Monte Carlo Simulation of the Affordable Care Act's Impact on Lung Cancer Mortality

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Introduction

➤ Affordable Care Act (ACA), Medicaid expansions began in 2014
  ○ >35 million people newly gained health insurance coverage & pre-existing conditions
➤ Intervening Supreme Court decision (2012), state can choose whether to implement Medicaid expansion
➤ Lung cancer is deadliest form of cancer, WV had highest mortality rate in 2022
➤ Research Goals:
  ○ Did ACA reduce lung cancer mortality?
  ○ Compare modeling techniques:
    ■ Difference-in-Differences, Linear Regression
➤ Factors: Obesity, Smoking, Air Quality ($PM_{2.5}$)
➤ Monte Carlo propagates covariate uncertainty

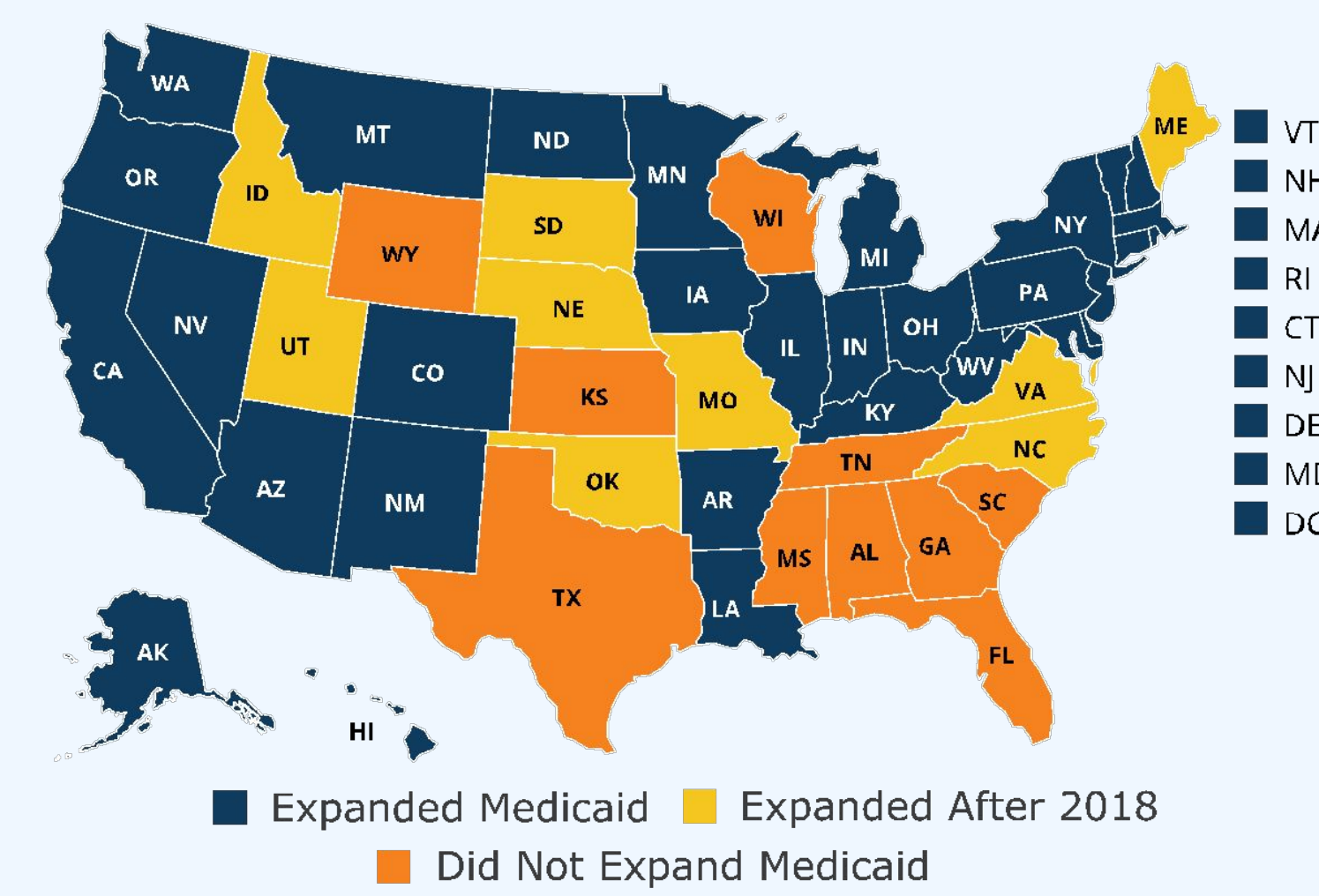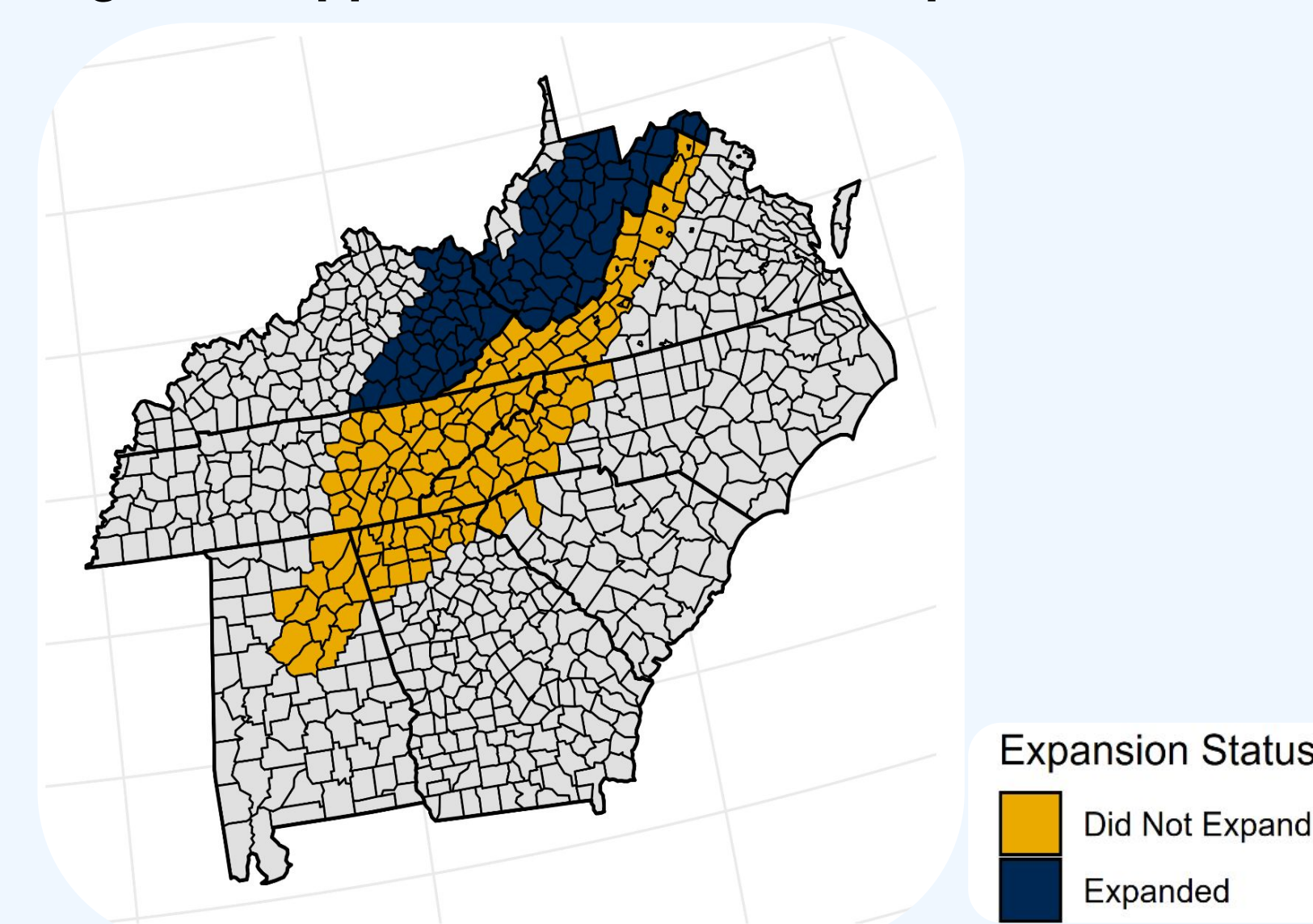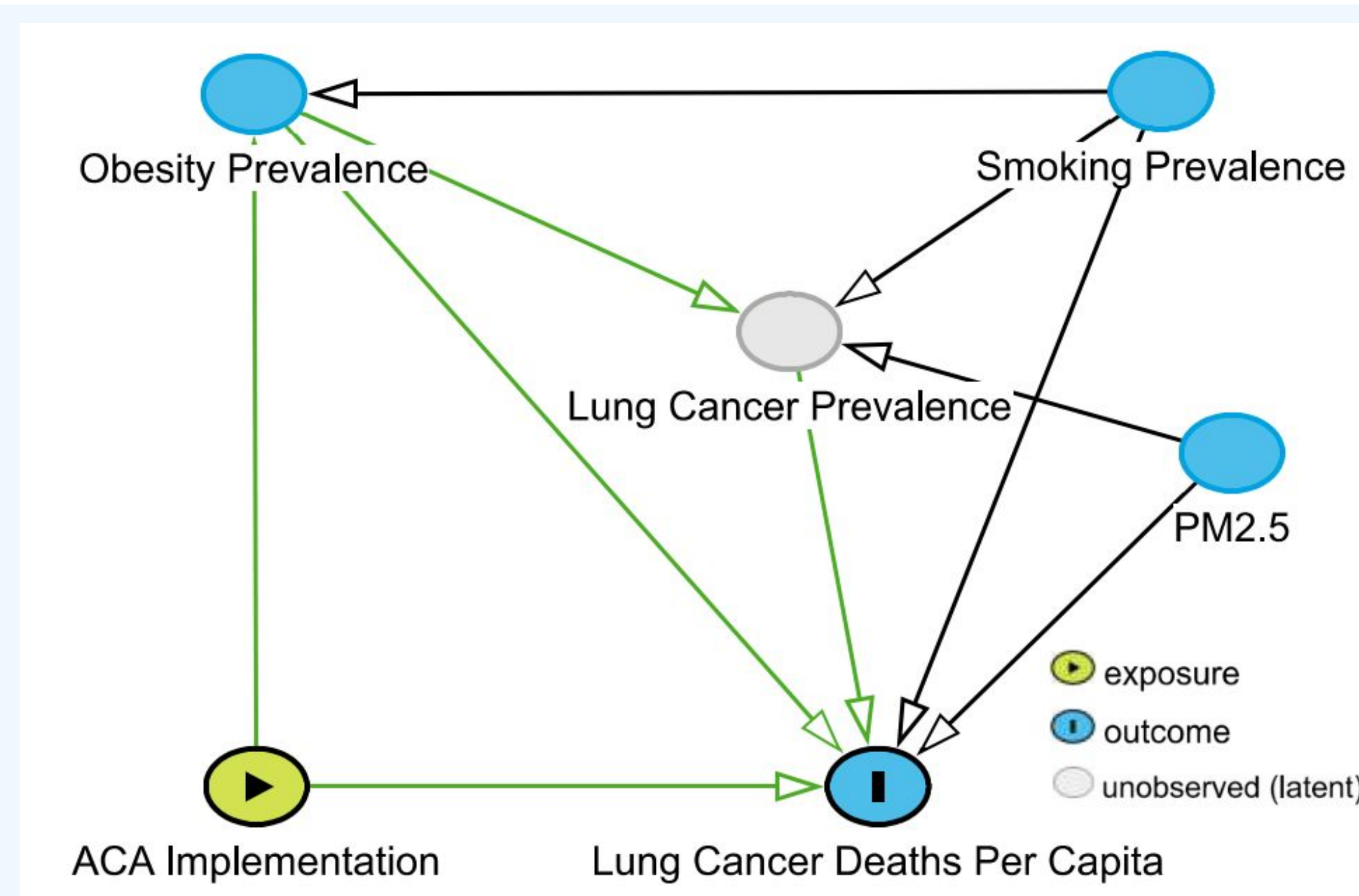**Figure 1: Medicaid Expansion Status of All US States**

■ Expanded Medicaid ■ Expanded After 2018
■ Did Not Expand Medicaid

Figure 2: Appalachian Medicaid Expansion Status

Expansion Status
■ Did Not Expand
■ Expanded

Consensus Appalachia, John Alexander Williams

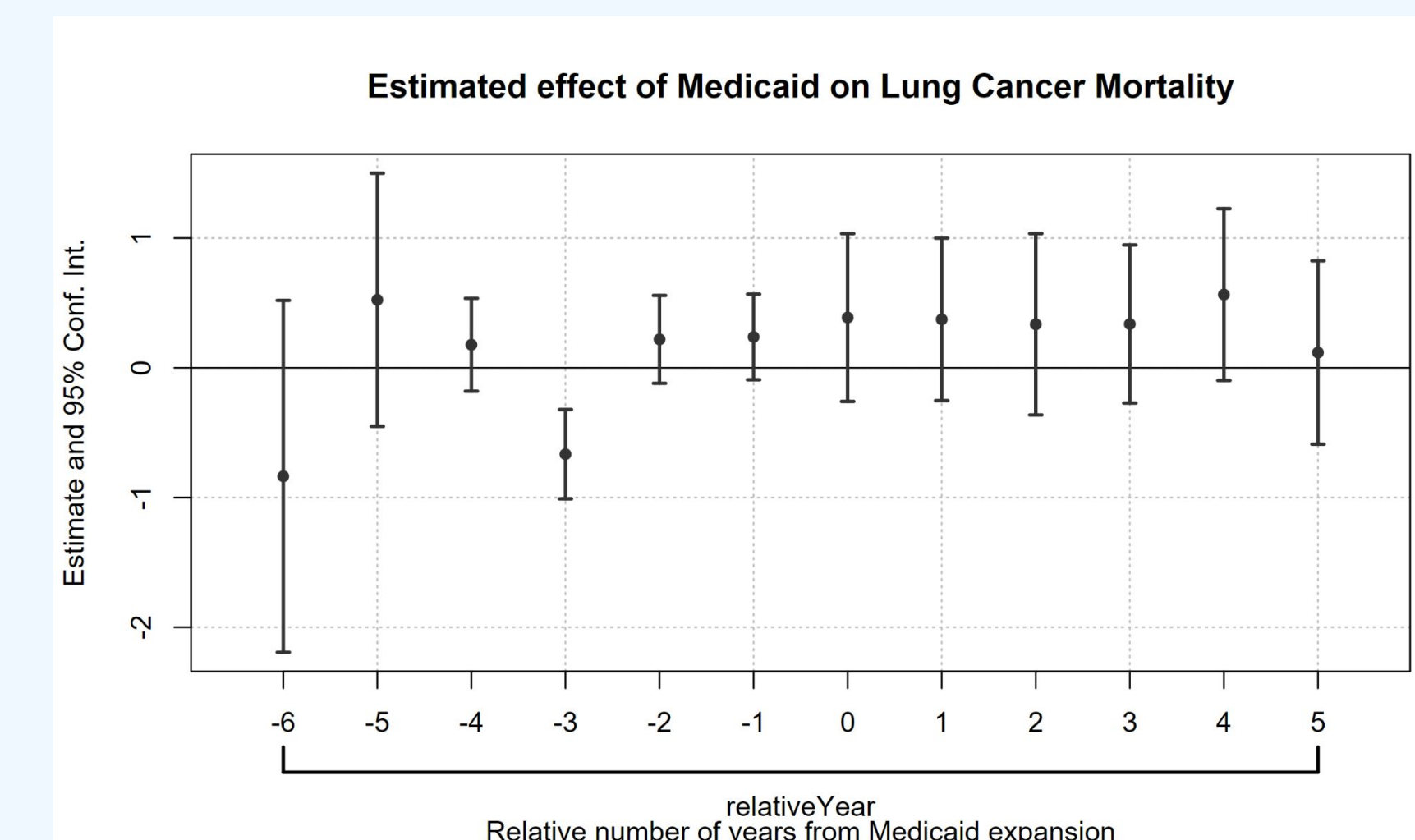## Methodology

● exposure
● outcome
○ unobserved (latent)

➤ Directed Acyclic Graph (DAG) shows causal relationships

➤ Estimated effect of the affordable care act on lung cancer deaths using DiD and Multiple Linear Regression

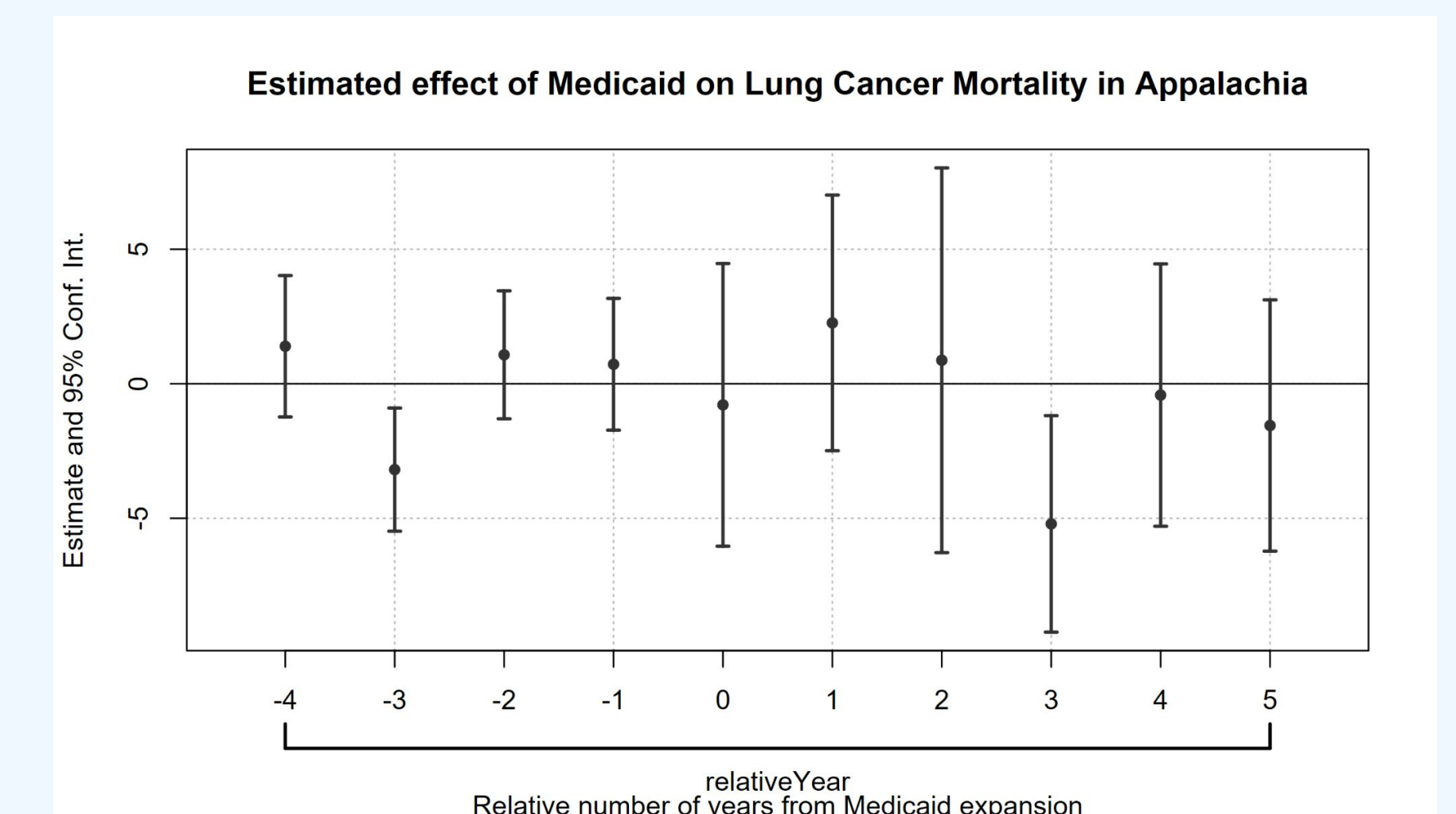➤ Error was propagated through MLR using Monte Carlo

Results
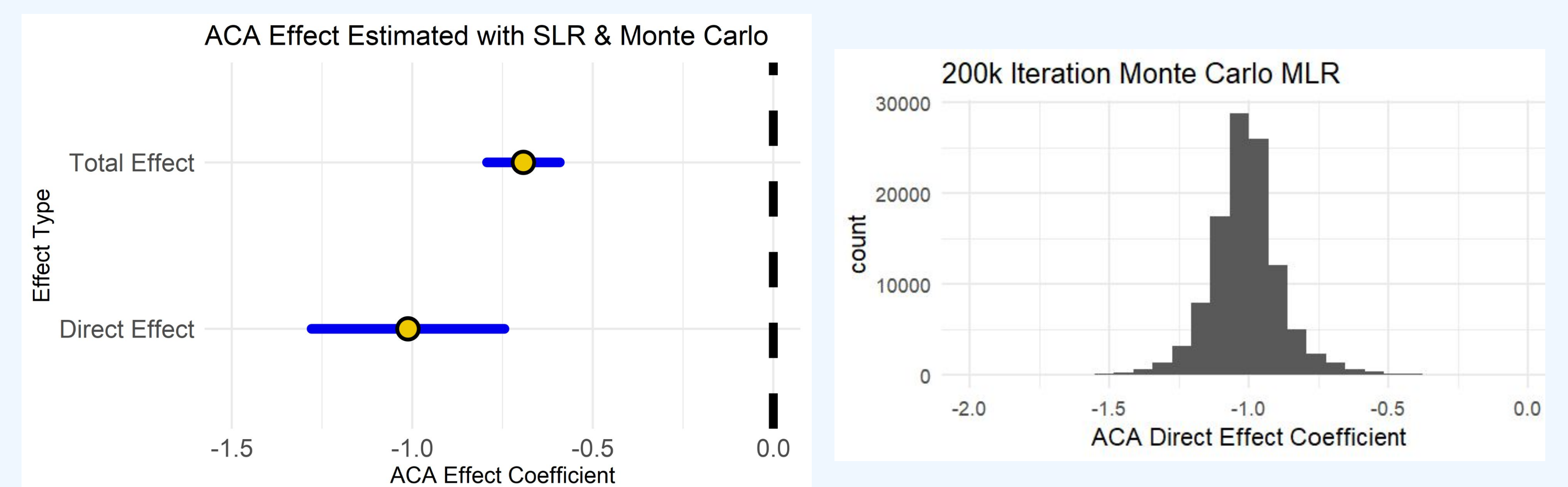
Difference-in-Differences (County-level)

Nationwide

Appalachia

Multiple Linear Regression (National)

Discussion & Conclusions

➤ There is evidence that the Affordable Care Act medicaid expansions **reduced lung cancer mortality** at the national level in the USA
➤ We estimate that this **prevented 6,837 to 9,167 deaths** from 2014 to 2019 (α = 0.05), based off the total effect estimate from our Monte Carlo SLR model
➤ Disagreement between methods:
  ○ DiD showed <u>no significant effect</u> of Medicaid expansions on lung cancer mortality
    ■ Parallel trends assumption -> potentially spurious
  ○ MLR showed the Affordable Care Act to have <u>significant total and direct reduction effects</u> on lung cancer mortality nationally
  ○ Deferred to the results of the Monte Carlo SLR & MLR models
➤ Future work:
  ○ More current DiD methods may work w/ different assumptions
  ○ Comparing model performance of PAR(p), GLM, ARIMA with current methods

Citations

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