Economic Implications of Unconventional Fossil Fuel Production
National Agricultural and Rural Development Policy Center Webinar
Amanda Weinstein, Assistant Professor
Department of Economics
The University of Akron
Mark Partridge, Professor
Agricultural, Environmental, and Development Economics
The Ohio State University
aweinstein@uakron.edu
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An Unexpected Turn

- Innovations in hydraulic fracturing, microseismic technology, and horizontal drilling reversed the trend of rising oil and gas imports
- Opened up previously uneconomical shale plays to oil and gas drilling across the U.S.
- U.S. oil and gas production has been steadily increasing
- U.S. is expected to be the world’s largest natural gas producer in 2015 and the world’s largest oil producer by 2017 (International Energy Administration, 2012)

U.S. Shale Plays
Oil Production from Shale

Natural Gas Production from Shale

The Benefits of Shale Across the U.S.

- A boom in oil and gas employment has accompanied the boom in oil and gas production
  - The industry still comprises a very small share of the economy
- Additionally, lower oil and gas prices benefit all energy consumers
Hydraulic Fracturing

Source: ProPublica

Stages of Shale Development

- Site selection (incl. leasing agreements with landowners)
- Site preparation and drill pad construction (1-2 months)
- Rig work and horizontal drilling (1 month)
- Hydraulic fracturing (2-5 days) and disposal of contaminated water
- Oil and gas extraction (for up to 30 years though flow rates are highest in the first few weeks)

Marcellus Shale horizontal drilling tower in Lycoming County, PA.

Capped well

Weighing the Costs and Benefits

- Costs associated with extraction are typically localized
  - Strain on infrastructure and public services, environmental, etc.
- In order to weigh all of the costs and benefits of shale, the economic benefits to local communities needs to be accurately assessed
- We need to create a counterfactual to estimate what would have happened if there was no shale development
  - The difference between what did happen and the counterfactual is the shale development effect
Impact Study Estimates

- Even a well-done impact study is not a counterfactual
- Impact study estimates find shale created or would create:
  - 140,000 Pennsylvania jobs during 2010 (Considine et al., 2011)
  - 200,000 Ohio jobs by 2015 (Kleinhenz & Associates, 2011)
- Aubrey McClendon CEO of Chesapeake Energy was quoted in the Columbus Dispatch saying, “This will be the biggest thing in the state of Ohio since the plow.”
- We are concerned that job numbers may be overinflated by the industry and ignoring the potential long term impact

Impact studies

- Input-output methodology used to estimate the total number of jobs supported by an industry
  - 1) Direct jobs (oil and gas jobs)
  - 2) Indirect jobs (pipeline construction)
  - 3) Induced jobs (restaurants, bars, hotels)

- In 2010, Pennsylvania’s direct oil and gas employment was just over 26,000 (after adding about 10,000 jobs since 2004)
  - Implies Considine’s multiplier was about 14
- Literature has generally found a multiplier closer to 2 for this industry
  - The total impact was more realistically closer to 20,000 (not 140,000) – Weinstein and Partridge (2011)
  - Reasonable to expect a similar impact for Ohio in the first 6 years of development (20,000 not 200,000)

Pennsylvania Shale

- Using the additional year of data since our study, the total employment impact from 2004 to 2011 is just over 38,000 (including the multiplier effect)
Putting it in Perspective

- **Pennsylvania**
  - Unemployment rates in Pennsylvania have actually increased from 5.4% in 2004 to 7.5% as of May, 2013 (BLS)
  - Oil and gas employment remains a small share of the economy at 0.64% in 2011

- **North Dakota**
  - Most pronounced shale boom
  - Mining employment (including coal) went from 3,600 in 2003 to 24,600 in March 2013 (U.S. BLS)
  - During this time total employment in North Dakota increased by just over 100,000 (U.S. BLS SAE)
  - Even if every new job in the state was the result of shale development (unlikely) that multiplier is still just over 5

Oil & Gas Employment Growth

Shale Development in North Dakota
Unemployment Rates in Shale States

- The unemployment rates in shale states seem to be unaffected or barely affected by shale development

![Unemployment Rates in Shale States Graph]

No Surprise

- It should be no surprise that the impact is relatively small
  - Small share: the mining industry is still just a small share (still under 6% for ND)
  - Capital intensive
  - About 55% of the windfall earnings are saved not spent in the local economy (Kelsey et al., 2011)
  - Skilled jobs go to out-of-state workers (about 37%) – Kelsey et al. (2011)
  - Displacement and other negative effects

The Impact on Smaller Communities

- Even with impressive growth rates, the impact of a rather small industry on a large state economy will be rather small
- If the impact is concentrated on a small economy – at the county level – we would expect the impact to be much more significant
- Additionally, communities most directly impacted are small rural counties many have been struggling
County
- Weinstein and Partridge (2011) compare drilling counties in PA to similar non-drilling counties
  - Still a modest impact on employment
  - The impact on earnings is nearly double the impact on employment
- Weber (2012) finds that $1 million in shale gas production results in just 2.35 net total jobs within counties in Texas, Colorado, and Wyoming
- Brown (2014) rural counties in a 9 state region (TX, NM, OK, KS, CO, WY, NE, LA, AR) multiplier of 1.7
- Weinstein (2013) finds the average U.S. county multiplier for shale development to be approximately 1.3
  - Modest impact on employment and nearly double the impact on earnings

Williston, ND
- Overall, there is a positive impact on employment in counties though still more modest than initial estimates
- Williston in the news
  - Williston, ND in Williams County has had the most pronounced boom in the country
  - More than double the employment from 13,000 in 2005 to 28,000 in 2011 (US BEA)
  - Average per capital income increased 166% from 2005 to 2011 (US BEA)
  - Housing rent increased from $500/mo in 2005 to $2,000 (Shactman, 2012) along with groceries and gas prices
  - Dilapidated roads and overstressed utilities
  - Overcrowded schools

Previous Energy Booms
- Williston is worried about its fate should this boom go bust like what happened 30 years ago
- The energy industry can be volatile and its fate rests in the hands of the energy industry
The Natural Resource Curse

- Short-term energy booms do not necessarily translate into long-term economic prosperity
- The "natural resource curse": where energy development leads to lower long-term economic growth
  - Has been documented at every level of geography from countries to U.S. states and counties (Papyrakis and Gerlagh, 2007; Kilkenny and Partridge, 2009; James and Aadland, 2011)
  - High wages crowding out other industries
  - Lower industry diversity
  - Lower incentive for higher education
  - Institutions (i.e. - government spending)

Conclusion

- We are concerned that job numbers may be overinflated by the industry and ignoring the potential long term impact
- Policy makers have used these job numbers to justify supporting the industry through tax breaks and other measures
- Need a realistic estimate of the economic gains communities can expect from shale development
- Take advantage of the short run economic gains to invest in the community's future and prevent the natural resource curse
  - Maintain and improve public resources and infrastructure
  - Mitigate any other costs associated with shale development (environmental)
  - Invest in local human capital (education, workforce skills, etc.)
  - Diversify the economy

Thank You

Amanda Weinstein
aweinstein@uakron.edu
The Counterfactual

- Method 1:
  - \( Y_{i0} = \beta_0 + \beta_1 \text{(Number of Wells)}_{i0} + C_i + \epsilon_{i0} \)  
  (1)
  - \( Y_{i1} = \beta_0 + \beta_1 \text{(Number of Wells)}_{i1} + C_i + \epsilon_{i1} \)  
  (2)
  - \( Y_{i1} - Y_{i0} = \beta_0 + \beta_1 \text{(Δ Number of Wells)} + \epsilon_i \)  
  (3)

- Method 2:
  - \( Y_t = \beta_0 + \beta_1 \text{(Drilling Period)} + \beta_2 \text{(Drilling County)} + \beta_3 \text{(Drilling Period*Drilling County)} + \epsilon_i \)