Legacies of Lead – Estimating homebuyer response to lead exposure

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Camp Resources XXIV

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Overview

- Lead in homes can create elevated blood lead levels, causing permanent mental and physical problems.
  - Policy responses create stigma/adverse effects.

- How does information disclosure about lead risks capitalize into house prices?
  - Utilize a spatially varying policy in Maryland to estimate effect.
  - Transaction from 2001-2010, two econometric methods.

- Consistent negative capitalization effect present.
  - Clustered in older houses.

Lead, lead, everywhere…

- Lead in homes a major environmental hazard and public safety issue.
  - 24 million US homes have elevated lead (CDC, 2013).
  - Estimated 4 million children.
- Adverse health effects of lead.
  - Children – Neurological, behavioral, slowed growth.
  - Pregnant women – damage to fetus.

Lead, lead, everywhere…

- Lead in homes from lead-based paints.
  - Banned in 1978.
  - BLLs have since declined significantly.
  - But no “safe” level of lead.

- Increased awareness -> public officials attempt to educate homeowners and provide remediation tools.

- How do homeowners respond to policy?

Previous literature

- Some previous work on potential lead exposure risk.
  - Dale et al. (1999) and McCluskey & Rauser (2001, 2003).
    - Dallas smelter.
- Focused on household disclosure of risk.
  - Utilize the Residential Lead-Based Paint Hazard Reduction Act (Title X).
  - Bae (2016), Zhao (2017) use AHS, find no effect.
    - AHS data based on owner reported price, may be biased (Kiel & Zabel, 1999).

Research Question

- I link homebuyer responses to a spatially varying lead risk to estimate how disclosure capitalizes into house prices.
  - How do homebuyers respond when entire areas are designated as a risk for potential lead exposure?
    - Utilize spatially explicit housing transactions.

- Exogenous policy shift in Maryland designated certain zip codes as at-risk areas for lead exposure.
  - All children in zip codes undergo BLL testing at 12 and 24 months.
  - Regardless of age of house.
    - Key point, uniform application of policy

Policy/Study Setting

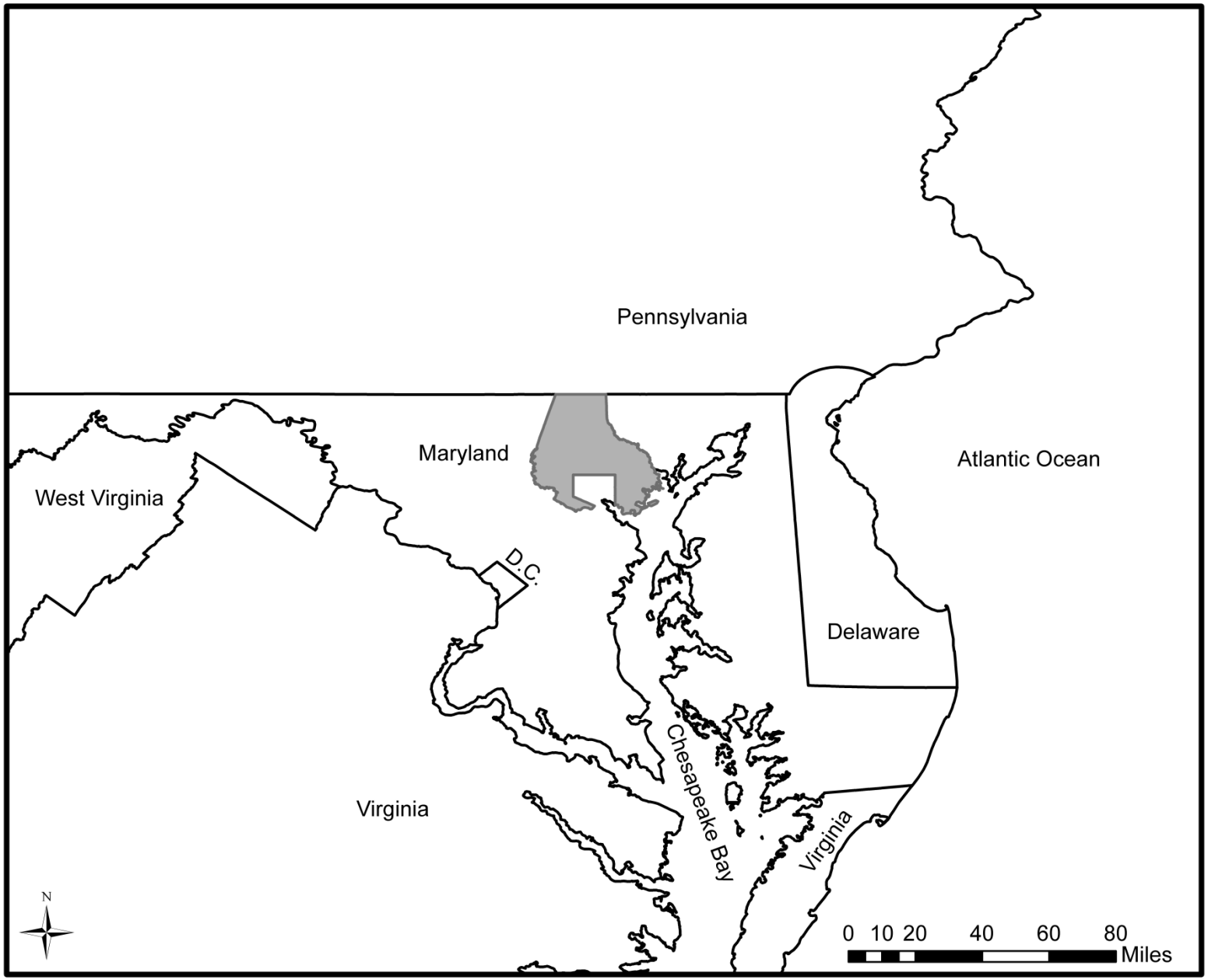
- Maryland very focused on reduction of lead.
  - 55% of all housing units built pre-ban (MDE, 2016),

- In 1997, state law charged DHMH to monitor BLLs.
  - Children under 6 & provide education in at-risk areas.
  - At-risk zip codes in 2000, revision in 2004, whole state in 2016.
    - Predictive statistical model determines risk designation, based on socioeconomic measures across the state.
  - Since program creation, significant successes.
    - Very high BLL (+10 µg/dL) – 3,500 in 2000 to 377 in 2015.
    - High BLL (5 µg/dL) – 18% in 2000 to under 2% in 2015.

Study Area/Data

- Focus on Baltimore County, Maryland.
  - Suburban county, completely surrounds Baltimore City.
- 86 zip codes in Baltimore County.
  - 25 designated at-risk in 2000.
  - 10 more in 2004.
    - Focus of my work.
- Corelogic housing transactions from 2001-2010.
  - Identify two samples: houses close to at-risk zips and repeat sales.

Variable	Mean	Std. Dev
Sale Price	242,700	166,719
House sqft	2,008.30	995.17
Full Baths	1.75	0.74
Parcel	0.30	0.65
Year Built	1969	23.60
Low Quality	0.40	0.49
High Quality	0.004	0.07
Stories	1.80	0.41
Fin base	0.58	0.49
Public Sewer	0.81	0.39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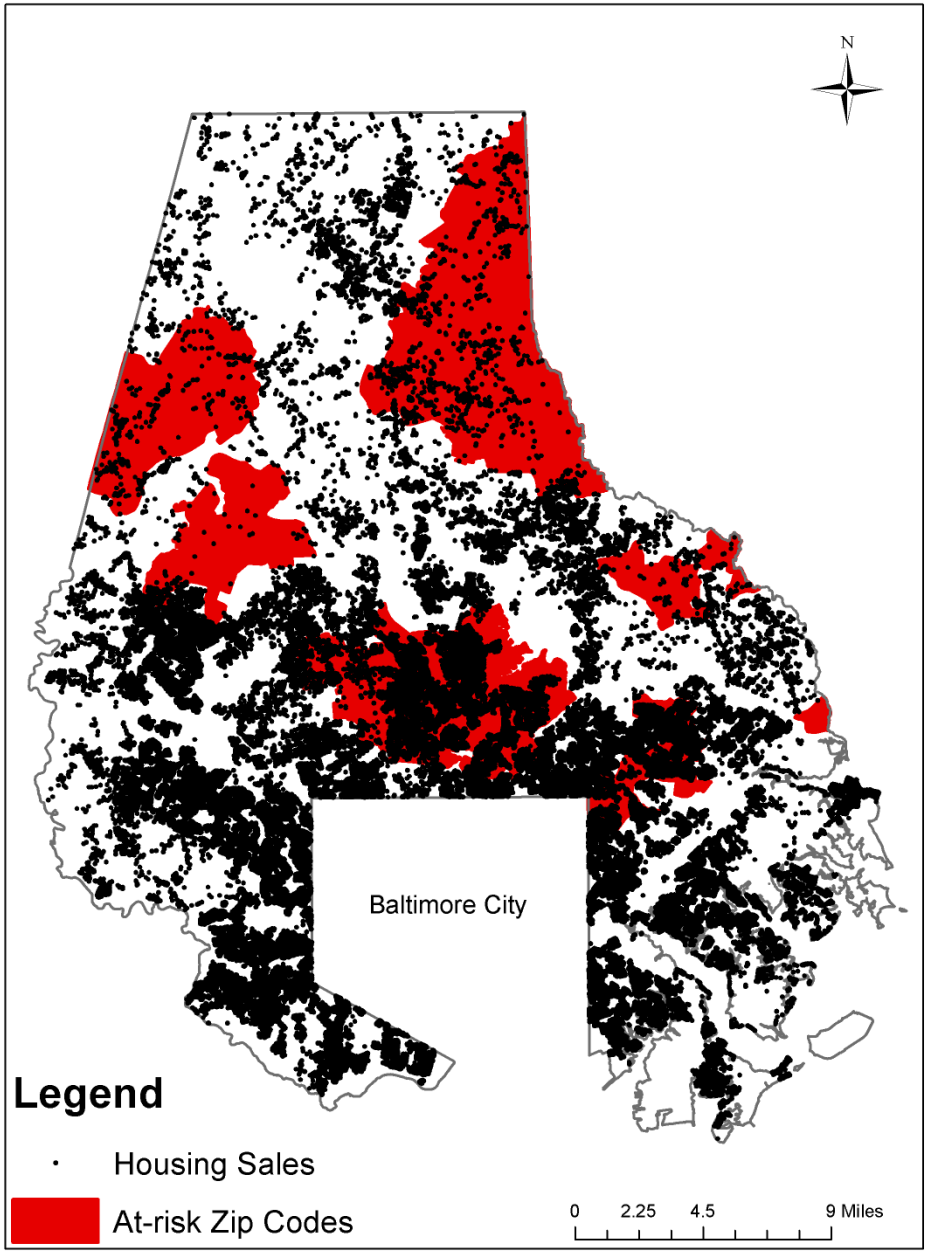
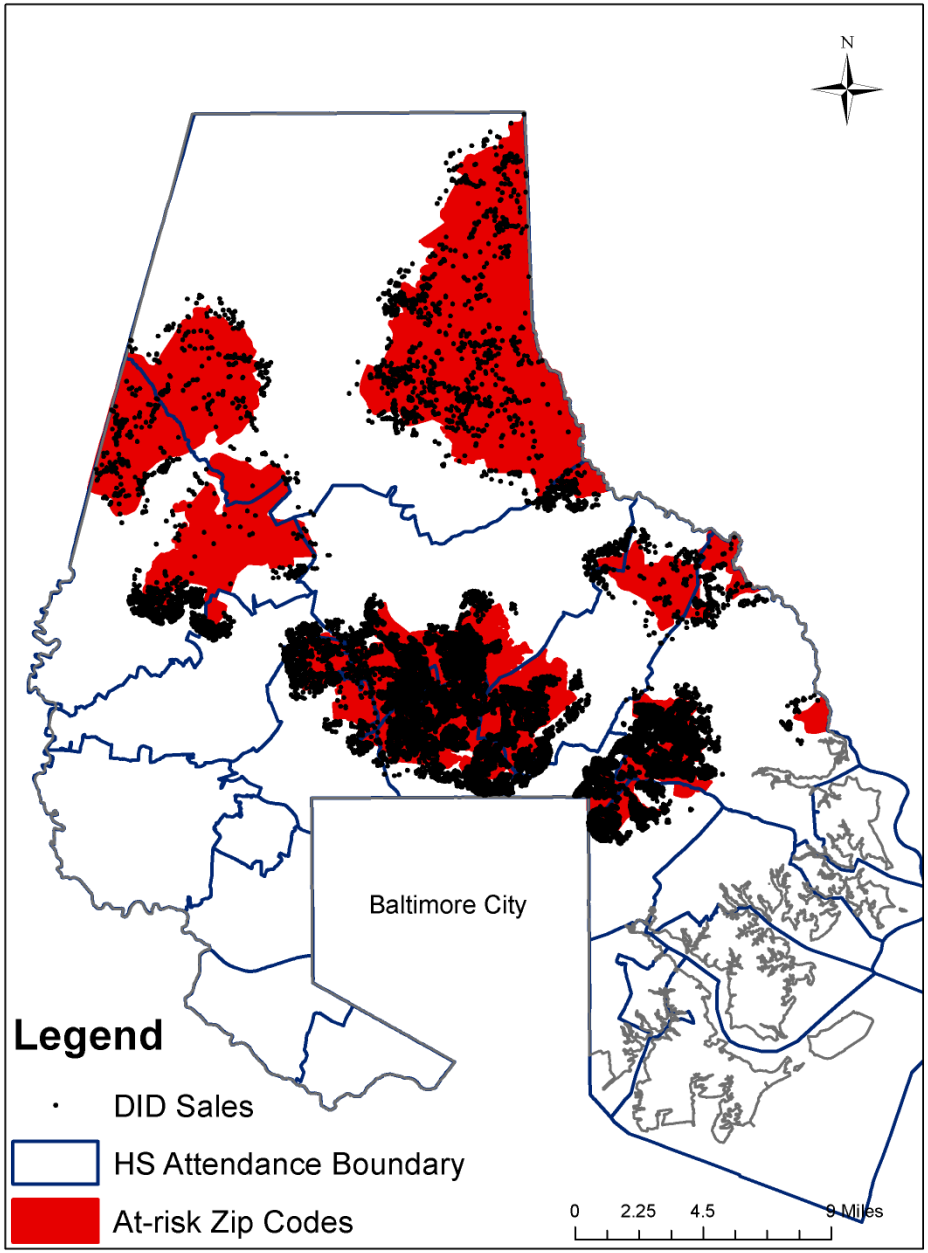

N
Baltimore City
Legend
Housing Sales
At-risk Zip Codes
0
2.25
4.5
9 Miles

Empirical Strategy, proximity

- First empirical method: quasi-experimental DiD hedonic model.
  - Exploit the spatially varying program to build treatment/control groups.

$$lnPrice_{ijt} = f(\boldsymbol{X_i}, \boldsymbol{N_j}, \boldsymbol{Year_t}, \boldsymbol{\alpha_i}, \boldsymbol{\gamma_i}, \boldsymbol{\theta_i}) \qquad (1)$$

    - $\boldsymbol{\alpha}$ = indicator variable for in at risk zip code.
    - $\boldsymbol{\gamma}$ = indicator variable for sold after policy.
    - $\boldsymbol{\theta}$ = treatment group (interaction of above two variables).
    - Semi-log model.
  - Utilize only houses within 0.25 miles of at-risk zip code but in same school district.
    - Allows me to address some sorting concerns.

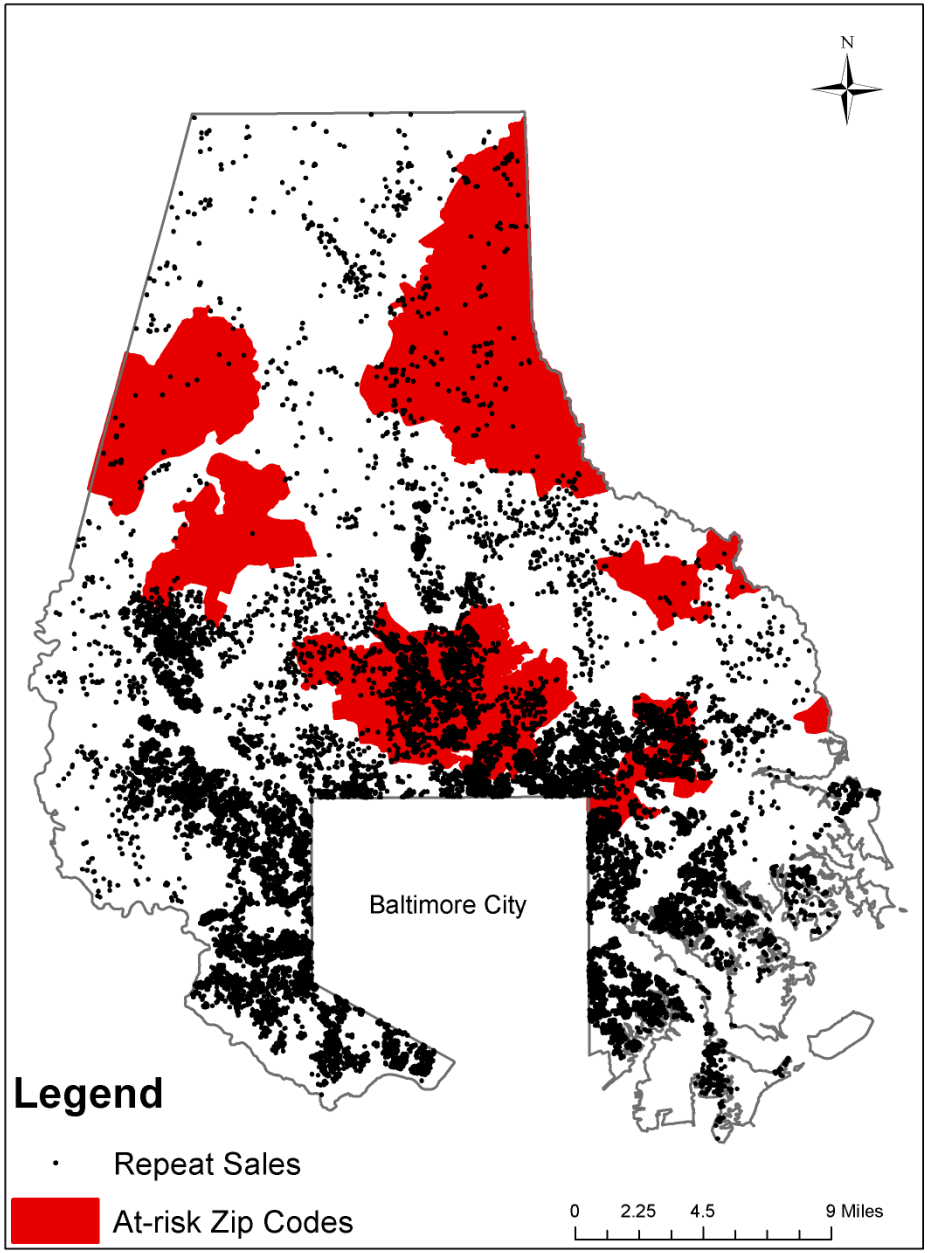

N
Baltimore City
Legend
DID Sales
HS Attendance Boundary
At-risk Zip Codes
0
2.25
4.5
9 Miles

Empirical Strategy, repeat sales

- Second empirical method utilizes a property-fixed effects model (repeat sales).
  - Can control for time-invariant property characteristics.

$$lnPrice_{ijt} = f(\boldsymbol{X_i}, \boldsymbol{Year_{jt}}, \boldsymbol{\alpha_i}, \boldsymbol{\gamma_i}, \boldsymbol{\theta_i}) \qquad (2)$$

    - $\boldsymbol{\alpha}$ = indicator variable for in at risk zip code.
    - $\boldsymbol{\gamma}$ = indicator variable for sold after policy.
    - $\boldsymbol{\theta}$ = treatment group (interaction of above two variables).
    - Only house characteristic left is “age”.
    - Semi-log model.


N
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Legend
Repeat Sales
At-risk Zip Codes
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Results

Variable	DiD model	PFE model	Old vs. New
Treated Group	-0.015** (0.0057)	-0.05*** (0.012)	-
Old houses (pre-ban)	-	-	-0.0511* (0.024)
New houses (post-ban)	-	-	-0.0271 (0.025)
N	29,611	33,950	29,611
Fixed Effects	School District & Year	Tract by Year	School District & Year

*p<0.1, ** p<0.05, *** p<0.01. clustered standard errors reported in parentheses.

- Small but significant price effect for at-risk houses.
  - Monetary terms, $3,600 to $11,800.
  - Estimates in the same range of Mastromonaco (2015).
  - Effect falls mostly on older houses (built before lead ban).

Robustness Results

Variable	Sales?	Placebo	Full County
Treated Group	-0.102 (0.508)	-0.005 (0.0096)	-0.0411** (0.0077)
N	482	29,611	108,268
Fixed Effects	Year by School District	School District & Year	School District & Year

*p<0.1, ** p<0.05, *** p<0.01. clustered standard errors reported in parentheses.

- However, what if something else is driving the results?
  - At-risk designation makes concerned homeowners (parents) want to move.
  - Log of yearly sales by zip code Muehlenbachs et al. (2015).
- Placebo test insignificant.
- Full county results mirror previous findings.

Key Findings & Future Work

- Strong evidence of a capitalization effect from the disclosure of lead risk.
  - Robust to alternative explanations and modelling choice.
- Evidence of unintended consequences from important environmental/public health policy.
- Loss of tax revenue for Baltimore County ~$1.7 million.
  - But how do we measure the benefits?
  - Estimates of “cost of lead” $0.5 million per year.
    - Special education, court costs.
- Future work
  - Expand analysis statewide.
  - Examine developer side.