Mountaintop Removal Mining in Appalachia

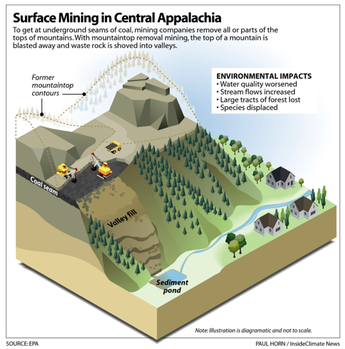
& its Economic and Wellbeing Impacts on Surrounding Populations

Abstract

This research seeks to build on the existing literature to determine the impact of mountaintop removal mining (MTM) on the economic and well-being outcomes of surrounding communities. We utilize satellite imagery data from SkyTruth.org of active MTM sites in Central Appalachia in tandem with data from the American Community Survey from 2012-2021 in order to build a two-way fixed effects linear model with inverse probability weighted group balancing. We observe fixed effects by year as well as at three regional levels: state, public use microdata area (PUMA), and mining versus non-mining areas of a state. Our model seeks to uncover the causal impact of MTM intensity in a given region on that population's employment, poverty, total income, and instance of disability. We determine significant yet somewhat ambiguous results, indicating a relatively positive impact of increased MTM activity on a PUMA, when compared to itself over the years, but a negative impact of MTM when compared to other MTM PUMAs and non-MTM PUMAs.

Mountaintop Mining

Coal mining can be conducted through two primary methods: deep mining and surface mining. Surface mining involves the removal of parts of or entire mountaintops to expose buried seams of coal, and the disposal of the excess overburden and interburden (rock between coal seams) in adjacent valleys. Today, two-thirds of American coal is produced from surface mines. (Administration 2023) The specific type of surface mining conducted in the Appalachian mountains is called mountain top removal mining or MTM. MTM is a highly destructive mining method and leaves landscapes permanently marred.



Natural Resource Curse

The term natural resource curse refers to the idea that states or regions wealthy with natural resources may experience lower long-run economic growth rates compared to non-resource-rich regions. Research from Douglas and Walker suggests that "the presence of coal in the Appalachian region has played a significant part in its slow pace of economic development." (2016) This work specifically labels Appalachia's shortcomings as a growth curse associated with coal and attributes this to a negative long-run association between coal mining and regional prosperity.

Data

Mining Sites: We source geographic data sourced from a nonprofit called SkyTruth.org, which details active mountaintop mining sites in Central Appalachia from 2012 to 2021.

Demographic Characteristics: We source demographic data from the American Community Survey (ACS) data, covering the years included in the geographic dataset: 2012-2021. The ACS is "an ongoing survey that provides vital information on a yearly basis about our nation [the United States] and its people."

Geographic Identifiers: The lowest geographic identifier utilized in this research is the Public Use Microdata Area (PUMA). These regions are non-overlapping, statistical geographic areas that are nested within state borders.

Independent Variable:
Share of PUMA experiencing MTM in a given year.

Outcome Variable:
Vector of Economic and Well-being outcomes (Income, Unemployment, Poverty, Disability).

Empirical Methodology

Baseline Two-Way Fixed Effects

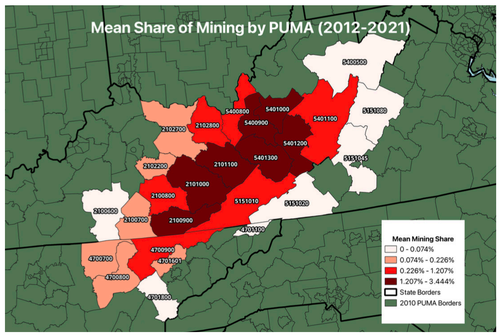
$$Y_{ijt} = \beta_0 + \beta_1 MiningShare_{jt} \times Treatment_{jt} + \beta_2 X_{1,ijt} + \eta_j + \sigma_t + \varepsilon_{ijt}$$

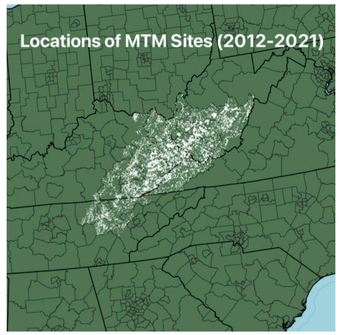
Control Group
Neighbors of Neighbors of MTM PUMAs

Fixed Effects
Regional: State, Area, PUMA
Time: Year

Balancing Weights
Inverse Probability Weighting

References:
1) Administration, U.S. Energy Information. Coal Explained. https://www.eia.gov/energyexplained/coal/ mining-and-transportation.php
2) Black, Dan A., Terra McKinnish, and Seth Sanders. "The economic impact of the coal boom and bust." Economic journal (London. Print) 115, no. 503 (April 2005): 449–476. https://doi.org/10.1111/j.1468- 0297.2005.00996.x. 10.1111/j.1468-0297.2005.00996.x.
3) Douglas, Stratford, and Anne Walker. "COAL MINING AND THE RESOURCE CURSE IN THE EASTERN UNITED STATES." Journal of Regional Science 57, no. 4 (November 2016): 568–590. https://doi.org/ 10.1111/jors.12310. 10.1111/jors.12310.
4) Rosen, S. (1986). Chapter 12 The theory of equalizing differences. In Handbook of labour economics (pp. 641–692). https://doi.org/10.1016/s1573-4463(86)01015-5





Results

Table 7: IPW-Balanced State & Year Fixed Effects for Neighbors of Neighbors

Outcomes	Employed	Ln(Total Income)	Poor	Disability
% Share of PUMA Mined	-0.0502***	-0.209***	0.0219***	0.0342***
Standard Error	(0.00114)	(0.00897)	(0.000990)	(0.000962)
Observations	766,864	766,086	766,864	766,864
R-squared	0.158	0.193	0.163	0.096

Note: *** p < 0.01, ** p < 0.05, * p < 0.1

Table 9: IPW-Balanced PUMA & Year Fixed Effects for Neighbors of Neighbors

Outcomes	Employed	Ln(Total Income)	Poor	Disability
% Share of PUMA mined	0.0328***	0.362***	-0.0279***	-0.00448
Standard Error	(0.00917)	(0.0748)	(0.00813)	(0.00791)
Observations	766,864	766,086	766,864	766,864
R-squared	0.167	0.199	0.178	0.100

Note: *** p < 0.01, ** p < 0.05, * p < 0.1

The ambiguity of our results poses a unique challenge to the analysis and discussion of our findings. However, our estimates do have consistencies with various literature as well as with aspects of our theoretical framework.

Compared to other years, a PUMA fares economically better as mining intensity increases. The PUMA fixed effect estimates use the time variation in mining share within PUMAs. In contrast, the state fixed effects estimates use all the variation in mining share within states. It is possible that a PUMA experiences better outcomes as mining increases, but worse outcomes when compared alongside non-mining PUMAs or other mining PUMAs.

The PUMA-level fixed effects are consistent with the theoretical literature, but are not entirely consistent with the existing research conducted in this field. Existing research generally indicates a negative impact on employment and wages as coal employment increases, which is reflected in our state-level fixed effect results.

The atmosphere of ambiguity in this realm of research ultimately highlights the need for more extensive research in this field.

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