



MANAGING THE BOOM-AND-BUST: WHAT CAN SHALE COMMUNITIES LEARN FROM COAL BOOMS AND BUSTS IN CENTRAL APPALACHIA?

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This paper is based on the research of the Shale Innovation Project at Ohio University. The Shale Innovation Project is an interdisciplinary collaboration between the Russ College of Engineering and Technology, the Voinovich School of Leadership and Public Affairs and the College of Arts and Sciences examining the impact of shale development on businesses and communities in Ohio's shale region. This project is generously supported by a three-year Innovation Strategy Award from the Ohio University Research Division.

Summary of Key Points

- Natural resource extraction (oil, gas, coal, etc.) follows boom-and-bust cycles: initial periods of increased industry activity and economic growth followed by slowed-down industry and economic activity.
- Boom-and-bust cycles may impact multiple facets of a community, including: strain on local roads and infrastructure; increased tax revenue during booms and decreased tax revenue during busts; altered diversity and social relationships in the community; demand for related extractive industry employees, resources, and services; rents and housing prices; real estate investment decisions; and wage disparity between extractive industry and non-extractive industry employees.

- Natural resource boom-and-bust cycles have been found to be associated with educational attainment, housing, population, infrastructure, employment, wage, per capita income, crime, corruption, poverty, and economic growth.
- The volatility of natural resource extraction has ramifications for communities where industry activity occurs, for workforces that rely on the industry, and for other competing industries; resource dependence may contribute to slower than average economic growth in the long-term.
- The resource curse is a term used to describe a situation in which a locality specializes in natural resource-related economic activity and shows slower than average economic growth over time.
- One challenge of managing natural resource boom-and-bust cycles is converting initial fiscal windfalls from boom periods into long-term, sustainable economic growth; one option for addressing this is establishing a permanent fund.
- Several U.S. states have already established permanent funds for the purposes of saving and investing natural resource tax and royalty revenues.
- Given the volatility of natural resource extraction, saving revenue from oil and gas industry activity for future investment may be a prudent policy option for Ohio and other states in the Marcellus and Utica shale play.

Introduction

Since 2012, Ohio's oil and gas industry has experienced a substantial boom in production (see Table 1). Like the nationwide trend of increased oil and gas production, Ohio's shale revolution can primarily be attributed to advances in drilling technology that made the previously difficult-to-explore Utica shale play accessible for drilling and production. Despite this boom, a more recent downturn in the upstream sector of the industry has caused concern for its longer-term sustainability. As drilling and production increased from 2012 to 2014, prices for oil and gas eventually dropped due in part to overproduction in the market. The drop in prices made drilling less profitable, and as a result, drillers started to cap their wells.

Table 1 – Ohio Oil and Gas Horizontal Shale Production, 2011 – 2015 (Ohio Department of Natural Resources)

	2011	2012	2013	2014	2015
Oil (Barrels)	46,326	635,874	3,677,734	11,001,117	21,984,163
Percent Increase from Previous Year	-	1,272.61%	478.37%	199.13%	99.84%
Gas (MCF)	2,561,524	12,831,292	100,119,054	453,053,944	954,744,514
Percent Increase from Previous Year	-	400.92%	680.27%	352.52%	110.74%

The recent boom cycle was stimulated, in part, by a merging of two firms in 2002. At the time, Mitchell Energy and Devon Energy combined technologies, which made drilling in deep, unconventional shale plays economically viable. Specifically, Mitchell Energy, an expert in hydraulic fracturing, was acquired by Devon Energy, the first company to commercially apply horizontal drilling in the Barnett Shale play of Texas. In 2010, production of natural gas from shale in the United States (U.S.) started to increase dramatically along with oil (U.S. Energy Information Administration, 2017c). This trend made drilling for shale gas attractive, and prices for oil and gas subsequently started to increase. As prices increased, drilling increased, until 2014 when supply outweighed demand and the price of oil dropped from \$105.79/barrel in June 2014 to \$47.22/barrel in January 2015 (and even further to \$30.32/barrel in February 2016). Similarly, the price of natural gas dropped from \$6.00/Million British Thermal Units (MMBtu) in February 2014 to \$1.73/MMBtu in March 2016 (U.S. Energy Information Administration, 2017d; U.S. Energy Information Administration, 2017e).

While this boom in production was triggered by a technological change, it is worth noting that such cycles can also be affected by other changes that impact supply and demand. Natural resources like oil, gas, and coal are commodities, and as such they are traded at prices that are generally volatile over time. This volatility has ramifications for communities where industry activity occurs, for workforces that rely on the industry, and for other competing industries (i.e. natural gas versus coal). Central to research on this topic is the theory of the “resource curse”: the idea that localities which are abundant in natural resources experience slower economic growth over time compared to other locations which are not resource abundant. Recent research on the resource curse, however, has theorized that an abundance of natural resources does not cause slow economic growth per

se, but rather policy failures may be to blame, and that strong policy mechanisms may mitigate negative impacts associated with the bust in a boom-and-bust cycle.

Perhaps one of the most infamous places impacted by natural resource boom-and-bust cycles over time is Central Appalachia. Known for its roots in coal mining, iron ore, and timber production, Central Appalachia is split into two sub-regions according to the Appalachian Regional Commission (ARC): Central and North Central. Together, these two sub-regions cover Southern Ohio, Eastern Kentucky, the entire state of West Virginia, part of Northern Tennessee, and part of Western Virginia (Appalachian Regional Commission, 2009). Historically, two states in this region, Kentucky and West Virginia, had been the leaders in coal production, until about 1988 when mining moved west toward the Powder River Basin in Wyoming, which now produces approximately 42% of coal in the U.S., as of 2015 (U.S. Energy Information Administration, 2017a). Two factors contributed to this migration of coal production: surface mining in Wyoming meant higher productivity, and the low sulfur content of coal from the Powder River Basin made it possible for power plants to still burn coal and comply with the Acid Rain Program established in the U.S. Clean Air Act (Union of Concerned Scientists).

Central Appalachia's history with coal mining, and other natural resource extraction industries, may provide valuable insights into how to manage these boom-and-bust cycles. This paper aims to shed light on current findings regarding how boom-and-bust cycles impact communities, how these impacts are similar and different between coal and oil-and-gas, and what best practices exist for managing these impacts through wealth retention mechanisms, economic diversification, and the development of strong institutions.

Community Impacts of Natural Resource Boom-and-Bust Cycles

In natural resource extraction industries, boom-and-bust cycles are typically characterized by periods of high production, economic gain, and increased industry activity followed by periods of low production, economic slowdown, and decreased industry activity. Perhaps one of the clearest visualizations of such a cycle was developed by Fernando and Cooley, who described a boom as “a complex social and economic phenomenon” (2016, p. 407). As such, they attempted to map the most recent oil boom in western North Dakota using a systems perspective, in order to understand its impacts at the community level. They found that the socioeconomic system of the boom is comprised of four interrelated cycles: the basic boom cycle, the social relationship cycle, the housing cycle, and the non-oil-industry cycle (Fernando & Cooley, 2016). The boom results in a number of impacts on these four facets of the community. Triggered by both the pace of drilling permit approvals and the rapid influx

of transient workers into the community, the authors find that the boom placed major strain on local roads and infrastructure; increased tax revenue; altered diversity and social relationships in the community; generated a strong demand for oil-industry employees, resources, and services; increased rents and housing prices; altered real estate investment decisions; and created a wage disparity between oil and non-oil-industry employees (Fernando & Cooley, 2016).

The bust is characterized by a slowdown of industry-related activity. As commodity prices rise along with drilling, supply starts to outstrip demand and eventually prices fall. As prices fall, the industry contracts and this can have some negative impacts on communities who host its activity. Tax revenue from oil and gas production can decrease along with job opportunities in the industry. Additionally, communities that may have come to depend on revenue from the industry may be negatively affected as production slows, as do suppliers of the industry. If the community does not have much in the way of other employment opportunities, out-migration may increase.

This is one example of the impacts that oil and gas-related boom-and-bust cycles may have on a community. As far as coal, another example is examined by Black, McKinnish, and Sanders (2005). By examining the economic impact of the U.S. coal boom in the 1970s and the bust in the 1980s on localities in Central Appalachia, the authors find that while there were positive spillover effects in construction, retail, and services from an increase in coal mining employment, the negative spillover effects of a bust in the coal industry on the same ancillary industries were larger (Black et al., 2005). The following sections of this paper augment these characteristics of boom and bust cycles through a deeper examination of prior literature of cases related to both the oil and gas and coal industries.

Oil and Gas

Existing literature has shown that increases in oil and gas production provides both positive and challenging implications for the communities that host such activity. Numerous studies have found varying associations between oil and gas booms and busts and educational attainment, housing, population, infrastructure, employment, wage, per capita income, crime, and corruption. For example, Goldenberg et al. (2010) found that education rates in their study area (Fort St. John, British Columbia, Canada) decreased during booms, whereas housing costs and population increased, placing strain on public infrastructure. They also noted a wage disparity that developed between oil and gas and non-oil and gas workers. Similar findings have been

echoed in other studies as well: see Christopherson et al., 2011; Christopherson & Right or, 2011; Randall, 2011; Saha & Muro, 2016; Small et al., 2014; and Stewart et al., 2015.

Typically, oil and gas booms also have initial net positive fiscal benefits for localities that host them. For instance, one recent study found that in most of eight states examined, oil and gas industry activity resulted in positive tax and royalty revenues (Raimi & Newell, 2016). However, converting these natural resource revenues into long-term economic benefits can be a challenge for many localities, so much so that the phenomenon has gained its own title: the resource curse (Auty, 1993). A locality is said to suffer from the resource curse when it specializes in natural resource-related economic activity and shows slower than average economic growth over time. While the causes of the resource curse continue to be studied, it is believed that one main contributing factor is a crowding-out effect: as natural resource extractive industry activity increases in an area, the large influx of revenue from the industry reduces incentives for development in other sectors. Additionally, a wage premium that often exists in natural resource extractive industries is theorized to draw workers away from other sectors (Sachs & Warner, 1997). Thus, economic diversification of the local economy is stifled.

The resource curse has primarily been studied on a country-level basis, but recent work has examined its presence at both the state and county-levels in the U.S; the results of which are mixed. In a 2014 study on the associations between oil and gas specialization and socioeconomic well-being in the western U.S., Haggerty et al. (2014) found that change in per capita income, crime, and educational attainment were all statistically associated with the *duration* of oil and gas development in that region. According to the researchers' findings, "continued exposure to above average levels of oil and gas activity lowers per capita income growth, such that initial income gains erode and may eventually become negative" (Haggerty et al., 2014, p. 193). They also found that continued specialization in oil and gas is associated with increases in crime and decreases in educational attainment (Haggerty et al., 2014).

Others, such as Brown (2013) have found "a modest positive impact on local labor market outcomes in counties where natural gas production has increased, and little evidence of a natural resource curse" (Brown, 2013, p. 6). According to Brown (2013), one natural gas job was associated with an increase in 1.7 total jobs. Known as the multiplier effect, this number suggests a modest spillover effect of employment from natural gas to other sectors, for every natural gas job 0.7 jobs are created in other sectors. However, it is important to note that this study only spanned a 10-year period from 2001 to 2011, during which natural gas was experiencing a boom. A more robust temporal assessment might use a 10-30-year time frame.

Coal

Similar to oil and gas, coal industry activity also has impacts on communities that host it. In a 2009 qualitative study on the social effects of mining in a few Australian towns, Petkova et al. found a number of impacts. Participants in the study noted a shortage of available housing for workers, decreased school enrollment, staff shortages, perceived increase in crime, increases in vehicle traffic, coal dust, power shortages, water shortages, and an influx of transient workers (Petkova et al., 2009). In the same vein, Deaton and Niman (2012) studied the association between coal mining and poverty rates in Central Appalachia and found that while increased coal mining employment reduced poverty rates in the short term, the long-term impact was an increase in poverty in the same area. Another study, carried out by Black et al. (2005) found that high school enrollment rates declined in Kentucky and Pennsylvania during the coal boom of the 1970s, and increased during the coal bust in the 1980s. The researchers theorize that the incentive for low-skill coal workers to not enroll in school was a wage premium that came with the coal boom, however, “the bust almost perfectly erased the wage gains obtained during the boom. In doing so, it widened the wage differential between high school dropouts and graduates... (Black et al., 2005),” and likely had negative impacts on the economy in the long-term.

Economically, the literature suggests that the coal boom-and-bust of the 1970s and 1980s had a similar result as oil and gas boom-and-busts: short-term economic gain followed by long-term negative impacts, albeit perhaps steadier in comparison to oil and gas. Black et al. (2005) studied the impact that this boom-and-bust had on local economies in Central Appalachia and found that while one mining job added generated an estimated 0.174 jobs in other sectors, one mining job lost during the bust was associated with a decrease of 0.349 jobs in other sectors. According to the researchers, coal counties grew at a faster rate than non-coal counties during the boom, but grew at a slower rate after the bust.

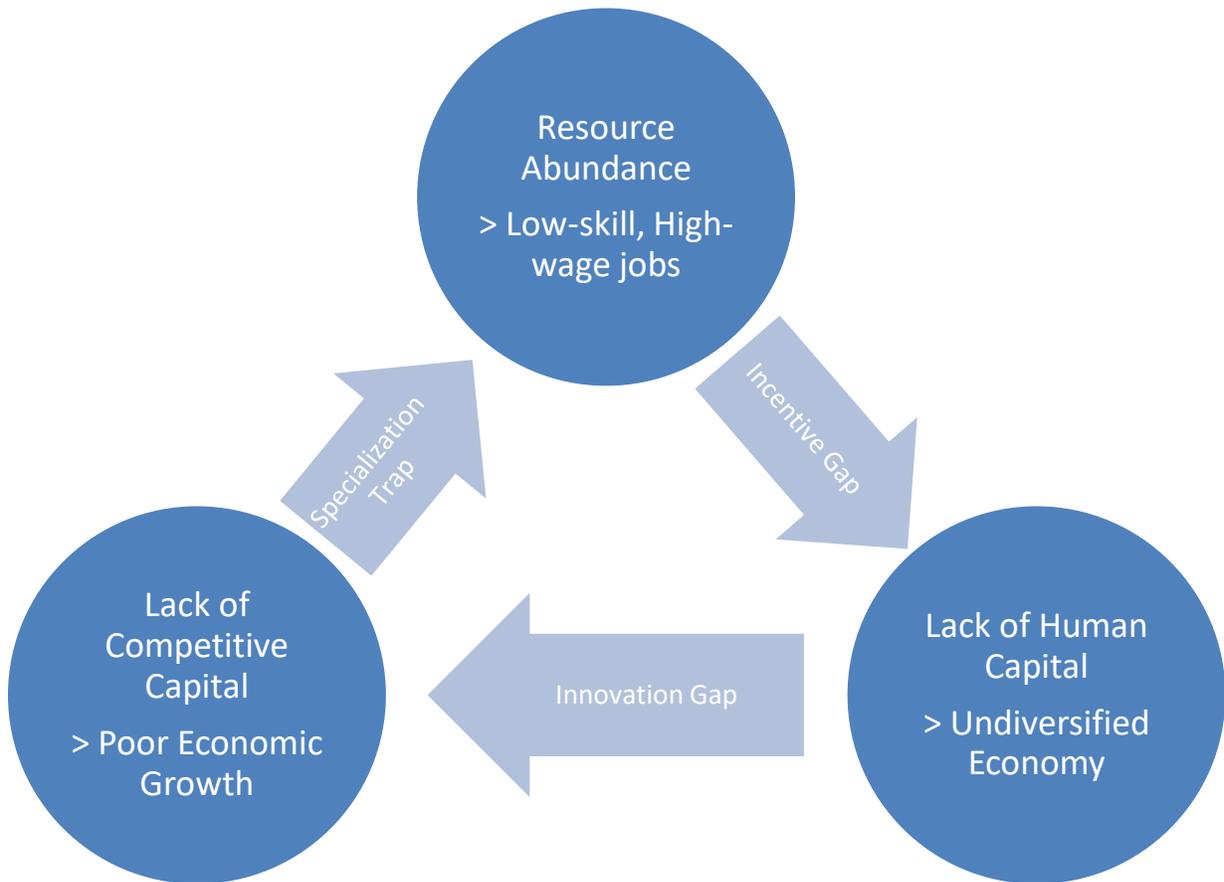
The slower than average growth rate in coal counties found by Black et al. (2005) aligns with the theory of the natural resource curse. Betz et al. (2015) examined this much deeper by disaggregating the Appalachian region from other U.S. locations due to its history with mining. The authors, like another 2012 study by Glaeser et al., state that “close proximity to a coal mine in Appalachia crowds out entrepreneurship (as measured by self-employment rates),” and that “the initial share of coal employment is negatively and significantly related to proprietors’ share of total employment” (Betz et al., 2015, p. 113). This suggests that when coal prices remain high the resource curse may act by limiting entrepreneurship (Betz et al., 2015).

The Resource Curse in General

As noted above, the resource curse has primarily been studied at an international level, comparing resource abundance and economic growth across nations. However, in recent years, scholars have started to examine the curse at both the state and county levels in the U.S. One study by Papyrakis and Gerlagh (2006) found evidence for the resource curse at a state level, indicating an association between natural resource abundance and decreased investment, schooling, openness, R&D expenditure, and increased corruption. Importantly, the researchers posit that “the crowding-out effect of natural resources...is indeed much interrelated to policy failures rather than the resources themselves” (Papyrakis and Gerlagh, 2006, p. 1025). This is a common theme in the resource curse literature: that weak institutions may be a primary mechanism of slow economic growth in resource abundant locations. Freeman (2009) adds to this, finding that states with larger taxes grow faster, all things equal. Additionally, Freeman (2009) highlights that resource-based economies are more volatile compared to other sectors, and thus may attract less investment over time.

At the county level, two studies find mixed effects of resource dependence on economic performance. James and Aadland (2011) find a negative relationship between natural resource earnings and economic growth. Conversely, Michaels (2010), in a study on the long-term economic impact of resource specialization in the Southern U.S., finds that this region has benefited from resource abundance, likely due to the establishment of strong infrastructure and strong local institutions that retain wealth locally. According to Michaels (2010), if resource abundance leads to poor economic outcomes, it is likely that the cause is a set of weak local institutions.

Figure 1 – Resource Curse Cycle (West Virginia Center on Budget & Policy, 2015)



Wealth Retention and the Role of Institutions

Perhaps one of the greatest challenges of managing natural resource boom-and-bust cycles is converting initial fiscal windfalls from boom periods into long-term, sustainable economic growth. In Appalachia, the coal boom of the 1970s lasted about a decade, and was associated with increases in per capita income and the ratio of employment to population, yet counties in the Central Appalachian region remained and still remain among the worst performing counties in the nation (Betz et al., 2015). Why has Central Appalachia not prospered more from its abundance of natural resources? Betz et al. (2015) theorize that the region’s dependence on coal may be to blame, stating that “Coal industry interests may be stronger in the ARC region, leading to a larger proportion of benefits flowing to mine owners rather than mine workers and the local

population” (Betz et al., 2015, p. 115). Indeed, some parts of Central Appalachia do have a long-standing dependence on the coal economy. One important lesson that may be taken from the region’s coal booms and busts is that strong institutions which support economic diversification, a strong tax base, and domestic investment may dampen the negative impacts of these cycles.

As a baseline understanding of what institutions mean in this context, consider a 2006 article by Mehlum, Moene, and Torvik. In an international study on the role of institutions as a mechanism for the resource curse, the researchers theorize that local institutions may either be “grabber friendly” or “producer friendly.” According to the researchers, grabber friendly institutions incentivize gains from specialization in a certain industry, whereas producer friendly institutions incentivize entrepreneurship and more productive industry activity, implying higher growth. Mehlum, Moene, and Torvik find that natural resource abundance is associated with lower income rates when institutions are grabber friendly, and the same is associated with higher income rates when institutions are producer friendly (Mehlum et al., 2006).

One institution that localities do have the potential agency to control is wealth retention. In order for a locality to take revenue from natural resource extraction and invest in things like economic diversification, infrastructure, and skill building, some wealth retention mechanism must be put into place. Such a mechanism would take tax and royalty revenue from drilling and mining and invest it into capital markets. In a 2016 report by the Brookings Institution, a Washington, D.C.-based nonprofit public policy organization, Saha and Muro recommend the establishment of a Permanent Trust Fund, which would do just that (Saha and Muro, 2016).

However, since natural resource prices are volatile, other scholars suggest that one fund may not be enough. Van der Ploeg and Venables suggest establishing three funds: 1) an intergenerational fund to smooth consumption long-term, 2) a stabilization fund to dampen the volatility that comes with natural resource pricing, and 3) an investment fund to hold windfalls until they are ready to be invested (Van der Ploeg & Venables, 2011). Other researchers like Sandbu (2006) propose the development of “Natural Wealth Accounts”, through which revenues from natural resources are transferred to all citizens of a locality directly, and then a percentage is taxed back by the government. Like Alaska’s Permanent Fund, the idea behind Sandbu’s Natural Wealth Accounts is that it would create an “endowment effect” in which citizens would necessitate that the government justify reasons for taxation, an “information effect” by educating citizens about the problem of natural resource revenue management, and an “income effect” by providing the population some of the revenue from natural resource wealth (Sandbu, 2006). One criticism of this approach, however, is that it may be politically difficult to

overturn if necessary, that once citizens become used to such payments they would not be likely to vote against them.

Wealth Retention Examples: Alaska, Texas, Wyoming, and Now West Virginia

A number of U.S. states have already established funds for the purposes of saving and investing natural resource tax and royalty revenues. Alaska, Texas, Wyoming, New Mexico, North Dakota, Alabama, Louisiana, Montana, and, as of 2014, West Virginia have all established permanent funds for this purpose (West Virginia Center on Budget & Policy, 2015). Dollars invested in these funds are earmarked for various development goals, and to act as a buffer to the volatility of resource economies.

Alaska's Permanent Fund takes at least 25% of all mineral revenue in the state and places it into the fund. The principal amount of the fund remains untouched, while earned interest and income are then invested into a diverse portfolio of income-generating assets. Alaska also pays dividends to eligible citizens on an annual basis. The state's fund is doing rather well, with a market value of \$60.7 billion as of July 19, 2017 (Alaska Permanent Fund Corporation).

Texas established the Texas Permanent University Fund in 1876 by an act of the legislature to fund investments into public education within the state. By saving and investing 100% of oil, gas, and mineral revenues from University of Texas lands, the Permanent University Fund has raised to a value of about \$17.5 billion. According to The University of Texas Investment Management Company, who manages the fund, it "provides support to 19 institutions of the UT and A&M Systems in providing educational opportunities to more than 180,000 students across the State of Texas" (University of Texas Investment Management Company, 2012, para. 1).

In 1975, Wyoming created the Wyoming Permanent Mineral Trust Fund, taking 1.5% of coal, oil, and natural gas severance tax revenue, as well as a statutory 1% of severance taxes and investing it into the fund. As of 2016, the market value of the fund was \$7.3 billion. Wyoming chooses to apply earnings from the fund to the State's General Fund, where it is invested into domestic projects at the legislature's discretion (Wyoming State Treasurer, 2016).

Relatedly, the latest state permanent fund to be established is in West Virginia, through the passage of Senate Bill 461 in 2014. The West Virginia Future Fund will invest 25% of natural gas and oil severance tax revenue, and like other funds only the interest and earnings on the principal balance of the fund will be spent. West Virginia, by legislative approval, has decided to require "moneys to be expended solely for economic

development projects, infrastructure projects and supplementing and increasing state salaries for teachers...” (West Virginia Legislature, 2014).

The theme central to all of these state-established permanent funds is a desire for prudent and sustainable investment. As mentioned earlier, perhaps one of the most challenging parts of managing natural resource boom-and-bust cycles is capturing initial fiscal windfalls and converting them into long-term, sustainable wealth. For more information and guidance on this topic, Columbia University has research, resources, and best practices on wealth retention here: <http://ccsi.columbia.edu/work/projects/natural-resource-funds/>.

Conclusions

Given the nature of boom-and-bust cycles, saving revenue from extractive industry activity for future investment may be wise for Ohio and other states in the Marcellus and Utica shale plays. As noted in this paper, West Virginia has already taken steps to establish a permanent fund, as it seeks support for the state to diversify its economy and address the decline of its legacy coal industry. Parts of Appalachian Ohio, where the bulk of the state’s shale oil and gas activity is taking place, deal with similar issues as West Virginia, including a lack of economic diversity, lower educational attainment rates, and slower economic growth compared to the U.S. average (Appalachian Regional Commission; Mix & Feser, 2014). One option available to the region for addressing these issues is to start establishing strong wealth retention mechanisms via oil and gas revenues, and to use revenues to diversify the regional economy.

Prior literature suggests that there is evidence of the natural resource curse at a state level, but also that strong policies that encourage investment in strategies such as economic diversification, education, and infrastructure may help local economies grow in the long-term. The volatility of the oil and gas industry is no secret, and the region has already seen a downturn in the industry with the fall of commodity prices in 2014. By following the lead of other resource-rich states, Ohio may start to establish a buffer against this volatility. Moreover, additional options for mitigating the negative economic impacts of boom-and-bust cycles may include building out the downstream sector locally, investing in economic diversification, and incentivizing education especially during boom periods when attainment rates historically seem to fall. Ohio needs to consider these

strategies as the state is poised for further development of the oil and gas industry; doing so may help the state better capture the value of its natural resources for more sustainable development in the long-run.

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