Pigskin, Tailgating and Pollution:

Estimating the Environmental Damage of Sporting Events

M. Taylor Rhodes

Department of Economics
UNC Greensboro

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Research Questions.

- I am exploring the environmental impacts of sporting events (specifically college football games).
- I attempt to answer 4 questions:
  1. Do cities experience an increase in pollution on game days (day-of effect)?
  2. Do cities also experience an increase in pollution the day before or day after game days (commuting effects)?
  3. Do these effects change over the course of the regular season (September to November)?
  4. Do these effects pose serious health-risks?

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Motivation / Policy Relevance.

- Why should we care?
  1. Health effects of pollution can be substantial.
     - Even if exposure is brief and the level of exposure is small (on-going examination in the literature).
     - Health risks include increase in daily mortality, cardiovascular death, respiratory mortality.
  2. Resource allocation for local governments.
     - How best to arrange traffic management resources.

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Sample.

- The sample was created in an attempt to minimize confounding effects from unobserved local economic activity that may in turn increase pollution levels.

- A city was included in the sample so long as the following three conditions held:
  1. The city does not host a major professional sports team,
  2. The city hosts at least one Football Bowl Subdivision Team (FBS; Div. 1A),
  3. The city has a common measure of pollution at the day level for at least some game and non-game days from Sept. 2010 to Nov. 2010.

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Data Sources.

- Time period is from Sept. 2010 to Nov. 2010 (i.e. a single regular season).

1. Daily measures of pollution (24-hour averages):
   - Air Quality System database by the EPA.
   - Most common to all cities in the sample is PM2.5.
2. Weather controls (daily precipitation and mid-range temperature):
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3. College football schedules and box scores:
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Econometric Framework.

1. Baseline (Day-of) Model:

$$PM2.5_{ijk} = \alpha + \beta_1 Host\ Game_{ijk} + X'\beta + \xi_{ijk} \tag{1}$$

   - where i denotes city, j denotes day and k denotes month; and, $\xi_{ijk} = \mu_i + \lambda_m + \varepsilon_{ijk}$.

2. Day-of and Commuting Effects:

$$PM2.5_{ijk} = \alpha + \beta_0 Day\ Before_{ijk} + \beta_1 Host\ Game_{ijk} + \beta_2 Day\ After_{ijk} + X'\beta + \xi_{ijk} \tag{2}$$

3. Month-specific Day-of and Commuting Effects:

$$PM2.5_{ijk} = \alpha + \beta_0 Day\ Before_{ijk} \times Month + \beta_1 Host\ Game_{ijk} \times Month + \beta_2 Day\ After_{ijk} \times Month + X'\beta + \xi_{ijk} \tag{3}$$

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Summary of Results.

- After controlling for city and month fixed-effects, weather controls and city-specific time trends:

1. Small, generally statistically insignificant but negative effects for September:
   - PM2.5 just before, on and after game days relative to all non-game days decreases by **.11**, **1.14** and **.98** micrograms per cubic meter of air, respectively.
2. Positive but statistically insignificant effects for October:
   - Relative to September, PM2.5 just before, on and after game days relative to all non-game days increases by **.58**, **2.28** and **1.58** micrograms per cubic meter of air, respectively.
3. Positive and statistically significant effects for November:
   - Relative to September, PM2.5 just before, on and after game days relative to all non-game days increases by **2.10**, **3.26** and **1.92** micrograms per cubic meter of air, respectively.

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Summary of Health Results.

- Are these marginal increases in PM2.5 hazardous?
  - Using a similar approach used by the World Health Organization hypothetical game day levels of PM2.5 required to increase the risk of cardiovascular and other mortalities from 0% to 1% are calculated.
  - Findings suggest that the game day levels required to increase cardiovascular mortality, respiratory mortality and asthma risk from 0% to 1% are on average **8**, **5** and **3** times larger, respectively, than the observable maximum game day levels in October and November.

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