On the Reduction of the Variance of Appalachian Topography

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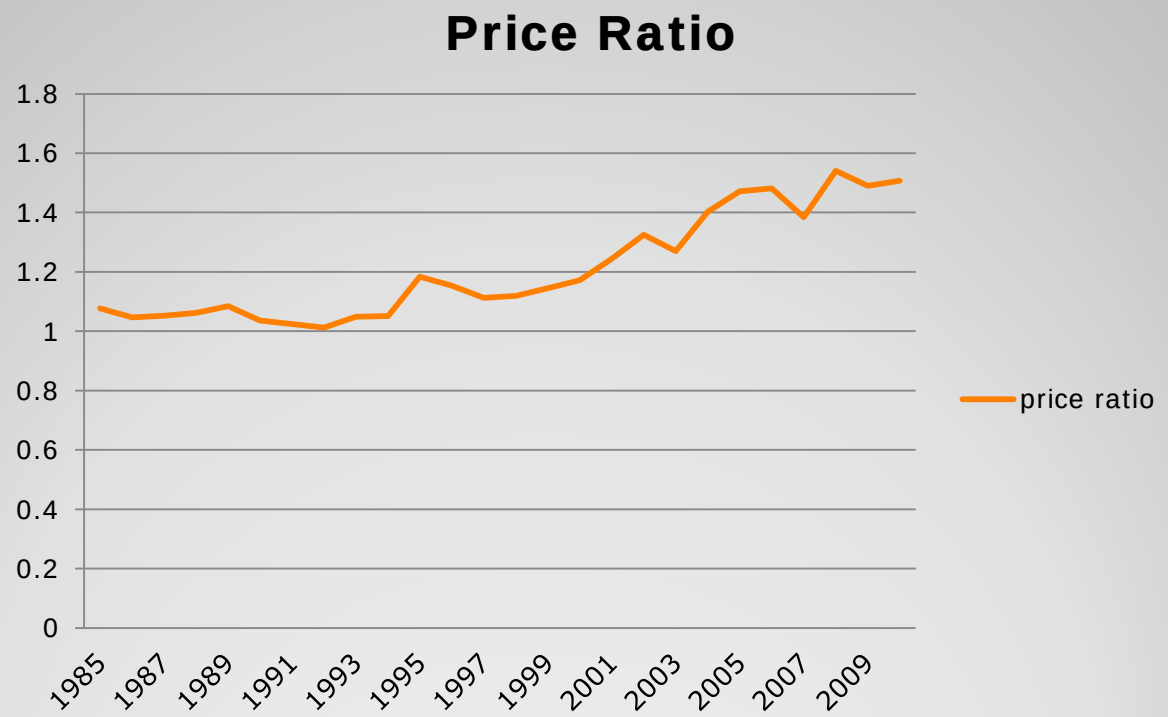
Motivation

The Clean Air Act Amendments of 1990, which created the SO2 permit trading system, caused a shift in relative demand from high sulfur coal to low sulfur coal.

While a large share of this coal came from Wyoming's Powder River Basin, this supply was supplemented by several low sulfur coal seems located in central Appalachia.

This shift in demand for the low sulfur coal relative to the high sulfur coal, which occurs in southern West Virginia and eastern Kentucky, can be seen by looking at the price ratio of the coal mined from the “low sulfur regions” of the two states to the “high sulfur regions.”



Mountain Top Removal

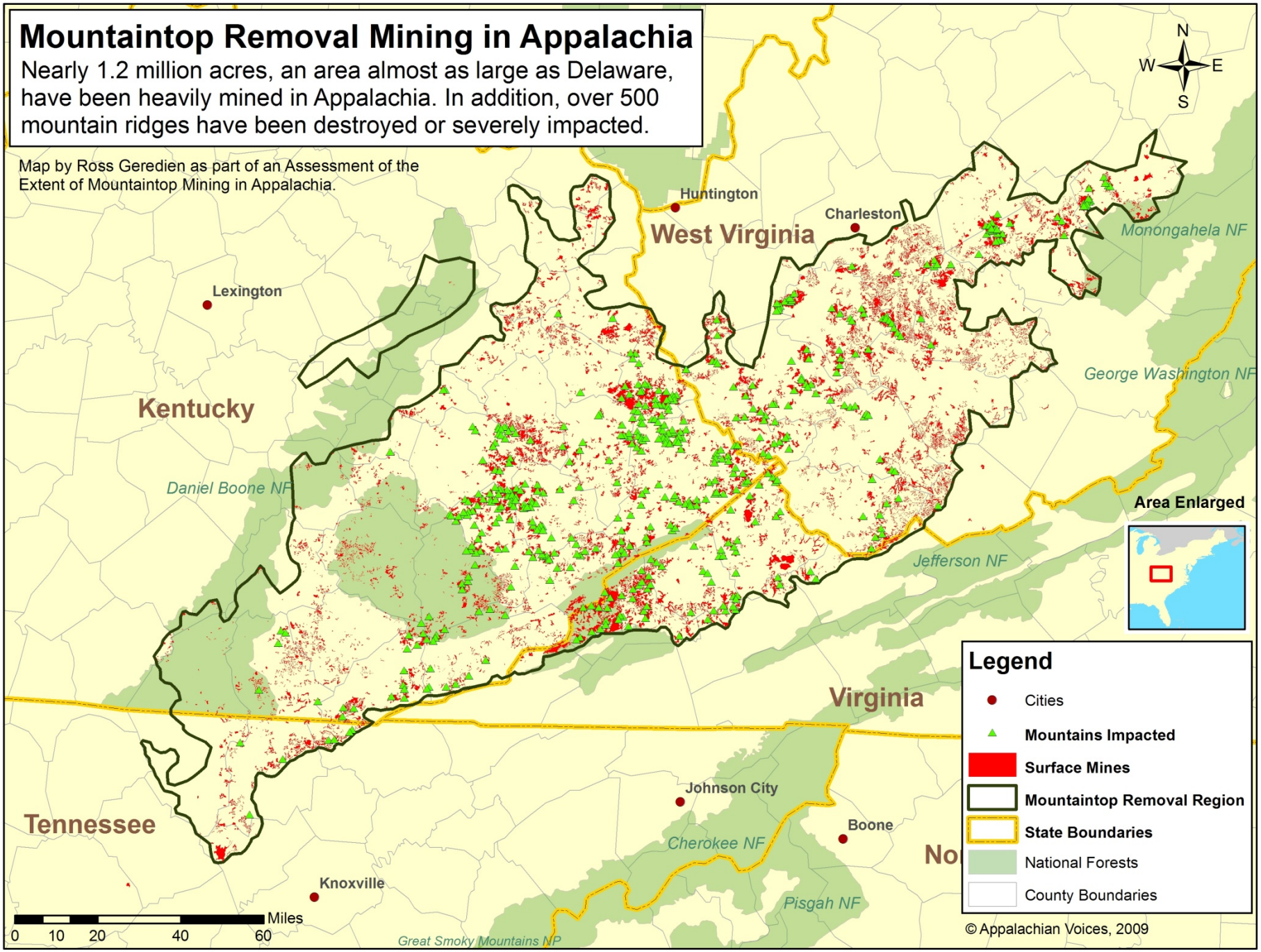
Within a subset of the counties in the “low sulfur region,” the mining practice of Mountain Top Removal is widely used.

The practice is highly controversial and contested by residents of the communities, who cite associated environmental degradation and negative health effects.

Mountaintop Removal Mining in Appalachia

Nearly 1.2 million acres, an area almost as large as Delaware, have been heavily mined in Appalachia. In addition, over 500 mountain ridges have been destroyed or severely impacted.

Map by Ross Geredien as part of an Assessment of the Extent of Mountaintop Mining in Appalachia.



My Study

During the mini-boom for low sulfur coal created by the CAAA, implementation of MTR became more widespread to get at the now more valuable low sulfur coal.

I use this natural experiment to measure the local employment effects of an exogenous increase in MTR mining activity, using a triple difference estimation approach.

Data

- Mining data comes from the EIA and Mine Safety and Health Administration annual reports
- Coal prices come from the EIA's Annual Coal Reports, and are reported in 2005 dollars
- Annual Payroll, Employment, and Number of Establishments come from County Business Patterns survey database

Comparison of Regions in 1990

Comparison of Regions in 1990			
	Non-MTR Region	MTR Region	Non-Mining Region
N	34	23	68
Population	25,045	31,065	21,067
	(19,687)	(18,503)	(18,102)
Employment	6,043	6,161	5,536
	(8,121)	(5,335)	(6,450)
Number of Establishments	478	567	415
	(563)	(448)	(399)
Total Payroll	149,864	181,035	136,527
	(229,183)	(156,763)	(171,895)
Coal Production	311,405	10,600,000	0
	(528,842)	(8,219,258)	0
Annual Federal Expenditures	86,218	161,356	73,098
	(74,047)	(189,758)	(106,990)
Per Capita Income	11,493	11,364	14,024
	(2,443)	(1,547)	(2,359)
Households in Poverty Status	7,659	8,776	6,150
	(5,661)	(5,331)	(4,851)

Standard Errors reported in parentheses below the sample average

Empirical Strategy

I use a triple difference estimator to examine the effects of the mini-boom for low sulfur coal on MTR communities in WV and Kentucky.

My dependent variables are annual payroll, employment, and number of establishments, all in log form and at the county level.

Empirical Strategy

My regression takes the form:

$$Y = \beta + \beta_1 low + \beta_2 MTR + \beta_3 post + \beta_4 (post * low) + \beta_5 (post * low * MTR) + \gamma\theta_i + \delta X_i + \sigma N_{it}$$

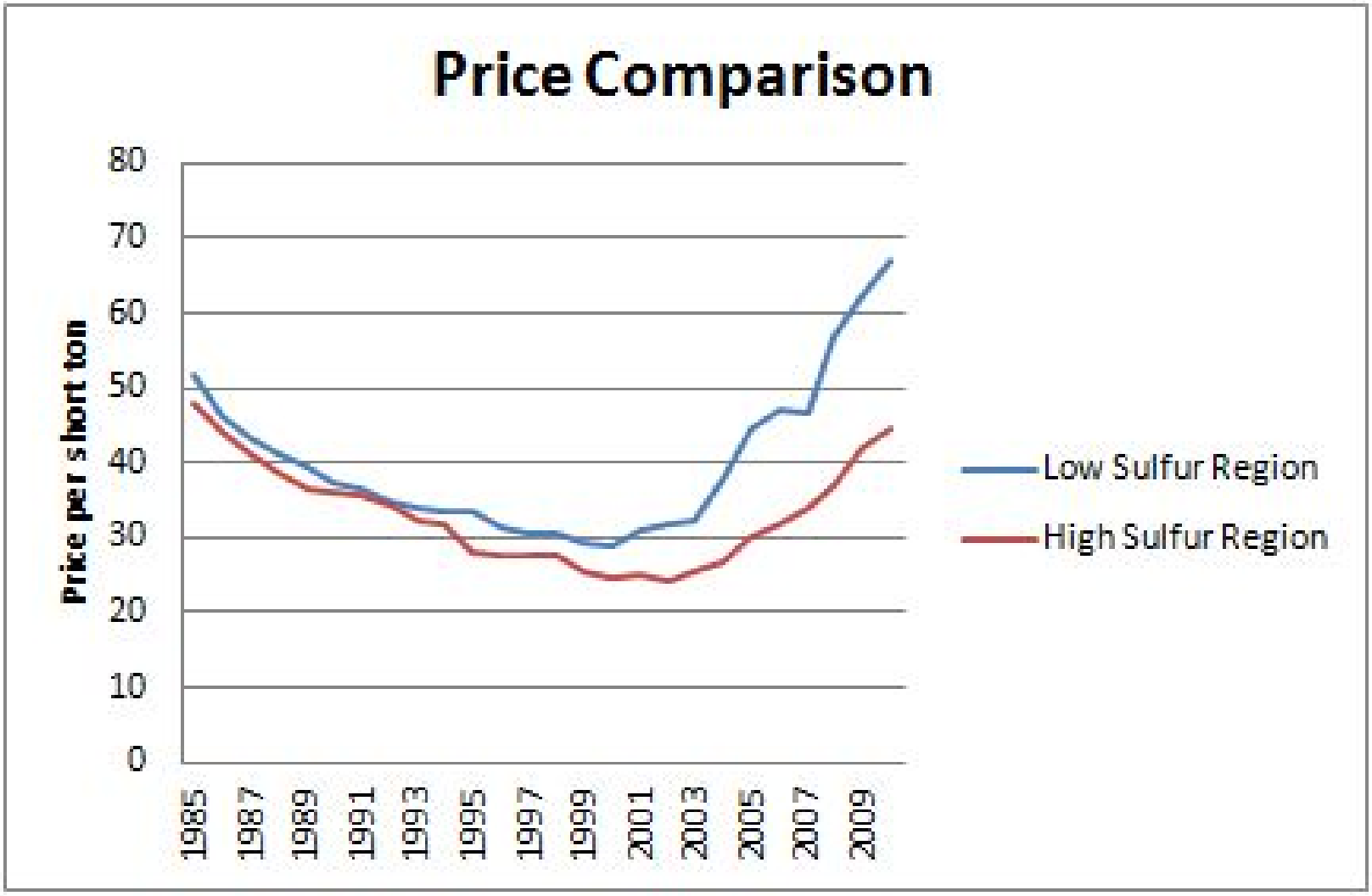
Results for Regressions on MTR Effects			
	Log(Payroll)	Log(Employment)	Log(Establishments)
Post Price Increase	-0.074*	-0.085*	-0.033***
	(0.034)	(0.029)	(0.019)
Low Sulfur County	0.203*	0.108*	0.088*
	(0.039)	(0.033)	(0.022)
MTR County	0.120*	-0.078***	0.042
	(0.055)	(0.047)	(0.031)
Post*Low	0.050	0.014	-0.011
	(0.056)	(0.048)	(0.032)
Post*Low*MTR	0.089	0.081	-0.004
	(0.072)	(0.063)	(0.041)
Kentucky	0.065**	0.129*	0.015
	(0.032)	(0.028)	(0.019)
Annual Coal Production	2.61 E-9*	1.51 E-8*	7.57 E-9*
	(0.000)	(0.000)	(0.000)
Price Ratio	-0.397*	-0.376*	-0.160*
	(0.105)	(0.092)	(0.061)
1990 Federal Expenditures	3.86 E-8*	5.24 E-7*	4.35 E-7*
	(0.00)	(0.000)	(0.000)
1990 Per Capita Income	1.54 E-4*	1.02 E-5*	7.29 E-5*
	(0.00)	(0.000)	(0.000)
1990 Families in Poverty	1.33 E-4*	1.30 E-4*	1.19 E-5*
	(0.00)	(0.000)	(0.000)
N	2552	2552	2552
Adjusted R-squared	0.9251	0.9284	0.9556

*, **, *** indicate significance at the 99%, 95%, and 90% levels respectively
Standard Errors reported below estimates in parenthesis

Discussion

This analysis is based on treatment occurring in the year 2000.

- National cap went into effect
- Appalachian coal prices began to rise sharply


Price Comparison
Price per short ton
80
70
60
50
40
30
20
10
0
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
Low Sulfur Region
High Sulfur Region

Alternate Treatment Date

It is also reasonable to use 1994 as the date for treatment to go into effect

- Implementation of regional cap east of the Mississippi River
- Relative price of low sulfur coal increases compared to high sulfur coal

Results greatly differ under this analysis

Comparing Variable of Interest

Comparison of Treatment Effects

	1994	2000
Log(Payroll)	-0.217*	0.089
	(0.068)	(0.072)
Log(Employment)	-0.128*	0.081
	(0.061)	(0.063)
log(Establishments)	-0.136*	-0.004
	(0.042)	(0.041)

*, **, *** represents significance at the 99%, 95%, 90% levels

Standard errors reported below in parenthesis

Comparing Variable of Interest

- It is clear that the results greatly change when date of treatment changes
- I currently do not have a story about why the results differ so greatly in magnitude and in sign.

Going Forward

Other specifications to be explored include:

- per-capita dependent variables
- regressing treatment group directly on price ratio

Thank you