

Crime Is In The Air: The Contemporaneous Relationship Between Air Pollution and Crime

Malvina Bondy

Sefi Roth

Lutz Sager

London School of Economics

Motivation

- The total cost of crime in England and Wales is approximately £60 billion per year
- A large body of literature studying the determinants of crime has offered several potential measures to tackle crime (e.g. increased police presence and better education)
- A link between crime and air pollution would suggest:
 - reducing air pollution in urban areas may be a cost effective measure to reduce crime
 - that a narrow focus on traditional health outcomes, such as hospitalization, may understate the true cost of pollution

This Study

- Uses a unique data set which combines readings of daily ambient air pollution concentrations with rich administrative records on over 1.8 million criminal offences recorded in London during the years 2004-2005
- Overcomes identification problems by using:
 - 1) Fixed effect models
 - 2) Instrumental Variable Approach
- Provides new evidence on a causal link between pollution and crime, explain the underlying mechanism and explore distributional aspects

Outline

- Section I: Background and potential pathways
- Section II: Data
- Section III: Empirical Strategy
- Section IV: Results
- Section V: Conclusion

Background

- The adverse health effects of ambient air pollution are well-established in the epidemiology and economic literature
- Strong link between air pollution and various health outcomes such as infant mortality and emergency room visits (Chay and Greenstone, 2003; Schlenker and Walker, 2015)
- More recently, a new wave of studies has examined the impact of pollution on other aspects of human life:
 - Labour Productivity (Graff Zivin and Neidell, 2012)
 - Human Capital and Cognitive Performance (Ebenstein, Lavy & Roth, 2016)
 - Road safety (Sager, 2016)

Potential Pathways

- The canonical rational choice model of crime proposed by Becker (1968) and Ehrlich (1973)

$$p_j U_j(W_j^c - \beta S_j^c) + (1 - p_j) U_j(W_j^c) > U_j(W_j^{nc})$$

- short-term fluctuations in air pollution may influence criminal activity through any of the following three channels:
 - (i) altering perceived payoffs: W_j^c and βS_j^c
 - (ii) altering risk perceptions: p_j
 - (iii) altering risk preferences: $U_j(\cdot)$

Potential Pathways

- In principle, a potential influence of air pollution may then either increase or decrease criminal activity

For example:

- if elevated levels of air pollution lead to increased risk aversion, we would expect to see a decrease in criminal activity on high polluted days
- Conversely, if air pollution reduces expected cost of future punishment, via lower discounting (β) for example, we would expect to observe increase in crime on days with pollution

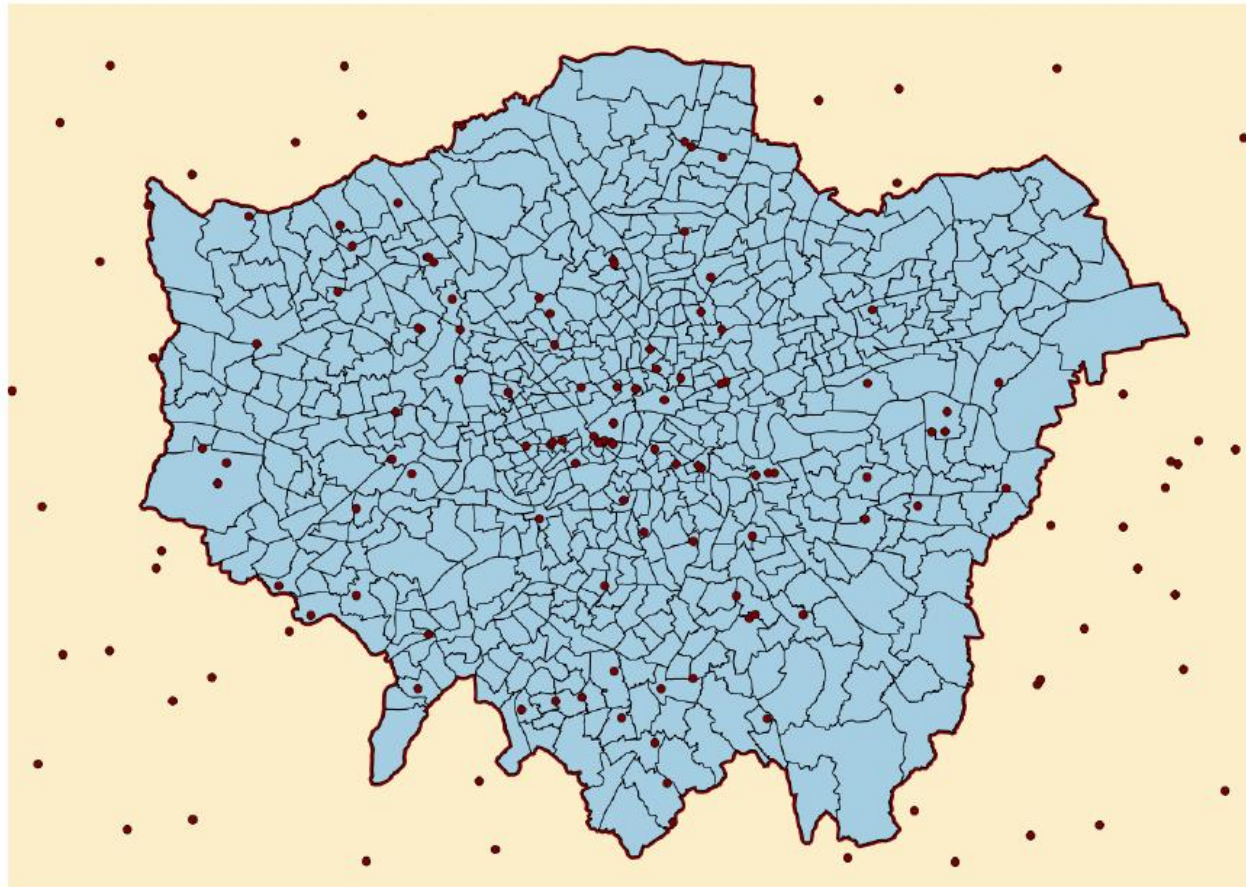
Data

- Administrative data on crime from the London Metropolitan Police Service which contains ward level daily data on:
 - All recorded crimes in the Greater London area (all types)
 - Police deployment
- Daily Pollution and weather data from the Department for Environment Food and Rural Affairs, (DEFRA) and the Met office
 - Five pollutants, temperature, relative humidity, rainfall and wind direction and speed
- Data on house prices (Land Registry)

Pollution and Weather Stations

Figure 1

Geographic coverage - London wards, AURN/MIDAS stations



Notes: Geographic coverage of greater London, divided into 624 wards (excluding the City of London)

Empirical Strategy

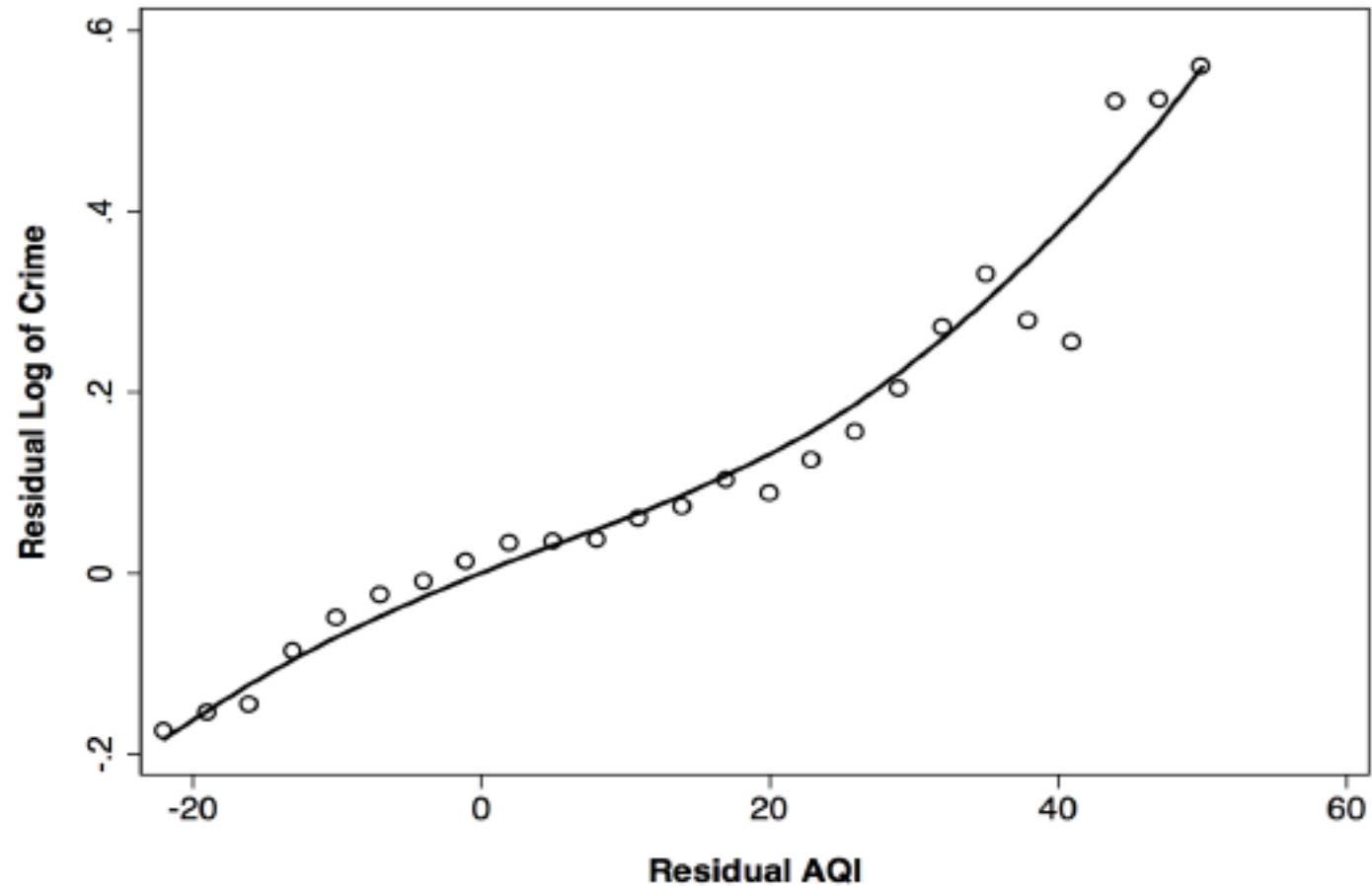
There are several challenges posed in trying to estimate the causal relationship between crime and air pollution:

- i. Omitted variables bias
- ii. Reverse Causality
- iii. Measurement error

We overcome these challenges by using:

- 1) Fixed Effects (Ward)
- 2) Instrumental Variable (Wind)

Preview of Results



Main Results

Table 2

Pooled OLS and Fixed Effect Models of Air Pollution's Impact on Crime

	Pooled OLS		Fixed Effects			
	(1)	(2)	(3)	(4)	(5)	(6)
AQI (10 units)	0.064*** (0.0124)	0.029*** (0.0101)	0.020*** (0.0041)	0.009*** (0.0025)	0.009*** (0.0025)	0.457*** (0.1134)
Controls	N	Y	Y	Y	Y	Y
Ward FE	N	N	Y	Y	Y	Y
DOW FE	N	N	N	Y	Y	Y
Year-Month FE	N	N	N	N	Y	Y
R-squared	0.007	0.060	0.372	0.383	0.385	0.688
Observations	419,210	398,437	398,437	398,437	398,437	433,277

Main Results

Table 3
Air Pollution's Impact on Crime

	Pooled OLS		Fixed Effects	
	No Controls (1)	Controls (2)	No Controls (3)	Controls (4)
Dummy for AQI >20 & <= 25	0.068*** (0.0110)	0.021** (0.0089)	0.039*** (0.0090)	0.014** (0.0054)
Dummy for AQI >25 & <= 30	0.096*** (0.0159)	0.021 (0.0140)	0.056*** (0.0115)	0.017*** (0.0064)
Dummy for AQI >30 & <= 35	0.134*** (0.0203)	0.031* (0.0183)	0.070*** (0.0129)	0.020*** (0.0071)
Dummy for AQI >35	0.177*** (0.0279)	0.035 (0.0241)	0.083*** (0.0142)	0.028*** (0.0077)
Observations	419,210	398,437	419,210	398,437

Notes: See Table 2. Each column in the table represents a separate regression.

Instrumental Variable

Table 4
Instrumental Variable Models of Air Pollution's Impact on Crime

	OLS		2SLS			
	(1)	(2)	(3)	(4)	(5)	(6)
AQI (instrumented)	0.009*** (0.0025)	0.009*** (0.0025)	0.127*** (0.0361)	0.018** (0.0083)	0.039*** (0.0141)	0.017** (0.0084)
Controls	Y	Y	Y	Y	Y	Y
Ward FE	Y	Y	N	Y	Y	Y
DOW FE	Y	Y	N	Y	N	Y
Year-Month FE	Y	Y	N	N	Y	Y
First stage (F-test)			22.91	13.69	13.25	13.54
Observations	398,437	396,521	396,521	396,521	396,521	396,521

Robustness

Figure 4
The Effect of Air Pollution on Crime - Lead/lag effects

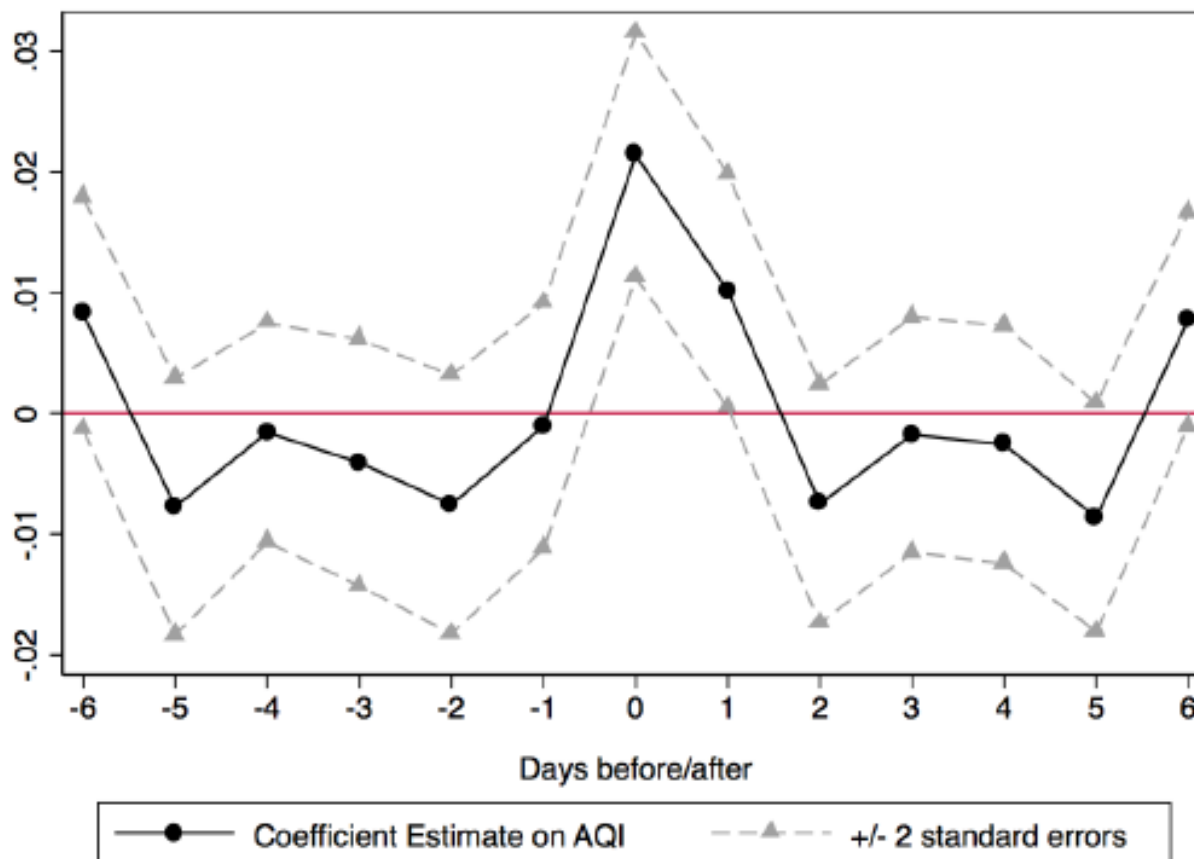
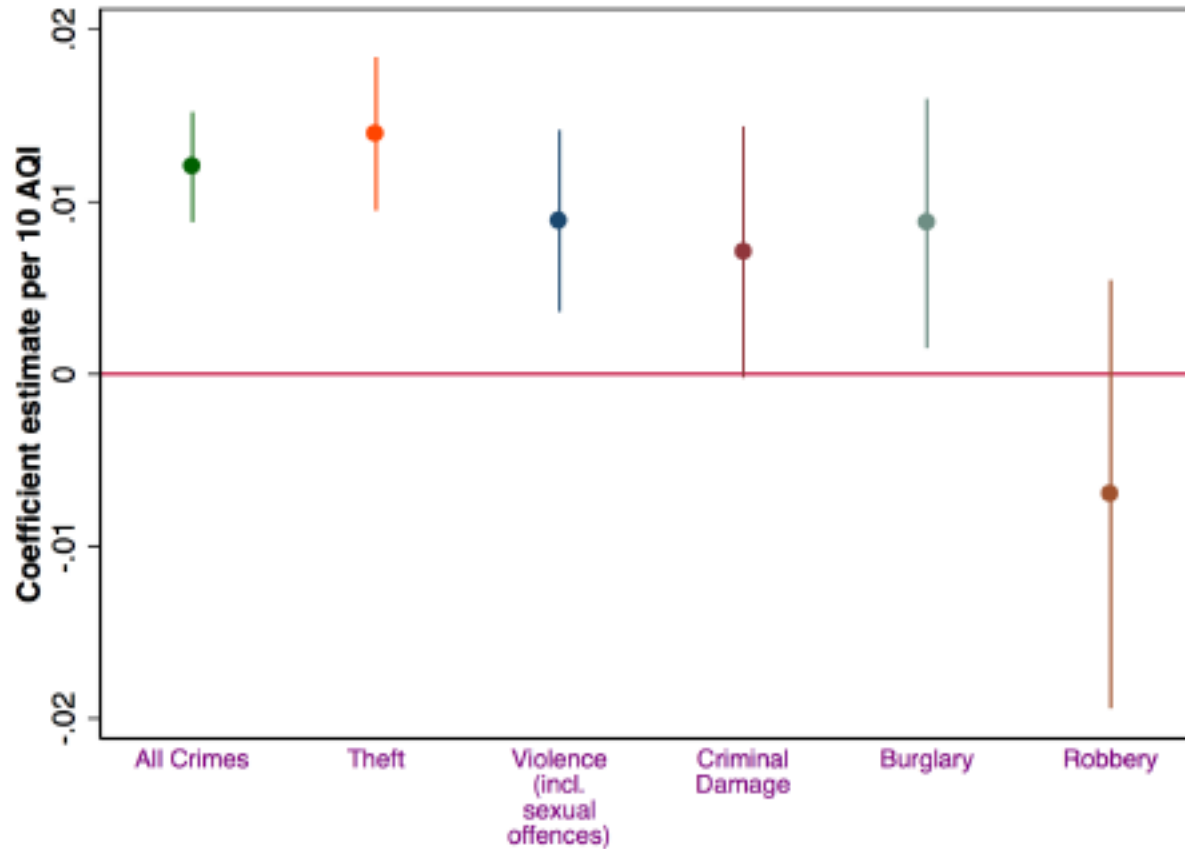


Table 5
 Measuring the Relationship between Crime and Air Pollution on the
 Actual Day and Irrelevant Days

	Pooled OLS		Fixed Effects	
	No Controls (1)	Controls (2)	No Controls (3)	Controls (4)
Day of Crime	0.062*** (0.0120)	0.027*** (0.0095)	0.022*** (0.0043)	0.009*** (0.0024)
Previous Week	0.050*** (0.0122)	0.017** (0.0085)	0.006 (0.0043)	-0.001 (0.0023)
Previous Month	0.038*** (0.0119)	-0.001 (0.0085)	-0.010** (0.0041)	-0.002 (0.0023)
Previous Year	0.041*** (0.0127)	0.003 (0.0094)	-0.002 (0.0055)	-0.001 (0.0032)

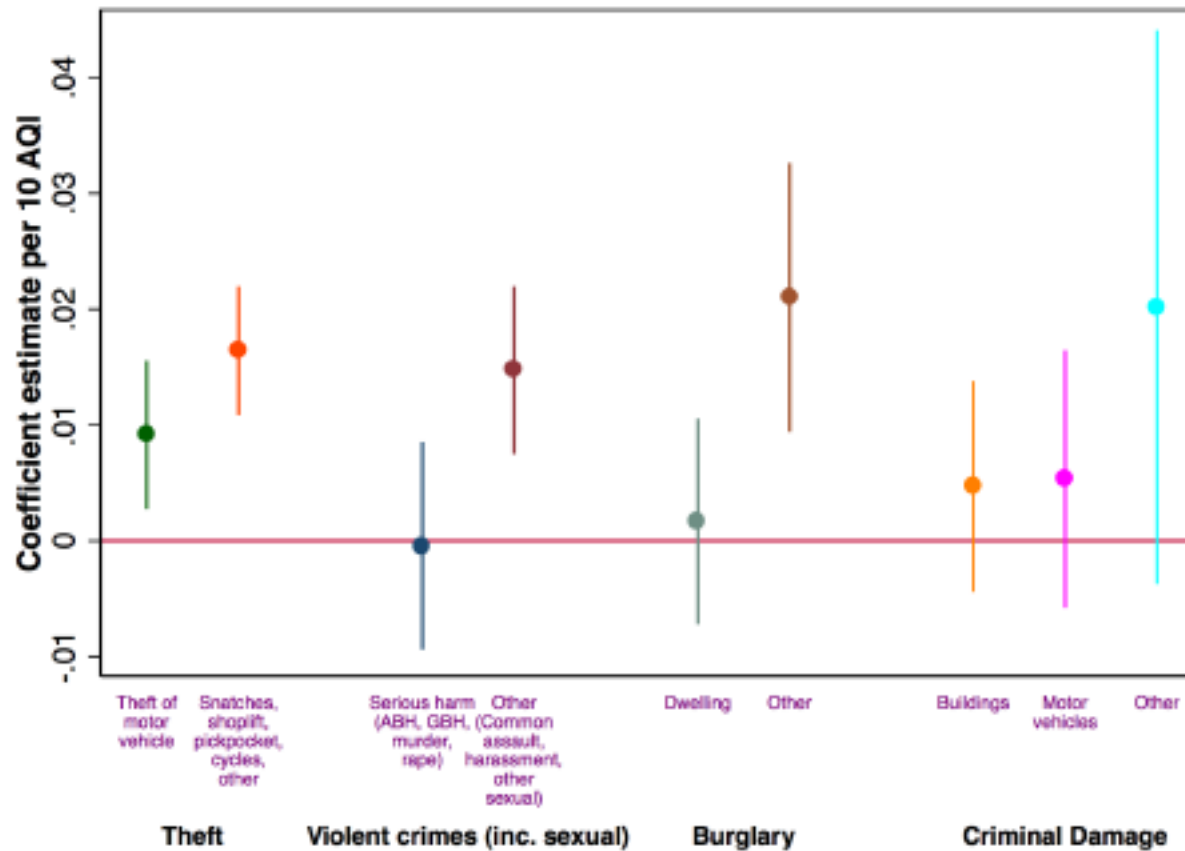
Heterogeneity

Figure 5
The Effect of Air Pollution by Crime Type



Heterogeneity

Figure 6
The Effect of Air Pollution by Crime Type



So what is the Mechanism?

- (i) altering risk preferences: $U_j(\cdot)$
- (ii) altering risk perceptions: p_j

No!

- (iii) altering perceived payoffs: W_j^c and βS_j^c

Yes! β

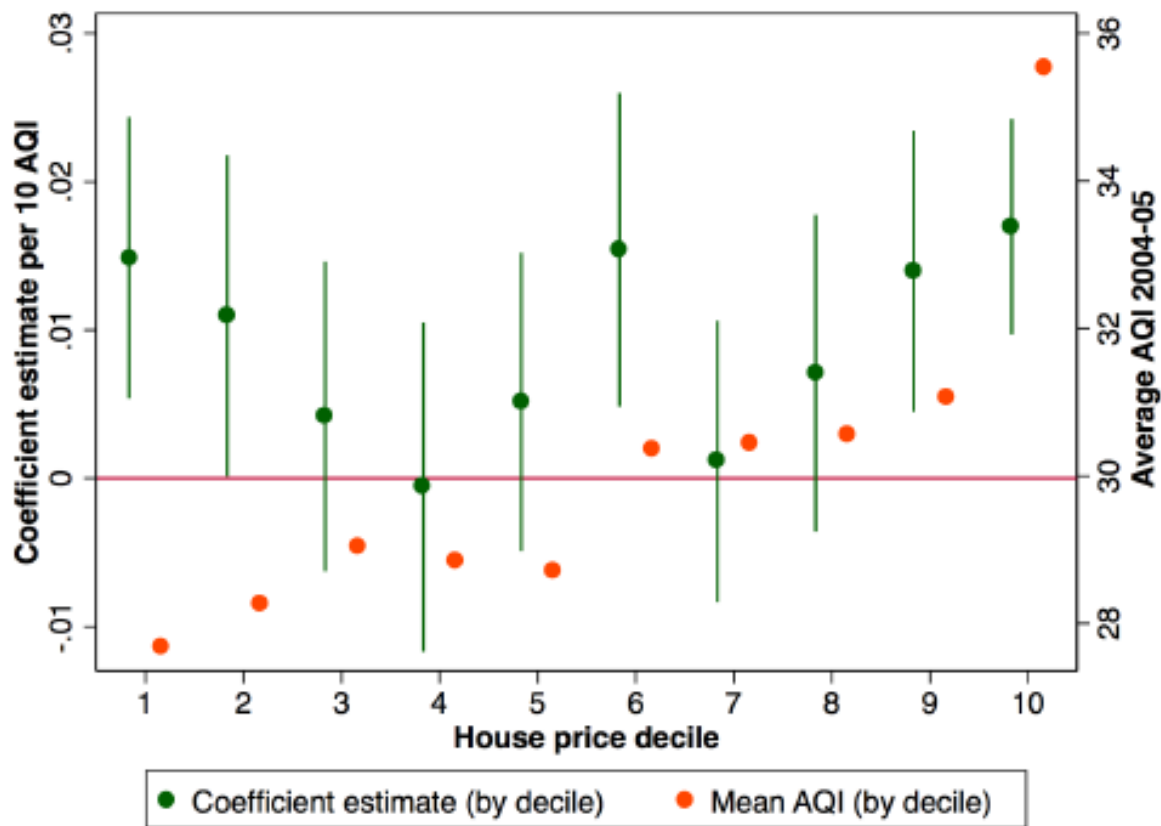
-> acute exposure to elevated levels of pollution leads to significant increases in stress hormones (Li et al., 2017)

-> heightened concentrations of stress hormone (cortisol), have been shown to alter time-preferences - increased preference for small immediate rewards relative to larger but delayed rewards. (Vestergaard et al., 2018)

Distributional Aspect

Figure 8

The Effect of Air Pollution on Crime by House Price Deciles



Concluding thoughts

- Strong relationship between crime and short-term exposure to air pollution
- These effects occur at levels well below existing limits
- The effects are unevenly distributed across residents income groups
- Reducing air pollution in urban areas may be a cost effective measure to reduce crime
- The results also suggest that the gains from improving air quality may be underestimated by a narrow focus on health impacts