Robert Todd Perdue and Gregory Pavela (2012) "Addictive Economies and Coal Dependency: Methods of Extraction and Socioeconomic Outcomes in West Virginia, 1997-2009" *Organization & Environment* Vol. 25(4): 368-384 [DOI: 10.1089/env.2011.0040] Version of Record Available @ (http://0-oae.sagepub.com.wncln.wncln.org/contentearly/2012/10/25/1086026612464767.abstract)

Addictive Economies and Coal Dependency: Methods of Extraction and Socioeconomic Outcomes in West Virginia, 1997-2009

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Abstract

Policy makers generally see resource extraction as a boon for local economies and citizens. Numerous studies, however, have shown negative socioeconomic outcomes in extractive communities, supporting the notion that resources can be more of a curse than a blessing. One aspect of this debate that requires further clarification is the role played by method of extraction. In this article, we use the case of West Virginia coal mining and a fixed effects model to test whether extraction methods affect socioeconomic outcomes. We observe little difference in these outcomes between surface and underground mining; rather, it is the presence or absence of mining that matters most. We find that nonmining counties have lower poverty and unemployment rates than mining counties. These results lead us to conclude that leaving remaining coal stores in the ground will likely prove most beneficial to the state's people and economy in the long run.

Keywords

coal, West Virginia, mountaintop removal mining, poverty, resource curse, addictive economies, Freudenburg

Does resource extraction benefit local communities? Twenty years ago, William Freudenburg (1992) addressed this misleadingly simple question and concluded it depended largely on the time frame employed. In the short term, communities are likely to benefit from increased employment and capital investment, the so-called "shot in the arm," but in the long run such communities tended to far worse than those independent from resource extraction. This led Freudenburg to compare the short-term logic of policy makers with that of drug addicts, and to label these Faustian arrangements "addictive economies." Freudenberg called for longitudinal research that could shed light on the human capital implications of these economies and determine how and why outcomes varied across regions and industries. A decade later, Freudenburg and Wilson (2002) noted an increase in such studies but concluded that "while the overall body of literature addressing the economic well-being of mining-dependent areas is vast, the number of studies explicitly offering systematic, quantitative data on the impacts of mining in the rural United States is actually much smaller" (p. 554).

Yet another decade has passed and these socioeconomic relationships are still murky. Clarification is important because the empirically questionable belief that resource extraction will be a boon for local economies and citizens is typically accepted without question in policy circles (Wilkinson, 1998). These decisions often result in degraded landscapes and communities as the environmental justice literature illustrates (Gedicks, 2001). Empirical research assessing the impacts of coal extraction is more critical than ever in Appalachia, as the ecological impacts of the mountaintop removal (MTR) mining method are clear (Environmental Protection Agency [EPA], 2010). The MTR method of extraction uses explosives to remove up to 1,000 feet of mountaintop, which is then pushed into neighboring valleys to reveal coal seams. The result is similar to a landscape of plateaus as more than 2,000 square miles of woodland have been deforested and more than 2,000 miles of Appalachian headwater streams buried in the past three decades (EPA, 2010).

Despite these significant ecological costs, little empirical evidence suggests that coal extraction tangibly benefits the people of the region, notwithstanding the claims of pro-industry supporters that coal is the lifeblood of Central Appalachia (Bell & York, 2010). In this article, we examine the impacts of coal extraction over a 13-year time period in West Virginia, the second leading producer of coal in the United States and its number-one producer of underground coal. As such, West Virginia is a useful case for evaluating the relationship between extraction and socioeconomic outcomes on the short- and longer timescales. West Virginia also permits examination of a key aspect of resource extraction that has received little empirical attention: the potential differential effects of methods of extraction on socioeconomic outcomes. Using a fixed effects model we analyze the association between poverty, per capita income, and unemployment rates with coal production and method of coal extraction, either surface or underground, in West Virginia counties from 1997 to 2009.[1] Our findings call into question the widely touted claim that coal adds to community well-being in the state of West Virginia, for coal may very well "Keep the Lights On," but our findings suggest that ending dependence on coal regardless of extraction modality would likely prove more beneficial to the state's economy and people.

Resource Dependence and Socioeconomic Well-Being

The political economy of Andre Gunder Frank (1967) grounds many debates of the costs and benefits of resource extraction, both internationally and domestically. Frank pointed out that peripheral nations economically enmeshed with core nations did not develop in the ways modernization scholars predicted, but rather were "underdeveloped." Frank's ideas influenced many key studies of economic development and dependency in Latin America (Bunker, 1985; Cardoso & Faletto, 1979), and informed Evans's (1979) notion of the "triple alliance" of colluding political leaders, multinational corporations, and local elites responsible for underdevelopment. The paradoxical presence of extensive poverty in the presence of great resource wealth became crystallized as the "resource curse," and stimulated numerous other studies attempting to unpack these complex dynamics on the international level (Bebbington, Hinojosa, Bebbington, Burneo, & Warnaars, 2008; Rajan, 2011; Ross, 2003; Sachs & Warner, 1995; Stedman, Parkins, & Beckley, 2004; Tonts, Plummer, & Lawrie, 2012).

A substantial body of literature has examined the relationships between resource extraction and variables such as income, unemployment, and poverty in the United States. Elo and Beale (1985) found not only that the counties heavily dependent on mining had higher proportions of households living in poverty and the highest rates of "extreme" poverty but also the "curious anomaly" of higher median wages. Krannich and Luloff (1991) compared agriculture- and mining-dependent counties, observing that mining-dependent counties had higher levels of unemployment than those dependent on agriculture, even in a period of agricultural restructuring and crisis. The Rural Sociology Society Task Force (1993) on Persistent Poverty furthered understandings of these relationships in 1993, concluding that resource extraction was not a panacea for rural poverty, but rather related to the creation and persistence of poverty. Lichter and McLaughlin (1995) supported this contention, finding that areas heavily depending on resource extraction had higher rates of poverty. Others, however, have found that resource extraction is correlated with positive socioeconomic outcomes. For instance, Bender et al. (1985) found that "mining-dependent"[2] counties had higher incomes and fewer people receiving social security benefits than nonmetropolitan counties, whereas Fisher (2001) found that communities that converted their forested land to agriculture tended to be more prosperous than those that did not.

Most of these studies are limited, however, by their use of cross-sectional data, which fail to register the long-term impacts of resource extraction. Even fewer studies apply these criteria to examinations of the impacts of mining. On this point, Nord and Luloff's (1993) work is seminal, because it compared data from the 1980 and 1990 U.S. censuses across three regions and three different mining sectors (coal, petroleum, and other). They found much better outcomes in the Western mining areas, including higher median family income and lower poverty rates, while the Southern region had much worse outcomes at both time points, while outcomes in the Great Lakes region worsened from 1980 to 1990. As such, Nord and Luloff made clear that time as well as space matter for the relationship between extraction and poverty. Nevertheless, few studies have used even the modest span of a decade to observe trends (but see, Elo & Beale, 1985; Fisher, 2001; Frickel & Freudenberg, 1996).

In their attempt to make sense of the mixed findings concerning mining and community well-being over time, Freudenburg and Wilson (2002) conducted a meta-analysis. Taking methodological differences into account, they found roughly half of the 301 findings analyzed were "adverse," whereas the remaining were divided between "neutral" and "favorable" outcomes (Freudenburg & Wilson, 2002, p. 556). Income proved to be the most consistently positive outcome, with a little under half of the findings pointing to mining dependence leading to higher incomes, whereas a third found income to be lower in these communities. Moreover, 44% of the findings observed higher rates of poverty in mining-dependent areas, 36% no statistical difference, and only 20% of mining-dependent areas had lower levels of poverty (Freudenburg & Wilson, 2002, p. 559). Mining-dependent areas had higher unemployment rates in nearly 60% of these findings, whereas only 16% indicated lower rates of unemployment (Freudenburg & Wilson, 2002, p. 560). In sum, Freudenberg and Wilson (2002) found that mining-dependent areas more often had higher incomes, poverty, and unemployment than nonmining areas. Freudenberg and Wilson's (2002) findings parallel Elo and Beale's (1985) "curious anomaly" of higher wages and greater poverty. Freudenberg and Wilson contend that this paradox is likely the result of mechanization, which "has become associated with relatively high wages in most U.S. mining operations today, but only for the small numbers of workers still employed" (Freudenburg & Wilson, 2002, p. 569). The importance of mechanization in turn raises the larger issue of the method of resource extraction. However, this factor is largely missing from the literature linking mining and community well-being. Freudenburg and Wilson conclude by citing the need for "analyzing communities' relationships with the characteristics of natural resources themselves and with the specific technologies that are developed to exploit these resources" (Freudenberg & Wilson, 2002, p. 572). This point is exceedingly important for studies of Appalachia and coal, as the mechanization of the coal industry revolutionized the modes of production and societal relationships in the region, with one commentator even referring to the post–World War II period as the "New Machine Age" (Thomas, 2010).

In this context, numerous studies have focused on coal mining and social well-being in Appalachia. For instance, Tickamyer and colleagues found higher gender and racial inequality in mining-dependent communities (Tickamyer & Latimer, 1993; Tickamyer & Tickamyer, 1988). Latimer and Mencken (2003) analyzed socioeconomic trends in mining-dependent counties in West Virginia, Kentucky, and Virginia in the 1990s. The authors concluded the region to be stagnant and ill-equipped for the changing global economy. Using qualitative methods, Bell (2009) found greatly diminished social capital and solidarity in the coalfields. In West Virginia, the top coal-producing state in Appalachia, many of these negative outcomes are extreme. The Gallup-Healthways Well-Being Index[3] ranked West Virginia 50th (last) out of 50 states in "Physical Health," "Emotional Health," "Life Evaluation," and "Overall Well-Being" for the years 2009 and 2010. In addition, Freudenburg's drug metaphor seems most apt given that the coalfields are currently awash in prescription drug abuse (Kobak, 2012).

Only recently have researchers attempted to differentiate social outcomes by mining type, however, notably by differentiating MTR areas from underground mining operations. Such research has documented negative health outcomes in MTR areas, including the study by Ahern et al. (2011) which found higher rates of birth defects and premature death from respiratory, heart, and kidney diseases near MTR sites. Hendryx and Zullig (2009) found higher rates of cardiovascular disease, angina, and heart attacks for both men and women living near MTR sites. Hendryx (2011) documented higher mortality rates, but importantly, also included socioeconomic variables, finding higher total poverty and child poverty rates in MTR areas. Although these studies are exceedingly valuable, more longitudinal work is needed to validate the above-mentioned findings. To this end, we seek answers to two main questions: (a) Do communities with coal extraction have better socioeconomic outcomes than other communities? (b) Among coal extraction communities, do those relying on underground mining methods have better outcomes than those where surface mining dominates? We use the case of West Virginia to answer these questions.

The Case: West Virginia and Coal

Like all coal-dependent states in the Appalachian region, West Virginia rode the "resource roller coaster" during the 20th century (Wilson, 2004). As demand for Appalachian coal dwindled in the interwar years, the formerly thriving coal industry went bust and the Great Depression was especially painful in the region. With World War II and the war effort, however, the region was catapulted into a boom time. Recognizing the key role played by coal, the U.S. government took control of coal operations during World War II to ensure an uninterrupted flow of the fuel (Couto, 1993), and miners suddenly became coveted. Harry Caudill (1963) describes this reinvigoration:

> . . . And the creek and hollow mountaineers, and the multitude of one-time miners employed on W.P.A. projects, turned eagerly to their calling . . . Empty camps filled again and the ghastly, painted houses swarmed with new brigades of ragged irrepressible children. (pp. 220-221)

The federal government made labor friendly deals with John L. Lewis and the United Mine Workers, resulting in a strong union, generous wages, and high times in the mountains (McGinley, 2004).

But as quickly as it had begun, the boom deflated as the war effort ended. The coal operators resumed control of the nationalized mines and accelerated production, resulting in a glutted market (McGinley, 2004). At the same time, domestic coal demand decreased as homeowners across the nation switched from coal to cleaner burning oil for their heat, while the railroads shifted to diesel power. As Thomas (2010) notes, “the disruption or disappearance of traditional coal markets led to falling coal production, narrower profit margins, and discharge notices for growing numbers of miners as coal operators mechanized to reduce labor costs” (p. 12). Indeed, mechanization processes only accelerated following the war, as McGinley (2004) points out, “In 1948, 117,104 miners were at work in West Virginia. In 1957, only 58,732 miners had jobs, and by 1961 employment of miners had shrunk to only 42,557 in West Virginia” (p. 34).

Mechanization altered both surface and underground mining operations. On the surface, the economies of scales created by massive power shovels, bulldozers, dump trucks, and train cars greatly increased efficiency and reduced the need for human labor, while simultaneously increasing coal extraction rates. Nevertheless, underground mining still accounted for 75% of all mining in 1950 (Bonskowski, Watson, & Freme, 2006), and the subterranean technological developments were every bit as dramatic as those on the surface, forever altering the work and health of deep miners. The continuous mining machine introduced by the Joy Manufacturing Company in 1948 automated the mines and virtually eliminated the need for hand loaders, dramatically reducing extraction costs (Thomas, 2010, p. 13). In terms of health outcomes, the number of mining fatalities decreased during the increasingly mechanized post war period, but injury rates increased due to the accelerated work pace and the increased noise of the jobsite (Thomas, 2010). But the most insidious danger of mechanization was created by the continual sawing and release of fine coal dust and, pneumoconiosis, black lung disease, soon emerged as an eminent health threat to miners.

Nevertheless, those with jobs were grateful for them, as newly out-of-work miners and their families had tough decisions to make. Thousands reluctantly left the mountains in search of work in Detroit, Akron, Cincinnati, Cleveland, and other industrial hubs in what became known as the Great Migration (Berry, 2000). As Rice and Brown (1993) note,

> Between 1950 and 1960 the population of West Virginia declined from 2,005,552 to 1,860,421, a loss in excess of seven percent at a time when nearly every other state gained population. More than seventy percent of the loss occurred in the ten leading mining counties. (p. 280)

At the same time, the landscape underwent dramatic changes as denuded mining sites replaced many family farms. In addition to the loss of jobs and environmental degradation, broad-form mining deeds challenged that seminal hallmark of American Capitalism, private property. Such deeds granted mining companies the mineral rights beneath the surface, allowing these companies to surface mine land under color of law.

The 1970s saw a continuation of the boom/bust cycle of the coal industry. The pain inflicted by skyrocketing oil prices reinvigorated interest in coal as a fuel source, and a short-lived boom ensued. Many of the shuttered company towns of Appalachia again sprang to life, with

> . . . significant numbers of job postings for the first time in decades as electric energy producers shifted from petroleum to a more reliable and less costly product. In West Virginia alone, more than 17,000 new miners were placed on payrolls during the period between 1973 and 1978. (McGinley, 2004, p. 43)

For perspective, the total number of miners in West Virginia in 2010 was just 20,225 (West Virginia Office of Miners’ Health Safety and Training [WVOMHST], n.d.-a). But this time the bust came sooner than later, and the boom in the coal fields lasted but a few years. The 1980s saw the region entering into yet another bust phase as a consequence of the recession of the early Reagan years and the economic restructuring away from manufacturing toward service and information sectors. More than 1,600 West Virginian mines closed at this time, while the amount

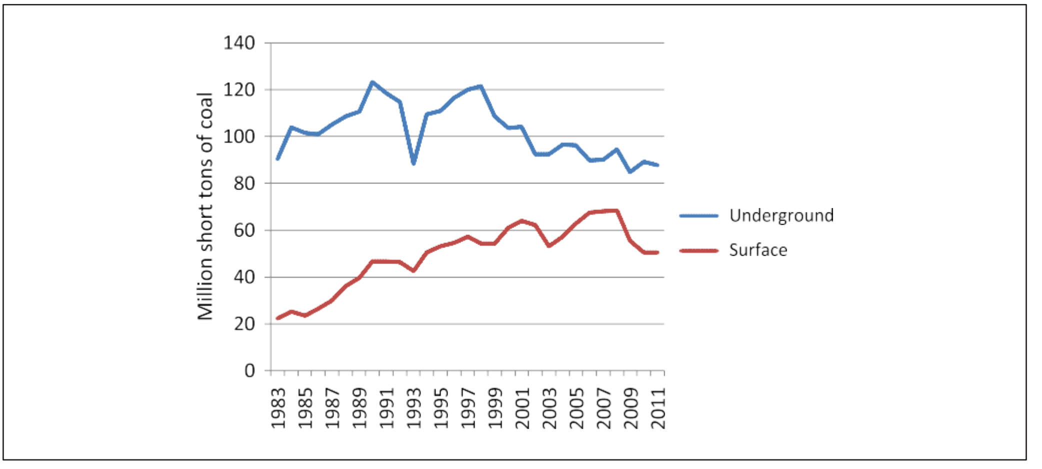

Figure 1. West Virginia coal production
Source: Mine Safety and Health Administration (n.d.).

of miners declined by half from 1980 to 1990 (Latimer & Mencken, 2003, p. 81), and by 1984 West Virginia led the nation in unemployment (Rice & Brown, 1993). A large factor in this decline was the surge in federal coal leasing in the Western United States, shifting production to these extensive and less expensive reserves (Nelson, 1983, p. 178).

Amendments to the Clean Air Act in 1990, specifically limits on sulfur dioxide emissions from burning coal, resulted in yet more upheaval in the coal industry. Utility companies, major emitters of sulfur dioxide, were left with two options: They could install expensive retrofits to their plants to reduce these emissions, or they could burn coal with less sulfur (Faber, 1998). These legislative acts made the high-sulfur mines of the Midwest much less desirable, evidenced by the shuttering of more than 1,000 high-sulfur mines (Faber, 1998, p. 45). In this context, the low-sulfur coal deposits in Appalachia became more attractive to utilities and 1997 (the first year of this study) witnessed the greatest total production recorded in West Virginia history, with about 180 million tons of coal extracted, roughly a third coming from surface operations (WVOMHST, n.d.-b). The use of MTR methods accelerated greatly at this time, expanding from about 77,000 acres in 1985 to 272,000 acres under MTR in 2005 (Skytruth, 2009). Indeed, MTR has come to be the dominant type of surface mining as 43 million of the 56 million tons of West Virginia coal extracted from the surface in 2009 came from MTR mines (WVOMHST, n.d.-c). While underground mining still dominates in West Virginia, production rates have declined steadily since the production highpoint of 1997. Conversely, surface-mined coal has increased at roughly the same rate that underground mining has declined since this time (see Figure 1).

These data show a clear shift in the way that coal is pulled from the ground in West Virginia. It is still unclear, however, if these methods of extraction matter for socioeconomic outcomes, or if coal extraction in general is associated with better socioeconomic outcomes for West Virginians. To shed more light on how coal dependency affects the people of West Virginia, we correlate available coal data broken down by county and extraction type from 1997 through 2009 with numerous socioeconomic indicators.

Data

Our analysis includes data from all of West Virginia's 55 counties over a 13-year observation period from 1997 to 2009. Unemployment data come from the Bureau of Labor Statistics, poverty data come from the U.S. Census Small Area Income and Poverty Estimates (SAIPE) data set, and per capita income data come from the Bureau of Economic Analysis. Coal-mining data come from the West Virginia Office of Miners' Health Safety and Training, which includes underground and surface totals of short tons of coal produced and employment in the sector at the county level.

Method

For each outcome of interest (poverty, per capita income, unemployment), we estimated a fixed effects regression using the mean deviation algorithm procedure. In our analysis, the mean deviation method computes means over time for each county and each time-varying variable. County-specific means are then subtracted from the observed values of each variable and the differences for the dependent variable are regressed on the differences of the independent variables (Allison, 2009). The model was estimated using the "xtscc" procedure in STATA 12 as follows:

$$Y_{it} = \beta X_{it} + \alpha_i + u_{it},$$

where subscript *i* indicates entity and subscript *t* indicates time, α_i is the unknown intercept, Y_{it} is the dependent measure for county *i* at time *t*, β is the coefficient for the vector of the set of time-varying variables included in the model, and u_{it} is the error term for observation *i* at time *t*.

Fixed effects models help control for omitted variables that differ between cases (counties in our model) but are constant over time. For example, the size of each county is different, but is likely to be the same over our observation period. If county size is somehow related to poverty, a fixed effects model accounts for its effect even though county size is not included in the model. A key assumption of fixed effects models is that the omitted variables which could simultaneously affect both dependent and independent variables are time invariant. For example, one of the counties may have discovered another valuable resource during our observation period, plausibly affecting both coal mining and poverty levels. In additional models (not shown) we included a measure of new natural gas footage because it varied between counties and over time. The inclusion of natural gas production did not affect the significance of our key independent variables.

A potential problem in our study is that several counties have similar rates of both underground and surface coal extraction. For the analytic sample, underground and surface extractions are indeed positively correlated (Pearson's correlation coefficient = .581, $p < .01$), however regression diagnostics (conducted using ordinary least squares regression) suggest that collinearity is not a significant problem (variance inflation factor [VIF] < 5 across all dependent variables, 1/VIF > .01 across all dependent variables). Regression diagnostics also indicated the presence of serial correlation in the errors, groupwise heteroscedasticity, and cross-sectional spatial correlations of errors; thus, estimators of the standard error robust to the cross-sectional and temporal dependence are used (Hoechle, n.d.).

Dependent Variables

We estimate three models, one for each outcome of interest: county-level unemployment percentage, county poverty percentage, and county-level per capita income in constant 2009 dollars deflated using the consumer price index. County-level unemployment is defined as the percentage of individuals who do not have a job, made at least one attempt to find a job in the past month, and were available for work (U.S. Department of Labor, Bureau of Labor Statistics, 2012). County poverty estimates come from the SAIPE program. The SAIPE program uses administrative records, intercensal population estimates, and the decennial census with direct estimates from the American Community Survey "to provide consistent and reliable single-year estimates of poverty" (U.S. Census Bureau, n.d.). County-level per capita income estimates come from the Regional Income Division of the Bureau of Economic Analysis (U.S. Department of Commerce, 2011). Per capita personal income is calculated as the personal income of the residents of a given area divided by the total resident population of that area using the Census Bureau's annual mid-year population estimates as the area population estimate (U.S. Census Bureau, n.d.).

Independent Variables

Independent variables included in the analyses are total coal tonnage produced within a county, tonnage of coal produced from underground mines as a percentage of total West Virginia underground production, tonnage of coal produced from surface mines as a percentage of total West Virginia surface production, a dichotomous indicator of either none or any mining activity (surface or underground) in a county, percentage of employment within a county in the mining sector, and an indicator for a linear effect of time. All these data are derived from WVOMHST. In addition, we included the price of underground West Virginia coal relative to the national average price of underground coal and the cost of West Virginia surface coal relative to the national average price of surface coal in constant 2009 dollars. These data come from the Annual Coal Report released by the Energy Information Administration (EIA, 2011). Finally, we include annual population estimates from the U.S. Census Bureau as a covariate.

Results

Table 1 reports the means and proportions of variables included in the analysis based on the entire observation period.

Table 1. Descriptive Statistics of Variables 1997-2009

Variable	Mean	*SD*	Minimum	Maximum
Per capita income (2010 dollars)	26249.07	4557.61	102	4,130
Percentage poverty	17.87	4.778	8.3	40.8
Percentage unemployment	6.43	2.31	2	17
Mining activity	0.506	0.500	0	1
Total county coal tonnage	2,975,003		0	34,197,230
Percentage WV underground coal	1.84	3.63	0	25.4
Percentage WV surface coal	1.81	4.55	0	30.1
Percentage employed mining	2.90	6.60	0	83.5
⊗WV underground price, national price	7.65	6.74	2	15
⊗WV surface price, national price ($)	32.01	6.89	22	41

Note: N = 715 observations. WV = West Virginia.

Average poverty across all observed counties and time periods is 17.87%. Mean per capita income was $26,249 and average unemployment was 6.43%. Approximately half of the counties had mining activity, with an average 2.975 million tons of coal produced per county over the 13-year observation period. Each mining county accounted for an average of 1.8% of all underground coal produced in West Virginia and 1.8% of all surface coal produced in West Virginia. Within each county, an average of 2.9% of all workers found employment in the mining sector. West Virginia underground coal was, on average, $7.65 more expensive than the average national price of underground coal, while surface coal was, on average, $32 more expensive than the average national price of surface coal.

Table 2 reports the results from the analysis estimating county-level poverty.

Table 2. Results From a Fixed Effects Model Predicting Poverty in West Virginia (WV) Counties, 1997-2009

Variable	Coefficient (*SE*)
Mining activity	
No mining	–0.64 (0.31)*
Total tonnage (per million tons)	–0.09 (0.06)
Percentage WV underground coal	0.11 (.05)**
Percentage WV surface coal	0.06 (0.04)
Percentage employed mining	–0.08 (0.21)
Resource pricing	
Relative cost WV underground coal	0.094 (0.05)
Relative cost of WV surface coal	0.082 (0.04)*
Population (per thousand)	–0.07 (0.02)
Linear time trend	–0.186 (0.16)
Constant	17.48 (0.98)***
R^2 (within county)	.16

*p < .10. **p < .05. ***p < .01.

Significant predictors of poverty include the presence of any mining activity in a county, the percentage of West Virginia underground coal produced within a county, and the relative market cost of West Virginia surface coal. Counties with no mining activity are expected to have lower poverty rates than counties with mining activity (b = –0.64, p < .01). Counties that produce a higher percentage of West Virginia's underground coal are expected to have slightly higher rates of poverty (b = 0.11, p < .05) and poverty is also expected to increase as the market cost of West Virginia surface coal increases (b = 0.08, p < .10).

Table 3 presents the results from the analysis estimating county-level per capita income.

Table 3. Results From a Fixed Effects Model Predicting *Per Capita Income* (2009 Dollars) in West Virginia (WV) Counties, 1997-2009

Variable	Coefficient (*SE*)
Mining activity	
No mining	92.83 (140.00)
Total tonnage (per million)	–71.06 (39.86)
Percentage WV underground coal	56.90 (40.20)
Percentage WV surface coal	12.27 (17.92)
Percentage employed mining	4.85 (6.69)
Resource pricing	
Relative cost WV underground coal	–26.60 (22.69)
Relative cost of WV surface coal	–64.32 (16.69)***
Population (per thousand)	–56.77 (21.60)**
Linear time trend	567.35 (32.01)***
Constant	26997.73 (848.35)***
R^2 (within county)	.84

*p < .10. **p < .05. ***p < .01.

The relative market price of West Virginia surface coal is significantly associated with per capita income. As the market price of surface coal increases, county per capita income is expected to decrease ($b = -64.32$, $p < .01$). The indicator of a linear time effect was also significant—across all time points per capita income increased by an average of $567.35 ($p < .01$).

Table 4 reports the results from the analysis estimating county-level unemployment.

Table 4. Results From a Fixed Effects Model Predicting *Unemployment* in West Virginia (WV) Counties, 1997-2009

Variable	Coefficient (*SE*)
Mining activity	
No mining	−0.55 (0.24)**
Total tonnage (per million tons)	−0.10 (0.09)
Percentage WV underground coal	0.16 (0.08)*
Percentage WV surface coal	−0.03 (0.05)
Percentage employed mining	−0.01 (0.01)
Resource pricing	
Relative cost WV underground coal	−0.12 (0.31)
Relative cost of WV surface coal	−0.17 (0.09)**
Population (per thousand)	0.11 (0.01)***
Linear time trend	0.24 (0.42)
Constant	8.0 (2.2)***
R^2 (within county)	.25

*$p < .10$. **$p < .05$. ***$p < .01$.

The presence of mining activity, the percentage of West Virginia underground coal produced within a county, and the relative market cost of surface coal are significantly associated with unemployment. Counties with no mining activity are expected to have lower unemployment levels ($b = -0.55$, $p < .05$). Unemployment is also expected to decrease as the relative market cost of surface coal increases ($b = -0.17$, $p < .05$). However, the percentage of West Virginia underground coal produced within a county is associated with higher unemployment—for each percentage increase in a county's contribution to West Virginia's total underground coal production, we expect a 0.16% increase in unemployment levels ($p < .10$).

Discussion

The foregoing analysis advances the literature on extractive industries and socioeconomic well-being by incorporating data over an extended period of time and by differentiating among extraction methods to identify whether they exert distinct effects on social well-being. We found that West Virginia counties with no coal mining have lower levels of poverty than mining counties. Moreover, counties that mine a higher percentage of underground coal relative to other counties have higher levels of poverty. These findings support much of the "resource curse" literature, which contends that dependency on natural resources results in stifled development and negative socioeconomic outcomes. This is due in large part to the fact that coal extraction is a primary industry; coal is pulled from the ground, cleaned, and shipped away. Therefore, little opportunity exists for these operations to be economically "linked" to secondary industries which process and transform raw materials into value-added finished products, such as refineries for oil (Freudenburg & Gramling, 1998) or paper plants and saw mills for forest products (Overdevest & Green, 1995). The very nature of the resource and the "fixity of extraction" require coal to be transported large distances to utilities and factories, reinforcing its peripheral nature (Bunker, 1985). Moreover, access to local markets ended after most Appalachian homeowners switched to oil and the railroads shifted to diesel-powered engines. These circumstances prevent coalfield communities and businesses from exploiting the processing and services which provide high-wage specialized jobs and additional tax revenue. As such it is not surprising that coal-dependent counties have higher rates of poverty than nonmining counties as little potential for capitalization of the resource exists.

The jobs found in the coal industry, however, are typically thought of as "good jobs" with relatively high pay, especially considering the low cost of living in the coal-bearing regions of the state. It is not, then, low wages paid to miners that contribute to the higher rates of poverty in coal-mining counties, but rather the sheer lack of opportunity. Mechanization of both underground and surface mines have dramatically reduced the number of jobs available to coalfield communities, for as Williams (2002, pp. 345-346) points out, more West Virginians work at Wal-Mart than in the mines. That the "curious anomaly" of higher poverty *and* higher per capita income was not found in this analysis suggests that even the relatively high-paying jobs of the mines are not substantial enough to raise overall income levels in these counties. Indeed, the increased capitalization and modest demand for labor in coal operations calls into question the assertion made by the coal industry and its supporters that coal is the lifeblood of the region. As Bell and York (2010, p. 121) point out, although West Virginia is the leading producer of coal in the region, coal contributed only 7% to the gross state product in 2004. This highlights the minor economic benefits of the industry, while others suggest that if the hidden costs of coal were internalized, coal would actually be a net loss for coal state economies (McIlmoil, Hansen, Boettner, & Miller, 2010).

We argue that our second main finding, that as the relative market price of West Virginia surface coal increases, poverty increases while per capita income decreases, is due to several factors which make up what Freudenburg (1992) called the "cost/price squeeze." In essence, higher coal prices do not necessarily infer higher profits, but instead signify a less attractive option for coal purchasers. In West Virginia, the main factors creating this cost/price squeeze are (a) depletion of productive and easily accessible reserves, (b) competition from cheaper Western coal, (c) increased competition from other energy sources, especially natural gas, and (d) tightening environmental regulations. These factors have increased the costs of coal production while reducing the price West Virginia coal can fetch, resulting in shrinking margins.

The most obvious of these factors is the exhaustion of productive and easily accessible reserves. Coal has been mined in West Virginia for hundreds of years and operators began mining in the most rewarding locations. Unlike the much newer mining operations in the Powder River Basin of Wyoming and Montana where coal is close to the surface and seams can reach 100-feet deep, Appalachian coal operators are forced to spend greater sums to reach and extract relatively thin seams of coal. Indeed, more coal is extracted from Wyoming mines than from all of Appalachia combined (EIA, 2011).

Another crucial factor lessening the viability of West Virginian coal, both surface and underground, is the explosion of natural gas drilling and use. New methods of extraction, such as hydraulic fracturing, have opened new vistas to the natural gas industry. Coupled with extensive reserves in many regions of the country (including Appalachia), the price of natural gas has dropped precipitously in the past few years, pushing coal out of many markets as its cost drops close to that of coal. As Nelder (2012) explains,

> In 1998, the cost of gas for electric utilities was 1.9 times higher than coal. That ratio rose to 5.4 in 2005. It now stands at a mere 1.2, making gas just slightly more expensive than coal for power generation.

When increased regulation and pollution control costs are factored into the equation, coal is even less attractive for utilities. Despite a recent ruling by U.S. District Judge, Amy Berman Jackson which restricted the authority of the EPA to withdraw Clean Water Act permits, allowing the largest ever MTR mining operation to go forward, the EPA has placed other significant obstacles in the path of the coal industry. Recently, the EPA proposed the first Clean Air Act standard for carbon emissions for future power plants, imposing much stricter allowances of CO_2 emissions and forcing new coal burning plants to capture a large portion of their pollution (EPA, 2012). Meeting these standards will be much easier for power plants using cleaner burning natural gas and coal's primacy as America's electricity provider is now in doubt. As the President of Duke Energy (one of the largest consumers of coal in the United States) Jim Roger concludes, "As we look out over the next two decades, we do not plan to build another coal plant" (National Public Radio, 2012). In addition, to these new standards, utilities are facing tighter restrictions on the disposal of coal ash at their facilities following the catastrophic damage following the failure of the TVA Kingston Fossil Plant's slurry lagoon in December 2008. Finally, as the reality of climate change is less easy to deny, regulations regarding the release of greenhouse gases will likely tighten further, a reality that utilities are undoubtedly factoring into their business models.

The above-mentioned factors have resulted in higher prices for West Virginia coal, which have in turn made it less competitive compared with coal mined from other regions and states. According to EIA, a short ton of underground mined coal from West Virginia in 2010 cost $11.65 more than the average short ton of underground mined U.S. coal.[4] West Virginian surface coal cost $42.11 more per ton than the U.S. average in 2010 (EIA, 2011). Although the coal mined in West Virginia is of higher quality than that found almost anywhere else in the nation, its premium price coupled with the increasingly competitive nature of natural gas is making it a less attractive option for energy providers. Indeed, those conglomerates heavily invested in the region are experiencing difficulties, evidenced by the bankruptcy filing of Patriot Coal, the third largest producer of MTR coal, in July 2012.

Finally, our model predicting unemployment suggests that differing extraction methods exert slightly different impacts in this realm. Indeed, the relationship between underground coal mining and unemployment is somewhat counterintuitive: Counties that produce a higher percentage of underground coal are expected to have higher levels of unemployment. As underground mines require more human labor than those on the surface, it would seem that employment should increase as more coal is produced. However, in many ways, underground mining has become as mechanized as that on the surface and increased production does not necessarily mean more human laborers are required. In addition, counties with high levels of underground mining typically have longer legacies of mining, which, as these findings suggest, creates dependency and stifles the development of other opportunities for employment.

The high costs of developing, maintaining, and expanding underground operations will likely push coal operators to extract more coal from the surface. This will continue a trend, evidenced by the steady decrease in underground production since 1997 and the halving of underground employment in the past three decades; in 1983, more than 26,000 miners were employed in the underground mining sector, while barely 13,000 found work in 2010 (Mine Safety and Health Administration, n.d.). Underground mines are the first to cut back on production and employment and to be shuttered by coal operators during bust cycles. For instance, in February 2012, Alpha Natural Resources announced plans to make cuts due to decreased demand. The company reduced worker hours at several surface mines, but two underground mines were completely shut down, resulting in the layoff of 320 workers (Ward, 2012). Such outcomes are likely to continue given the bleak future of the Appalachian coal industry, for as McIlmoil et al. (2010) project,

> coal production in Central Appalachia faces a decline from 234 million tons in 2008 to 99 million tons by 2035. . . .This represents a decline of 58% over the next twenty-five years, with the greatest share of the decline occurring in the next decade. (p. 9)

As such, a replication of this study in another decade may yield very different results. For now, our findings make clear that transitioning away from coal dependence, regardless of extraction method, will benefit both the land and the people of West Virginia.

Conclusion

As Freudenburg (1992) pointed out, the temporal scale employed is critically important in natural resource decision making. Our analysis contributes to these understandings by analyzing the relationship between coal extraction and community well-being in West Virginia during a period when rates of surface mining increased and underground mining decreased. We find little difference in socioeconomic outcomes between surface and underground mining, but rather, find that it is the presence or absence of mining that matters most. These findings call into question the argument that coal extraction is beneficial for citizens of the Mountain State as counties that do not extract coal have lower rates of poverty than extracting counties, while poverty increases in mining counties as relative extraction rates increase. Moreover, coal-mining counties do not have higher per capita income or employment than nonmining counties. In addition, we find that as the relative market price of West Virginia surface coal increases, so too does poverty, a phenomenon explained by the "cost/price squeeze." Given the negative socioeconomic ramifications of coal mining and the price squeeze on Appalachian coal, it seems that a radical restructuring of the West Virginian economy is in order *before* resource exhaustion. Indeed, it seems that the state would be better off capitalizing on other natural resources, namely its scenic beauty and economically viable wind power, while conserving its ancient ecosystems. Leaving remaining coal in the ground will likely prove the best alternative in the *long run* for West Virginians, as the opportunities to capitalize on renewable and, therefore, perpetual economic development are great.[5]

That said, it is still uncertain how generalizable these findings are to other regions and resources. Future research examining if and how extraction method matters in diverse contexts is needed, especially on the international scale. Our findings suggest that the method of extraction is less important than the capital intensity of production, supporting the main thesis of dependency theorists, as well as that of the treadmill of production school (see Schnaiberg, 1980). The rapid acceleration of mechanization in both underground and surface mines following World War II, the concomitant production increases, and the demise of organized labor heightened the region's dependency on coal. This dependency has resulted in dire socioeconomic outcomes in West Virginia that are similar to those found in other peripheries. Opportunities exist, however, for alternative economic pathways to be constructed as coal's viability diminishes, but increased scrutiny of the relationships between local elites and outside capital is also necessary. Finally, communities contemplating or currently taking part in the natural gas boom should consider the outcomes found in the coalfields of West Virginia, for as Pellow (2011) notes, "the domination over people is reinforced and made possible by the domination of ecosystems" (p. 247). In this light, the relationship between resource addiction and the pain of withdrawal becomes all too clear.

Acknowledgments

The authors would like to thank the *Organization & Environment* reviewers, Shannon Bell, John Henretta, Mel Mattison, Stephen Perz, Joshua Sbicca, and Richard York for their helpful comments and suggestions on earlier drafts of this article. We would also like to gratefully acknowledge Bill Freudenburg's encouragement of this project.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Notes

1. *Surface mining* is an umbrella term that refers to numerous specific methods of extraction, including contour mining, area mining, auger and highwall mining, and mountaintop removal (MTR) mining. The unifying characteristic of these various techniques is that instead of subterranean extraction of coal, the rock and soil ("overburden") covering deposits are removed from the surface to facilitate mining. Because of limitations in coal production data we were unable to disaggregate these types of mining in our analyses. However, MTR mining has come to dominate surface techniques in the region.
2. For Bender et al. (1985), "mining-dependent" counties are those where 20% or more of total labor and proprietor income come from the industry.
3. The Gallup-Healthways Well-Being Index (WBI) surveys 1,000 Americans 350 days a year to assess behavioral and economic measures: http://www.well-beingindex.com/stateCongresDistrictrank.asp
4. This based on average open market sales price of coal by state and mine type: http://205.254.135.7/coal/annual/pdf/table28.pdf
5. See, for instance, http://www.wvcommerce.org/energy/renewable_energy/wind.aspx

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