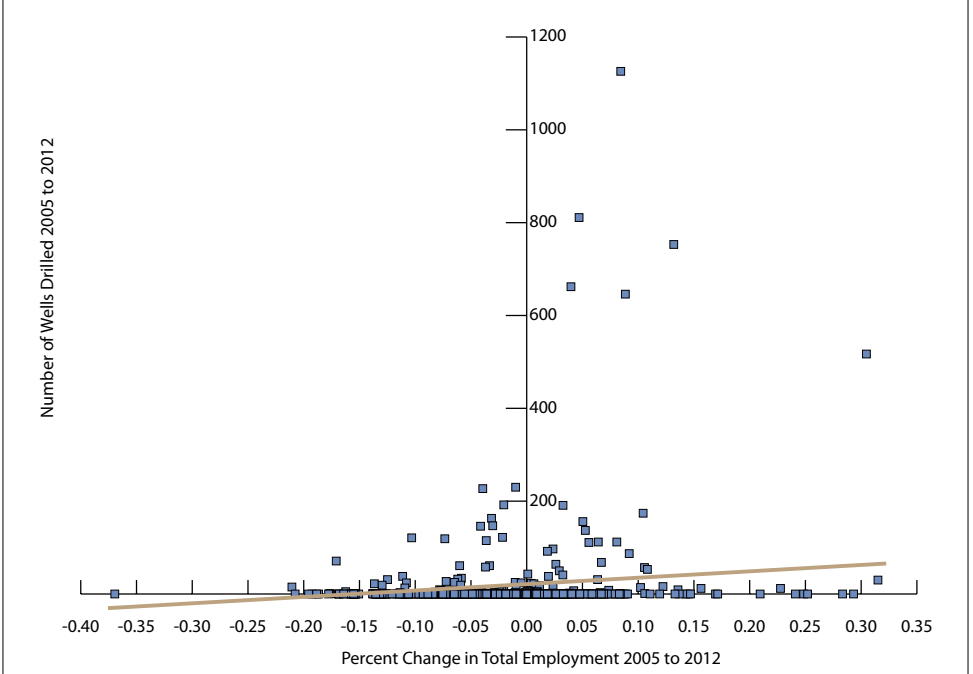
Source: Multi-State Shale Collaborative based on QCEW data.

Shale-related Employment at the County Level

Looking at county-level shale employment, most top job-growth counties across the region did not have a single well drilled. Only Greene County in Pennsylvania was among the top 10 counties for job growth. (See Figure 13.) While the green “best fit” line in Figure 13 shows that there is a slight correlation between wells drilled and job growth, the relationship is a very weak one.

The 23 counties with 100 or more shale wells drilled between 2005 and 2012 did experience employment growth that helped cushion them from the worst effects of the Great Recession. Even so, in only five of those 23 counties did Natural Resources and Mining account for more than one out of 10 overall jobs. (See Table 6.) And not every county with high shares of employment in Natural Resources and Mining

Figure 13. Percent Change in the Total Covered Employment by the Number of Wells Drilled



were guaranteed good overall employment performance. Boone County in West Virginia, for example, had the highest share of employment in Natural Resources and Mining (40%) and the second-biggest percentage point decline in total employment (-7.3%).

Table 6.

| State, County | Natural Resources & Mining Employment | | | Total Shale Wells Drilled Between 2005 & 2012 | Total Covered Employment | Natural Resources and Mining as a Share of Total Covered Employment |
|------------------|---------------------------------------|------|------------|---|-----------------------------|---|
| | 2005 | 2012 | Change | | Percent Change 2005 to 2012 | |
| PA, Bradford | 333 | 1540 | 1207 | 1126 | 8.4% | 6% |
| PA, Tioga | 99 | 471 | 372 | 811 | 4.7% | 3% |
| PA, Washington | 1403 | 3126 | 1723 | 753 | 13.2% | 4% |
| PA, Lycoming | 296 | 2057 | 1761 | 662 | 4.0% | 4% |
| PA, Susquehanna | 504 | 821 | 317 | 646 | 8.8% | 9% |
| PA, Greene | 2528 | 4269 | 1741 | 517 | 30.5% | 28% |
| PA, Fayette | 433 | 892 | 459 | 230 | -1.0% | 2% |
| PA, Westmoreland | 731 | 1115 | 384 | 227 | -3.9% | 1% |
| WV, Kanawha | 2524 | 2434 | -90 | 192 | -2.1% | 2% |
| WV, Logan | 1457 | 2069 | 612 | 191 | 3.3% | 17% |
| PA, Butler | 715 | 634 | -81 | 174 | 10.4% | 1% |
| WV, Ritchie | 281 | 531 | 250 | 163 | -3.2% | 17% |
| WV, Harrison | 756 | 1032 | 276 | 156 | 5.0% | 3% |
| PA, Clearfield | 722 | 765 | 43 | 147 | -3.0% | 2% |
| PA, Armstrong | 1580 | 1478 | -102 | 146 | -4.1% | 8% |
| WV, Doddridge | | | | 137 | 5.3% | |
| WV, Upshur | 1053 | 673 | -380 | 122 | -2.2% | 8% |
| WV, Jackson | 93 | 65 | -28 | 121 | -10.3% | 1% |
| WV, Boone | 3877 | 3165 | -712 | 119 | -7.3% | 40% |
| WV, Wetzell | 32 | 125 | 93 | 115 | -3.6% | 3% |
| OH, Carroll | 39 | 173 | 134 | 112 | 6.4% | 3% |
| PA, Wyoming | 146 | 414 | 268 | 112 | 8.1% | 4% |
| WV, Lincoln | 390 | 545 | 155 | 111 | 5.6% | 17% |
| Average | | | 382 | | 3.2% | 8% |

Source. Multi-State Shale Collaborative based on QCEW and Bureau of Economic Analysis (BEA) Data.

Between 2001 and 2005 (before horizontal drilling began in earnest) and from 2005 to 2012 (when horizontal drilling intensified), Natural Resources and Mining employment growth helped boost overall employment in 335 counties or county groups³⁸ across the six states. (See Table 7 and Figure 14, which define a drilling county as having at least one well drilled between 2002 and 2012.) From 2001 to 2005, however, drilling counties experienced slower total employment growth than non-drilling counties (0.73% versus 3.45%) despite growth

38 There are 432 counties in the region. No employment data was disclosed for two small Virginia Counties, South Boston City and Clifton Forge City. Another 53 Virginia counties have personal income data reported by the Bureau of Economic Analysis in one of 24 county groups. We used the same 24 county groups for Virginia in our analysis. Employment data in another 66 counties were not disclosed in Natural Resources and Mining and thus were not included in our analysis.

in Natural Resources and Mining employment of over 16%. From 2005 to 2012, which includes the Great Recession, drilling counties experienced faster employment growth than non-drilling counties, buoyed in part by 59% growth in natural research and mining jobs. Nonetheless, drilling and non-drilling counties alike experienced negative total employment growth — -0.62% and -2.98%, respectively.

Table 7.
Percent change in employment in natural resources and mining employment and total covered employment in two periods in drilling and non-drilling counties in MD, NY, OH, PA, VA & WV

| Counties | 2001 to 2005 | | |
|-----------------------|------------------------------|---------------|---|
| | Natural Resources and Mining | Total Covered | Total Covered Minus Natural Resources and Mining [¥] |
| Non-drilling counties | 3.85% | 3.45% | 3.58% |
| Drilling counties | 16.13% | 0.73% | 0.28% |
| Counties | 2005 to 2012 | | |
| | Natural Resources and Mining | Total Covered | Total Covered Minus Natural Resources and Mining [¥] |
| Non-drilling counties | 7.28% | -2.98% | -3.04% |
| Drilling counties | 59.16% | -0.62% | -2.10% |

Note. [¥] There are 432 counties in the region. No employment data was disclosed for two small Virginia Counties, South Boston City and Clifton Forge City. Another 53 Virginia counties were consolidated into 24 county groups to ease comparison with employment data published by the Bureau of Economic Analysis leaving data for 401 counties or county groups. Of those 401 counties 66 had employment data for Natural Resources and Mining not disclosed by the Bureau of Labor Statistics leaving 335 counties represented in the analysis above.

Source. Author's analysis of the Quarterly Census of Employment and Wages.

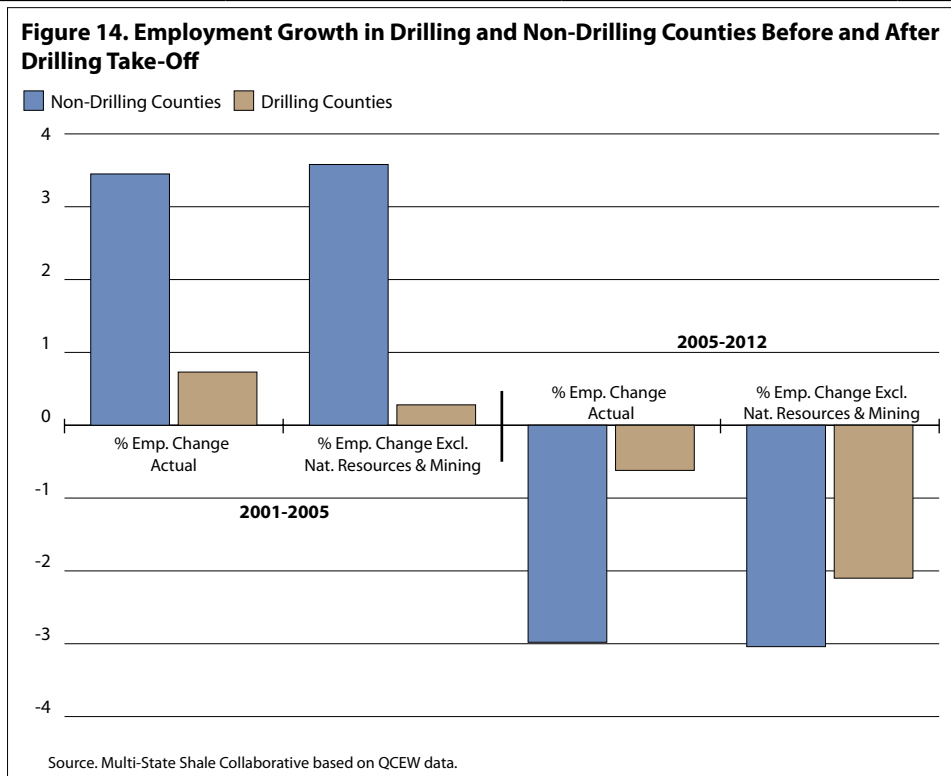


Table 7 presents employment trends for drilling and non-drilling counties using only crude averages, without taking into account other factors that impact employment trends. Weinstein and Partridge go beyond

examining simple correlations between drilling and job growth, employing a statistical model to disentangle the impact of drilling on county employment and income from other factors, including the Great Recession.³⁹ In Pennsylvania counties between 2005 and 2009, they found no statistically significant link between the number of wells drilled and overall employment growth. The authors suggested that this may be due to the capital-intensive nature of drilling (which reduces its employment impact) or the negative impact of shale on jobs in other sectors (e.g., tourism). The authors did find a positive and statistically significant relationship between the number of wells in a county and the percentage change in income growth; they suggested that this may reflect the impact of leasing and royalty payments to local landowners.⁴⁰

In Table 8, we update the Weinstein and Partridge analysis of drilling and employment to 2012 and include counties in Maryland, New York, Ohio, Virginia and West Virginia in addition to Pennsylvania.⁴¹ The Great Recession, represented by the variable Time Period – had a large and statistically significant impact on employment. The variable Time Period * Total Wells, which measures the effect on employment of the wells drilled from 2005 to 2012, is not statistically significant.⁴²

Weinstein and Partridge’s difference in difference analysis for Pennsylvania also finds no statistically significant link between the number of wells drilled and overall employment growth from 2005 to 2009. We replicate this finding for Pennsylvania employment data from both the BEA and the QCEW for the period 2005 to 2009 as well as for 2005 to 2011 (BEA data) and 2005 to 2012 (QCEW data). We also applied this difference in difference model to a sample limited to just observations from counties in West Virginia, Ohio and Pennsylvania and still find no statistically significant link between the number of wells drilled and employment growth in either QCEW (2005 to 2012) or BEA employment data (2005 to 2011).

| Table 8. | | | |
|--|--------------------------|----|---------|
| Percent Employment Growth | Total Covered Employment | | |
| | coefficient | | t-value |
| Time Period * Total Wells | -0.0007 | | -0.510 |
| Time Period | -0.0480 | ** | -8.020 |
| Total Wells | 0.0009 | | 0.640 |
| Log Population (2001) | -0.0076 | * | -2.060 |
| Log Per Capita Income (2001) | 0.1072 | ** | 4.380 |
| Constant | -0.9806 | ** | -4.510 |
| N | 802 | | |
| R-Square | 0.1285 | | |
| Notes. * and ** indicate significance at the 5 and 1 percent levels respectively. | | | |
| Source. Author’s analysis of data from the Quarterly Census of Employment and Wages and Bureau of Economic Analysis. | | | |

39 Weinstein, A.L., & Partridge M. D., “The Economic Value of Shale Gas in Ohio”, December 2011. See Appendix 2 on Page 33-34.

40 In a separate analysis, Weinstein and Partridge paired high-drilling and non-drilling counties in Pennsylvania, matching these counties on the basis of “population and similar employment and income dynamics before 2005 and the advent of shale drilling,” as well as ensuring matched counties were in the same part of the state. Weinstein and Partridge. Tracking the counties’ employment growth from 1995 to 2009, they found “no clear employment effects for heavily drilled counties.” Looking at the same counties, the researchers did see an advantage for the high-drilling counties with respect to per capita income growth after 2004, a result that may reflect leasing and royalty payments.

41 Weinstein and Partridge rely on the U.S. Commerce Department’s Bureau of Economic Analysis (BEA) employment data in their analysis. Our results presented in Table 8 rely on employment data from the Quarterly Census of Employment and Wages (QCEW) which is current through 2012. Our results using QCEW data are similar to our results when using employment data from BEA which is current through 2011.

42 Weinstein and Partridge op. cit.

Clearly, drilling for shale oil and gas creates jobs on drilling rigs, driving water trucks, building pipelines, and staffing local restaurants and hotels. The statistical results presented in Table 8 do not contradict those observations but serve to put that job creation in the proper context. Most of the job impacts of unconventional shale oil and gas development have been concentrated in roughly two dozen small mostly rural counties. (See Table 6.) In a statistical analysis using a sample of all counties from the entire Marcellus/Utica region, the impact of drilling on jobs is not substantial.

Similarly at the state level, shale drilling has made a positive contribution to overall job growth in a period of exceptionally weak overall employment growth, but that impact is small and has not fundamentally changed the trajectory of any of the state labor markets considered here. (See Table 5.)

Box 2. New Hires Are Not New Jobs

In 2011, a confluence of errors led to widespread citation in Pennsylvania of a little-known statistic – known as “new hires” – as if it were the same as employment creation.

New hire numbers come from a database developed by the Office of Child Support Enforcement at the U.S. Department of Health and Human Services to track employment of non-custodial parents liable for child support payments. In response to industry and public interest in information on the natural gas industry, the Pennsylvania Department of Labor and Industry began to publish estimates of new hires in shale-related industries in its quarterly Marcellus Fast Facts publication. This quickly led to citations of new hire figures (first 48,000, then 72,000) as if they were job creation at a time when direct shale-related employment was under 10,000.⁴³

The Department of Labor and Industry now points out clearly when it publishes Marcellus Fast Facts that new hires should not be confused with job growth. The difference is that new hire data capture employee additions to payrolls but not employee separations – including layoffs, retirements, or resignations. There is a great deal of churn in the U.S. labor market, and new hires must be offset by separations to accurately track actual employment growth. For example, in Pennsylvania between the 2nd quarter of 2012 and 2013, there were about half a million new hires. Over the same period, total nonfarm employment in Pennsylvania climbed by just 20,933, or 0.4%. The number of new hires equaled about 24 times the number of new jobs.

In sum, equating the number of new hires in shale-related industries to new jobs wildly overstates employment creation resulting from hydrofracking. Fortunately, the misuse of this new hire data to fan inflated estimates of the jobs created by shale drilling in Pennsylvania has largely faded.

⁴³ For more on the misuse of data on new hires see the Keystone Research Center’s report “Drilling Deeper into Job Claims” available online at http://keystoneresearch.org/sites/keystoneresearch.org/files/Drilling-Deeper-into-Jobs-Claims-6-20-2011_0.pdf.

IV. The Total Employment Impacts of Shale Drilling

The employment impacts of the shale gas industry go beyond the extraction and support activity jobs discussed in the previous section. They include jobs in suppliers to the industry, such as trucking companies that carry water to well pads, drilling equipment manufacturers, and real estate companies that assist gas companies acquire drilling leases on land rich in shale gas. Beyond suppliers, jobs are also created when workers, business owners, and landowners spend the wages, profits, or royalties earned from the shale industry or its suppliers. Economists refer to supply-chain jobs as “indirect jobs” and jobs created by the spending of income earned from the industry or its suppliers as “induced jobs.” Jobs at drilling companies themselves are referred to as “direct” jobs.⁴⁴

Input-Output Studies of the Jobs Impact of Shale Drilling

The standard approach to estimate the total jobs footprint of an industry – including direct, indirect, and induced jobs – is to use what economists call an “input-output model.” For each direct job created in any industry or group of industries, an input-output model provides estimates – based on actual economic data – of how many indirect and induced jobs are produced in all other industries.⁴⁵

In recent years, input-output studies on the actual or potential jobs impact of shale drilling have been conducted in four of the six Marcellus/Utica states: West Virginia, Pennsylvania, Ohio, and New York. Many of these studies have been funded by the industry, while others have been conducted by academic or other researchers without industry ties.

We begin with Pennsylvania, which has been the subject of the largest number of studies, allowing comparison and analysis of differences in estimates. In addition, enough time has passed to allow us to compare the earliest projections of future employment in Pennsylvania with actual employment numbers.

Table 9 summarizes shale-related job estimates from seven different studies, four of them industry-funded studies authored by former Penn State and current University of Wyoming Professor Timothy Considine and various co-authors. The Considine studies with results for 2009 and 2010 can be compared with independent academic studies published by Penn State Professor Timothy Kelsey and Bucknell Professor Thomas Kinnaman. For 2010, the Considine studies have jobs estimates two to seven times higher than the Kelsey and Kinnaman studies. What explains these wide variations?

The Considine, Watson, and Blumsack study in 2010, which produced the highest job estimates, was based on a 2009 survey of drillers, in which drillers reported spending \$4.5 billion in 2009 and planning to spend \$8 billion in 2010 and \$11 billion in 2011. Considine and his co-authors then fed these spending levels into an input-output model known as IMPLAN, concluding that these spending levels translated into 21,778 direct, 8,732 indirect, and 13,587 induced jobs in 2010 – for a grand total of 44,098. This was roughly twice the 2009 estimate of Kelsey et al., who based direct job estimates on detailed natural gas company spending for 2008, adjusted to 2009 using other publicly available industry data. Considine et al. used the projected spending levels from their survey of gas companies to estimate direct jobs in 2010 and 2011, leading to total job projections as much as seven times higher than Weinstein and Partridge. To generate their lower estimates of direct jobs in 2010, Weinstein and Partridge did not use data on natural gas company spending. Instead, they

44 We avoided the use of the term direct jobs earlier in the report because Shale Gas Extraction and Support Activities as we have defined them include some indirect as well as direct jobs.

45 Standard input-output models can also translate dollar amounts of economic activity in an industry (or industry aggregate) into dollar amounts in other industries as a result of indirect and induced demand.

used the increase (from 2004 to 2010) in employment in a group of industries similar to what we have called Shale Gas Extraction and Support Activity – roughly 10,000 jobs – as their estimate of direct jobs, and then used an input-output model to generate estimates of the indirect and induced jobs.

| Table 9. | | | | | | | | |
|---|--------|--------|---------|---------|---------|---------|---------|---------|
| Estimates of shale-related employment levels in Pennsylvania drawn from input-output studies | | | | | | | | |
| Study | 2008 | 2009 | 2010 | 2011 | 2012 | 2015 | 2020 | 2035 |
| Considine, Watson, Entler, & Sparks (2009) | 29,284 | 48,590 | 107,040 | | | 160,570 | 174,700 | |
| Considine, Watson, & Blumsack (2010) | | 44,098 | 88,588 | 111,413 | | 160,205 | 211,909 | |
| Considine (2010)* | | 44,098 | | 98,222 | | 121,816 | 140,169 | |
| Considine, Watson, & Blumsack (JUL 2011) | | | 142,146 | 156,000 | 180,000 | 215,979 | 256,420 | |
| IHS (2012) | | | | | 102,668 | | 220,635 | 387,360 |
| Kelsey et al. (2011) | | 23,500 | 44,000 | | | | | |
| Weinstein & Partridge (2011) | | | 20,000 | | | | | |
| *Estimates are those associated with “medium development” scenario, i.e., an intermediate range of the number of projected wells. | | | | | | | | |
| Source. Multi-State Shale Collaborative | | | | | | | | |

The Considine et al. estimates of shale’s total jobs impact exceed those in the two academic studies for two main reasons. The first is that their spending survey generates direct job totals far in excess of the direct jobs estimated using spending data by Kelsey et al. or using actual employment data by Weinstein and Partridge. The second reason is that the multiplier effects that result from Considine et al.’s models produce much higher ratios of indirect and induced to direct jobs. Two articles, one authored by Weinstein and Partridge and the other by Thomas Kinnaman, help explain how the assumptions made by Considine and his co-authors inflated job estimates associated with shale drilling:⁴⁶

- The Considine studies assumed with little empirical support that 95% or more of expenditures would occur within the state being studied.⁴⁷ Assuming such a large fraction of spending remains within the boundaries of a state – and little of the spending “leaks out” to other states – inflates the estimate of the jobs created within that state. Considine’s Pennsylvania studies assumed, in effect, that 95% of the

46 See Kinnaman, T.C., (2011). The Economic Impact of Shale Gas Extraction: A Review of Existing Studies. Ecological Economics, 70, 1243-1249. and Weinstein A. L., & Partridge, M. D., (2011) The Economic Value of Shale Natural Gas in Ohio. Working Paper.

47 Given the Considine et al. approach, which begins with gas company spending levels from a survey, the assumption that spending occurs 95% in Pennsylvania inflates the direct jobs estimate as well as the indirect.

economic benefit of the purchase of a durable good such as a car paid for with natural gas lease royalties would occur with the boundaries of Pennsylvania when, in fact, other states (or countries), manufacture most cars and car parts.

- The industry studies assumed that all leasing royalties generated by drilling were spent on goods and services in the year they were received. Assuming that none of the leasing income that families receive will be saved or used to pay down debt is an extreme assumption without support in the economic literature.⁴⁸ Because more than half of spending by drilling companies represents lease payments this assumption is extremely important and substantially overstated the job gains associated with the expansion of drilling.
- Input-output analysis does not typically take into account the potential lost economic activity associated with development. For example, many of the communities in which drilling has expanded are relatively sparsely populated. It is widely perceived in these communities that the expansion of drilling led to a shortage of available hotel rooms. As a result, drilling may have crowded out tourism jobs because tourists could not find a room at a reasonable price or at all. More generally, the increase in drilling may, through rising input prices, lower employment in other parts of the local economy.

As the preceding bullets make clear, the results of input-output analysis depend on the accuracy of the assumptions made. Policymakers, the media, and the public at large should know that input-output analysis is a useful tool, but it is important that the analysis it produces is replicable by other researchers and that its assumptions are stated clearly and well-supported by relevant literature and economic theory.

Tables 10, 11, and 12 summarize the estimates of employment impacts from studies in West Virginia, Ohio, and New York. While (with one noted exception) the studies shown in the tables have been funded by industry, there are some variations in their findings.

In West Virginia, a Considine study produced estimates roughly twice as high as two other industry studies. (See Table 10.) The two other studies' findings are quite compatible with the estimates of Shale Gas Extraction and Support Activity jobs generated earlier in this paper. A 2010 study produced by West Virginia University and funded by the West Virginia Oil and Natural Gas Association estimated that Marcellus Shale development was responsible for 7,600 jobs (3,600 direct; 4,000 indirect and induced) in the state in 2009.⁴⁹ The study's authors deemed these estimates conservative because the data used for their input-output analysis did not include the economic impact of royalty payments and transportation and processing of gas. As a point of comparison, the direct employment estimate is nearly twice the increase in West Virginia Oil and Gas Extraction and Support Activities jobs since 2005 (although similar to the increase in such jobs from 2003 to 2012). (See Table 3.) IHS estimated total (direct, indirect, and induced) shale-related employment in West Virginia at nearly 12,000 for 2012, compatible with our estimate of 6,000 West Virginia shale-related employment in 2012. Looking ahead, IHS forecast the total jobs stemming from shale gas and oil development in 2035 to reach 58,000, or 6.8%, of West Virginia's labor force, "helping to reduce unemployment and creating a steady source of payroll growth for the next two decades."⁵⁰

48 Kelsey, T.W., Shields, Ladlee, J. & Ward, M. (2011) Economic Impacts of Marcellus Shale in Pennsylvania: Employment and Income in 2009. Marcellus Shale Education and Training Center found that landowners save or invest 55% of the income they earn from leasing royalties.

49 Amy Higginbotham, Adam Pellillo, Tammy Gurley-Calvez, and Tom S. Witt. The Economic Impact of the Natural Gas Industry and the Marcellus Shale Development in West Virginia 2009. West Virginia University. December 2010. <http://be.wvu.edu/bber/pdfs/BBER-2010-22.PDF>

50 IHS. State Economic Contributions.

| Table 10. | | | | | | |
|---|--------|--------|--------|--------|--------|--------|
| Estimates of shale-related employment levels in West Virginia drawn from input-output studies | | | | | | |
| Study | 2009 | 2011 | 2012 | 2015 | 2020 | 2035 |
| Considine (2010)* | 13,249 | 18,437 | | 20,864 | 25,810 | |
| Higginbotham et al. (2009)** | 7,600 | | | | | |
| IHS (2012) | | | 11,884 | | 29,656 | 58,244 |
| *Estimates are those associated with “medium development” scenario, i.e., an intermediate range of the number of projected wells. | | | | | | |
| **Estimate does not include impact of leasing and royalty payments. | | | | | | |
| Source. Multi-State Shale Collaborative | | | | | | |

In Ohio, the bulk of shale development is expected to center on the Utica Shale, rather than the Marcellus. A 2011 study undertaken by Kleinhenz and Associates for the Ohio Oil and Gas Energy Education Program projected total (direct, indirect, plus induced) shale-related employment in Ohio at about 4,600 jobs in 2011. (See Table 11.)⁵¹ Our estimate of shale-related employment in 2011 is only about 1,500 so 4,600 implies a rather high multiplier — the ratio of indirect plus induced jobs to direct jobs. Considerably more incompatible with actual employment data is the Kleinhenz estimate that total shale-driven employment would more than quadruple in 2012, to 22,297. Given our estimated change in shale-related employment from 2011 to 2012 of only about 1,000, this Kleinhenz projection seems an overestimate. More inconsistent still with recent employment trends is the Kleinhenz projection of employment growing to 200,000 by 2015. A report authored by academics from several institutions and published in 2012 by the Ohio Shale Coalition, a project of the Ohio Chamber of Commerce, estimated total shale-related employment at 12,150 in 2012 and forecast to reach about 66,000 in 2014.⁵² This is lower than Kleinhenz and Associates but still a very rapid increase and inconsistent with 2012 data. As with the other studies referenced, input-output analysis was used, but the authors acknowledged weaknesses associated with this method in general and with previous industry-sponsored shale studies in particular, and their method addressed a number of these concerns. IHS estimated Ohio total 2012 shale-driven employment at nearly 39,000, 1.7 times larger than the Kleinhenz and Associates estimate and 3.2 times the size of the Ohio Shale Coalition level.⁵³ IHS’s forecast for Ohio echoed that for West Virginia, once more stating that shale-related employment would be “helping to reduce unemployment and creating a steady source of payroll growth for the next two decades.”⁵⁴

| Table 11. | | | | | | | |
|---|-------|--------|---------|---------|---------|---------|---------|
| Estimates of shale-related employment levels in Ohio drawn from input-output studies | | | | | | | |
| Study | 2011 | 2012 | 2013 | 2014 | 2015 | 2020 | 2035 |
| IHS (2012) | | 38,830 | | | | 143,595 | 266,624 |
| Kleinholz & Assoc. (2011) | 4,614 | 22,297 | 102,924 | 178,088 | 204,521 | | |
| Thomas et al. (2012) | 2,275 | 12,150 | 40,606 | 65,680 | | | |
| Source. Multi-State Shale Collaborative | | | | | | | |

51 Kleinhenz and Associates. Ohio’s Natural Gas and Crude Oil Exploration and Production Industry and the Emerging Utica Gas Formation: Economic Impact Study. September 2011. <http://energyindepth.org/wp-content/uploads/ohio/2011/09/Ohio-Natural-Gas-and-Crude-Oil-Industry-Economic-Impact-Study-September-2011.pdf>

52 Andrew R. Thomas, Iryna Lendel, Edward W. Hill, Douglas Southgate, and Robert Chase. An Analysis of the Economic Potential for Shale Formations in Ohio. 2012. http://urban.csuohio.edu/publications/center/center_for_economic_development/Ec_Impact_Ohio_Utica_Shale_2012.pdf

53 IHS. State Economic Contributions.

54 IHS. State Economic Contributions.

In New York, a moratorium enacted in 2010 has so far precluded hydrofracking, but Considine, Watson, and Considine (2011) forecast the employment impact if hydrofracking proceeded in a study for a conservative think tank, the Manhattan Institute. (See Table 12.) Considine and his co-authors projected 15,000 to 18,000 total jobs if hydrofracking were allowed in the Southern Tier and Western New York.⁵⁵ If hydrofracking were permitted in a more widespread area, including Utica County and Southeastern New York (an area that includes New York City’s watershed), Considine et al. projected an additional 75,000 to 90,000 jobs. Given New York’s labor force of over 9.5 million in 2012, even 90,000 jobs is less than 1% of state employment.⁵⁶ The track record of Considine studies compared to more independent studies and actual employment trends strongly suggests that this number is much higher than can reasonably be expected and exceeds actual employment in other drilling states. New Yorkers might reasonably conclude that 90,000 jobs would be unlikely to materialize.

| Table 12. | | | |
|---|-------|----------------|--------|
| Estimates of shale-related employment levels in New York drawn from input-output studies | | | |
| Study | 2011 | 2015 | 2020 |
| Considine (2010)* | 1,419 | 15,727 | 18,027 |
| Considine, Watson, & Considine (2011)** | | 15,000-18,000 | |
| Considine, Watson, & Considine (2011)*** | | 90,000-108,000 | |
| *Estimates are those associated with “medium development” scenario, i.e., an intermediate range of the number of projected wells. | | | |
| **Assumes drilling limited to Southern Tier and Western New York | | | |
| ***Assumes drilling occurs in Southern Tier, Western New York, Utica, and Southeastern New York | | | |
| Source. Multi-State Shale Collaborative | | | |

Most “Marcellus Shale Ancillary Jobs” Are Not Related to Shale Drilling

A second approach to gauging the indirect jobs associated with shale drilling is a data series on “ancillary” jobs developed by the Pennsylvania Department of Labor and Industry. As explained in more detail below, the Department has identified 30 industries into which most suppliers to shale gas companies fall, which is reasonable, and then added up all the jobs in these industries attributing them all to the Marcellus, which is not reasonable. As a result, the agency’s total ancillary employment number overstates the employment impact of the industry.

Unfortunately, a growing number of shale industry champions have used the total number of jobs in so-called shale ancillary industries in highly misleading ways. For example:

- The U.S. Chamber of Commerce’s Institute for 21st Century Energy “Shale Energy in Pennsylvania” fact sheet⁵⁷ highlights, in an infographic, “238,000” as the number of “Jobs in Shale-Related Industries Through 2011” with a footnote indicating that this information is “According to the Pennsylvania Department of Labor and Industry.”⁵⁸

55 Timothy J. Considine, Robert W. Watson, and Nicholas B. Considine. The Economic Opportunities of Shale Energy Development. Center for Energy Policy and the Environment at the Manhattan Institute. May 2011. http://www.manhattan-institute.org/pdf/eper_09.pdf

56 Bureau of Labor Statistics Local Area Unemployment Statistics.

57 Available online at http://www.energyxxi.org/sites/default/files/file-tool/Pennsylvania_Fact_Sheet.pdf.

58 “2011 Q4 Marcellus Shale related industries total employment was 238,400, from Pennsylvania Department of Labor and Industry,” *Marcellus Shale Facts*, June 2012 Edition, July 5, 2012, p. 4.

- A two-page profile of “Marcellus and Utica Shale Gas” on the web page of the Pennsylvania Department of Community and Economic Development (http://www.newpa.com/webfm_send/3057) says, in a sub-section titled *Economic Benefits*, “The Shale gas industry has impacted Pennsylvania’s economy dramatically. In 2010, shale development...supported nearly 240,000 jobs in the oil and gas industry.”⁵⁹
- On November 6, 2013, Pennsylvania Governor Corbett told a crowd in Pittsburgh: “The energy industry in Pennsylvania is now supporting the livelihoods of over 200,000 people and their families who work in good-paying middle class jobs.”⁶⁰ Commonwealth of Pennsylvania Energy Executive Patrick Henderson made clear in an online comment that the Pennsylvania Department of Labor and Industry core plus ancillary employment figures were the basis for the Governor’s claim.

As noted, the Pennsylvania Department of Labor and Industry does indeed publish figures for employment in what it calls Marcellus Shale core plus ancillary, or “related,” industries. The Department’s core industries are the six detailed industries we used earlier in this report to measure Oil and Gas Extraction and Support Activities (with the change in employment since 2005 our proxy for shale employment).⁶¹ The ancillary industries include the 30 industries shown in Table 13 — examples include “highway, street, and bridge construction,” “sewage treatment facilities,” “general freight trucking,” and “industrial machinery and equipment wholesalers.”

The official names of the ancillary industries make clear that most are broad sectors that support the entire manufacturing sector and sometimes support retail, wholesale, and portions of the public sector or consumer industries as well. Only in the handful of industries directly linked to the shale supply chain – upstream or occasionally downstream – is shale gas likely to drive substantial employment in an ancillary industry. An example is natural gas distribution. In most of the broader industries – which also tend to be the larger industries, accounting for most of the 200,000 job aggregate – shale demand accounts for a tiny fraction of ancillary industry demand. To be fair, shale also accounts for a tiny portion of demand in lots of other industries not included in the ancillary list – identifying those impacts (a few jobs here, a few more there) is precisely one of the things that input-output analysis (with reasonable assumptions) does to gauge overall employment impact. That is why input-output analysis can be a reasonable and defensible methodology. Adding up ancillary jobs is not a defensible methodology.

Another simple way to see that the vast majority of ancillary jobs have nothing to do with shale drilling is by observing that these sectors had virtually the same number of jobs before and after shale drilling began. Figure 15 shows jobs since 2001 in ancillary industries in Pennsylvania, denoting the ones that existed from 2001 to 2005 as “Private Sector Ancillary Jobs Prior to Significant Fracking.” From 2005 forward in the diagram labeled “Projected Private Sector Ancillary Jobs Supporting Industries Other than Shale Gas” we assume private sector ancillary employment represents 2.926% of total covered employment (it’s share in 2005). The area labeled “Shale-Related Private Sector Ancillary jobs” is the increase in private sector ancillary employment above what we projected and therefore what might possibly be the result of increased drilling.⁶²

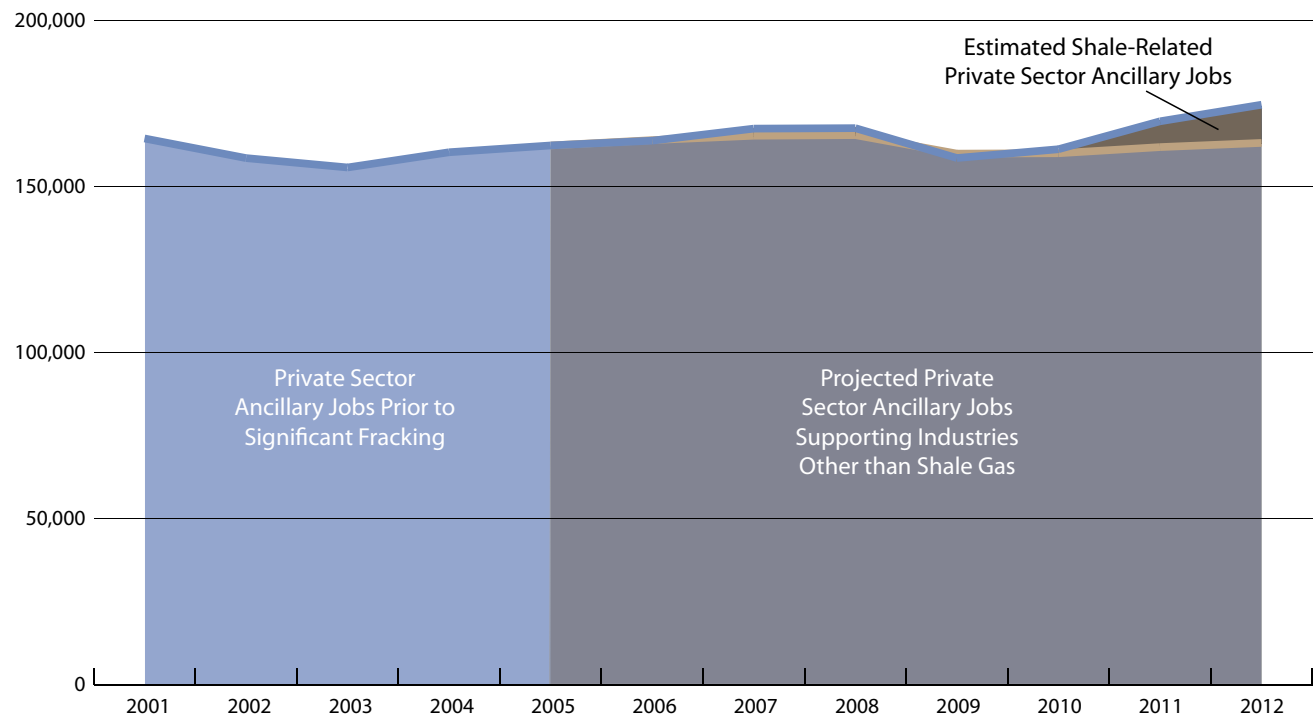
59 The actual *Marcellus Shale Fast Facts* figure for the fourth quarter of 2010 was lower – about 217,000 – but it still seems likely that the DCED source was echoing the *Marcellus Shale Fast Facts* headline, although possibly getting the year wrong. For the 217,000 figure, see Pennsylvania Department of Labor and Industry, *Marcellus Shale Fast Facts*, September 2011, p. 7.

60 Marie Cusick, “Economists Question Corbett’s Marcellus Shale Job Claim,” *State Impact*, online <http://stateimpact.npr.org/pennsylvania/2013/11/06/economists-question-corbetts-marcellus-shale-jobs-claims/>

61 The six Marcellus Core industries (NAICS) are: Liquid Extraction (211112); Drilling Oil & Gas Wells (213111); Support Activities for Oil & Gas Operations (213112); Oil & Gas Pipeline & Related Structures Construction (237120); and Pipeline Transportation of Natural Gas (486210).

62 Note that the method displayed in the figure is not a reliable way of estimating the actual ancillary industry jobs that support shale – it is too rough for that. It is simply a conceptual way of displaying that the number of jobs supporting shale in the ancillary industries is a tiny fraction of total employment in those industries.

Figure 15. Very Little Change in Ancillary Employment



Note. Projected Ancillary employment is calculated in 2006-2012 as 2.926% of total covered employment in each year. The data presented here as for private sector employers.
 Source. Multi-State Shale Research Collaborative based on Quarterly Census of Employment and Wages data.

The Pennsylvania Department of Labor and Industry’s Marcellus Shale Fast Facts include the following disclaimer about ancillary jobs: “While the vast majority of Marcellus Shale related employment can be found in these industries, not all establishments in these industries are involved in Marcellus Shale.” Given that a very small fraction of establishments and jobs in these industries are involved in Marcellus Shale, this disclaimer seems inadequate. Also inadequate, and misleading, is the recent statement of Department spokeswoman Sara Goulet to the Associated Press, “We can’t guarantee that every one of those employees are working in the Marcellus Shale ... We don’t have that ability to drill down to determine that.”⁶³ In fact, the Department does have its own input-output model, which likely could be used to show that the share of jobs in ancillary industries that relate to shale drilling (or even to a broader sector such as Natural Resources and Mining) is small.

The confusion about Marcellus ancillary jobs allows the U.S. Chamber of Commerce to continue reporting Marcellus Shale-related employment figures as if these jobs were truly Marcellus-related.

63 http://m.apnews.com/ap/db_268748/contentdetail.htm?contentguid=Z0NWKUm8. In fact, the Pennsylvania Department of Labor and Industry does have its own input-output model, which likely would allow it to crudely estimate the share of ancillary jobs in each ancillary industry associated with the broad industry aggregate within which shale drilling falls (this aggregate may be Natural Resources and Mining).

Table 13.**The Vast Majority of Ancillary Jobs Are Not Related to the Shale Gas Industry**

| NAICS Code | Industry Name | Likely Share of Industry Jobs in PA Supported by Shale Gas Industry |
|------------|--|--|
| 221112 | Fossil Fuel Electric Power Generation | Moderate – some PA fossil fuel electricity generation is coal-based |
| 221210 | Natural Gas Distribution | Moderate: 90% of PA natural gas comes from shale but many jobs in natural gas distribution pre-date fracking |
| 221310 | Water Supply & Irrigation Systems | Tiny |
| 221320 | Sewage Treatment Facilities | Tiny |
| 237110 | Water, Sewer, & Related Structure Const. | Tiny |
| 237310 | Highway, Street, & Bridge Construction | Substantial in localized areas; tiny as a share of statewide jobs |
| 238912 | Nonresidential Site Preparation Contractors | Tiny |
| 325110 | Petrochemical Manufacturing | Small currently – could grow |
| 325120 | Industrial Gas Manufacturing | Moderate |
| 331111 | Iron & Steel Mills | Very small – shale gas a small part of total demand |
| 331210 | Iron, Pipe, & Tube Mfg. from Purchased Steel | Very small – shale gas a small part of total demand |
| 333131 | Mining Machinery & Equipment Mfg. | Moderate |
| 333132 | Oil & Gas Field Machinery & Equip. Mfg. | Moderate |
| 423810 | Const. & Mining Mach. Equip. Wholesalers | Small – construction is a bigger customer than mining and shale is only part of mining |
| 423830 | Industrial Machinery & Equip. Wholesalers | Very small – shale gas a small part of total demand |
| 423840 | Industrial Supplies Merchant Wholesalers | Very small – shale gas a small part of total demand |
| 484110 | General Freight Trucking, Local | Tiny |
| 484220 | Specialized Freight Trucking, Local | Very small – shale gas a small part of total demand |
| 484230 | Specialized Freight Trucking, Long-Distance | Tiny |
| 531190 | Lessors of Other Real Estate Property | Very small – shale gas a small part of total demand |
| 532412 | Const., Mining, & Forestry Equip. Rental | Small – shale gas a small part of total demand |
| 541330 | Engineering Services | Tiny |
| 541360 | Geophysical Surveying & Mapping Services | Tiny |
| 541380 | Testing Laboratories | Tiny |
| 541620 | Environmental Consulting Services | Very small – shale gas a small part of total demand |
| 562910 | Remediation Services | Small – could grow as need to reclaim old well sites grows |
| 811310 | Comm. & Industrial Mach. & Equip. Repair | Tiny |
| 924110 | Admin. of Air & Water Res. & Waste Mgmt. | Small |
| 924120 | Admin. of Conservation Programs | Very small |
| 926130 | Reg. & Admin. of Comm., Elec., Gas, & Util. | Small |

Note. Industries are given a rating of “tiny” when the shale industry likely only accounts for a share of jobs similar to its share of the overall economy (well under 1%). Ratings of very small and small indicate sectors in which the shale industry accounts for more of the industry than the overall economy but still only a small portion of overall demand (hence jobs). Ratings of moderate and most are explained on those lines.

Source. Multi-State Shale Collaborative

V. Conclusion

The analysis presented in this report shows how the job benefits of horizontal drilling in the Marcellus and Utica Shale have been exaggerated by the drilling industry and its supporters. While the industry has created jobs, particularly in Pennsylvania and West Virginia, the shale-related jobs numbers are far below industry claims. We show how shale-related jobs are in the range of thousands to—at best—a few tens of thousands of jobs. They are not in the hundreds of thousands of jobs as claimed by the industry and its proponents.

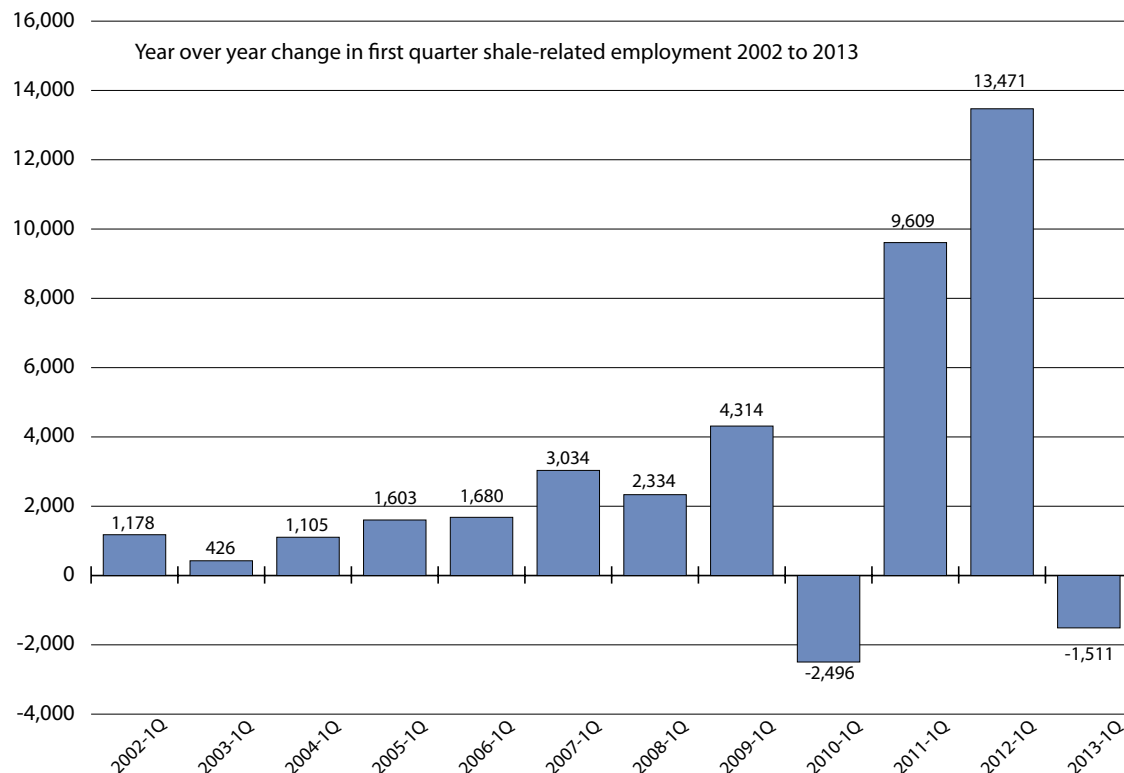
Shale-related employment is small even in West Virginia and Pennsylvania as a share of overall employment. In the relatively sparsely populated, drilling-intensive areas in those states, the jobs created have been enough to cushion those regions from job losses during the Great Recession and weak recovery. But, they are not enough to make much difference in the overall job growth in those states.

In addition, shale jobs have made little difference in job growth relative to other states. For example, New York has a moratorium on shale development, yet it ranked 12th in job growth between 2005 and 2012. That growth outpaced all of the other Marcellus states. (See Table 5.)

Box 3. Shale-related Job Growth Has Slowed Recently

In 2012 the number of new wells drilled in the region fell as falling natural gas prices led to drilling companies to curtail the development of new wells. Figure 16 presents the change in shale related employment from the 1st quarter of each year (the most recent quarter of data available) to illustrate that as new drilling has slowed, shale related job growth has slowed as well. Pennsylvania had a bigger decline in jobs in 2013 relative to 2012 than the region as a whole.

Figure 16. Shale-Related Employment Fell in the Past Year



Note. Shale related employment is defined here as employment in Oil and Gas Extraction (211), Support Activities for Mining (213), and Oil & Gas Pipeline & Related Structures Construction (237120) in MD, NY, OH, PA, VA and WV.

Source. Multi-State Shale Collaborative based on QCEW data

Together, these key findings show how shale development is simply not a significant driver of job growth or the overall economies of the six states with major deposits.

Furthermore, this report also documents the beginning of a pull back of the industry which raises questions about the stability and permanence of even the small number of jobs that have been created. For example, we identified a drop in the number of wells drilled in 2012 (Table 1), and a drop in the number of jobs. We show that much of this is related to low natural gas prices.

Although the region is likely decades away from any exhaustion of shale gas and oil resources, this pattern is consistent with the boom and bust that characterizes extractive industries. Researchers have found that, in the long run, communities where natural resource extraction represents a significant portion of the economy are poorer than economies less dependent on natural resource extraction. This has been characterized as a “resource curse.”⁶⁴

Recommendations

The most general implication of our research is that the jobs bounty of shale drilling is not so enormous that public officials should be intimidated from honest scrutiny of its impacts. As well as some economic benefits, shale development brings with it costs and impacts—on health, the environment and local services—that are not discussed in this report, but are documented elsewhere. These impacts demand careful review by state and local policymakers. Given the limits of existing jobs data in the area of shale drilling and the need to more fully understand the actual job impacts, we recommend better data reporting and the creation of a collaborative effort to arrive at a consensus way to measure the job impacts of shale drilling.

First, two data series published regularly by the Pennsylvania Department of Labor & Industry in its *Marcellus Shale Fast Facts* report have contributed to inflated claims about jobs from drilling. These are the series on New Hires and the series on “ancillary jobs” discussed in this report. We recommend that the Department stop publishing the ancillary jobs and new hire series to avoid misinterpretation and misuse of the data.

Second, we recommend the creation of a six-state “Multi-State Shale Commission” that includes respected academics, industry and other stakeholders, representatives of each state government and of local officials in each state. Ultimately, such a Commission could have a broad set of research and policy responsibilities, but its first charge should be to develop a consensus methodology for estimating shale-related employment. Then, a consensus input-output model (or other methodology) could be developed with transparent explanation of methodological assumptions. In addition, commission members should have opportunities to publish minority opinions if they believe alternative assumptions would be more accurate. Over time, the Commission could also be a resource for developing reliable estimates of the industry’s tax payments and of its impact on other industries, and policy options and policy consensus.

In the long run, state and local policymakers in the six-state Marcellus and Utica Shale region should be collaborating to enact regional energy development policies that serve the public interest. For those states that authorize responsible drilling, communication and cooperation on policy issues can help shape fiscal, employment, economic development, and regulatory policies that maximize the public benefits – and minimize the public costs – of any development that does take place. A key first step towards policy coordination on shale gas extraction that serves the public good would be agreeing to count the jobs resulting from fracking accurately.

64 For a comprehensive review of the academic literature, see William R. Freudenberg and Lisa J. Wilson, “Mining the Data: Analyzing the Economic Implications of Mining for Nonmetropolitan Regions,” *Sociological Inquiry*, 72(4), Fall 2002, pp. 549-575.

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Appendix A

| Table A1. | |
|--|-------------|
| Description | NAICS Codes |
| Supersector: Natural Resources and Mining | |
| Sector: Agriculture, Forestry, Fishing and Hunting | 11 |
| Sector: Mining, Quarrying, and Oil and Gas Extraction | 21 |
| Subsector: Oil and Gas Extraction | 211 |
| Industry: Crude Petroleum & Natural Gas Extraction | 211111 |
| Industry: Natural Gas Liquid Extraction | 211112 |
| Subsector: Mining (except Oil and Gas) | 212 |
| Subsector: Support Activities for Mining | 213 |
| Industry: Drilling Oil & Gas Wells | 213111 |
| Industry: Support Activities for Oil & Gas Operations | 213112 |
| Industry: Support Activities for Coal Mining | 213113 |
| Industry: Support Activities for Metal Mining | 213114 |
| Industry: Support Activities for Nonmetallic Mining (Except Fuels) | 213115 |
| Supersector: Construction | |
| Sector: Construction | 23 |
| Subsector: Construction of Buildings | 236 |
| Subsector: Heavy and Civil Engineering Construction | 237 |
| Industry: Oil & Gas Pipeline & Related Structures Construction | 237120 |
| Five (5) Other Industries | |
| Subsector: Specialty Trade Contractors | 238 |
| Supersector: Trade, Transportation and Utilities | |
| Sector: Wholesale Trade | 42 |
| Sector: Retail Trade | 44 & 45 |
| Sector: Transportation and Warehousing | 48 & 49 |
| Subsector: Pipeline Transportation | 486 |
| Industry: Pipeline Transportation of Natural Gas | 486210 |
| Three (3) Other Industries | |
| Ten (10) Other Subsectors | |
| Sector: Utilities | 22 |
| Seven (7) Other Supersectors | |

Table A2.**Percent change in total covered employment and total covered employment minus shale related employment by state 2001-2012**

| State | 2001 to 2005 | | | | 2005 to 2012 | | | |
|---------------|--------------------------|------------------|-----------------------------------|------------------|--------------------------|------------------|-----------------------------------|------------------|
| | Total Covered Employment | | Total Covered Minus Shale-Related | | Total Covered Employment | | Total Covered Minus Shale-Related | |
| | Percent Change | Rank (out of 43) | Percent Change | Rank (out of 43) | Percent Change | Rank (out of 43) | Percent Change | Rank (out of 43) |
| Maryland | 3.1% | 12 | 3.1% | 12 | 0.6% | 20 | 0.6% | 19 |
| New York | -0.9% | 36 | -0.9% | 36 | 2.6% | 12 | 2.6% | 12 |
| Ohio | -2.3% | 40 | -2.3% | 40 | -4.9% | 40 | -5.0% | 40 |
| Pennsylvania | -0.001% | 34 | -0.026% | 33 | 0.5% | 21 | 0.1% | 23 |
| Virginia | 4.1% | 10 | 4.1% | 10 | 1.1% | 18 | 1.1% | 16 |
| West Virginia | 1.4% | 22 | 1.1% | 26 | 2.2% | 13 | 1.3% | 14 |
| U.S. | 1.5% | | 1.5% | | 0.1% | | -0.1% | |

Source. Multi-State Shale Collaborative based on QCEW data