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Do Exploitations of Marcellus and Utica Shale Formations Improve Regional Economy in Ohio, Pennsylvania, and West Virginia? A Synthetic Control Analysis

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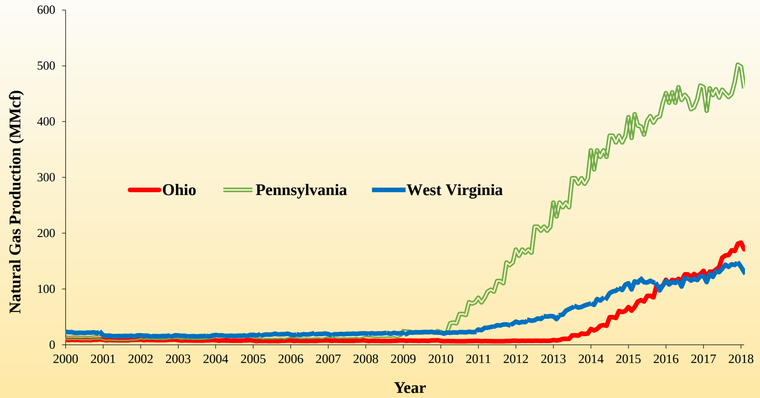
Introduction

- The first natural gas well of the Marcellus play, which underlies parts of NY, PA, OH, WV, MD, and VA, was drilled in 2003
- Drilling in Utica shale play, which lies under the Marcellus play in a much deeper stratum but contains a massive natural gas reserve, began in 2010

Monthly Natural Gas Production of OH, PA, and WV, 2000-2018



Source: U.S. EIA 2018

	OH	PA	WV
Jan. 2000 to Dec. 2009 Monthly Avg (MMcf)	7.70	14.96	18.49
Jan. 2011 to Nov. 2018 Monthly Avg (MMcf)	76.17	340.14	91.18
Percentage Increase	889%	2174%	393%

Source: U.S. EIA, 2018a

Data

	Oil and Gas Nonmetro Counties (mean) N = 16					
	OH4	OH15	PA4	PA15	WV4	WV15
Outcome Variables						
Population	393.8	828.8	231.6	746.2	122.1	327.8
Poverty rate (%)	14.08	16.11	14.92	14.58	21.62	16.14
Total employment	203.9	396.6	112.8	368.5	594.1	142.8
Personal inc. per capita ($)	32122	28421	31829	32536	30994	19768
Predictor Variables						
Median household income ($)	42,678	39,395	41,151	40,134	34,779	24,619
Total wage (million $)	5.4	10.1	3.2	9.7	1.9	4.1
Rural-urban code	4	5.32	5.24	5.35	6.01	5.16
Urban-Influence code	3.47	5.15	4.44	5.28	8.57	5.85
Population growth (%)	0.03	0.02	-0.3	-0.33	-0.55	-0.37
Median age	39.46	39.26	40.8	41.48	42.07	31.36
% w. high school graduate	44.91	45.08	46.94	48.41	39.41	30.31
% w. associate degree	21.81	20.6	18.75	18.86	18.34	13.15
% w. bachelor degree	13.46	11.86	14.91	13.78	12.19	7.81

Sources: USDA ERS, CENSUS, EIA

Objectives

- Comprehensively assess the economic benefits of shale development to the three shale-states: Ohio, West Virginia, and Pennsylvania
- Four indicators: total employment, poverty rate, income per capita, and population are evaluated in this study

Methodology

- We need a weight matrix **W** to conduct the synthetic $(Y_{1,t}^{N})$ of the treated state
- Two requirements for the weight matrix **W**
  - each unaffected state $(s = 2, \dots, S+1)$ is assigned a weight (w_s) between 0 and 1
  - the sum of the weights of unaffected states equals 1
- Use all states' set of observed predictors and outcomes from the pre-boom period to match and find an optimal weighting vector $W^* = (w_2^*, \dots, w_{S+1}^*)'$
- $W^*$is a weighting matrix measuring the relative importance of each unaffected state in the synthetic of the boom state
- The estimated impact of boom on the shale state:
  - calculated as the difference between the actual economic outcome of the boom state and the economic outcome of the synthetic boom state

$$\hat{\alpha}_{1,t} = Y_{1,t} - Y_{1,t}^{N}$$

- Examples of W-Weight

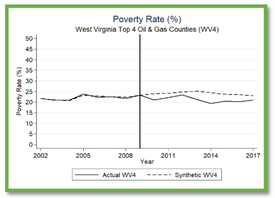
Synthetic of PA Top 15: Population

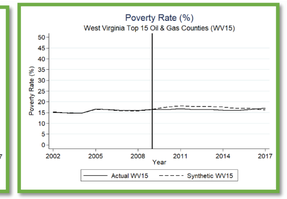
Control States	W-Weight (W^*)
Connecticut	0.2
Indiana	0.032
Maine	0.471
Mississippi	0.119
New Hampshire	0.066
South Carolina	0.112

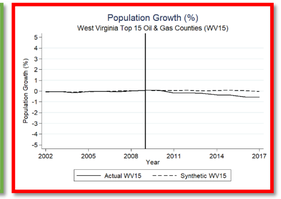
Synthetic of WV Top 15: Poverty Rate

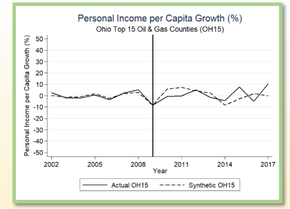
Control States	W-Weight (W^*)
Arizona	0.128
New Hampshire	0.169
Utah	0.408
Virginia	0.295

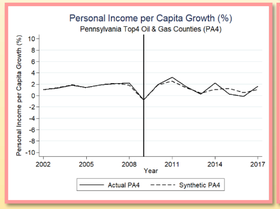
Results

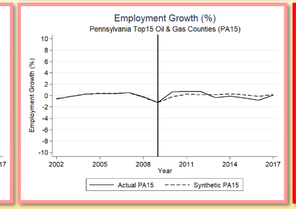


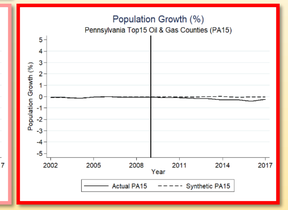












Conclusion

- Positive impacts tend to be short term or temporary
  - Not many additional jobs in other industries (e.g. retail, transportation, etc.) were created
  - The shale industry may crowd out other industries (e.g. coal mining)
- Negative long-term impacts on population in WV and PA
  - Negative externalities cause the population to move away
  - The regions may be seriously harmed in the long-term
- Policymakers should invest the tax profit generated from shale development to local infrastructures and economy
- Policymakers should navigate and find solutions for the negative externalities and population shifts
- The policymakers should also estimate the cost of externalities and conduct a more comprehensive review while reevaluating the related regulations and programs