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**Size-Based Regulations, Productivity, and Environmental Quality:
Evidence from the U.S. Livestock Industry**

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Size-Based Regulations, Productivity, and Environmental Quality: Evidence from the U.S. Livestock Industry

Introduction

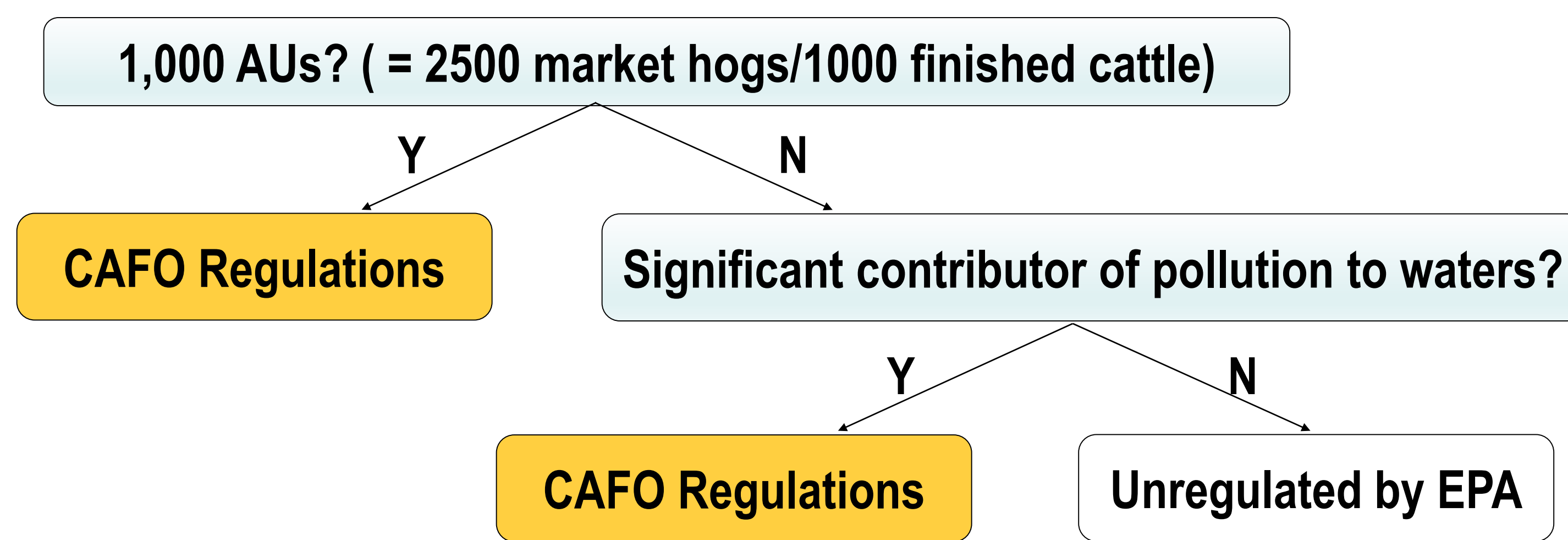
- Policymakers in some regions are increasingly concerned about environmental externalities from livestock agriculture given increased prevalence, size, and intensity of production in a few key states
- The U.S. agricultural sector is largely exempt from Clean Water Act (CWA) regulations, despite substantial contributions to poor water quality
- Major exception are animal feeding operations (AFOs)
 - Face size-based environmental regulations.
 - However, size-based regulations incentivize strategically sorting

Research Questions

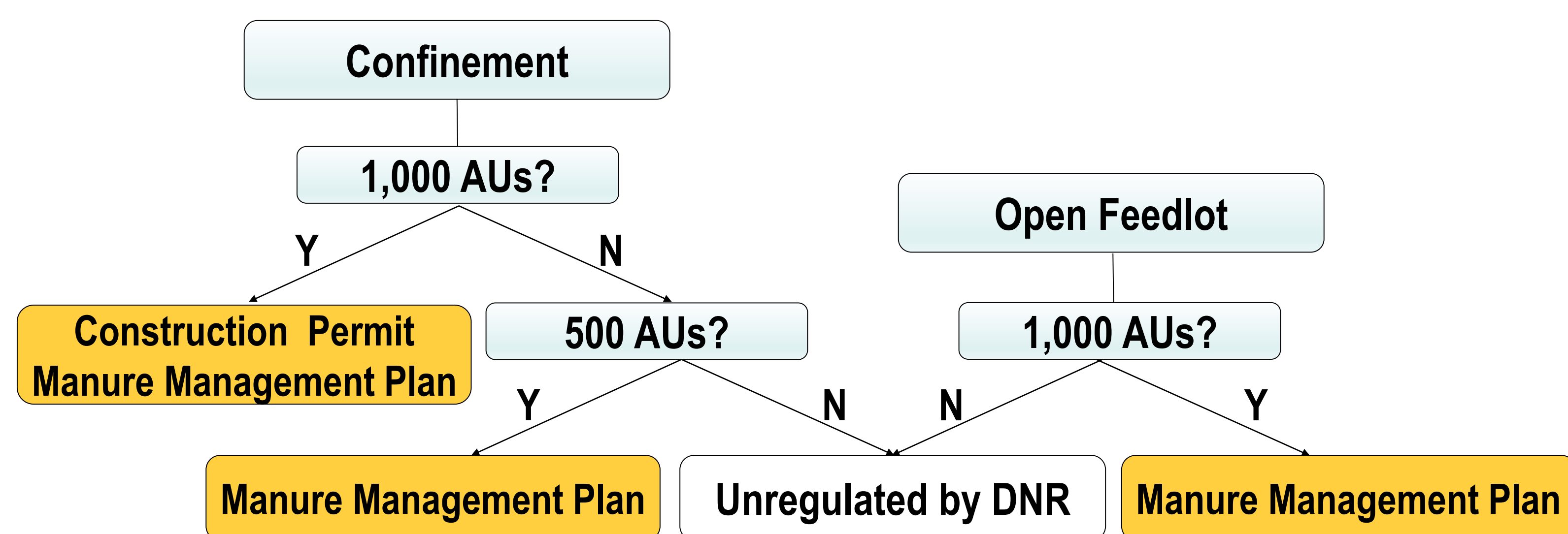
- How do federal and state AFO regulations impact operations' costs and productive efficiency?
- Are there environmental benefits to these regulations?
 - Improved local surface/ground water quality?
 - Improved local air quality?

Policy Background

Federal Regulation: EPA 2003/2008 CWA Update



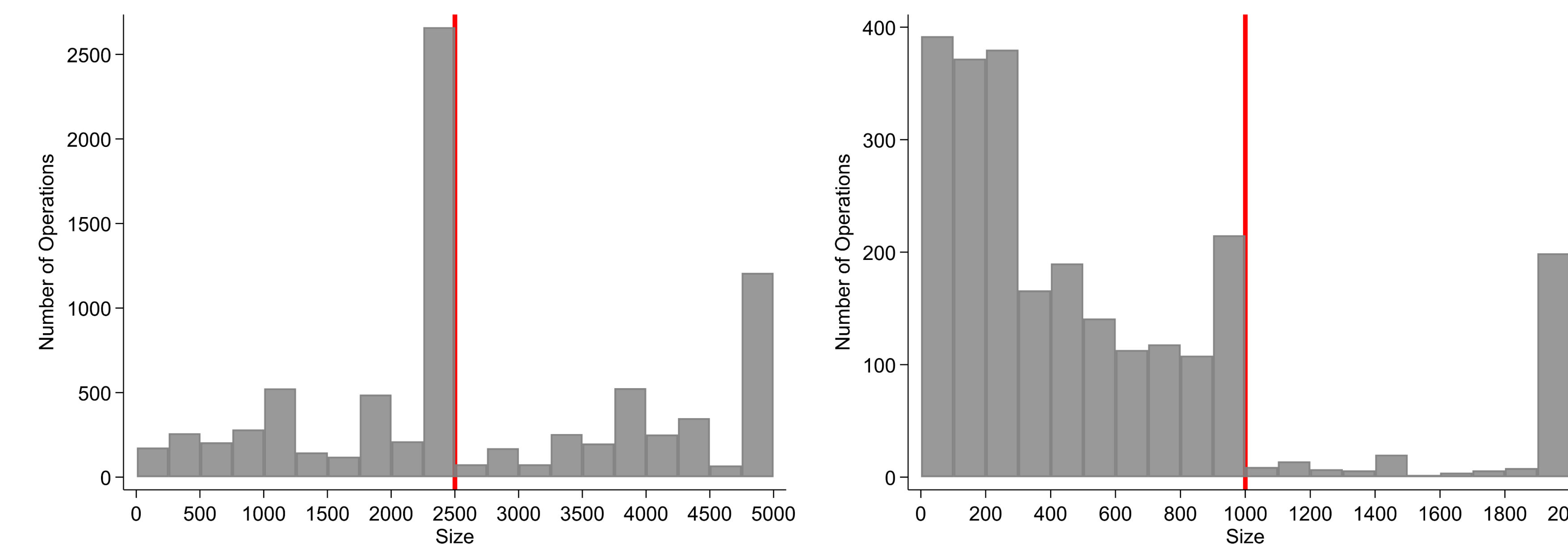
State Regulation: Iowa DNR (Delegated by EPA)



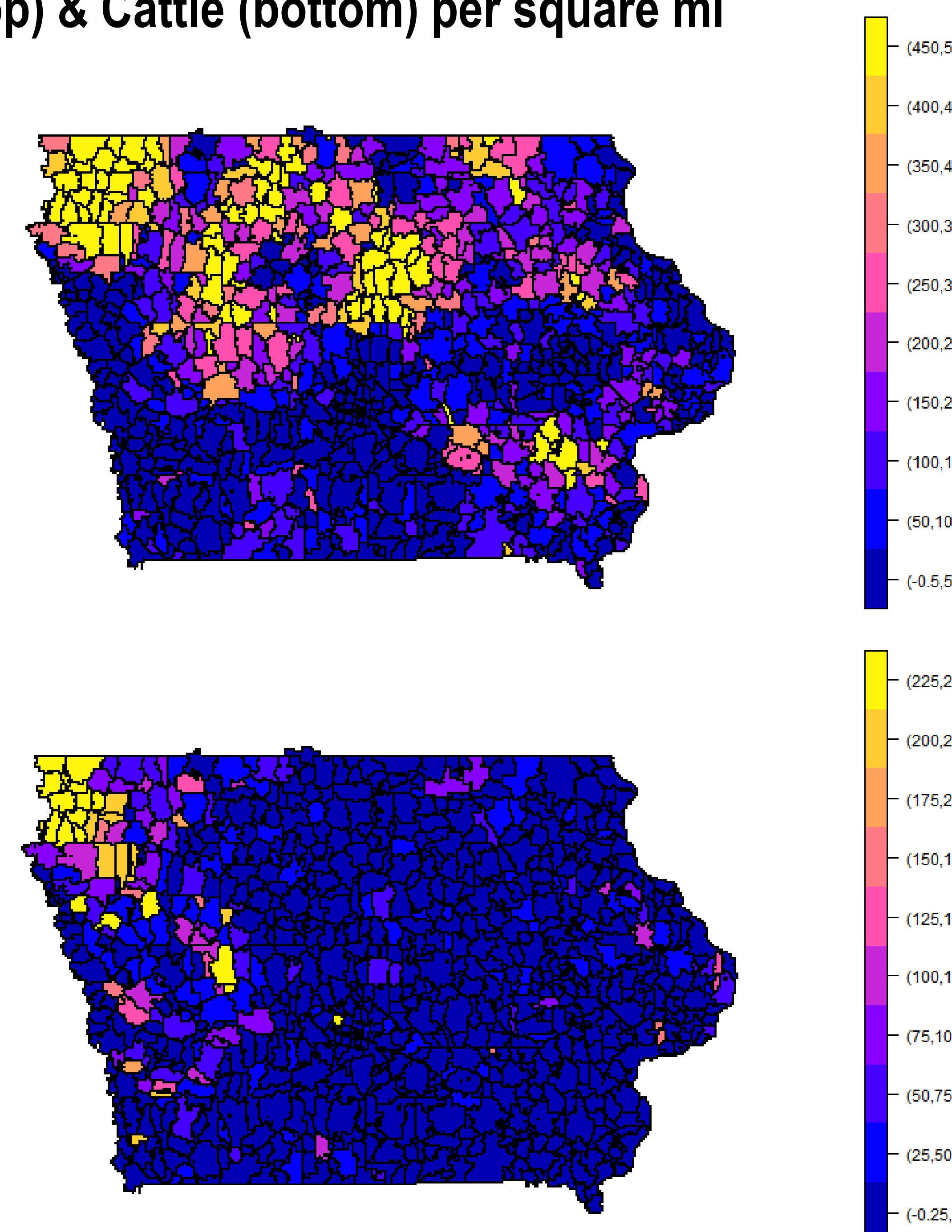
Data

- AFOs (Iowa DNR): 8,215 hog and 2,363 beef cattle operations in Iowa as of 2018
- Water Quality (EPA STORET/Iowa AQUA): Surface water quality monitor data
 - Phosphates, Ammonia/Nitrogen
- Precipitation and temperature data (PRISM)

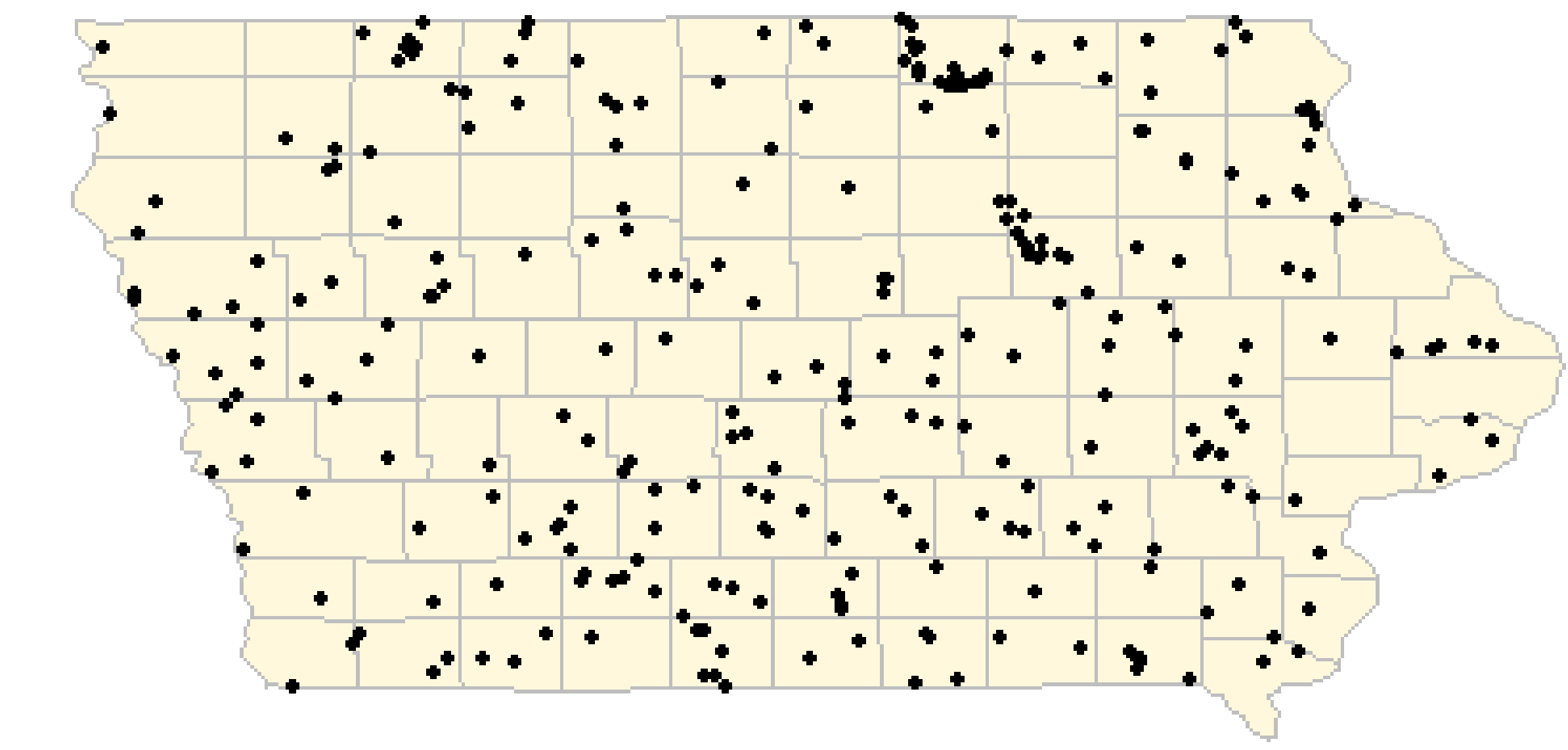
Iowa AFOs size distribution: Hogs (left) & Cattle (right)



Hogs (top) & Cattle (bottom) per square mi



Water Quality Monitor Stations



Empirical Strategy (Difference-in-Difference)

$$y_{ijt} = \alpha_i + \beta_1 \mathbf{1}[MMP_{it}] + \beta_2 \mathbf{1}[CAFO_{it}] + X'_{jt} \delta + \xi_{j(t)} + e_{ijt}$$

where, for AFO i in year t in zip code j :

y_{it} = log water quality (phosphates or ammonia/nitrogen concentrations)

$\mathbf{1}[MMP_{it}]$ = manure management plan indicator

$\mathbf{1}[CAFO_{it}]$ = CAFO indicator

X_{jt} = weather controls

$\xi_{j(t)}$ = spatial (e.g., zip code) and temporal (e.g., month, year) fixed effects

Discussion and Future Work

- Incorporate AFO characteristic data
 - Iowa DNR historical panel
 - USDA Ag Census microdata
- Incorporate additional environmental outcome data
 - USGS Groundwater quality data
 - MODIS aerosol air quality data
- Incorporate cost of regulations
 - Extend Sneeringer and Key (2011) on productivity impacts
 - Construct engineering cost estimates of CAFO/MMP requirements