An economic perspective on accountability research

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Valuation: Cost benefit analysis

- $ in job loss, emissions compliance, ...

- # of deaths, hospitalizations, ...

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Valuing benefits

- V = mortality effect + hospital effect + ...
  - Mortality effect = effect of pollution on mortality * value of mortality risk
  - Hospital effect = effect of pollution on hospital * hospital charge + lost work days * wage rate

Valuing benefits

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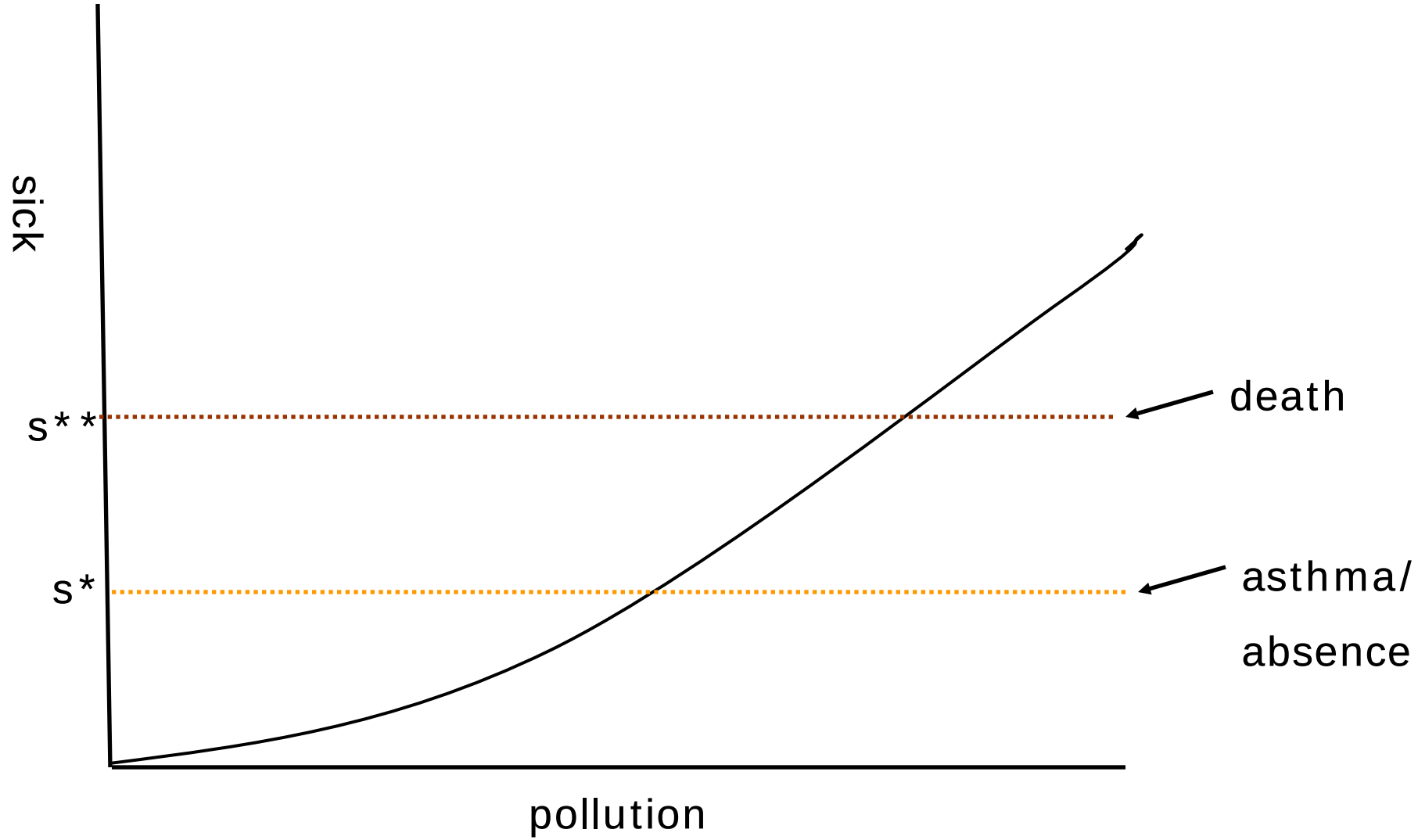
  - Hospital effect = effect of pollution on hospital * hospital charge + lost work days * wage rate
  - Avoidance effect = effect of pollution on avoidance * cost of avoidance

Valuing benefits

- V = mortality effect + hospital effect + ...
  - Mortality effect = effect of pollution on mortality * value of mortality risk
  - Hospital effect = effect of pollution on hospital * hospital charge + lost work days * wage rate
- Include all health effects
  - Focus on “extreme” outcomes
    - Misses subtle effects: ear nose and throat (ENT), eyes, etc.
    - Absenteeism vs. presenteeism
  - New outcomes: human capital & worker productivity
    - Easily monetizable
    - More widespread: not just vulnerable

Extreme vs. subtle measures of health



Causal effect of pollution

- Economic models of residential location
  - Pollution exposure “endogenous”
- Quasi-experimental methods
  - Isolate “exogenous” sources of pollution → causal relationships
  - Placebo testing

Choosing where to live

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$

$


School


School


School

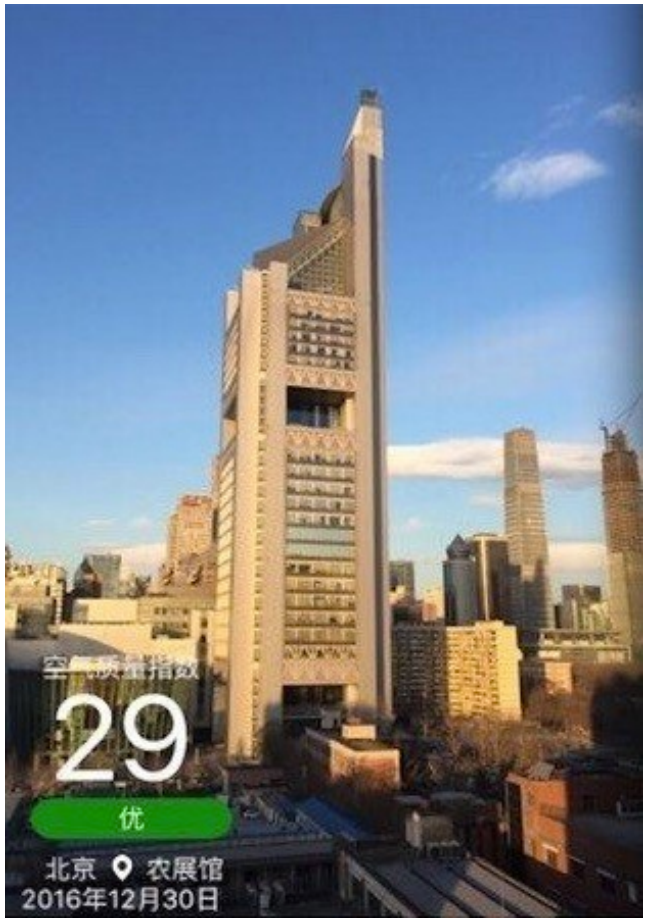
Orange arrows show correlated factors

“Endogenous” exposure

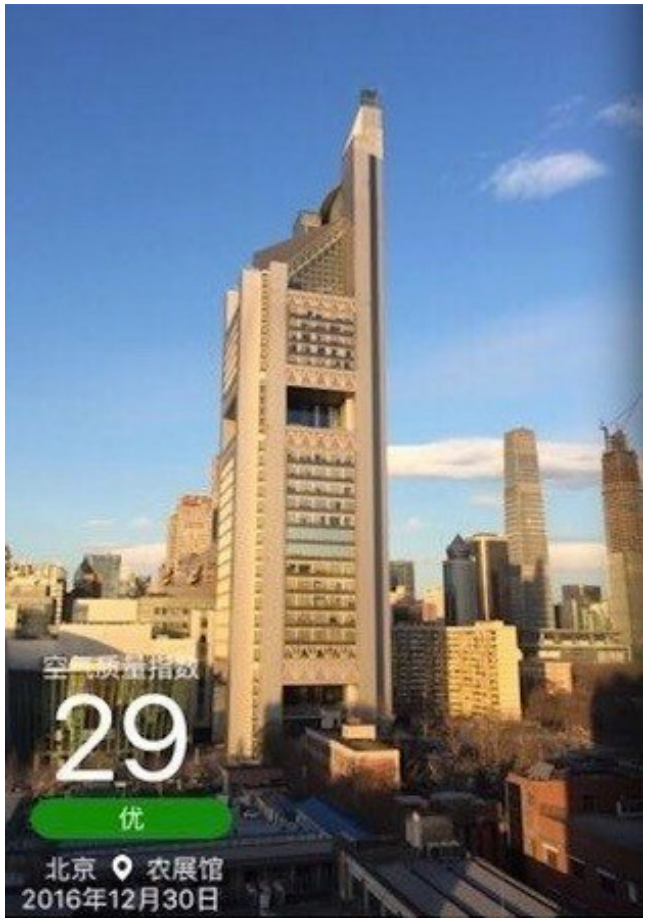
“Endogenous” exposure

“Exogenous” variation in pollution

“Exogenous” variation in pollution



“Exogenous” variation in pollution



“Exogenous” variation in pollution

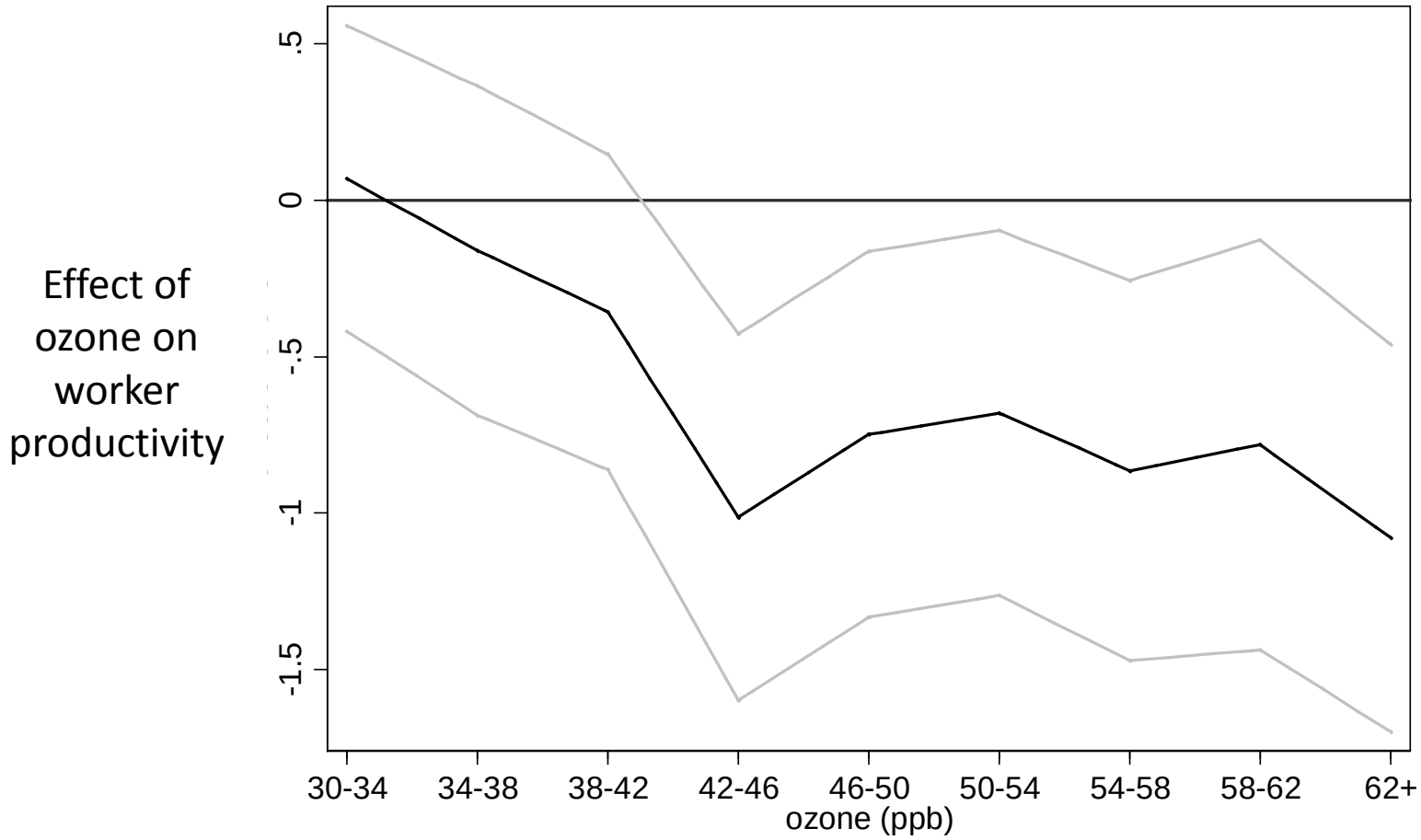
- Various ways to implement
  - Cross-sectional and fixed effect regressions
  - Difference in differences
  - Instrumental variables
  - Regression discontinuity
- Limitations
  - Response to changes
    - Rain → less time outside → less exposure
    - Regulation → employment → health
  - External validity
  - Construct validity

Example: worker productivity

- Collect data from farm
  - Workers paid piece rate → Daily measures of productivity
  - Workers followed over time
  - Daily ozone and confounders (co-pollutants, temperature, humidity, wind, rain, sun, ...)
- Daily regression
  - Firm not source of emissions
  - Control for worker sorting with fixed effect
  - Flexible controls for weather, seasonality
  - Concern: labor supply → test directly
- Findings
  - 10 ppb increase in ozone → 5.5% decrease in productivity
  - Apply to all farms: $700m in labor costs

Inspired by Michael Brauer's work in Fraser Valley

Low levels of ozone related to productivity



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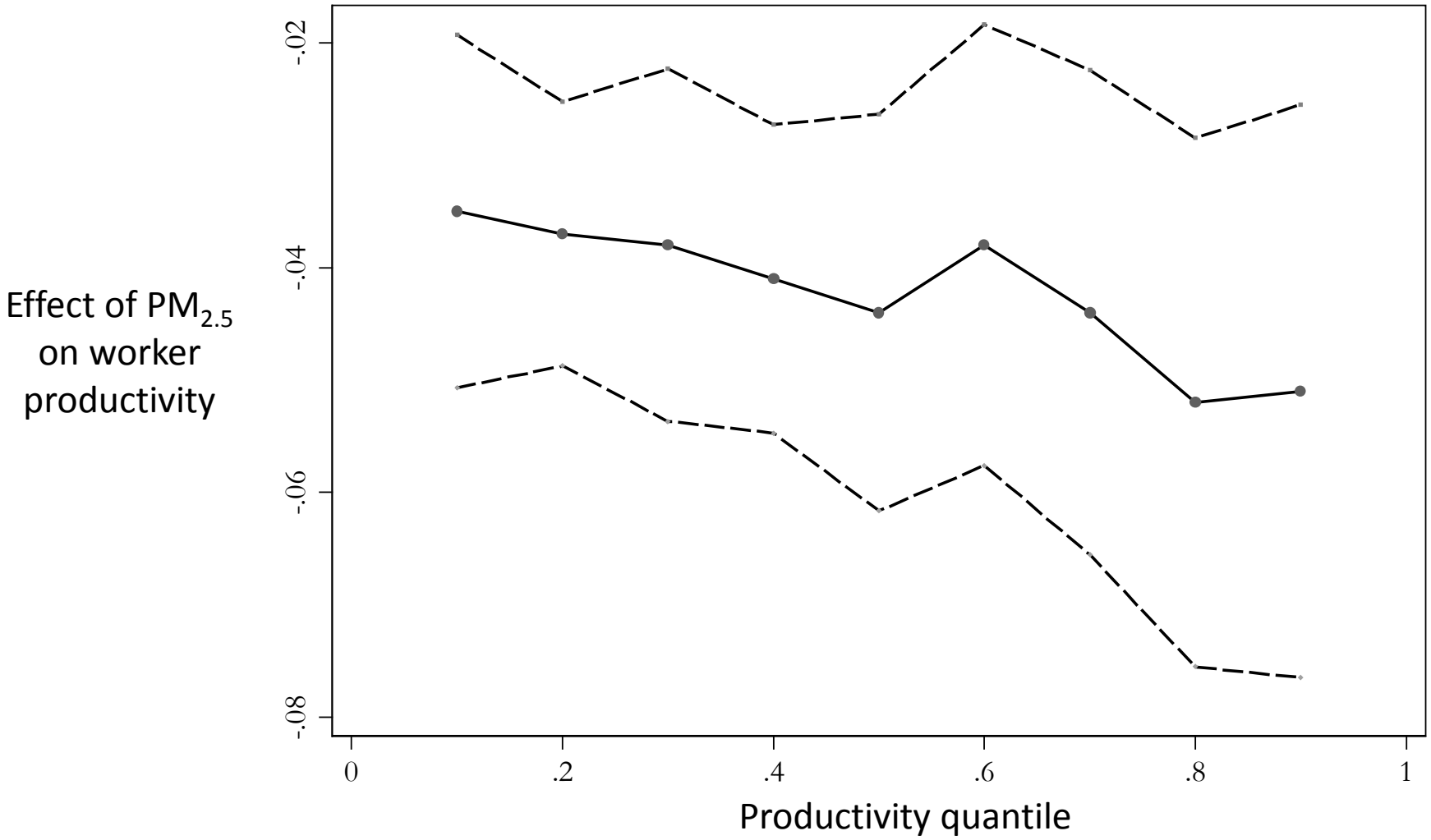
- Limitations
  - Exposure based on central monitoring site
  - Limited external validity: < 1% US (and similar) in agriculture

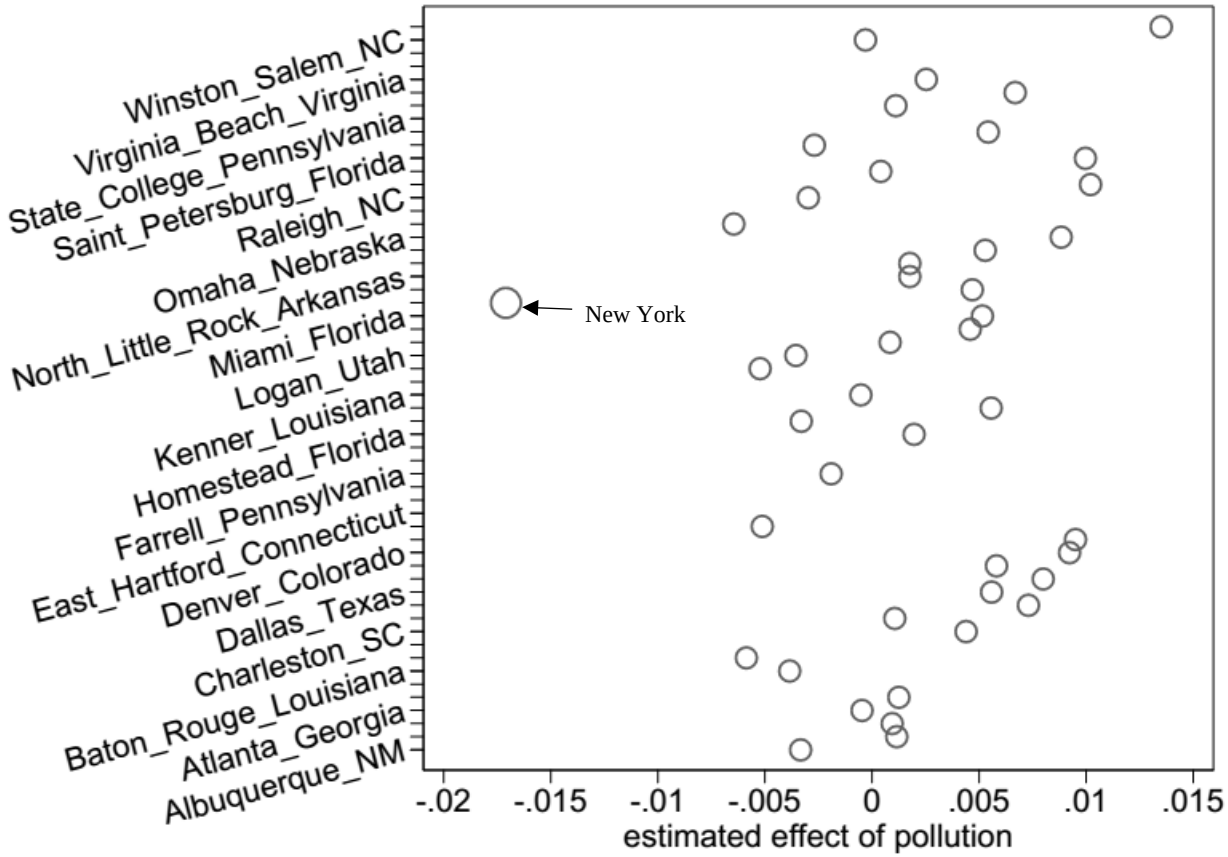
Extensions to the indoor workplace

- $PM_{2.5}$ penetrates indoors
- Manufacturing
  - Piece rate workers at pear packing factory (mean $PM_{2.5}$=8.9 μg/m^3)
  - Similar daily regression with worker fixed effects (FEs)
  - Finding: 1 μg/m^3 change in $PM_{2.5}$ → 0.6% change in productivity
  - Aggregate productivity benefits: $19.5b
- Service sector
  - Call center workers, partly performance based pay
  - Similar daily regression with worker FEs
  - Finding: 10 unit change in air pollution index (API) decreases calls by 0.3%
  - $2.2b to China (10 unit); $525m in Los Angeles (AQI < 100)
- Finance
  - Stock prices as proxy for investor behavior
  - Pollution → cognition, mood → risk aversion
  - Similar daily regression (no worker FEs)
  - Finding: significant negative correlation between $PM_{2.5}$ and daily returns

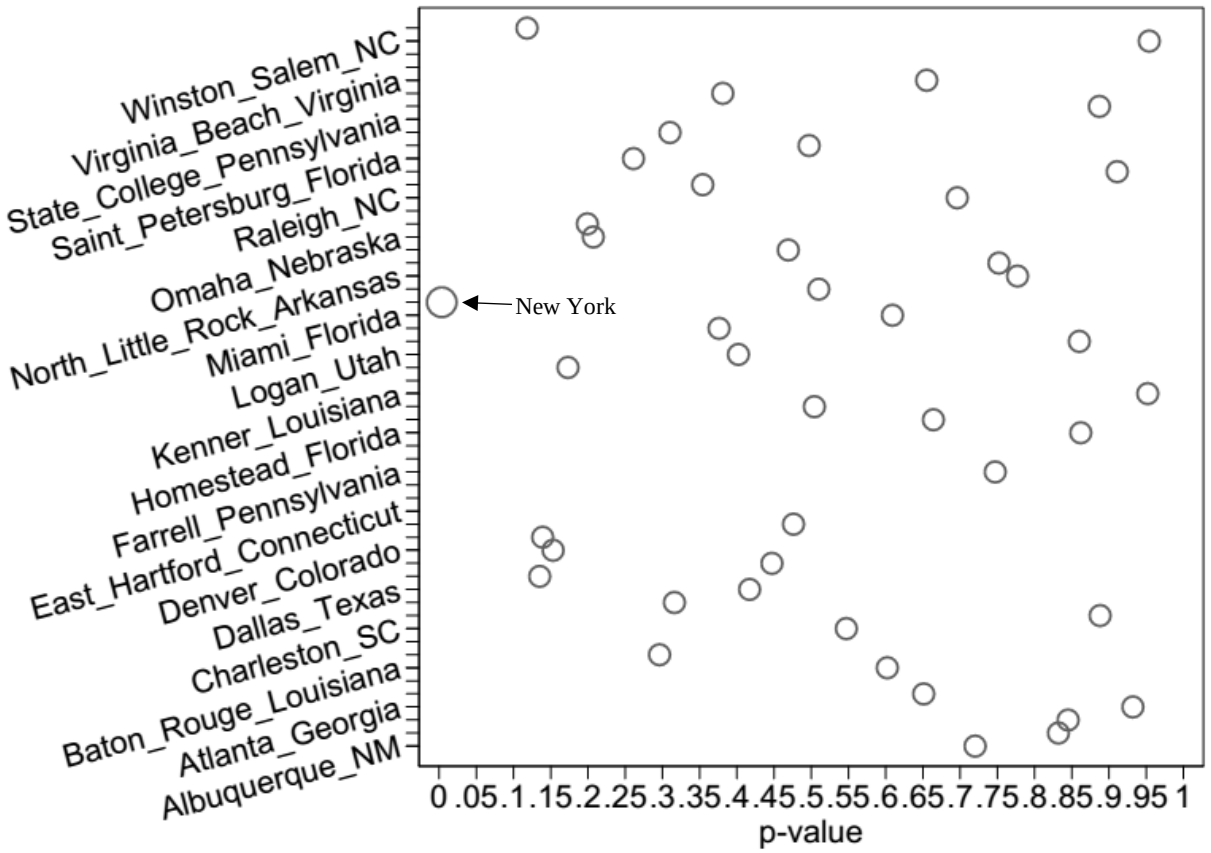
Heterogeneity of $PM_{2.5}$ effects on productivity



Placebo testing: Effect of pollution from all cities on stock market prices



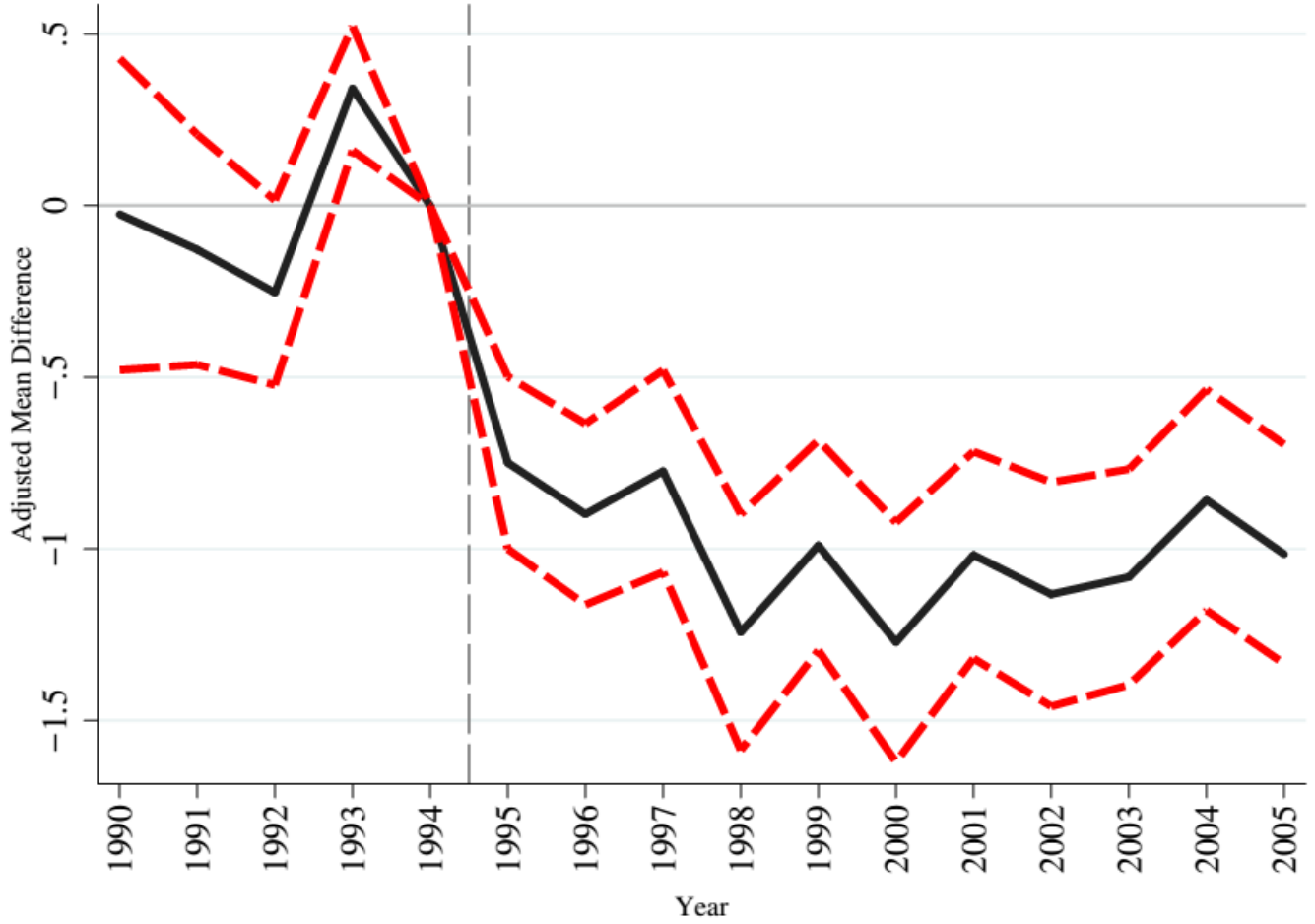
Placebo testing: Statistical significance of effect of pollution from all cities on stock market prices



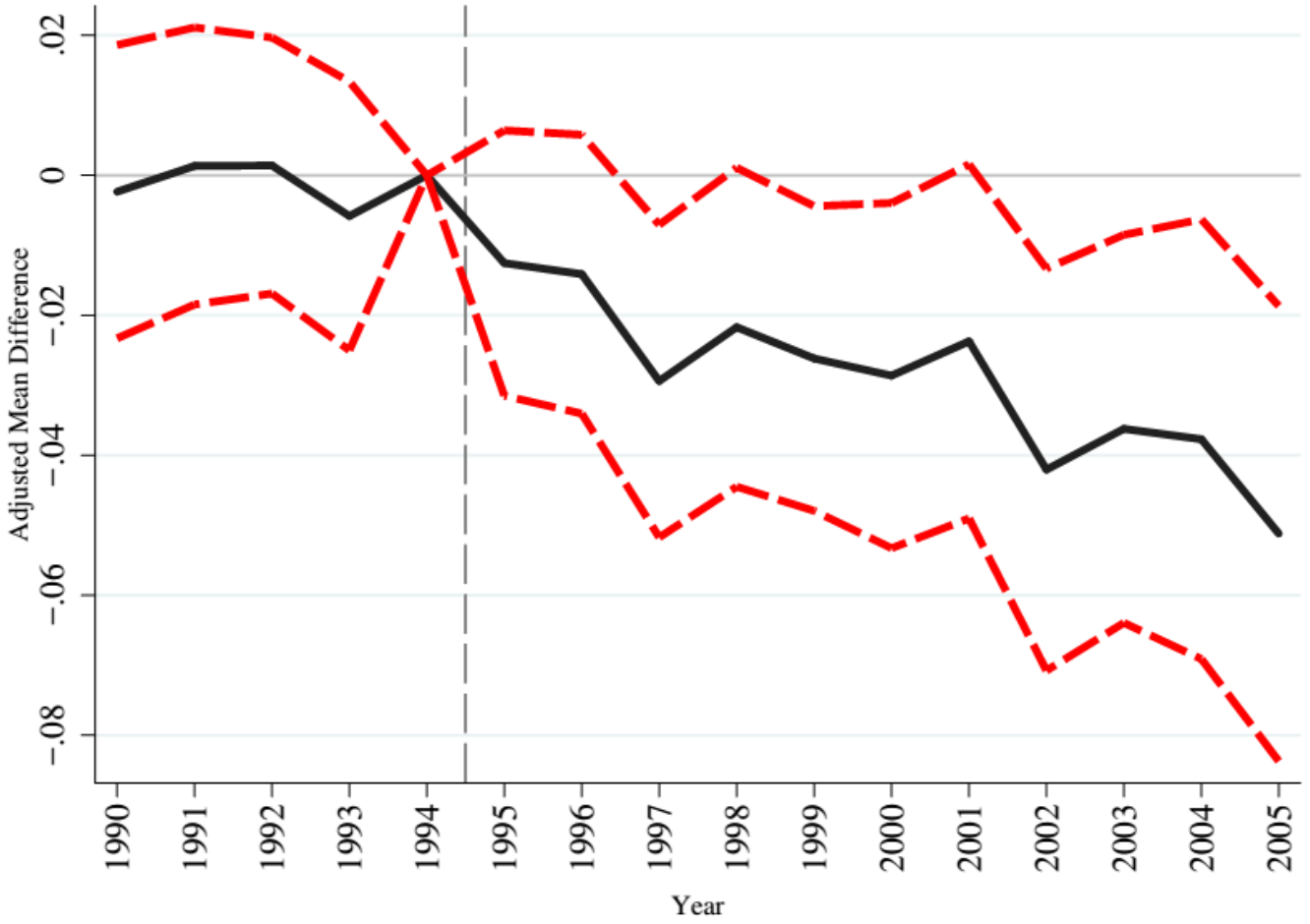
Long term effects: Evidence from the Acid Rain Program

- 1994 Acid Rain Program focused on SO_2
  - Decreased $PM_{2.5}$
  - Affected 110 plants
  - Limited behavioral responses
    - Minimal employment effects
    - Broad “treatment” areas (100 miles)
- Difference in differences “event study” from 1990-2005
  - Compare “close” vs. “far” counties over time
    - Use propensity-score to select “far” counties
  - Compare pre-Acid Rain Program period
  - Focus on prime working age 35-64

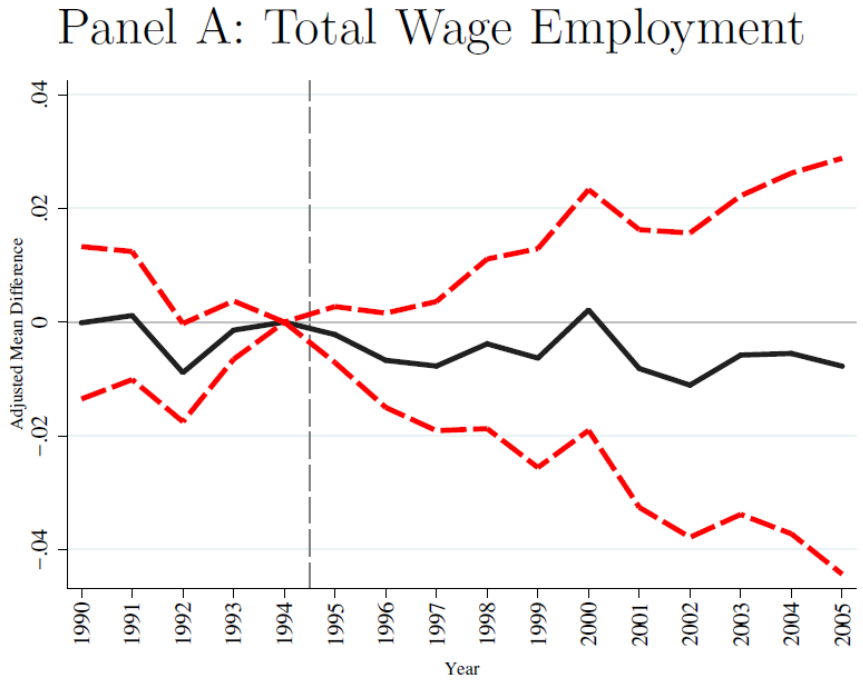
Difference in SO_2 between “close” and “far”

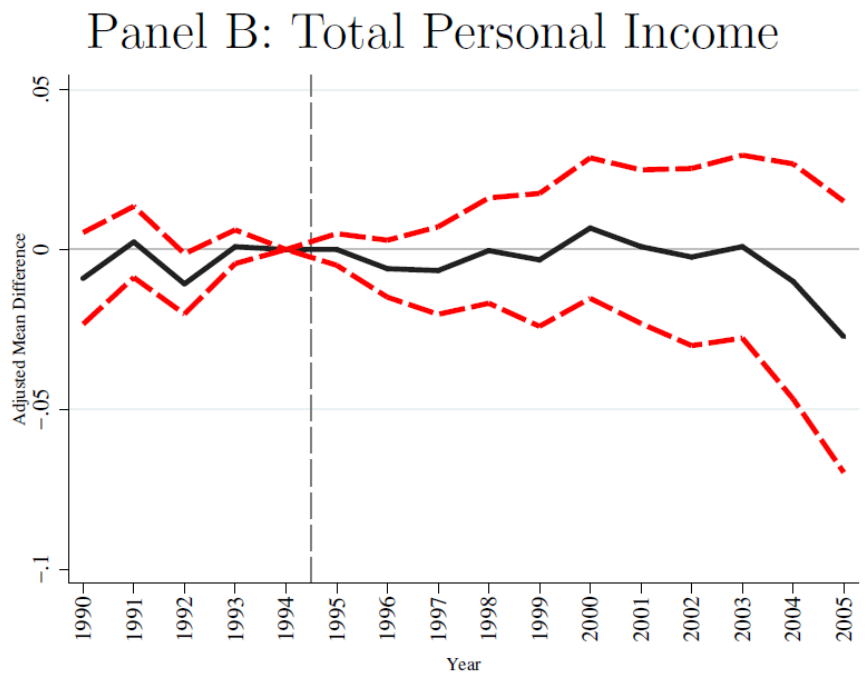


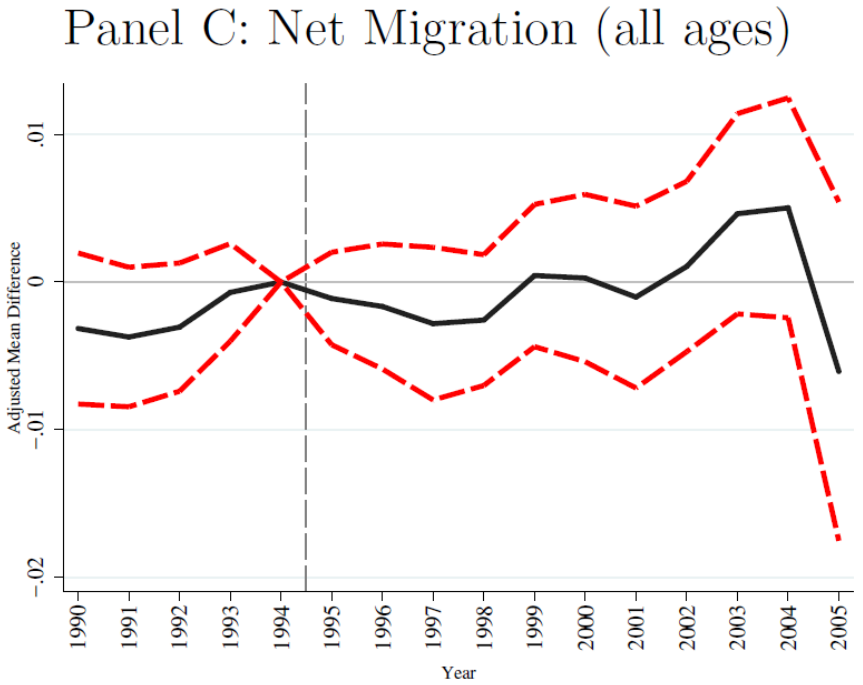
Difference in mortality between “close” and “far”

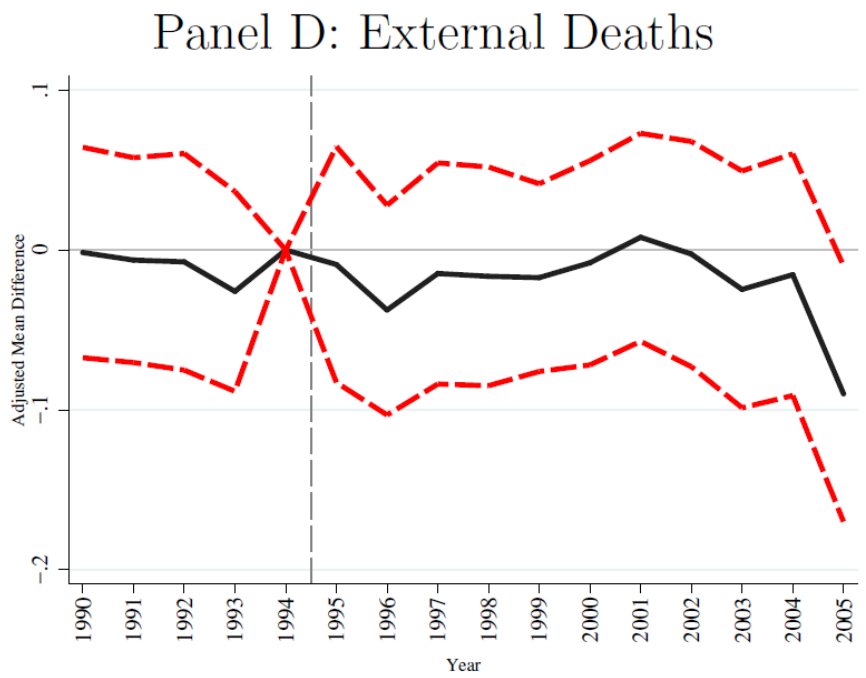


Testing model assumptions









Conclusion

- Economic perspective
  - Valuation
    - Making cents of benefits
    - Old & new outcomes
  - Economic models
    - Behavioral confounding → endogenous exposure
    - Quasi-experimental methods → exogenous exposure, placebo testing
- Worker productivity
  - Impacts on outdoor & indoor, low & high skilled
    - No relationship to labor supply
  - Effects on all workers, at low levels of pollution
  - Environmental regulations as a tool for promoting growth?
- Effects from long-term exposure
  - ARP as “exogenous” source of variation
  - Prime working age adults: benefits = ~$150b per year
  - Potential implications for Clean Power Plan

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