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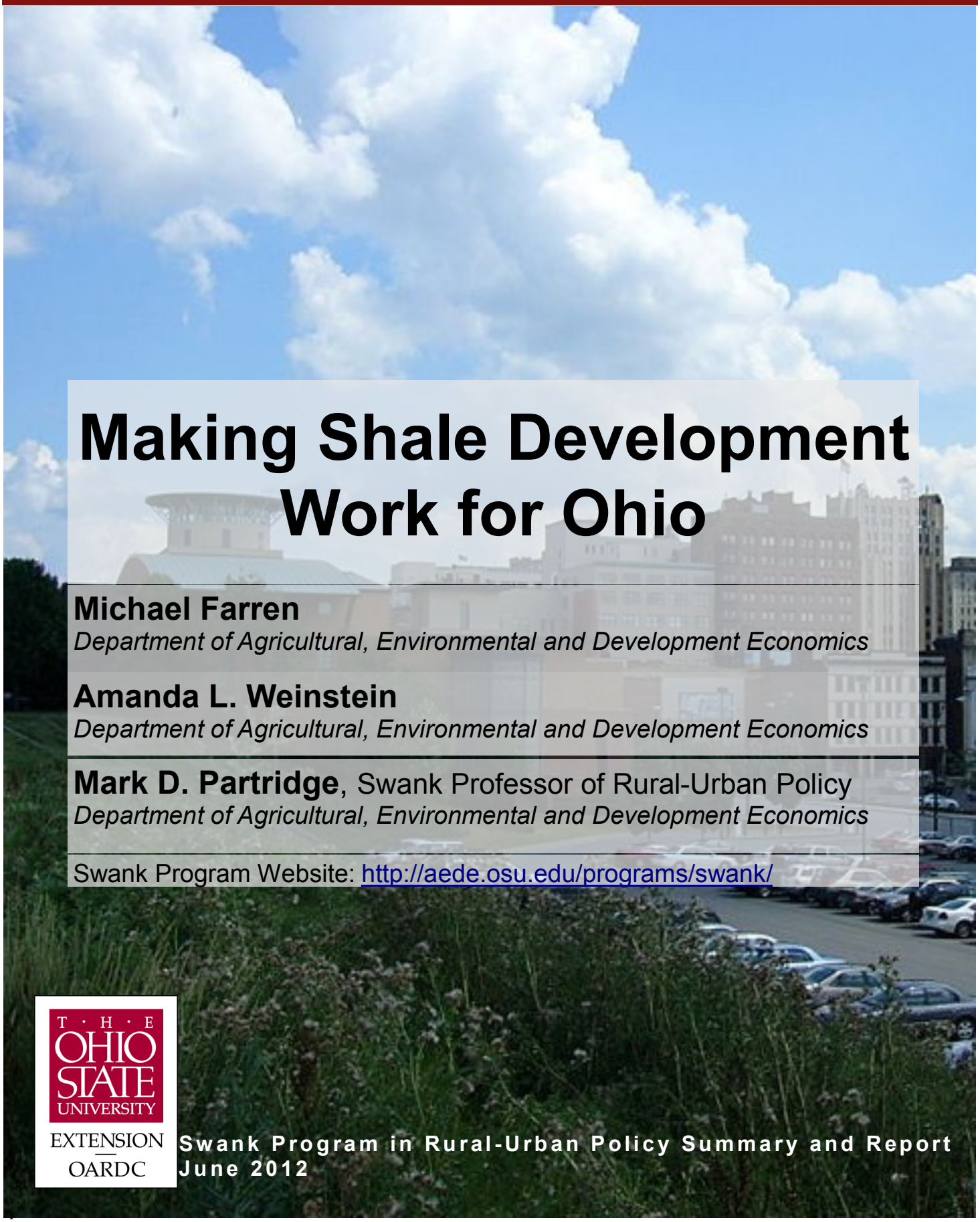

Making Shale Development Work for Ohio

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THE OHIO STATE UNIVERSITY
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Swank Program in Rural-Urban Policy Summary and Report
June 2012

Pictured above: Youngstown, OH recently expanded its steel mill operations to produce pipes for used in shale oil and gas extraction.

Michael Farren Short Biography

Michael Farren is a PhD student and a Graduate Research Associate in the C. William Swank Program in Rural-Urban Policy in the Department of Agricultural, Environmental, and Development Economics at The Ohio State University. His previous research in this field includes investigations into the wind and biomass energy resources in Ohio. His other research interests include policy analysis and the effects of infrastructure and energy development on the U.S. and developing economies. He previously earned his bachelor's and master's degrees in Civil Engineering at Ohio State. Before joining the PhD program, he worked as a consulting engineer in the roadway/bridge and structural engineering fields and served as an intern in the highway construction division of the Ohio Department of Transportation. He is a licensed professional engineer in the State of Ohio.

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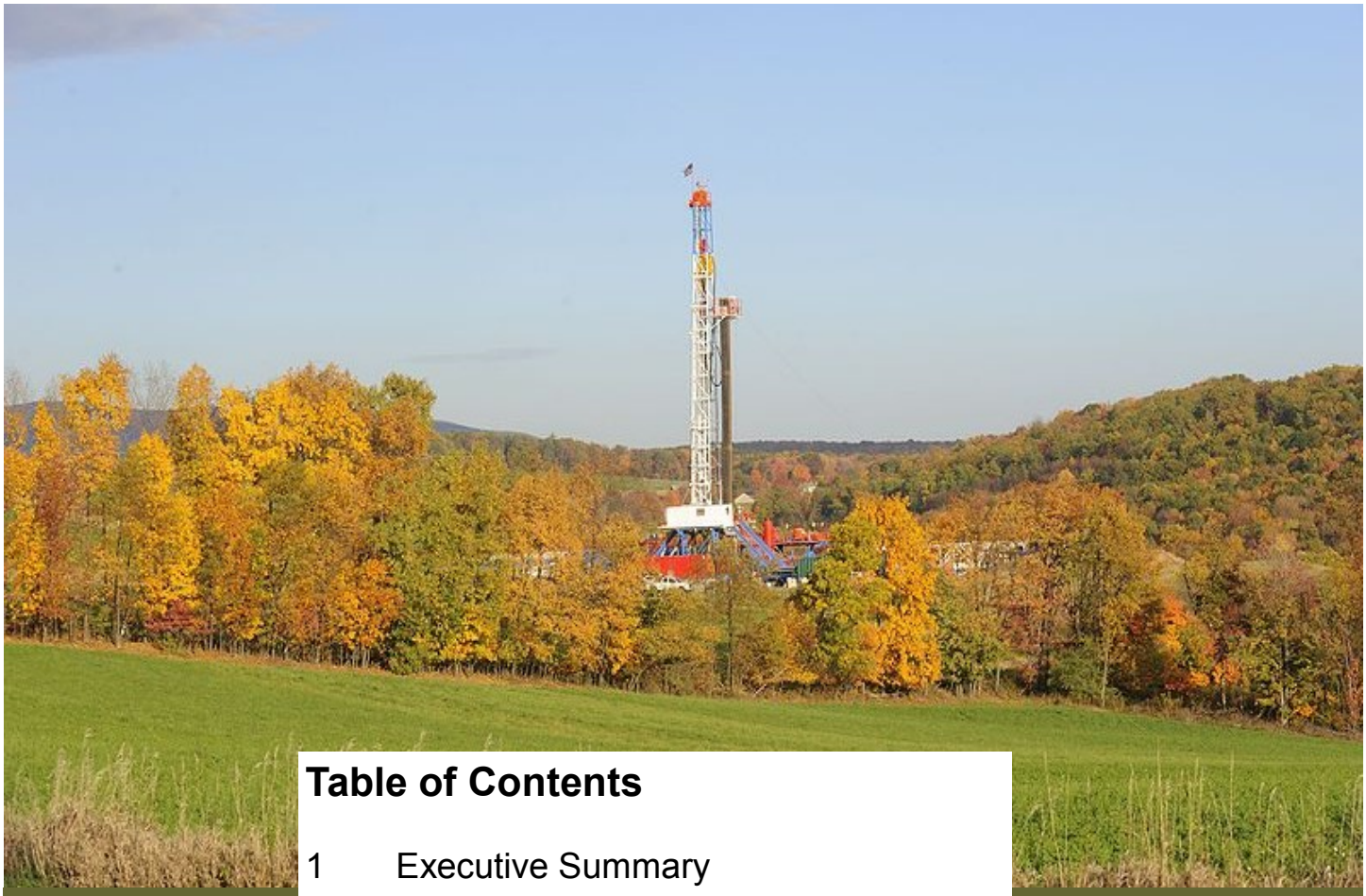
Amanda Weinstein is a PhD candidate in the Department of Agricultural, Environmental, and Development Economics at The Ohio State University. Her research as the C. William Swank Graduate Research Associate includes policy briefs about the employment effects of energy policies and general regional growth and policy issues. She is an OECD consultant advising on the economic impacts of alternative energy policies on rural communities. Her other research interests include women's role in economic development examining women's effect on regional productivity growth. She was awarded the Coca-Cola Critical Difference for Women Graduate Studies Grant to continue her work on gender issues in economics. She is also conducting research on the skills most valued during a recession. Before starting her PhD at OSU, she was a commissioned officer in the United States Air Force after graduating from the United States Air Force Academy. As a Scientific Analyst in the Air Force and then as a Sr. Management Analyst for BearingPoint, she advised Air Force leadership on various acquisition and logistics issues. She is currently an adjunct faculty member of Embry-Riddle University and DeVry.

Mark Partridge Short Biography

Mark Partridge is the Swank Chair of Rural-Urban Policy at Ohio State University. He is a Faculty Research Affiliate, City-Region Studies Centre, University of Alberta and an adjunct professor at the University of Saskatchewan. Professor Partridge is Co-Editor of the Journal of Regional Science and is the Co-editor of new the Springer Briefs in Regional Science as well as serves on the editorial boards of Annals of Regional Science, Growth and Change, Journal of Regional Analysis and Policy, Letters in Spatial and Resource Sciences, The Review of Regional Studies, and Region et Developpement. He has published over 100 peer-reviewed scholarly papers and co-authored the book The Geography of American Poverty: Is there a Role for Place-Based Policy? Professor Partridge has received research funding from many sources including the Appalachian Regional Commission, Brookings Institution, European Commission, Infrastructure Canada, Lincoln Institute of Land Policy, U.S. National Science Foundation, U.S. National Oceanic and Atmospheric Administration, and Social Science and Humanities Research Council of Canada. His research includes investigating rural-urban interdependence and regional growth and policy. Dr. Partridge served as President of the Southern Regional Science Association and he was recently elected a fellow of the association.



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Making Shale Development Work for Ohio

The Ohio State University

Swank Program in Rural-Urban Policy
Summary and Report June 2012

Executive Summary

Recent reports of the shale potential in Ohio, Pennsylvania, West Virginia, and New York make it appear as though these states have won a multi-billion dollar jackpot. These states overlie Marcellus and Utica shale deposits containing natural gas and oil reserves. Recent innovations in hydraulic fracturing (or "fracking") and horizontal drilling methods have made previously uneconomical shale resources available. Now U.S. and international energy companies find themselves in a breakneck race, trying to purchase mineral access rights from property owners in those states. Of these four states, Pennsylvania is the furthest along the shale gas development path and its experience should help shape Ohio's expectations. However, Pennsylvania's shale development is still nascent and cannot provide insight into the long-run economic outcomes of the shale gas boom, specifically some of the negative consequences that economists refer to as the "natural resource curse."

The "resource curse" is the term coined for the seemingly counterintuitive occurrence of slow long-term economic growth in regions rich in natural resources. In this series from the C. William Swank Program in Rural-Urban Policy at The Ohio State University, Weinstein and Partridge (Dec., 2011 available at http://aede.osu.edu/programs/swank) examined the expected short-run effects on employment and income of the coming shale oil and gas boom in Ohio. This report takes the analysis a step further by examining the long-run implications.

Resource economies experience a boom-bust cycle that follows the rise and fall of energy prices contributing to the volatility of the local economy, thereby affecting economic growth. Regions in the U.S. like Houston, Tulsa, and Williston, North Dakota are presented as repeat riders on the energy price roller coaster. Their differing economic outcomes offer evidence that the first step in mitigating the boom-bust cycle is to foster a diverse economy, like that of Houston, which can weather the sudden changes in fortune that extensive energy resources can bring.

As the natural resources sector of the economy grows, it attracts workers, causing a shift away from other economic sectors. The increased wealth flowing into the local economy from the resource sector increases local prices and wages while driving other industries to relocate to other regions with lower prices and wages. The net result is the shrinking of the non-booming sectors and an over-specialization of the economy towards its natural resource wealth, which causes it to be more vulnerable to economic shocks. After the energy boom subsides, these other sectors are smaller and weaker than what they otherwise would have been.

There are several main points that Ohio policymakers need to remember if Ohio is to be a future example of how to turn the resource curse into a blessing:

1. Short-term costs of extraction, particularly the hidden costs, must be compensated for to ensure infrastructure, amenities, and other public service levels are maintained.
2. Long-term tradeoffs must be countered by increasing levels of human and physical capital and economic diversity.
3. Oil and gas industry taxes should be set appropriately to cover the short-term and long-term costs and tradeoffs of a natural resource boom.
4. Good governance is critical to ensure public policies and expenditures from the tax revenue are effective and efficient, supporting all businesses and industries.

It is important to account for the immediate costs of natural resource extraction that are often ignored. For instance, hydraulic fracturing has been shown to cause significant roadway degradation due to the large numbers of heavy trucks servicing the drilling sites. Additionally, many of these costs are hidden, including potential damage to Ohio waterways. Such hidden costs of shale drilling should be incorporated into the energy companies' decision-making process, either through impact fees, taxes or some other formalized structure. In order to minimize the negative effects on Ohio residents and businesses, the level of infrastructure and amenities must be maintained, if not increased, over the long run to counter the loss of a nonrenewable resource.

The most important effect may be the tradeoffs that natural resource extraction induces. Natural resource booms force regions to make a tradeoff between the current payoffs associated with present extraction and future payoffs through maintaining current resource levels for future extraction. Non-renewable natural resource extraction permanently reduces a region's natural capital. Thus, it is important for Ohio to counter the reduction in its natural resources capital with a corresponding increase in public and human capital (education and job

skills). Investing in education is especially crucial as higher wages resulting from the shale boom and the availability of relatively high-paying jobs provides a disincentive for workers to obtain more education or skills. This effect has been noted in the coal-rich areas of Appalachia. The underlying problem is that regions with lower levels of education have consistently shown lower rates of economic growth.

By taxing the natural resource extraction and using that revenue to account for its short-term and long-term costs, some regions like Texas and Calgary, Alberta in Canada have managed to avoid the resource curse. Conversely, Ohio's current oil and gas severance taxes are noticeably lower than the top oil and gas producing states. Ohio seems less prepared to account for all of the costs associated with oil and gas extraction, although Governor Kasich's proposal to increase oil and gas taxes is a step in the right direction. In order to stay on the right path, Ohio should ensure that this tax revenue is spent appropriately to cover the short and long-term costs.

Finally, good governance is required to ensure that this new tax revenue is spent appropriately. Good governance does not permit individuals, firms, or government officials to engage in rent-seeking behavior. Rent-seeking is an economic term which describes activities that attempt to use the power structures in society to achieve personal gain, often to others' detriment. Rent-seeking behaviors can also leave a government beholden to an industry, allowing the industry to dictate spending, the regulatory environment, taxes, and other public policies, rather than the government being an advocate for all industries and citizens. It is still essential for governments to be efficient despite the influx of money that may come from oil and gas tax revenues. Governments should allocate these funds effectively and efficiently without becoming accustomed to large tax revenues from the oil and gas industry and spending like they have just won the lottery.

Ohio's Oil and Gas Jackpot

According to recent reports on the shale potential of Ohio, it appears that the state has won a $500 billion dollar lottery.[1] This good fortune is due to improved drilling techniques and technology that allow the extraction of previously economically unfeasible underground reserves of natural gas and oil. Pennsylvania, New York and West Virginia share the good fortune of being located above extensive deposits of the Marcellus and Utica shale which carry the oil and gas trapped in porous portions of the rock. The extraction of oil and gas resources from the Marcellus and Utica shales in Ohio is still in its early stages, but extraction in Pennsylvania began approximately five or six years before Ohio and it is already experiencing many of the effects that Ohio may soon face. Conversely, New York has had a moratorium on hydraulic fracturing since 2008, choosing not to pursue these untapped resources because of the potential environmental costs that accompany this "winning lottery ticket," though this policy is currently under review (CBS Moneywatch).

This policy brief follows from the December (2011) policy brief by Weinstein and Partridge that evaluated the short-term economic benefits of the shale resource, predicting a modest increase in oil and gas-related employment as well as a more substantial increase in income for state and local area residents. Policymakers often focus solely on job creation when discussing the merits of shale development and other initiatives, but should instead turn their focus to measuring the benefits against the costs of shale development. This policy brief addresses some of the long-run costs regarding the natural resource curse mentioned in the previous report and addresses the strategy needed to tackle some of the short and long-term concerns that have been associated with similar natural resource booms in the past.

The lottery metaphor is especially apt in this case. Many Ohio landowners now possess property that is suddenly substantially more valuable than it was before. Additionally, if Ohio oil and gas taxes are increased to be comparable with other oil and gas producing states, state tax revenues will also experience a significant increase. However, history is full of examples of poor spending decisions by political leaders flush with money from energy resources. The plight of governments or communities who have depended too much on a single source of revenue after that source has dried up or left is unfortunately a common story. This begs the question: How does an individual or community go about using the sudden flow of cash to the greatest long-term, preferably sustainable, benefit? Perhaps more importantly, what are the pitfalls that are to be sidestepped if a future bust after the economic boom is to be avoided?

Is the Boom Worth It?

Although policymakers like to focus on the positive aspects of a resource boom, especially the rise in employment, there will also be substantial strains on Ohio communities accompanying the boom. Hydraulic fracturing, or "fracking", the method used to extract gas and oil from shale, places a substantial strain on the public infrastructure, especially the roads and water system. The sudden and somewhat unexpected influx of new workers to the area adds to the strain on the local infrastructure, water and sewer systems, energy grid, and other local services. If the infrastructure and level of services and public amenities are not maintained, the boom can leave an area especially vulnerable to a subsequent bust. An economic bust due to either a drop in energy prices or other market forces can leave a community worse off than before the boom began, providing an example of the "natural resource curse".

This report will examine the nature of economic booms, specifically those caused by natural resource discoveries, and the associated bust when the resource is exhausted or prices drop. The concept of a "resource curse" – a situation where the abundance of natural resources actually leads to slower economic growth - has been extensively investigated in academic literature (Corden 1984, Auty 1994, Warner & Sachs 1997 and Papyrakis & Gerlagh 2007, among many others).

A discussion of the origin of the resource curse will help illuminate the underlying causes of the bust, which in many cases is actually caused by the boom itself. Armed with this knowledge, recommendations toward avoiding the potential future economic bust will be presented along with policy suggestions that may help Ohio alleviate the potential negative side effects of shale gas drilling.

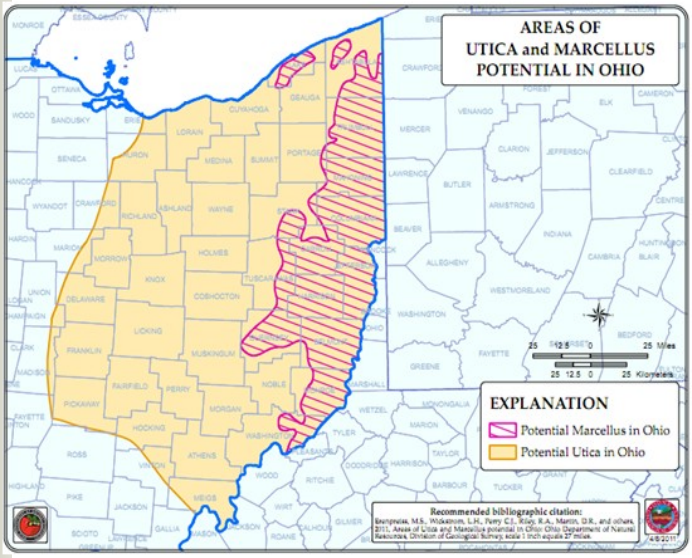
1. Ohio's State Geologist, Lawrence Wickstrom, estimates the resources recoverable from Ohio's Utica Shale could be as high as 15 trillion cubic feet of gas and 500 billion barrels of oil. Given April 2012 market prices of approximately $2 per Mcf (thousand cubic feet) of gas and $100 per barrel of oil, the market value of each resource would be $30 billion and $500 billion respectively (Downing 2011; US Energy Information Administration). For perspective, keep in mind that this would be over a 30 year period (or so). According to the BEA, the Ohio state GDP was $477.7 billion in 2010, which would total $19.4 trillion in 2010 dollars over this 30 year period assuming a very modest 2% annual real growth in GDP.

Hydraulic Fracturing in Ohio

Much of the economic development from the extraction of shale gas and oil is likely to take place in the rural plains of northwestern Ohio and the rolling hills of the southeastern Appalachian region. Ohio's shale resources are split between a small portion of the state overlying the Marcellus shale deposit and a larger area over the Utica shale (see Figure 1).

The spacing of hydraulic fracturing wellheads, using the horizontal drilling technology currently available, allows for horizontal drill lengths of up to 10,000 feet. Chesapeake Energy, which has leased over 1.3 million acres of mineral rights, has said that it anticipates constructing 12,000 wellheads, which could mean that a wellhead might tap an area of 125 acres on average and that wellheads might be spaced about every ½ mile (Chesapeake Energy, 2011). The actual wellhead locations and density of construction will depend on the shale resource itself, which can be surprisingly variable over short distances, but there exists the potential that nearly every Ohioan living east of Columbus will have a wellhead (or multiple wellheads) located within a few miles of his or her household.

Figure 1: Ohio Shale Resources



Source: ODNR

The equipment required to access the shale gas is not excessive, but it does require a substantially larger area than the traditional oil or gas wells that many Ohioans are familiar with (see Figure 2). This area often covers several acres in size and includes the drilling pad, gas handling machinery (gas driers, compressors, condensate holding tanks, etc) and often a holding pond or storage tanks for the substantial amounts of water used for hydraulic fracturing and the subsequent wastewater called "flowback water" or "produced water".

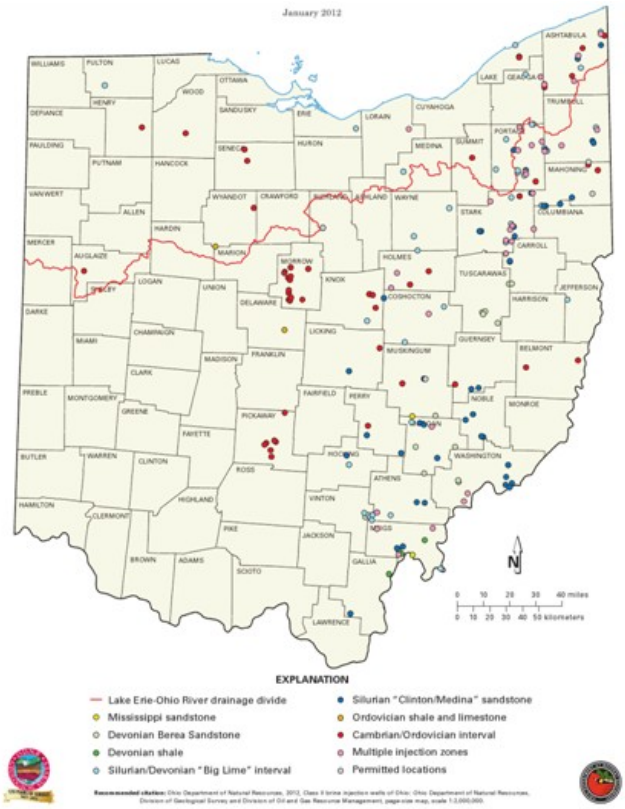
Figure 2: Horizontal drilling tower in Pennsylvania.

Source: Wikipedia

Both the Marcellus and Utica shales are rich in natural gas trapped in the pores of the rock,[2] while the Utica shale may contain additional petrochemical compounds and oil, increasing the value of the resource. Gas and other compounds are released from the rock via hydraulic fracturing, a process which involves pumping a mixture of water and chemicals into the rock at very high pressure. This water, anywhere from 1 to 8 million gallons per well, is the equivalent of two to twelve Olympic-sized swimming pools and must be brought into the site by truck or drawn from a local waterway or the public water supply (Weinstein and Partridge, Dec. 2011). Once the gas and water mixture is extracted, any wastewater that isn't reused must be transported via truck to an injection well for disposal. Many of these injection wells are located in eastern Ohio and have already been used for Pennsylvania's hydraulic fracturing wastewater (see Figure 3 on the next page).

2. For a more detailed investigation of Ohio's shale resource and discussion of the process of fracking, see Weinstein and Partridge (Dec. 2011).

Figure 3: Class II Brine Injection Wells in Ohio



Source: ODNR

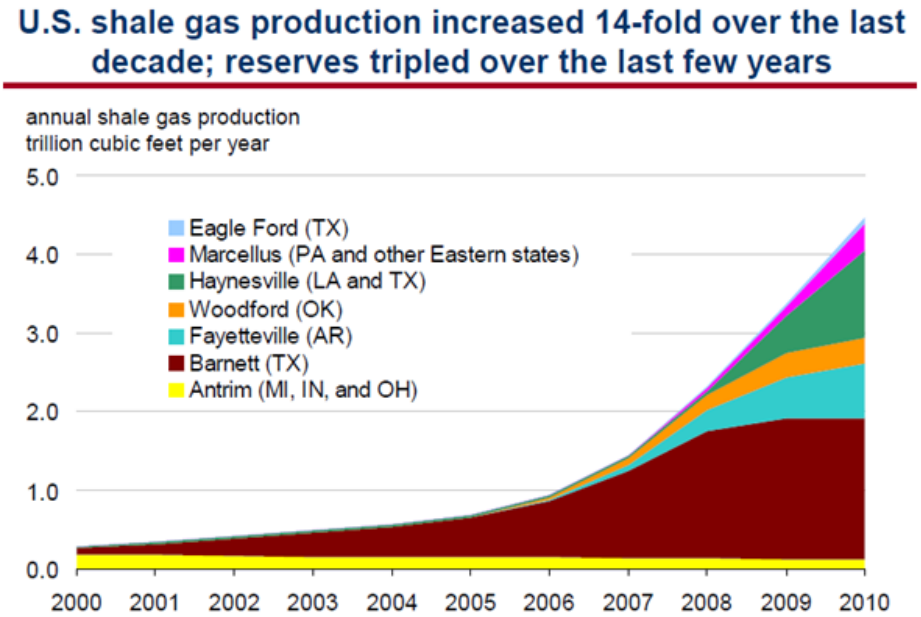
In December 2011, a number of small earthquakes near Youngstown, Ohio were attributed to an injection well accepting flowback water from Pennsylvania. It seems that the events in Youngstown constituted an unusual case of a well located above a small fault line and which was potentially drilled too deep into bedrock which then required higher injection pressures (WKNB 27 CBS). The sum total of these circumstances allowed the naturally-occurring seismic stresses to be released, but this should not be a concern for most other injection wells (Phillips 2012). However, this incident does provide tangible evidence of the risks, both known and unknown, associated with fracking.

Southeastern Ohio in particular, which traditionally has seen limited economic growth and dependence on natural resource extraction in other forms, could experience a new rejuvenation in the regional economy from the development of shale gas resources. However, the experience of southeastern Ohio with past natural resource booms also serves as a warning to regions and communities that depend too much on natural resource exploitation to achieve economic growth. This report is devoted to addressing the actions that Ohio can take to ensure that the influx of cash from the extraction of this natural resource will spur sustainable growth that leads to lasting value.

What's Causing Ohio's Boom?

An economic boom can be caused by several different changes in the economy (Corden 1984). First, production of goods can become more efficient, often due to some technological change in the production process, such as the creation of the assembly line in automobile manufacturing. Second, the global demand and price of locally-produced goods could increase, meaning that local producers would see increased revenue. Lastly, and most importantly for Ohio, there can be a windfall discovery of some resource which is essential to the economy. A shale gas well has the potential to produce gas for 50 years, but 25-50% of the total production is likely to occur in just the first two years (Innovation Ohio 2012, Green 2010). Figure 4 below shows the shale gas boom that has already started in Texas, Pennsylvania, and other areas in the U.S.

Figure 4: Shale Gas Production



Source: US EIA 2011 Annual Energy Outlook reproduced from Weinstein and Partridge (Dec., 2011)

The Race for Resource Rights

American and international energy companies are purchasing mineral rights to property overlying the Marcellus and Utica shales at an astonishing pace. Chinese, French and Japanese companies recently committed over $8 billion to acquire mineral rights to drill into shale gas deposits from Texas to Ohio and Pennsylvania (Carroll and Polson, 2012). Indeed, Table 1 indicates that 4 million acres of mineral rights for shale gas in Ohio have already been purchased by out-of-state companies (mainly from Oklahoma and Texas). Additionally, the belief that the western region of the Utica shale contains substantial reserves of oil has led the larger petroleum companies to take an interest in this resource, with BP recently purchasing 84,000 acres (Carroll and Polson, 2012; BP, 2012).

Employment and Income Effects

Given that the Utica shale in Ohio may represent a more valuable resource than the Marcellus shale in Pennsylvania, the prices that Ohioans can charge energy companies for their mineral rights should be correspondingly higher. The consideration of appropriate reimbursement for mineral rights contracts is very important as it is one channel through which many Ohioans will see benefits from the extraction of shale gas. This influx of cash to the state will increase the buying power of the households holding these mineral rights, which can be associated with increased economic development. Weinstein and Partridge (Dec. 2011) found that local areas will experience a significant increase in income due to shale gas development. The first question is how these property owners will use these payment for their mineral rights, since that is the first effect that the state will experience. Kelsey et al. (2011) find that approximately 55% of the money residents receive in royalties is saved rather than injected directly into the local economy, limiting the employment effects of the surge in income. Also, absentee landowners further limit these effects.

Because many energy companies are headquartered in traditionally prominent oil and gas-producing states, many of the shale gas workers are likely to come from outside of Ohio. Kelsey et al. (2011) find that 37% of Marcellus oil and gas employment went to out-of-state residents. Additionally, because there are established energy supply chain industries in other states, many of the highly technical or industry-specific inputs into the production process are also likely to come from outside Ohio, limiting the supply chain effect of a shale boom in Ohio.[3] For this reason and others detailed

Table 1: Major Holders of Utica Shale Rights in Ohio (April, 2012)

	Land Holdings (Acres)	Headquarters	Shale Permits	Active Wells*
Chesapeake	1,357,500	OK	82	58
Enervest & EVEP	780,000	TX	7	2
Chevron	600,000	CA	0	0
Anadarko	300,000	TX	3	7
Hess Corporation	185,000	NY	3	1
SA	154,750	France	0	0
Devon Energy Production	110,000	OK	2	2
Consol/CNX Gas	100,000	PA	3	2
BP	84,000	United Kingdom	0	0
Gulfport	62,500	OK	0	1
Rex Energy Corp	58,700	PA	0	0
Phillips Exploration	45,000	PA	1	1
Petroleum Development Corp	40,000	CO	0	0
HG Energy	30,000	WV	10	5
XTO Energy (ExxonMobil)	25,056	TX	2	0
Triad Hunter	16,000	TX	0	1

*Includes all wells classified as drilling, drilled, producing, and completed

Source: Ohio Department of Natural Resources http://www.ohiodnr.com/oil/shale/tabid/23174/Default.aspx , Ohio Shale Coalition (Thomas et el. 2012), and Utica Shale Ohio http://oilshalegas.com/uticashale.html

3. Supply chain effects are the secondary economic effects that a new industry has on a local or regional economy. For example, a new automobile factory might help create local industries for glass, rubber and upholstery.

by Weinstein and Partridge (Dec. 2011), local employment impacts may be less than many Ohioans currently anticipate.

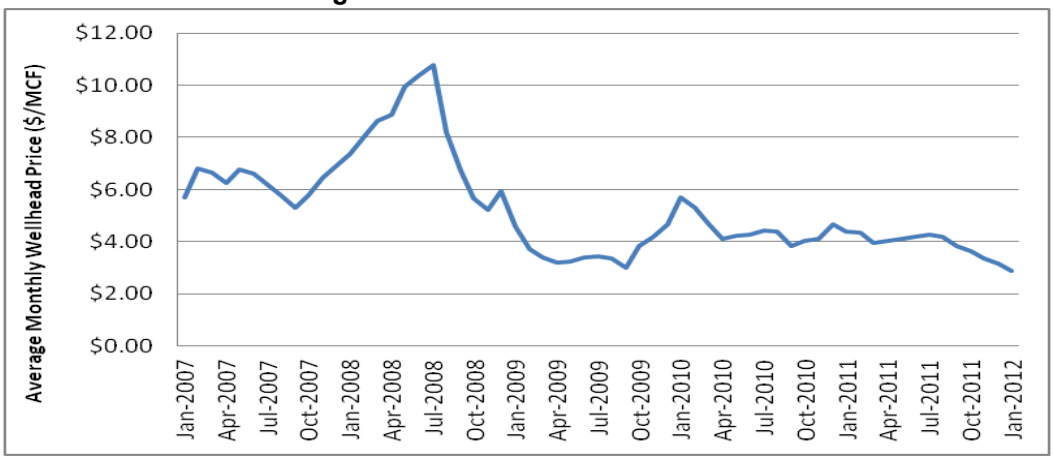
It is important that policymakers remember that employment increases are likely to be modest and communicate this fact to their constituents to avoid future problems arising from unrealistic expectations. For example, many businesses expanded after hearing policymakers tout the coming green jobs boom, only to be disappointed with some even filing for bankruptcy when the employment impact was more modest than they had expected (Dugan and Scheck, 2012).

Energy Prices are Paramount

Often the excitement associated with a new resource discovery in conjunction with increasing energy prices causes the benefactors to forget about other determinants of an energy market, including the variability of demand and the possibility of falling energy prices. In the energy market, the contemporaneous prices and demand for oil and gas are the most important determinants of the course a boom will take, not the potential reserves.

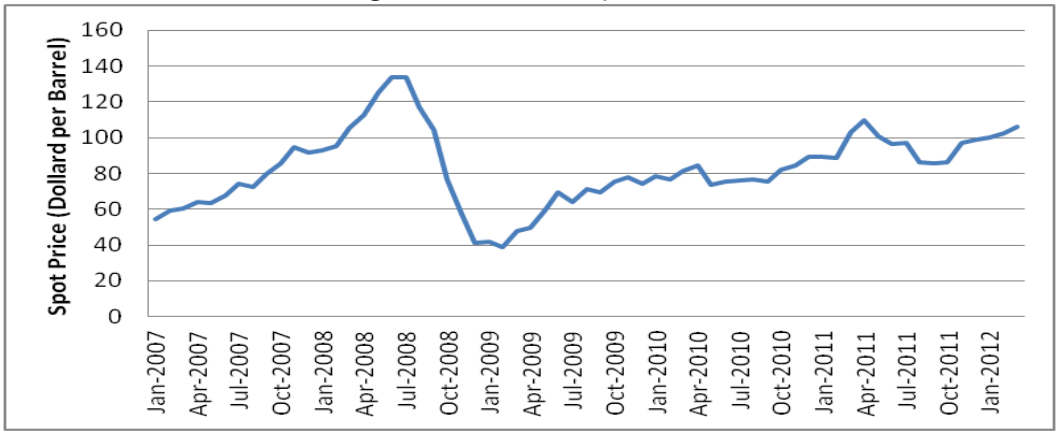
The current shale boom for several other states began around 2006-2007 which coincided with dramatic rises in natural gas prices (see Figure 5). Natural gas prices have since dropped, causing established shale gas industries in areas like Texas and Oklahoma to stop increasing the rate of natural gas production, as seen in Figure 4. Additionally, a warmer than average winter decreased natural gas heating demands, leaving record amounts of gas in storage (Funk, 2012). Shale gas discoveries have also been made not only around the country but around the world which further places downward pressure gas prices. Thus, focus has turned more recently to the oil potential of shale resources rather than natural gas. Figure 6 shows that although oil prices similarly dropped in 2008, oil prices have since been increasing whereas natural gas prices have remained stagnant or have decreased.

Figure 5: Natural Gas Wellhead Price



Source: U.S. EIA http://www.eia.gov/dnav/ng/hist/n9190us3m.htm

Figure 6: Crude Oil Spot Price



Source: U.S. EIA http://www.eia.gov/dnav/pet/pet_pri_spt_s1_a.htm

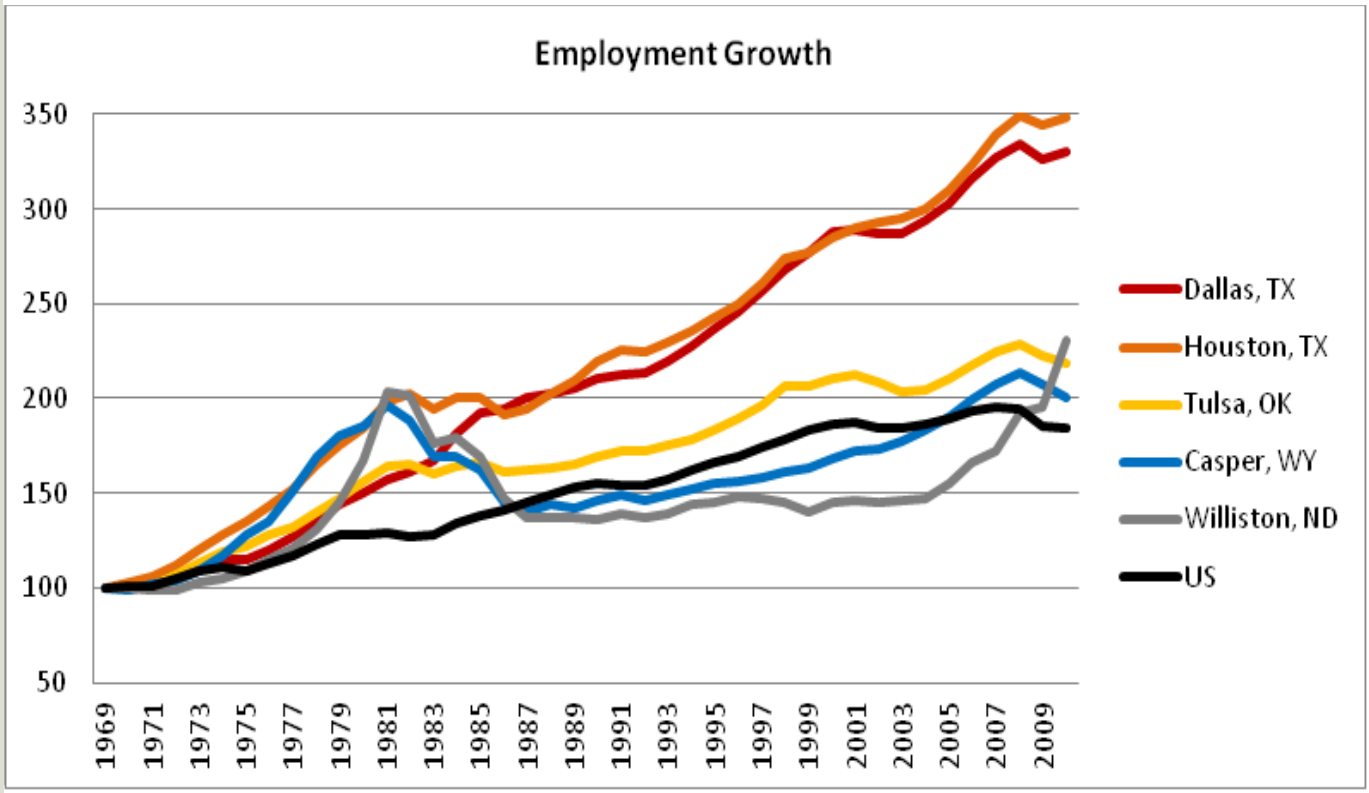
Lessons from Previous Energy Booms

We can look to recent natural resource booms, specifically the oil boom in the 1970s and early 1980s, to help characterize what the shale gas boom may look like for Ohio. Figure 7 below shows regional employment growth (benchmarked at 1969 levels) for a number of communities starting in 1969 just before the oil boom. Casper, WY in Natrona County and Williston, ND in Williams County (in the center of the Williston Basin oil reserve and the Bakken reserves) provide good examples of rural areas with limited economic diversity before and after the energy boom. Both areas experienced significant oil booms when oil prices spiked in the 1970s and subsequent busts when prices dropped in the early 1980s. After the bust their employment growth, which had previously surpassed the U.S. average growth rate, declined and went through a period of stagnation, performing below the U.S. average.

Tulsa, OK is a larger city than both Williston and Casper. Its economy is more diverse, especially after significant efforts were made to diversify the economy and improve its infrastructure and local amenities following decreasing oil prices in the 1980s. Dallas and Houston were chosen as examples of cities with highly diverse economies before and after the boom. Both cities had experienced oil booms earlier in their histories and were able to establish an oil and gas supply chain that includes the headquarters for many oil and gas companies. Dallas and Houston also had initial advantages in economic growth as transportation hubs, which assisted in their development of large, diverse economies. As a result, both cities have generally higher growth rates in employment than the U.S. average. Despite its advantages over less-diverse economies in the smaller cities, Houston still showed the effects of the oil bust via a period of employment growth stagnation before rejoining Dallas's high growth rate.

This range of community sizes and economic diversity provides a comparison of what similar regions in Ohio might experience from the shale gas boom. A key les-

Figure 7: Total Employment and Previous Oil Booms in the U.S.



Source: US Bureau of Economic Analysis

son here is that the energy economies that "permanently" gain the most jobs are (1) more diversified, using their wealth to attract new industries outside of energy and (2) large enough to have energy industry headquarters and an entire energy supply chain. Unfortunately for Ohio, many companies will likely select Pittsburgh as their regional headquarters for their shale gas production due to its size, central location in the Marcellus and Utica shale region, and a long established oil and gas industry. Shell Oil has already selected a site northwest of Pittsburgh in Monaca, PA as the location of their forthcoming multi-billion dollar ethane cracker to process shale gas products. Nonetheless, the most important element in avoiding the bust is having a highly diversified economy, which is still possible for Ohio to achieve.

The Seeds of the Bust are Sown in the Boom

Countless historical examples show that, in general, a contraction will follow an economic expansion. The stronger and more sudden the expansion, the harsher and more abrupt is the contraction. This is especially the case when it is one sector of the economy that is expanding rather than broad-based economic growth (Partridge and Olfert, 2011). The effects are compounded further when this economic boom is occurring in one specific region and the impetus for the boom is external to the region, as is the case in Ohio. The global demand for energy is the external force driving the race to capitalize on the sudden availability of shale resources. Even if natural gas prices rebound from their current slump (refer to Figure 6) to allow for continuous extraction, Ohio would still face a similar situation that has undermined many economies before, that of the 'natural resource curse'.

The Natural Resource Curse

The resource curse is an economic effect that typically occurs in regions with economies based in large part on the use of natural resources. However, a similar effect can be created whenever an economy specializes too much in a single sector, especially when that sector is responsible for a large portion of the value created in that economy. A variant of this effect is called "Dutch disease" because of the well-known example involving the Netherlands.[4] The resource curse is present across countries and also at the disaggregated county level and left unchecked these effects imply substantially reduced standards of living for future generations relative to non-resource-intensive counties (Black et al., 2005; James and Aadland, 2011; Kilkenny and Partridge, 2009; Papyrakis and Gerlagh, 2007).

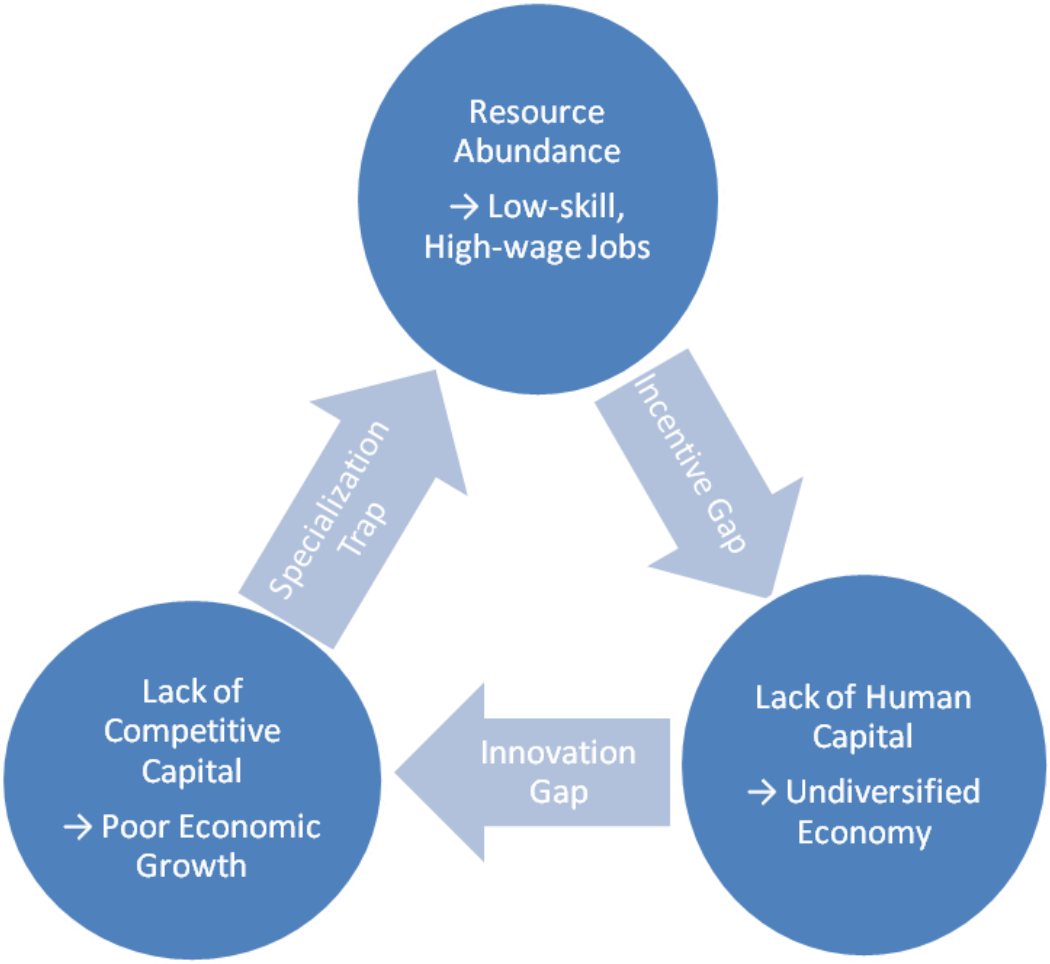
The root cause of the resource curse is the tradeoffs that it induces. Southeastern Ohio and Appalachia in general has seen the effects of this for several generations. Central Appalachia has historically been dependent on its mineral wealth, especially coal. The availability of relatively high-wage, low-skill jobs creates a disincentive for people from that region to invest in higher levels of job-related skills or advanced education. This in turn limits the potential for innovation and for other industries to grow in that region, both because of the reduced job skills of the average worker and because of the higher wages that a fledgling industry would have to pay to compete with the energy companies for workers. This leads to a 'vicious cycle' situation where the means to grow beyond an energy-based economy, a strong and innovative manufacturing sector and high levels of human capital, are impaired from developing precisely because the energy sector is so lucrative (see Figure 8 on the next page).

The Appalachian Coal Boom

Black et al. (2005) carefully document the experience of Central Appalachia during the coal boom in the 1970s and the subsequent bust in the 1980s. They discovered that during the boom mining employment rose sharply (6.8% per year) while mining wages increased at even higher rates (12.3% per year). This encouraged younger males, which compromise the primary demographic of coal miners, to work in the coal industry rather than seek advanced education or leave the region in search of other employment. There were also spillover effects from mining into other sectors of the economy in terms of increased employment and wages in sectors serving the mining industry. Using actual data and not

4 Dutch disease refers to the negative economic effects of natural gas discoveries in the Netherlands in the 1970s. The ensuing boom and demand for workers raised the price of labor and appreciated the Dutch currency, rendering Dutch manufacturers less competitive on international markets. After the initial boom settled down, employment declined in the natural gas industry, while simultaneously Dutch manufacturers found it hard to regain their footing in the international market, which created a long-lasting inhibition on general economic growth. In general for local economies, a boom in one sector bids up wages and costs, making the rest of the local economy less competitive in terms of attracting workers. In energy boom economies, this can be seen when other businesses can't find workers (for example, in the service sector or construction) or firms decide not to locate in the region due to the higher labor costs. This leads to a less diversified economy, which is dependent on the boom industry and therefore more vulnerable to economic shocks.

Figure 8: The Vicious Cycle of the Resource Bust



computer projections, Black et al. (2005) found that for every 100 coal mining jobs created, 25 additional jobs in the rest of the economy were created, giving coal employment a multiplier of 1.25. Black et al. (2005) also observed increases in wages for manufacturing workers in the coal-rich counties compared to counties lacking a coal industry, which is evidence of Dutch disease effects. Following the bust in coal prices, employment in mining dropped faster than it had increased during the boom. Mining income also decreased substantially, causing economic decline and outmigration of workers.

Motor City is only Idling

The result of over-specialization can also be seen in economic malaise that Detroit has experienced in recent years. When the automobile industry chose Detroit as their main operations and manufacturing base, the city and the local economy prospered. However, the high wages that the car companies paid and the large portion of the local labor force they employed resulted in "crowding out" of other industries that might have grown up there. When the automobile industry fell on hard times, so did the entire city. A dependence on natural resources or in any one industry can lead to an "all your eggs in one basket" situation, which is difficult to recover from when there is a shock to that specific sector. However, it is not just the shock to the system but the nature of the boom itself which can impact the bust. Williston, ND in Williams County is a good example of how a poorly managed boom can sow the seeds of a bust.

Williston, ND

Source: Johnson, 2012

Despite its previous oil booms, Williston, ND is a small city with a population of about 15,000 in 2010. Williston again finds itself in the throes of a new oil boom with a flurry of economic activity bringing more jobs than its residents can fill, despite the relatively high pay associated with them. The average annual salary in Williams County has grown 79% from 2005 to over $56,000 in 2010 (Oldham, Jan 2012). Although experience has taught Williston that a bust may be on its horizon, right now Williston is more concerned with the problems associated with the current oil boom.

One of the most visible signs of strain is on Williston's infrastructure, most notably its roads and traffic. Rural gravel roads mainly used by farmers now have 800 trucks traverse them in a single day (Oldham, Feb 2012). Additionally, the sheer number of people flocking to this small city has put a considerable strain on its infrastructure and services which also includes the sewer system, water system, and energy grid. Five new hotels and 1,200 apartments and single family homes are planned in Williston. Williams County recently banned new construction of "man camps" until the infrastructure was upgraded to handle the increased demands (Oldham, Jan 2012). This increased demand on housing and other goods has bid up prices throughout the region increasing rent from an average of $500 per month in 2005 to approximately $2,000 (Shactman 2012). Prices for gasoline and groceries are 30% higher (Oldham, Jan 2012). Hence, increases in real wages are much smaller than the nominal increase suggests.

Williston's few restaurants are packed with lines of up to an hour for lunch. Wait times for services are not likely to decrease as restaurants, hotels, and retailers are finding it hard to compete with oil and gas salaries to hire new employees. The limited local amenities, including restaurants and other entertainment venues, have led to problems with alcohol abuse which has also increased stabbings, rape, abuse, and even prostitution. Calls into the police department increased by 250% from 2009 to 2010 (Shactman, 2012).

School buildings are also overcrowded and the school district is underfunded. With 3,800 students, Williston primary schools have 57% more students than they were built to hold (Oldham, Jan 2012). Teachers have to deal with overcrowded classes and homeless students (approximately 100 of them) with no housing available or any homeless shelters in the small town. Williston schools need about $87 million to build 3 new schools and hire new teachers, but state lawmakers voted down a bill last year that would have provided funding (Oldham, Feb 2012).

In North Dakota, oil companies pay approximately 11.5% in taxes which amounted to approximately $2.6 billion in 2008 (Oldham, Jan 2012 and Feb 2012). This new revenue has helped fund projects to improve drinking water pipelines and update the state prison in Bismarck, but the local share of oil and gas taxes is only 11% (Headwaters Economics, 2012). Of the $1.2 billion that has been set aside so far to help drilling counties, about $885 million remains to be distributed. Many in Williston and other drilling areas say it's still not enough to cover the strains on their small towns (Oldham, Jan 2012 and Feb 2012).

Williston is struggling to maintain its infrastructure, services, and amenities let alone the able to improve them. Residents are trading off temporary, high-paying jobs in return for a reduced quality of life. Williston officials hope this boom will last at least 10 years, but expect to retain only about 30% of the new workers afterwards. With limited public infrastructure, amenities stretched, and jobs waning, there will be few reasons for these families to stay when the boom ends. Even if 30% stay, the town of Williston will be left looking like the old ghost towns in the California gold rush (Ellis, 2011).

Avoiding the Bust

The resource curse causes a number of adverse effects on a regional economy, starting with the initial boom. However, the long run effects may be the most important impacts to mitigate. The negative effects of a resource boom in the short term and long can best be avoided by ensuring the following:

1. Short-term costs of extraction (especially the hidden costs) are addressed and compensated for. This ensures infrastructure, amenities and other public service levels are maintained or even improved.
2. Long-term tradeoffs are countered to maintain or increase levels of capital and economic diversification.
3. Oil and gas industry taxes are set appropriately to cover the short-term and long-term costs and tradeoffs of a natural resource boom.
4. Good governance is critical to ensure public policies and expenditures from the tax revenue are effective and efficient - supporting all businesses and industries.

1. Accounting for the Costs of Extraction

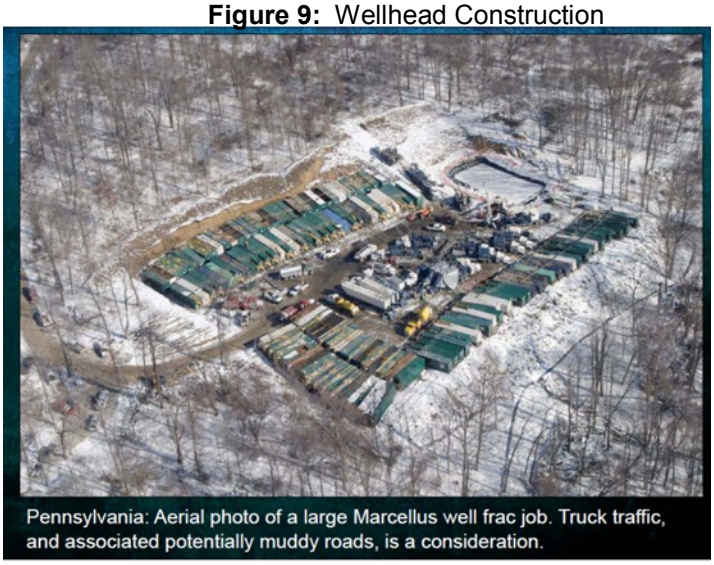
Nearly every activity has some sort of hidden costs. In economics the hidden costs that are not incorporated into the decision-making process of the person that creates them, but which still must be borne by someone else, are called "externalities." Essentially, the cost of the decision is 'external' to the decision-maker. The most common example is that of a polluting factory causing an externality on its neighbors. Shale gas drilling will create its own specific externalities, for which systems must be created to eliminate the impact or compensate the affected parties. If this system is not created, then the hidden costs of extracting shale gas will be transferred onto Ohioans who are not benefitting from the resource.

Roadway Infrastructure Effects

The clearest example of such hidden costs is the damage to Ohio's roadways that drilling and extraction activities will create. Each well will require 1 to 8 million gallons of water for hydraulic fracturing, some of which will flow back to the surface (Weinstein and Partridge, Dec. 2011). This 'flowback' water must then be transported off of the well site, generally by large semi-trailer tankers. Assuming a standard tanker volume of approximately 9,000 gallons (which approaches the maximum gross vehicle weight 80,000 lbs. allowed on Ohio roadways per ORC Sec. 5577.04) and a return flow of flowback water between 15% and 20% of what was used to conduct the fracturing (Ohio EPA/ODNR 2011), then each well on the drill pad will require between 17 and 178 fully laden semi-trailers of contaminated water to be shipped off-site. Since each drill pad will likely end up being the source of 6-8 wells, then each drilling location will produce between 100 and 1425 fully-loaded semi-trucks on Ohio's roadways (Thomas et. al., 2012). The high density and number of wellheads planned by energy companies lead to the conclusion that Ohio roadways, especially in rural areas, will see an increase of heavy truck traffic far in excess of what they were originally designed to withstand, especially rural roads. Note that these impacts on roads have only considered the wastewater that is transported away from the wellhead and not any actual construction, drilling or extraction activities (See Figure 9 for an example of the trucking volume created by these activities). It appears that the overall reduction of the functional life of Ohio's roads will be substantial.

A report on the economic potential of shale gas sponsored by the Ohio Shale Coalition estimates that the monetary costs of roadway upgrades borne by the shale gas production companies would be $1.1 million per wellhead (Thomas, et al. 2012). This value seems quite low given the discussion above and taking into consideration that "road upgrades will be required for each pad, probably multiple times" (Thomas, et al. 2012). Additionally, Pennsylvania has put a moratorium on any injection of flowback water into underground disposal

Figure 9: Wellhead Construction



Pennsylvania: Aerial photo of a large Marcellus well frac job. Truck traffic, and associated potentially muddy roads, is a consideration.

Source: Wickstrom (2011)

wells, causing substantially increased shipments of this contaminated water into Ohio for disposal, for which the road damage costs are not being compensated by the drilling companies.

Other Hidden Costs

The increased roadway repair costs are only one hidden cost associated with shale gas extraction. The case of Williston, ND provides an example of other such immediate costs, especially for more rural areas, that are associated with the boom and the costs of extraction. Here is a short, but not complete, list of costs that should be considered for Ohio:

- Roadway infrastructure repairs, especially on rural roads and small bridges, that will reach their estimated lifetime amount of heavy truck loads much quicker than anticipated when they were constructed.
- Costs associated with preparing Ohio's emergency response officials and first responders for shale gas-related emergencies, should any arise.
- Increased costs of construction and energy workers on limited rural infrastructure, public utilities and social service networks. Some small Pennsylvanian towns have experienced sudden surges in demand for wastewater treatment, schooling provision and traffic from the influx of shale gas industry workers (Cauchon, 2012).
- Increased costs on the public safety network, especially on police and emergency medical services, which have generally risen during resource booms in other areas (Shactman 2012).

Ohio must maintain and if possible improve upon its public services, amenities, and infrastructure in order to mitigate the direct impacts of oil and gas extraction and to compensate for the permanent loss of nonrenewable resources. Additionally, accounting for the immediate costs of oil and gas extraction will promote economic growth in the short and long term. However, if these costs are not paid for by the energy industry, these costs will be pushed onto other industries reducing the competitiveness of the broader Ohio economy.

2: Countering Tradeoff Effects of the Boom

In addition to the direct and oftentimes hidden costs that accompany the resource boom, there are side effects that impact the long-run economic growth of regions, contributing to the resource curse noted in the literature. These effects are related to the idea of Dutch disease discussed earlier and the tradeoffs that the energy boom will cause.

Despite the widespread prevalence of the resource curse, there exists some shining examples of communities and regions that managed to avoid the bust or at least the natural resource curse. Calgary in Alberta, Canada provides an example of a city that took advantage of their resources to encourage long-run sustainable economic growth, creating an environment where workers and firms want to locate despite the boom-bust nature of the energy sector in the province.

Diversification is Key

In order to avoid or at least ameliorate some of the effects of the resource curse, Ohio should utilize lessons learned from Calgary, Dallas, and Houston. Ohio should focus on diversifying its economy. Resource rich economies are often less diverse. Less diverse economies are more volatile and vulnerable to economic shocks and downturns hindering growth (Hammond and Thompson, 2004; Gunton, 2003; Randall and Ironside, 1996). Lower industrial diversity has also been associated with higher unemployment (Izraeli and Murphy, 2003). On the other hand, a diverse industrial base provides an array of sectors for workers to find employment, which will serve as an economic safety net when energy prices fall and gas and oil extraction slows.

To diversify its economy, Ohio needs to make investments that make it more attractive to locate for businesses and their workers. Promoting all firms while encouraging small businesses, entrepreneurs, and innovation. Ohio should improve its business environment by decreasing firms' costs (through broader tax cuts or better infrastructure) and increasing productivity (through a higher quality labor force).

High paying energy sector jobs generally reduce the incentive for workers to attend college or pursue other forms of advanced education to develop skills which contribute to higher regional levels of human capital. Conversely, a diverse economy is more likely to have high-skill, high-wage jobs requiring its residents to attain higher levels of education and skill. High levels of human capital have been strongly associated with high regional economic growth rates (Simon, 1998). Economic growth, low unemployment rates, and high-skill high-wage jobs will attract high-skill workers from other areas.

Higher levels of human capital encourage innovation and economic growth which in turn attracts more firms to the area, further diversifying the economy. If a virtuous circle such as this (shown in Figure 10) can be created then much of the full effect of the natural resource curse will be negated.

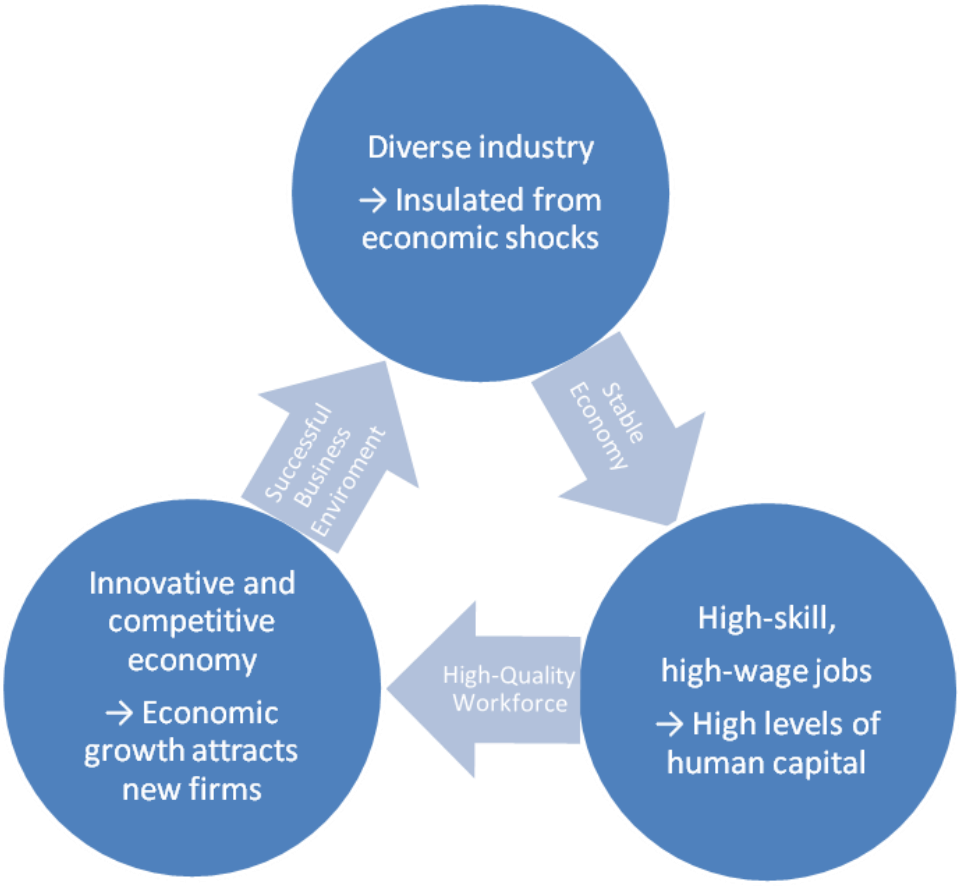
The Solow-Hartwick Rule

The discovery of reserves of non-renewable resources forces regions to make a tradeoff between the current payoffs associated with extracting the resource now and maintaining current resource levels for future extraction and future payoffs. Non-renewable natural resource extraction permanently reduces the natural capital levels of a region. Countering the reduction in capital levels requires a corresponding increase in public or human capital (education and job skills). This is known in economics as the Solow-Hartwick Rule and, simply stated, it means that to achieve the maximum sustainable benefit from an exhaustible natural resource, governments should invest the profits produced from that resource in forms of capital that have long-lasting value (Solow 1974, Hartwick 1977). Thus, public capital such as infrastructure, water systems, and public education should not only be maintained to counter the direct effects of extraction, but increased to counter the loss of natural capital in the long run. As mentioned previously, it is critical to increase levels of human capital through investing in education and job-training, including STEM (Science, Technology, Engineering and Math) scholarships at Ohio colleges and universities, with incentives for the students to keep their skills in Ohio after graduation.

3: Setting the Appropriate Level of Oil and Gas Taxes

In order to fund the maintenance of local infrastructure and other public amenities, an appropriate amount of tax revenue from oil and gas companies should be collected. This revenue should be used not only to maintain infrastructure and local amenities, but should also to ensure the local area is prepared for the bust as well as the boom. Appropriate oil and gas taxes will help ensure that Ohio and its residents are benefitting from its natural resources and that all of the value from shale gas and oil isn't flowing to other states where the energy companies are headquartered (see Table 1). If state taxes on shale gas and oil extraction are too low, Ohio will help out-of-state energy companies increase their

Figure 10: The Virtuous Circle of a Diverse Economy



profits at the expense of reducing the potential benefit that Ohioans could experience from this resource, while simultaneously increasing the state's vulnerability to an economic. Ohio's oil and gas taxes should be comparable to other states so that energy companies face the same total cost of gas and oil extraction in Ohio that they do elsewhere in the U.S.

Ohio's Current Taxes on Oil and Gas

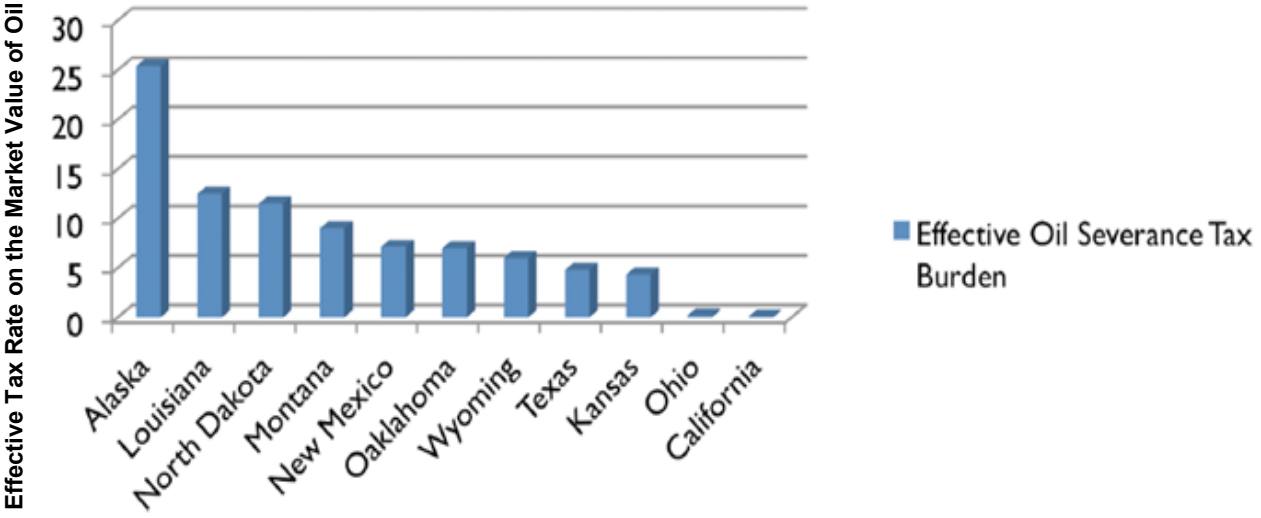
Severance taxes are taxes designed to reclaim a portion of the value lost when natural resources are extracted and consumed (Headwaters Economics, 2012). Ohio's oil and gas severance taxes are $0.03 per Mcf (thousand cubic feet) of natural gas and $0.20 per barrel of oil (Patton, 2011). At January 2012 market prices, this corresponds to a tax rate of approximately 1.04% for natural gas and 0.2% for oil (very low compared to North Dakota's oil and gas taxes at approximately 11.5%). Ohio severance taxes are currently used to fund the ODNR regulatory functions of the oil and gas industry. In 2010, $2.6 million in oil and gas severance taxes were collected from the energy industry and $9.4 million in total taxes, which includes the Commercial Activity Tax, state income tax, and property taxes (Innovation Ohio 2012). Figure 11 compares Ohio oil severance taxes to other oil-producing states while Figure 12 on the next page compares Ohio's taxes on gas extraction. In both instances Ohio is at the bottom of the rankings.

Governor Kasich's Tax Proposal

Governor Kasich has released a plan to increase severance taxes on oil and gas extraction and to use that revenue to lower state income tax rates. The levels of the proposed severance taxes are still relatively low compared to other energy-rich states. Natural gas will be taxed only 1% of its market value (which at the current market prices actually results in the same amount of tax as the current $0.20 per Mcf severance tax) and 4% of the market value of oil and natural gas liquids (Vardon, 2012). However, the severance tax on oil and natural gas liquids drops to 1.5% during the first two years a well is in production, during which it produces 25-50% of its lifetime production (Innovation Ohio 2012, Green 2010). Since oil and natural gas liquids are the most valuable portions of the shale gas resource, this means that a significant portion of the extracted value will be taxed at a much lower rate. In addition, energy companies will have a significant incentive to extract as much of the oil and gas as possible in the first two years.

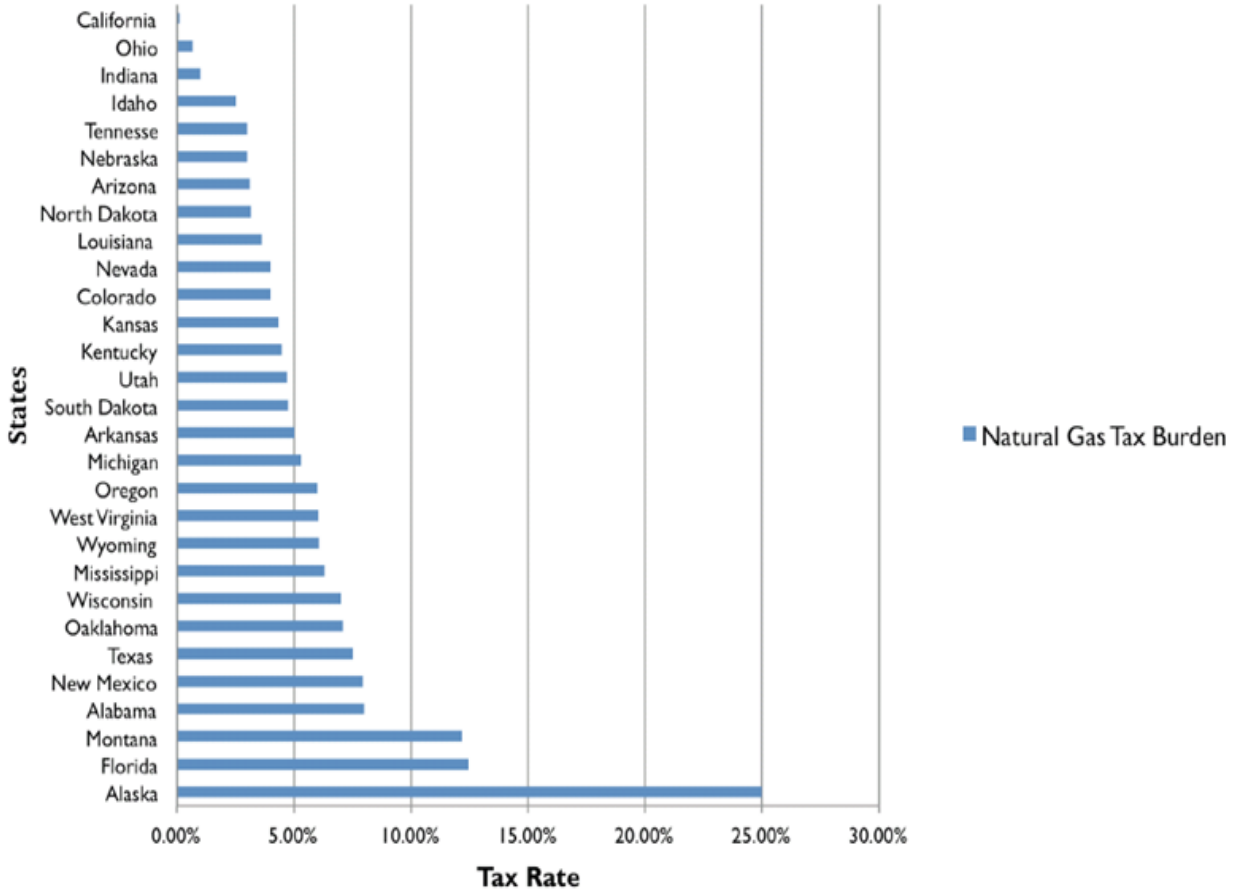
There are several issues with Governor Kasich's proposed plan from the standpoint of avoiding a resource curse. First, the use of severance taxes to displace income taxes may not be the most effective method to avoid the adverse effects of the resource curse – unless it somehow promotes diversification. In general a better use of the severance tax funds to drive future economic growth would be to create public capital (infrastructure or amenities) or human capital (education) to counteract the decrease of natural resource capital. Lastly, the effects of the income tax reduction would likely not be realized until just before Governor Kasich's re-election.

Figure 11: Top 10 Oil Producing States Compared to Ohio



Source: Innovation Ohio http://innovationohio.org/wp-content/uploads/2012/02/Fracking-Fairness-and-the-Future-Full-Report.pdf

Figure 12: Effective Natural Gas Tax Burden



Source: Innovation Ohio http://innovationohio.org/wp-content/uploads/2012/02/Fracking-Fairness-and-the-Future-Full-Report.pdf
Note: The tax rate is based on the market value of the resource.

Ohio Democrats' Counterproposal

Ohio House Democratic lawmakers have countered with a budget proposal that implicitly accepts the higher level of oil and gas taxes but would devote all increased severance tax revenues to grants aimed at generating increased employment in schools and public service positions in Ohio communities (Bell, April 2012). This plan could be a step in the right direction, since spending the severance tax revenues in this way could enhance the value of primary and secondary education, creating higher levels of human capital, and increasing public safety, an amenity.

However, in the current form, the plan is somewhat vague and would be more effective at fighting against the potential of a resource cures if it had a stronger focus on the specific amenities to be created or if the funded education was directed towards specific degree programs that would contribute towards economic growth and industry diversity (degrees in STEM – Science, Technology, Engineering and Mathematics for example). The plan would also be strengthened by including incentives for degree recipients to keep their skills in Ohio. Allowing too much latitude in how the severance tax dollars are allocated risks the funds being spent on short-run benefits, for political purposes negating the ability to resist the resource curse, which should be the primary goal.

4: Good Governance is Critical

Once the appropriate level of taxes is determined, governments must then decide exactly how to allocate the revenue to best mitigate the negative effects of the shale boom while enhancing the positive effects. Good governance is critical to ensuring these revenues are spent effectively. Taxation from a booming resource often provides a false sense of financial security, leading to increased governmental deficits during the bust.

Rent-Seeking Behavior[5]

The motivations of policymakers and the quality of governance are perhaps the most critical factors in determining the effect of a natural resource boom. There is a large portion of the resource curse literature that investigates the effect that public institutions have on the results of the boom. Weak governance has a tendency to spur the resource curse by allowing "rent-seeking" activities to flourish. A "resource rent" in economic terms is the value of a resource above the normal costs required to produce it (essentially, think of a "rent" as a "superprofit"). In this case, the "resource rent" that makes shale gas such an attractive commodity is the fact that energy prices are set by the level of demand and are often substantially higher than the cost to actually extract and bring the energy resource to market.

There aren't many goods in an economy that produce "rents" like this, so they are highly sought after by anyone with the means to pursue them. This includes investors, companies, property owners, and even governments. Whenever a new resource like this is suddenly made available, it produces a race to determine who will be able to capture the rents for themselves. Rent-seeking activities are wasteful because they consume money and resources without actually producing anything. Rent-seeking behaviors can also leave a government beholden to an industry, allowing the industry to dictate spending, the regulatory environment, taxes, and other public policies.

The Race to the Bottom

The oil and gas industry will lobby to receive lower taxes and other financial incentives from the government. This can lead to a "race to the bottom" scenario where states compete to have the lowest taxes in order to attract oil and gas firms. Goetz et al. (2011) find that lower taxes are not a significant factor in determining state economic performance and that these financial incentives favoring specific firms or industries are associated with lower economic growth. A possible example of this "race to the bottom" is the multi-billion dollar ethane cracker plant that Shell Oil recently announced plans to build to process shale gas byproducts (Stuhldreher, 2012). Shell rightly expected the states of Ohio, Pennsylvania and West Virginia to compete for the plant by offering various financial incentives. The West Virginia legislature passed legislation that would give the plant a 25-year property tax break should Shell decide to locate the plant in West Virginia (Bell, Jan. 2012). This race to the bottom would limit the benefits West Virginia may get from this cracker and may even cause negative impacts to accompany the cracker development. Shell subsequently announced that Monaca, PA, northwest of Pittsburgh, was selected as the site for the cracker due to the supposed suitability of the city, its location and the 15-year tax exemption Pennsylvania offered (Stuhldreher 2012).

Corruption

Robinson et al. (2006) argues that the political incentives generated by the resource wealth determine whether or not the resources are a curse. Corruption is a major problem in the developing world, where the quality of public institutions is generally low and policymakers wield power more as authoritarian rulers than as public servants. The temptation to use revenues from the shale resources in Ohio in the pursuit of political ideology or favor-currying by those in power might be difficult to resist for any politician. Goldberg et el. (2008) found indications of political incumbents using oil revenues in Louisiana and Texas to maintain their grip on power through patronage systems where those in political office purchased political support by creating governmental posts for their allies while at the same time keeping taxes low or supplying increased public amenities to appease the voters. However, the position of power can also be twisted to create a situation where energy companies exert undue influence on government officials to act in the companies' interests, rather than the citizens'. Protecting against both forms of special influence is critically important if Ohio is to avoid the resource curse.

The Teapot Dome Scandal

Governmental corruption related to energy resources has a long history in the U.S. In the 1920s, a bribery scandal surrounding the oil and gas industry in Casper, WY, the Teapot Dome scandal, was called the "greatest and most sensational scandal in the history of American politics". The Secretary of the Interior Albert Fall was imprisoned for selling low-rate Navy oil reserve leases without competitive bidding in return for gifts and no interest loans (Cherny, 2009). Ohio should create systems wherein the potential uses of revenue from shale gas extraction are strictly controlled to avoid the incentive of political office holders to use them toward their own benefit.

5. Rent-seeking behavior can be defined as individuals or firms in society attempting to influence decisions of the social authority (i.e.- the government) to render judgments in their favor, generally to the detriment of others. Krueger (1974), who coined the term, used the example of a domestic firm lobbying the federal government for import restrictions on foreign firms so that it could dominate the domestic market and act monopolistically.

Calgary, Canada

In the province of Alberta within Canada, Calgary is one of the few examples of an energy economy that has been able to move beyond its prominent oil booms to diversify its economy, leading to more sustainable and robust economic growth.

Oil reserves were first discovered in Calgary in 1914, but it was not until significant reserves were discovered in the late 1940s that the oil industry gained such prominence in the area, reducing the importance of the agricultural and ranching sector. From 1947 to 1965, Calgary's population grew from 100,000 to 325,000. When oil prices spiked in the 1970s, Calgary experienced its largest oil boom which led to tremendous growth in its economy. Close access to natural amenities in addition to economic growth attracted many people to Calgary with approximately 3,000 people arriving each month during this boom (History of Calgary). Calgary quickly became an energy center with numerous oil industry headquarters and a significant energy supply chain.

Although its population and economy were quite large, Calgary's economy in the 1970s and 1980s was inextricably tied to the oil industry and thus oil prices. When oil prices peaked in 1981, Calgary's economy also peaked and then began to decline. Unemployment rates quickly became a significant problem for Calgary. Calgary soon realized that its economy needed to be more resilient by becoming less reliant on the oil industry (History of Calgary).

Thus, Calgary began to make a concerted effort to diversify its economy. Calgary invested in research and development to encourage innovation. Tax credits and access to capital were offered to small businesses to further spur innovation and new industries. Calgary specifically encouraged the development of industries outside the oil and gas industry including financial and IT services, high-tech manufacturing, agri-business, distribution and transportation. However, many of these industries also built upon Calgary's comparative strengths, for example, in agriculture.

To diversify its economy, Calgary made investments that made it a more attractive place for businesses and workers to locate. Calgary has since continued to grow and attract new workers. Calgary's metropolitan area population is now over 1.3 million. Calgary developed one of the first light rail systems of its kind in North America. It has proved popular - 15% of Calgary's downtown workforce commutes by public transit (Calgary Economic Development). These investments have helped make Calgary a transportation hub for central and western Canada. It has also served to reduce traffic congestion and pollution.

By encouraging its tourism industry, Calgary further diversified it economy as well as its local amenities to maintain and increase quality of life. Calgary promoted its "cowboy culture" based on its ranching history and natural amenities utilizing its proximity to the Rocky Mountains. Calgary promoted and developed recreational facilities including those for winter sports. All of these investments helped transform Calgary into a global city that hosted the Winter Olympics in 1988.

Although the oil industry still comprises a significant portion of Calgary's economy, its diversification efforts have limited this overspecialization and have led to an economy that is more resilient and better able to maintain its low unemployment and high income in the long run.

Conclusion

It seems that Ohio has won the jackpot. By luck of location, the state sits on top valuable shale resources and now the innovative combination of micro-seismic technology with hydraulic fracturing and horizontal drilling has allowed this resource to be tapped. However, Ohio should take a second look at its 'winning numbers' due to the potential economic effect called the 'natural resource curse.' Despite the potential value that shale resources hold, previous experience indicates that more often than not such potential is wasted or ill-used. A bust and the resource curse may not be the inevitable aftermath of Ohio's shale boom. Through preventative action, Ohio may at least be able to ameliorate the effects of the bust and resource curse, if not avoid it completely.

First, the unsubstantiated exuberance surrounding shale gas and oil should be moderated with the knowledge that out-of-state energy companies responsible for extracting the resources will likely be the greatest beneficiaries. Weinstein and Partridge (Dec., 2011) found that although the income effects may be significant, the employment effects will be more modest than initial predictions suggested. If managed well, Ohio's leaders should view this as a welcome opportunity for the state, but not as a silver bullet that is the solution to all the state's problems. Appropriately handling the expectations of Ohio firms and residents about shale development is the first step toward ensuring a favorable outcome. Rather than relying on the energy industry to be the savior of the economy, Ohio should use this opportunity to build upon its own strengths- for example, developing an energy supply chain able to build upon Ohio's comparative advantage to compete with the established energy supply chain in traditional oil-producing states such as Texas and Oklahoma, as well as Pennsylvania and other states that are also trying to establish an energy supply chain. For example, Ohio has already begun to build upon its manufacturing experience to meet the needs of this burgeoning industry. Steel mills in Youngstown, Ohio (pictured on the cover) are already expanding to meet increased demand for steel pipes from the oil and gas industry (Schneider, 2012).

Ohio must then take steps to ensure the short-term costs of extraction are accounted for by investing in infrastructure, public services, and amenities (including decreasing 'disamenities' like traffic congestion and environmental degradation). Moreover Ohio should not just maintain these levels of public capital but should work to increase them along with human capital and workforce development initiatives to account for the permanent loss of natural capital from the oil and gas extraction. If Ohio wants to avoid sudden economic shocks and the long-run resource curse, then it must insulate its economy by encouraging a broad base of diverse industries to hire laid-off workers from the energy sector during busts and promote long-run economic growth. In order to counteract all of the costs and tradeoffs associated with a resource boom, Ohio must first ensure it is setting oil and gas taxes appropriately. Ohio has a good chance of being one of the few examples where a wisely and consciously managed natural resources boom was used to foster an economy that is focused on lasting value if state leaders ensure that they craft policies with the following attributes:

1. Limit rent-seeking behavior (by citizens, firms and government entities) and avoid giving special treatment to energy companies.
2. Make certain that the hidden costs associated with the extraction of shale resources are adequately compensated.
3. Mitigate the economically harmful trade-off effects that the shale gas boom will create.

There are plenty of examples of regions that were unable to do this; regions that are suffering from the resource curse. This final example shows that Ohio should instead take Norway as its role model. After discovering extensive energy reserves in 1960's, Norway created two sovereign wealth funds to manage and invest the taxes and dividends collected from the extracting the oil and natural gas resource. These funds were created in order to avoid the negative economic consequences of the future depletion of the oil resource and the drop in national income that would follow. In addition, a budgetary rule was created wherein the Norwegian legislature may only use a maximum of 4% of the wealth funds' assets to pay for government expenditures each year. This was done in part to help avoid the currency appreciation effects of Dutch disease as well as to restrain rent-seeking behaviors by government officials. Also, by the creation of two energy-wealth investment funds targeted towards international and domestic business investments, Norway has allowed for the diversification of investment risk while at the same time provided a means to encourage a diversification of Norwegian industry, the combination of which has resulted in a thriving economy with a high standard of living.

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