

Response to Energy In Depth's "Cracking the Nut on OSU's Jobs Report" press release.¹

Mark Partridge and Amanda Weinstein--AED Economics, The Ohio State University, December 31, 2011.

Summary response: The natural gas industry released their critical "Cracking the Nut" press release on December 21, 2011 (available at <http://www.eidohio.org/cracking-the-nut-on-osu%E2%80%99s-jobs-report/>) in response to our *The Economic Value of Shale Natural Gas in Ohio* report (available at: <http://aede.osu.edu/programs/swank>). The irony with the industry's hostility to our report is that we argue there seems to be a good case for natural gas development because its benefits appear to exceed its costs (including environmental costs), even if job creation is going to be relatively modest and far below industry estimates. We also surmise that "fracking" may have gotten a bad rap because the comparison should not be fracking versus no fracking, but fracking versus what we would likely have to do in its place (likely more coal mining or other unpleasant things). With the exception of more chemical disclosure, we also caution against further environmental regulations (in Ohio or nationally) unless forthcoming EPA research shows a direct link between water quality and drilling in deep shale. Bizarrely, our points that support the industry are misrepresented in "Cracking the Nut." Also note that our report is part of an objective series of reports on Ohio's economy and has not been funded by any outside group. For example, we made few friends in the environmental community a few years ago when we clearly pointed out that green energy was not a road to economic stimulus and job creation (as history has borne out).

The main point of contention is whether our 20,000 job estimate is reasonable versus industry claims of 200,000. Hence, we focus on this point. Their other claims are minor and usually taken from our report out of context. The backdrop is that we examine the early Pennsylvania experience as a roadmap of what to expect in Ohio over the next 3-4 years.

We reject their press release's criticisms as not being defensible to credible economists. In most cases, if we had actually followed their criticisms, our job forecast would have been markedly smaller. The authors of the press release engage in a debate with themselves about several factors and are confused as to what would increase or reduce our jobs estimate. They state that our primary shortcoming (they call it a "trick") is that we begin examining job creation in Pennsylvania 1-2 years before the drilling really takes off in 2007. If we actually began looking at job creation in 2007 as they argue, we would have lost new activity starting up in anticipation of the drilling boom (which they subsequently argue is an important effect, contradicting themselves). Specifically, if we only considered job creation beginning in 2007, it would have lowered our job creation estimate by 40%--from 20,000 jobs to 12,000 jobs. Our detailed response below provides more details. In another case, if we incorporated their reasoning, we would have only estimated 1600 new jobs, not 20,000. Apparently not knowing it, they also provide justification for why our job estimate is relatively low while gas production continues to accelerate.

It should not be surprising that our estimate of 20,000 jobs is almost identical to another independent Penn State study that estimates 23,000 jobs over a similar period (Kelsey et al, 2011). Moreover, like good scholars, we engage in numerous sensitivity checks to show that our estimates are sensible including statistical analysis. *One simple "smell test" is that if Pennsylvania is undergoing such a boom led by shale drilling, why has Ohio's job growth been faster over the last year (without an appreciable boom) and why has Ohio's unemployment rate declined faster?* [Between Nov. 2010-Nov. 2011, Ohio nonfarm job growth equaled 1.5% and its unemployment rate fell 1.1 percentage points. Pennsylvania only had 0.9% faster job growth and an unemployment rate decline of only 0.6 percentage points: Source US BLS,

¹We thank Rose Olfert (University Saskatchewan), Dan Rickman (Oklahoma State University), Tim Haab (The Ohio State University), Alessandra Faggian (The Ohio State University), Allen Klaiber (The Ohio State University and formally of Penn State University) for their help with this response.

CES and US BLS State and Local Unemployment Statistics]. With the robust job creation numbers suggested by the industry reports, we would have expected the reverse.

In terms of revitalizing Ohio's economy, while nontrivial, our 20,000 job figure needs to be kept in perspective given the size of the state's economy (5.1 million jobs). For the next few years, we annually need about 100,000 new jobs in order to keep up with natural labor force growth and to allow for people who had dropped out of the labor force in the midst of the Great Recession. Ohio needs further economic reforms to ensure prosperity—no one industry will save us.

Our perspective is Ohio communities need to be cautious about a boom-bust cycle of energy development. They need to take seriously the displacement effects in which growth in one industry can actually harm other industries due to higher wages, rents, and land costs, as well as possible social costs. In terms of energy development, economists often describe the general long-term underperformance of energy intensive economies such as Nigeria, Venezuela, West Virginia, and Louisiana, while the examples of over performance are surprisingly short (e.g., Houston, Norway, and Alberta). Economists refer to factors such as the "Natural Resources Curse" and "Dutch Disease" to explain this phenomenon. There is a long history of economic peer-reviewed scholarship to justify our concerns. Ohio should adopt policies to ensure it falls in the over performance category.

To restate, early evidence suggests that further shale development is sensible for the country, but the favorable local economic development implications have been vastly overstated by the industry.

Our detailed response follows below and is a little more technical.

Detailed Response.

The detailed response is organized around the following principles:

- Our report favored further shale development, but questions the hyped-up local economic effects.
- Scientific peer-reviewed research is more credible than non peer-reviewed research in forming conclusions and supporting arguments (especially those funded by special interests should be viewed with caution—regardless of the special interest).
- The industry funded reports do not consider displacement effects and use non credible in-state purchase coefficients.
- If we followed the key “suggestions” of the press release, our estimated job response would have been significantly smaller.
- The superior quality of official government data that is publically available (which we use to support our case).
- Confusion with how multipliers should be applied in input-output analysis.
- Supply chain responses in a national/global market.
- The fact that we conducted rigorous sensitivity analysis to support our results.

Introduction:

The “Cracking the Nut Press Release” produced by Energy in Depth (<http://www.eidohio.org/cracking-the-nut-on-osu%E2%80%99s-jobs-report/>) is a set of contradictory claims that often take our statements out of context. The authors are confused as to what would increase or reduce our job estimate—often criticizing us for not using assumptions that would have actually reduced our job estimate.

The press release never responds to our main concern about the industry-funded reports that new economic activity (regardless of the source) usually displaces some of the existing activity that would have otherwise occurred. This reduces the actual job creation numbers from what is predicted in simple input-output models. Likewise, there is no mention that the industry funded studies employ estimates of within-state expenditures that are far too high (90-95% remain in state), which greatly boosts their job creation figures.

Another theme of the press release is that it places consultant reports and news reports on the same level as scientific peer reviewed research. Nothing could be further from the truth. Peer reviewed research in economics typically undergoes scientific assessment by reviewers who are not disclosed to the authors of the papers. In peer review, authors are often required to redo their analysis and discussion if it does not meet scientific standards. The whole process can take years to complete. Consultant reports typically receive a light “read” and there is little or no obligation to take make changes regardless of the validity of any comments. Since consultants are paid by their clients, they often feel pressure to produce results desired by the client (which also helps them get more business if they are “cooperative”). This is the reality of the business world, but it means that studies funded by a given special interest group should, as a rule, receive more scrutiny, regardless of the special interest that paid for the report. In our assessment, we use peer reviewed literature and official government data to support our claims on job creation.

The irony with the industry’s hostility to our report is that we argue that even with relatively modest job creation, there seems to be a good case for natural gas development because its benefits appear to exceed its costs (including environmental costs). We also surmise that “fracking” may have gotten a bad rap because the comparison should not be fracking versus no fracking, but fracking versus what we would likely have to do in its place (likely more coal mining or other unpleasant things). With the exception of more chemical disclosure, we also caution against further environmental regulations unless forthcoming

EPA research shows a direct link between water quality and drilling. Bizarrely, our points that support the industry are mischaracterized in “Cracking the Nut.”

Below, we assess the primary criticisms of our job estimates.

1. Energy in Depth Debates Themselves over whether Anticipated Job Effects Should be Included in our estimates.

We begin with refuting the primary (“**First**”) criticism in the “Cracking the Nut” press release on page 2 which corresponds to our discussion on pages 11-13 of our report. Specifically, they argue that we understate mining activity because we consider the full 2004-2010 period and they argue that shale type mining only became important in 2007. Thus, they contend that we should have only considered the 2007-2010 (versus the 2005-2010 period that we used). However, if we follow their advice, we would lose the “anticipation” effects where new Pennsylvania businesses started up in anticipation of the drilling boom and related infrastructure and site preparation work. Indeed, backtracking two paragraphs down, the press release then argues that such anticipation effects are potentially non trivial (see the paragraphs spanning pages 1 and 2). At the top of page 2, they argue that there are possibly 5,000 jobs in Ohio in *anticipation* of drilling (though economists always caution that job announcements are far from actual job creation).

The state of modern regional and urban economics is to count the anticipation of start-ups occurring before the drilling takes off in full force (assuming real jobs are created). We thus start counting jobs in 2005 and 2006. To be clear, our analysis on pages 11-13 would capture all jobs created in 2005, 2006, 2007, 2008, 2009, and 2010. No jobs are thrown away over this period as the press release mistakenly assumes, which is clear in our report. In fact, when looking at Figure 12 on page 12 (reproduced at the end of this response), if we had used the 2007 to 2010 period as they suggest, there would have only been 6,000 direct jobs created between 2007-2010. Applying our multiplier of 2 would have suggested only 12,000 total jobs created by the industry—or our 20,000 new job forecast would have been reduced by 40 percent. [Note that the press release at the bottom of page 1 does not quibble with our use of a multiplier of 2.] Figure 12 shows that there were 4,000 direct jobs created in 2005 and 2006. Using a multiplier of two, there would be another 4,000 indirect jobs created for a total of 8,000 jobs created during that earlier span. Our 20,000 job estimates counts those jobs even though the industry press release argues we should omit those jobs.

In the middle of page 3, the press release states that the total number of wells drilled in Pennsylvania dropped by 29% over the last 6 years, while production greatly increased. Assuming their figures are correct, this decrease in drilling activity would likely be a key reason for why we found relatively low job figures despite the high production. Basically, the industry is able to do more with fewer employees, which is good for low energy costs, but doesn’t create many jobs. This is clearly one explanation to help explain our results.

The report then states that “...Marcellus shale wells barely accounts for 8 percent of all active natural gas wells in Pennsylvania—and only 1.1 percent of all total wells drilled.” This is important point because we assumed when using the data in Figure 12 that all of the increase in natural gas related direct employment is due to Marcellus shale (as we describe, we made this generous assumption in order to not understate the industry’s importance). If we instead had estimated that only 8% of mining activity jobs was in the Marcellus region, then we would have estimated only 800 direct jobs created over the 2004-2010 period—i.e., $.08 \times 10,000$ direct PA Marcellus region mining jobs (overlooking any differences in job requirements across PA’s regions). Hence, following the release’s logic, the estimated total job creation number would be 1,600 after applying the multiplier of two ($2 \times 800 = 1,600$ jobs). We find that figure

far too low. However, these points illustrate that the authors of the press release actually criticize us for factors that in actuality would have produced significantly lower job figures.

2. Quality of our Publically Provided Employment Data versus Confidential Data used in Industry Reports or Newspaper reports in the press release.

The press release questioned our employment data. All of our employment data sources are publically available and documented. They come from the federal government (either from the Bureau of Economic Analysis or the Quarterly Census of Employment and Wages, U.S. Bureau of Labor Statistics). Hence, the data are not confidential such as in the Kleinhenz et al. (2011) report and they reflect real people working—not the estimates from computer software. The federal government collects the QCEW data primarily on the basis of unemployment insurance tax reporting. Generally, the QCEW data underlies much of the data used by the industry studies (embedded in their consultants’ computer models) and in our report. The federal government cooperates with all of the states’ Department of Labor (or their equivalent) in its collection. So, unlike many of the statements in the press release used to support its claims, our data are not based on press reports, but on official government data. Thus, we stand by our employment data as the best available. If the industry and their representatives believe that there are significantly more direct jobs in the industry, then why are energy firms not paying unemployment insurance taxes on those “missing” workers? That would be the only plausible explanation for them not showing up in Pennsylvania employment figures that are reported in the official QCEW data (which is the source for our data in Figure 12)?

The industries we selected are commonly used as direct natural gas industries. We followed the industry’s funded *IHS Global Insight* report cited in our report as a starting point for picking the industries that we consider direct. The press release incorrectly said that we only used two industries for direct employment (our figures 12-18 clearly show that we use eight direct industries from drilling, site preparation, pump manufacturing, to pipeline construction). If anything, pipeline construction and related manufacturing should be considered as an input (an indirect effect) and not included in the 10,000 direct jobs. Yet, we added these jobs in so as to not to understate the direct job creation effects of the industry.

Some of the employment number shown in Figure 12 also include employment in other sectors—most notably oil and conventional natural gas. Nevertheless, we assume all of the increase in direct jobs in Pennsylvania is due to shale natural gas (not due to oil or conventional natural gas) to again (if anything) overstate the effects of the industry.

We also did not include industries such as NAICS 32512-Industrial gas manufacturing and NAICS 22121-Natural gas distribution. The reason is that former industry showed a massive decline of over 4,200 jobs (or almost 75%) for the 2004-2010 period, while the latter showed a decline of nearly 300 jobs (using the same QCEW source). We simply believe those negative job trends are unrelated to Marcellus shale mining. Yet, if we had included those sectors, we would have derived an even smaller job estimate on the order of 9,000 jobs, reducing our estimated effects from 20,000 to 11,000 (i.e., a loss of 4,500 direct jobs multiplied by a multiplier of two). In sum, our approach works to *increase* the direct effects of the shale natural gas industry. Finally, we note the nearly 75% loss of industrial gas manufacturing jobs in Pennsylvania over the 2004-2010 period throws a cautionary note to those who argue that low cost natural gas will immediately lead to massive spin-off jobs in other industries (at least on a local basis).²

²Further supporting our caution about a buildup of supply chain industries is Pennsylvania’s early experience in the manufacturing of oil and gas field machinery and equipment (NAICS 333132). In 2004, this critical component of

3. *“Cracking the Nut” Confuses How Multipliers Should be Used.*

First some academic background. The input-output multiplier process for estimating jobs created or supported is that you take the direct jobs engaged in an industry then multiply that by a multiplier. These additional jobs produced by the multiplier include the indirect jobs (supply-chain jobs for things such as steel piping and pipeline construction) and the induced household-spending effects from industry wages, royalties and leases. If you place the supply chain jobs and induced household expenditures in the direct effects (as the industry press release argues we should do on page 2), you would double-count these jobs because in effect, you are applying the multiplier twice. This would be a serious error and such double counting represents one of the biggest reasons for why poorly done impact studies overstate the economic effects. So, if we had followed the press release’s suggestion in the second paragraph of page 2 to include indirect and induced effects as direct effects, we would have been committing a serious mistake of double counting.³ This would not be “objective” analysis as the press release asserts, but misguided analysis at best. Essentially, the press release acknowledges that industry funded reports have engaged in this double counting.

To be sure, our 20,000 job estimate includes the 10,000 jobs directly employed and the 10,000 indirect/induced jobs created due to inputs to the industry and due to household expenditures such as from royalty payments and leases.

As we describe in our report, credible impact analysis produces employment multipliers of less than two. Because of the royalty/lease payments, we use an upper-bound multiplier of 2 even though the energy industry is very capital intensive and would not directly employ as many workers as a typical industry for a given level of output. The press release incorrectly argues on page 2 that in our analysis, these lease/royalty revenues would not create a “single job” and “they may have as well been buried in the backyard.” Actually, as explained in our report, those induced spending effects are included in the latter

the supply chain employed 263 workers, but employment only increased by 62 workers to 315 in 2010 (source QCEW data shown in Figure 12 of our report). These minor employment responses support our claims that the industry acquires equipment from a global supply chain that limits the scope of local input-output linkages (and provides another example of why we believe that the assumption that 95% of the industry’s inputs being from Pennsylvanian sources is extremely over optimistic).

³Regarding our accounting for direct jobs for industry, the press release states on pages 1-2:

“...As it turns out, the researchers only include a few basic employment categories in their analysis of the new jobs expected to be created from responsible resource development in Ohio – while leaving out many others (all of them relevant to the Utica) that any other reasonable, objective analysis would have incorporated.

To Partridge, only jobs related to the drilling of new wells, construction of new pads, geophysical surveying of new areas, and the manufacture of new pipe “count” as jobs that can be ascribed to the industry. Jobs in other sectors of the economy – from retail, to trade, to insurance, to manufacturing, to legal work and environmental consulting – simply don’t make the cut in this analysis.”

Actually, the only way (say) retail and law firms could be counted as direct impacts as they suggest, is if the natural gas industry directly sets up retail establishments and legal firms and directly operate them. If instead, retail establishments hire more workers because landowners spend royalties there or natural gas firms hire more law firms to help them with legal work, then those effects are counted as indirect or induced effects. To do otherwise, would engage in double counting and a gross overstatement of economic impacts. An apparent example of such double-counting can be found in Considine et al. (2010) in Tables 2, 3, and 4. An example of applying input-output analysis correctly can be found in Kelsey et al. 2011. To be sure, in our final number, these types of jobs show up as indirect and induced effects and are included in our job estimate. However, we also caution that there are better ways to evaluate economic impacts such as the matching and difference-in-difference approaches we incorporate in our report—though we caution that even those approaches have to properly identify the causal mechanism for growth.

10,000 category. Indeed, that latter 10,000 indirect/induced category includes the additional workers from iron workers, to construction workers, to insurance workers, to farmers who are “indirectly” affected by expansion of the industry. Moreover, a careful read of our report would note that we find larger income effects from natural gas mining (not employment effects), which we mostly attribute to the royalty and lease payment. The source of their confusion appears to be that the authors of the press release are unfamiliar with basic economic terminology.⁴

4. Supply Chain Effects of the Industry.

The “Cracking the Nut” report discusses on pages 2, 7 and 8 the supposed positive effects along the supply chain due to lower natural gas prices. It should first be noted that this is not an explanation for any discrepancy between the job estimates in industry reports such as Considine et al. and our report. Specifically, both are based on input-output effects that do not account for such global price changes.

As we describe in the report, we take no position on the size of these lower-cost effects at the national level. However we note that shale energy is a national and international phenomenon (which is also a point of the press release) that will lower energy prices for not just Ohio’s businesses, but also for many (or most) of our competitors. For the U.S., almost all businesses across virtually all states would gain from lower gas prices. Thus, there is no low-cost competitive edge that is unique to Ohio’s businesses that they could then exploit against their competitors. Unfortunately, if everybody’s energy costs fall by (say) ten percent, no one gains an edge they can exploit against their competitors (i.e., if manufacturers in Louisiana and Ohio both get a 10% cost reduction, there is no change in initial relative competitive advantage). Nonetheless, as we point out several times in the report, lower energy costs are certainly a good thing in general (assuming environmental costs are figured in), but these positive effects will be dispersed across the nation and the world.

5. The Industry Consultants did not Conduct Sensitivity Analysis and We Do.

Sensitivity Analysis is typically conducted in peer-reviewed economic research to convince readers that the authors got it right. Namely, do the results hold up if entirely different approaches are used and do the results hold up when considering different regions (external validity)? We provide a host of sensitivity analysis to support our figures. To quote the report: “We show this through (1) an assessment of impact analysis, (2) comparison of drilling counties with similarly matched non-drilling counties in Pennsylvania, (3) statistical regressions on the entire state of Pennsylvania, (4) employment comparisons with North Dakota’s Bakken shale region, and (5) an examination of the employment life cycle effects of natural gas and coal per kilowatt of electricity.” If five different approaches keep pointing you the same direction, you can feel more confident that your results are accurate.

We encourage readers to read that discussion to see the great care that we took in ensuring that our results are sensible. For example, we statistically show that employment growth in Pennsylvanian counties is not significantly related to the number of new wells drilled in that county, but that income growth is positively related (in a statistical sense). Likewise, we describe North Dakota’s experience in the Bakken shale region. We note that both Pennsylvania and North Dakota have experienced similar increases in mining employment that would drive a boom. So, we would expect 100,000 to over 200,000 jobs if the underlying assumptions in the industry funded consulting reports are correct. Rather, since 2007, U.S. government data suggests that North Dakota’s employment has only risen 39,000 (our data source is official U.S. government data as clearly cited in the report, not press releases or consulting reports). We

⁴See Drabenstott (2005) for a discussion of why direct payments to landowners yield limited local economic development effects.

further point out that some of these employment gains are attributable to prosperity in North Dakota's large farm sector, not energy (and North Dakota rarely suffers during recessions as we note in the report). Also, much of North Dakota's employment gains are hundreds of miles from the Bakken region (e.g., Fargo and Grand Forks) which would presumably be less affected by such booms. We again note that if the industry and their representatives believe that there has been significantly more job creation in North Dakota than what official data suggests, then they are again arguing that there are "missing" workers that are somehow lost in official government reports (see our discussion of point #2 above).

6. Are Input-Output Models at the Cutting Edge of Regional and Urban Economics?

Here is some background. Input-output multipliers gained popular attraction due to the seminal work of Wassily Leontief from the late 1920s to the late 1940s. These contributions were among the reasons why Leontief was awarded the Nobel Prize in Economics almost 40 years ago in 1973. One of the founders of the *Journal of Regional Science* (which Partridge currently co-edits) was Walter Isard, who made other seminal contributions in the 1950s and early 1960s. His work helped form the basis for many regional input-output models used today. Other *JRS* editors such as Ron Martin made contributions as well. The *Journal of Regional Science* is proud of its contribution in disseminating this research and we view it as one of our greatest contributions to the early formation of regional and urban economics.

However, much the way that the Model T is no longer the family sedan of choice, the input-output approach faded from the academic limelight over time as more powerful new approaches such as Regional Computable General Equilibrium modeling in the late 1980s and later the rise of natural experiment approaches in the 1990s came into vogue. These latter approaches are considered much more accurate in forecasting impacts and are current best practice for evaluation. However, given their low expense with software such as IMPLAN, input-output models continue to thrive in the consulting world. When used well, models such as IMPLAN can be invaluable in understanding a local economy and we have only minor quibbles with the software, but major quibbles with how the models are used and interpreted. Indeed, Partridge once served on the Scientific Committee for one International Input-Output Association conference.

Nonetheless, the modern profession clearly maintains that input-output multipliers should not be used to estimate new job creation effects or estimate counterfactuals (what would have happened to job creation if there was no drilling). Instead, the more modern approaches are viewed as much more accurate (especially the natural experiment approaches). Basically, input-output models represent a technology that dates back to the early 20th Century. They have their values for limited applications, but there have been significant advances in best practice. Core regional and urban economic journal articles do not use input-output models to establish the counterfactual of what would have happened in forecasting new "job creation" or other economic effects. When used, extensive caveats need to be expressed to state the limitations of input-output modeling.⁵

Generally, as we discuss in our report, credible input-output studies would suggest local area multipliers in the 1.1 to 1.6 range (which is consistent with instrumental variable estimates of employment growth

⁵Partridge's experience in this regard comes from experience as being an author of over 100 peer-reviewed economic studies, reviewer of hundreds of papers, and an editor of one of the core regional and urban journals (*Journal of Regional Science*) as well as editor of a Springer Book series on Regional Science. He regularly consults with other editors of top core journals including *Growth and Change*, *Papers in Regional Science*, *Journal of Economic Geography*, *Journal of Urban Economics*, and *Regional Science and Urban Economics*.

using statistical analysis).⁶ However, economists have long questioned the assumptions of even credible input-output models. For example, see Edmiston (2004) who describes how manufacturing plant openings in Georgia produced significantly fewer jobs than what even credible input-output models would have predicted (illustrating displacement effects). For further discussion of the limitations of these models, see Kilkenny and Partridge (2009) and Irwin et al. (2010). A less technical discussion of some of the general limitations of these models can be found in U.S. Bureau of Economic Analysis (2009, especially page 59).

7. Other Studies.

We encourage readers to check out the co-authored work of David Aadland from the University of Wyoming (James and Aadland, 2009). Using credible statistical techniques, they find that natural resource extraction is associated with negative growth. They published their paper in a well-respected natural resources journal after undergoing scientific peer review. We reproduce their abstract below:

“Research consistently shows that natural resource dependence tends to be associated with lower economic growth. However, the studies typically focus on differences across nations or states. We fill a gap in the literature by testing the so-called resource curse at a more disaggregated county level. Our results show clear evidence that resource-dependent counties exhibit more anemic economic growth, even after controlling for state-specific effects, socio-demographic differences, initial income, and spatial correlation. A case study analysis of Maine and Wyoming, and the counties within, highlight the growth effects of specializing in natural resource extraction.”

We also provide citations to other peer-reviewed papers that draw similar conclusions.

8. The Press Release does not accurately describe who read our report.

The press release mentions that a representative of OSU was a member of the “project committee” for the Kleinhenz et al. report. However, this person also read our report and indicated that the statistical approach we used to estimate employment impacts is sound. He also agreed with our conclusion that the ‘debate’ needs to be on benefits and costs of production (which appears to favor more shale development). Also, that committee contained no urban and regional economists that would be most qualified to directly comment on jobs figures.

We also had Dr. Dan Rickman from Oklahoma State University read our report. Professor Rickman was employed by REMI (who produced the model used in the Kleinhenz et al. report). In peer-reviewed articles, Dr. Rickman has written extensively comparing multipliers from IMPLAN and REMI and other approaches and is a distinguished regional and urban economist. To be sure, neither the industry reports nor our report underwent a formal scientific review. Yet, our report’s contents were vetted by very capable economists with long peer-reviewed scientific publication records.

⁶Using the parlance of input-output analysis, using regression analysis, Partridge et al. (2012) find that over the seven-year 2000-2007 period, a direct impact of 100 jobs results in final net-job creation between 90 to 217 (multiplier of 0.9 to 2.17) with the smallest figure applying for rural counties and the largest response applying for large metropolitan counties. Also see Kilkenny and Partridge’s (2009) empirical evidence of the small links between export sector employment growth (such as mining) and rural non-basic sector employment growth.

Other References Cited not in the Original Report.

Bureau of Economic Analysis. (2009) "Regional Quarterly Report." *Survey of Current Business*.
http://www.bea.gov/scb/pdf/2009/04%20April/april09_regreport.pdf#page=5?

Considine, Timothy, Robert Watson, Seth Blumsack. "The Economic Impacts of Pennsylvania Marcellus Shale Natural Gas Play: An Update." (May, 2010).

Drabenstott, Mark (2005) "Do Farm Payments Promote Rural Economic Growth?" In *The Main Street Economist: Commentary on the Rural Economy*. Center for the Study of Rural America, Federal Reserve Bank of Kansas City, Kansas City, MO.

Edmiston, Kelly D. (2004) "The Net Effects of Large Plant Locations and Expansions of County Employment." *Journal of Regional Science* 44: 289-319.

Irwin, Elena G., Andrew M. Isserman, Maureen Kilkenny, and Mark D. Partridge. (2010) —A Century of Research on Rural Development and Regional Issues. *American Journal of Agricultural Economics* 92(2): 522–553..

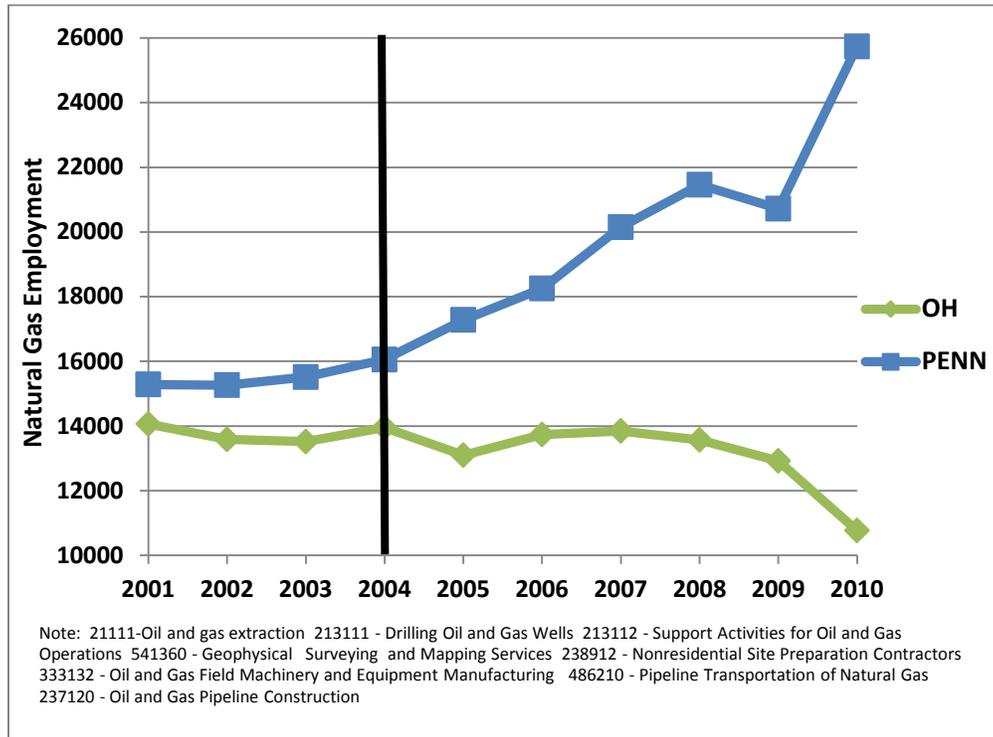
James, Alex and David Aadland (2011). "The Curse of Natural Resources: An Empirical Investigation of U.S. Counties." *Resource and Energy Economics* 33: 440-453.

Kelsey, Timothy W. and Martin Shields, James Ladlee, and Melissa Ward. —Economic Impacts of Marcellus Shale in Pennsylvania: Employment and Income in 2009. | Marcellus Shale Education & Training Center. (Aug., 2011)
<http://www.marcellus.psu.edu/resources/PDFs/Economic%20Impact%20of%20Marcellus%20Shale%202009.pdf>.

Kilkenny, Maureen and Mark D. Partridge. (2009). "Export Sectors and Rural Development." *American Journal of Agricultural Economics* (91): 910-929.

Partridge, Mark D., Dan S. Rickman, M. Rose Olfert, and Kamar Ali. (2012) "Dwindling U.S. Internal Migration: Evidence of a Spatial Equilibrium or Structural Shifts in Local Labor Markets?" *Regional Science and Urban Economics*. (42): 375-388. doi:10.1016/j.regsciurbeco.2011.10.006.

Figure 12: Ohio and Pennsylvania Natural Gas Employment



Source: BLS <http://data.bls.gov/pdq/querytool.jsp?survey=en>.

Notes: The direct effects would commonly include the drilling and extraction activities while indirect effects would normally include inputs such as pipeline construction and field equipment manufacturing. Hence, this is why we state that we are already including most of the key inputs as indirect employment in Figure 12.