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Coal mining, economic development, and the natural resources curse☆

Michael R. Betz [a,*], Mark D. Partridge [d], Michael Farren [b], Linda Lobao [c]

[a] The Ohio State University, Department of Human Sciences, Campbell Hall, Room 171A 1787 Neil Avenue, Columbus, OH 43210, USA
[b] The Ohio State University, Dept. of Agricultural, Environmental, and Development Economics, Agriculture Administration Building, Room 227, 2102 Fyffe Road, Columbus, OH 43210, USA
[c] The Ohio State University, School of Environment and Natural Resources, Kottman Hall, Room 320D, 2021 Coffey Rd., Columbus, OH 43210, USA
[d] The Ohio State University, Dept. of Agricultural, Environmental, and Development Economics, Agriculture Administration Building, Room 336, 2102 Fyffe Road, Columbus, OH 43210, USA

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ABSTRACT

Coal mining has a long legacy of providing needed jobs in isolated communities but it is also associated with places that suffer from high poverty and weaker long-term economic growth. Yet, the industry has greatly changed in recent decades. Regulations, first on air quality, have altered the geography of coal mining, pushing it west from Appalachia. Likewise, technological change has reduced labor demand and has led to relatively new mining practices, such as invasive mountain-top approaches. Thus, the economic footprint of coal mining has greatly changed in an era when the industry appears to be on the decline. This study investigates whether these changes along with coal's "boom/bust" cycles have affected economic prosperity in coal country. We separately examine the Appalachian region from the rest of the U.S. due to Appalachia's unique history and different mining practices. Our study takes a new look at the industry by assessing the winners and losers of coal development around a range of economic indicators and addressing whether the natural resources curse applies to contemporary American coal communities. The results suggest that modern coal mining has rather nuanced effects that differ between Appalachia and the rest of the U.S. We do not find strong evidence of a resources curse, except that coal mining has a consistent inverse association with measures linked to population growth and entrepreneurship, and thereby future economic growth.

1. Introduction

Nations globally are undergoing an energy revolution that is not only altering the international geopolitical balance but also the economic landscape of energy producing communities. The related effects are producing winners and losers *between* regions as well as *within* affected U.S. communities. Factors underlying this revolution in the U.S. include (1) the Clean Air Act of 1990 that increased demand for low-sulfur Western coal at the expense of Appalachian coal; (2) innovations in unconventional drilling in shale formations for oil and natural gas that began in the late 1990s; (3) U.S. climate change policies to reduce carbon which would further increase demand for natural gas relative to coal; and (4) growing demand for natural gas and coal in India and China (EIA, 1999, 2005, 2013). The transformation of the U.S. energy sector raises a critical need to identify the impacts of energy development across the nation and particularly for communities in Appalachia that have historically been influenced by coal and where new shifts in the energy industry may be altering regional economic well-being.

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* Corresponding author.

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In particular, understanding the economic effects of policies aimed at limiting carbon and coal mining on local communities affected is urgently needed.

The federal policy environment, the Great Recession, along with the falling prices of now abundant natural gas, diminished demand for coal after 2008. Coal consistently accounted for 48% to 53% of U.S. electricity generation from 1990–2008 before falling to 37% in 2012; by contrast, natural gas's share of electricity production rose from 12% in 1990 to 30% in 2012 (EIA, 2013). The U.S. Energy Information Agency forecasts natural gas to be the most-used fuel for electricity generation by 2035. However, regulatory changes affected energy production long before the energy revolution. For one, the Clean Air Act of 1990 helped redistribute coal production from Appalachian to Western regions. Appalachia's share of coal production fell from 43% in 1997 to 28% in 2012 and the Western share rose from 41% to 53% (EIA, 2014). While aggregate U.S. gross coal production fell 7% over this period, Appalachian coal production fell by 37% and Western production rose 20% before peaking in 2008. Thus, depressed Appalachian communities have experienced additional pressure as the region's coal production began to lag long before the natural gas boom spread nationally.

As electricity producers substitute away from coal toward natural gas, coal jobs are eliminated and natural gas jobs are created. The result is that while there has been a (gross) expansion of jobs related to the recent shale oil and gas boom, many of these jobs have come at the expense of falling employment in the coal industry. This shift may produce net positive or negative local economic effects depending on factors such as each industry's relative capital intensity, supply chain size, and the proportion of jobs that go to local residents versus transient workers. Communities in the midst of the shale energy boom have seen economic growth – e.g., the Eagle Ford region in Texas and the Marcellus Shale region, but many of these jobs are offset by falling coal employment elsewhere.

These new and diverging trends within the energy sector suggest an urgent need to identify the community impacts of energy development, especially at a research scale that considers the entire nation. However, research on the recent energy boom is surprisingly sparse. Most studies focus on the pre-boom period that are less germane to trends associated with new technologies. Other related research examines general boom/bust cycles in energy and whether there is a "natural resources curse" in which natural resource intense locations appear to have lower long-run growth rates when averaging over the boom-bust cycle (Van der Ploeg, 2011). Some regional shale based research exists. Weber (2012) examines the shale gas boom in Colorado, Texas, and Wyoming and finds modest employment effects below those reported by industry sponsored research. Weinstein and Partridge (2011) examine the initial effects of the Pennsylvania Marcellus shale boom. They likewise find modest employment effects but also robust income growth effects presumably due to high royalty/lease payments and wages in the industry, though these studies examined more the short- to medium-term impacts of extraction.

In the case of coal, research scrutinizing the industry's recent economic effects is rare. Most prior studies focus on the boom/bust of the 1970s and 1980s (e.g., Black et al., 2005a) or on the long-run 20th century natural resources curse (Deaton and Niman, 2012). Yet questions associated with recent coal production are pivotal to America's energy economy. First, with intense competition from natural gas and a challenging regulatory environment, coal mining communities face tremendous pressures for which it is important to understand losers as well as winners. Second, the modern coal industry may have long-term effects different from those in the past which could challenge the prevailing understanding of the natural resource curse. In this manner, the industry has undergone tremendous technological change with falling employment and increased capital-intensive techniques such as mountain-top mining. Finally, as noted above, there has been a spatial redistribution of the industry with production moving west. Thus, the impacts of the coal industry are likely quite different now across both time and space.

In this study, we take a new look at the coal industry by assessing its net impacts on local communities today and providing unique contributions that respond to gaps in past work. First, we appraise a variety of indicators of economic well-being that include employment, population, and income distribution. These indicators allow us to assess not only coal mining's effects *between* communities – but also the winners and losers *within* communities. Second, we treat two distinct epochs of energy development: 1990–2000 – a period of low coal prices but modestly rising production; and 2000–2010 – a period of higher coal prices but more stable production. Third, the analysis examines Appalachia separately from the rest of the United States and contributes to assessing short-term as well as long-term effects associated with the natural resources curse. Fourth, we make summary comparisons with the impacts of the oil and gas industry; few if any past studies assess the performance of coal relative to these sectors. Finally, a key advantage of our empirical analysis is the use of instrumental variables in accounting for the non-random location of coal mining. We consider exogenous geological instruments both for the quantity of coal as well as the quality of coal. In doing so, we contribute to the emerging methodological literature measuring the impact of energy development.

In what follows, we first review the literature and evaluate recent trends in the coal industry. The conceptual model is then explained, followed by sections that discuss the empirical model, empirical results, and research conclusions.

2. Previous literature

Recent interest in the impacts of natural resource extraction on economic development has shifted from cross-country research to subnational analyses of local economies. Scrutinizing the economic impacts of natural resource extraction at a regional level is important in part because factors salient at a national level (e.g. civil wars and exchange rates) play less confounding roles. Further, because the impact of natural resource extraction on local economic outcomes is highly dependent on context (i.e. the resource being extracted, the specific economic outcome, and the local setting), subnational studies provide a finer resolution of the specific situation. As subnational research has expanded, nuances about diverse contexts as well as the identification of broad patterns that hold across contexts have begun to emerge. Below we summarize findings for the most recent investigations of economic outcomes at a subnational level. They generally point to short-term employment and wage increases, especially during boom periods, but are mixed for long-term outcomes in natural resource dependent areas.

The impact of natural resource booms on employment or wages both in the energy and non-energy sectors are investigated in several recent studies. Marchand (2012) analyzes the effects of oil and gas extraction in Western Canada on employment and earnings in the energy sector. Energy sector employment and earnings rose in boom periods, while decreases during the bust were not statistically significant. Marchand (2012) also finds the positive employment and earnings effects spill over into non-energy industries such as construction, retail trade, and service sectors during the boom, though some of the spillover gains are lost during the bust. Weber (2012) investigates the employment, income, and poverty effects of shale oil and gas drilling in the Western U.S. states of Colorado, Texas, and Wyoming. He uses a triple-difference model with instrumental variables to control for endogenous factors that might be correlated with shale development in drilling counties. He finds the value of gas produced has positive effects on employment, wages, and median household income over the 1998–2008 boom period, although the results are more modest for employment. Using a similar instrumental variable approach, Brown (2014) found that communities situated near oil and gas shale booms also experience positive income and employment effects but the employment effects are mainly concentrated only within the mining sector.

Because of their focus on coal, Black et al.'s (2005a) study is particularly germane to our research. The authors use the presence of coal