How does economic activity adapt to pollution pricing? Evidence from London's ULEZ

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Motivation

Data

Empirical approach

Results - ULEV adoption

Results - house prices

London's ULEZ

- Low emission zones (LEZ) are increasingly common.
- We investigate the introduction of London's Ultra LEZ (ULEZ).
- £12.50 to drive into London for most petrol vehicles pre-2006, and most diesel vehicles pre-2015, but residents exempt.
- Brief timeline:
 - 1. March 2015: ULEZ announced.
 - 2. April 2019: first introduced (central London).
 - 3. October 2021: expanded to North/South Circular.
 - 4. August 2023: expanded to Greater London.

Our paper

Research question

What was the response of economic activity to the introduction of London's ULEZ?

We investigate:

- Adoption of electric vehicles.
- Substitution towards public transport.
- Switch towards remote work.
- Effect on house prices.
- Effect on business creation.

ULEZ expansion



sky news

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Data sources

- Vehicle registrations by postcode district and quarter, 2012 2022 (VEH0122).
- 2. Ultra-low emission vehicle registrations by postcode district and quarter, 2012 2022 (VEH0134).
- 3. Postcodes subject to ULEZ (initially, and then two expansions).
- Postcode district crosswalks to output areas (OAs), lower- (LSOAs) and middle-super layers (MSOAs). These areas have 310, 1500, 7500 average residents, respectively.
- 5. Population at OA level, to construct ULEZ exposure and weights.
- 6. 2011 Census commuting behaviour to compute commuting shares.

Data preparation

- 1. Create time series of vehicle registrations.
- Allocate ULEZ by postcode district population-based allocation from the more disaggregated postcode level where we know ULEZ assignment.
 - E.g., W1 4GE is in the ULEZ with 1,000 people, but W1 7PU with 500 people is not. Therefore W1 has a population-adjusted ULEZ score of 0.66.
- Compute ULEZ exposure. Calculate vehicle-weighted shares of (ULEZ-taxable) commuting multiplied by ULEZ score.
 E.g., for given postcode district, what share of commuting involves driving into the ULEZ?

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Identification

- There is geographic variation in how "exposed" different areas are to "shock" of the ULEZ, based on commuting behaviour into the ULEZ.
- There are two sources of randomness:
 - 1. Randomness of the ULEZ boundary.
 - 2. Randomness of share of people who drive into the ULEZ.

Exposure to ULEZ through commuting

Central areas highly impacted



ULEV adoption variation

Correlates with wealth?



ULEV share rises faster with high ULEZ exposure

Divergence occurs when ULEZ expansion confirmed.



Empirical approach

Baseline

Regression specification

ShareULEVs_{it} =
$$\alpha_i + \alpha_t + \beta$$
ULEZ_i
+ γ_t ShareDriveULEZ_i + ε_{it}

where i is a postcode district and t is a quarter.

 γ_t is the coefficient of interest.

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Relationship between ULEV adoption and ULEZ exposure



How did policy affect ULEV Adoption? Baseline regression - first ULEZ announcement was in Q1 2015



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Relationship between house prices and ULEZ exposure



How did policy affect house prices?

Baseline regression - first ULEZ announcement was in Q1 2015



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- 1. Extensions: public transport substitution, location of business creation, working from home.
- 2. Weights: appropriate weighting at various levels of analysis.
- 3. Additional controls: GVA/capita, electric charging points?
- 4. Data: UK Driver and Vehicle Licensing Agency household-level data.
- Robustness checks: regression discontinuity, synthetic control methods, placebo tests. Use additional expansions/announcements as repeated shocks (but less clean?).
- 6. Other analysis: Effect on particulate pollution?

Appendix

Summary statistics

	Mean	Ν	StDev	Min	p(25)	p(50)	p(75)	Max
All Vehicles	12,587	11,645	8,259	49	7,325	12,007	17,648	66,267
ULE Vehicles	80.77	11,645	179.41	0	6	27	94	7531
Population	29,317	11,645	21,407	0.065	15,284	27,734	40,653	140,711
ULEZ	0.081	11,645	0.22	0	0	0	0	0.91
Taxable ULEZ Share	0.012	11,645	0.0075	0.0034	0.0078	0.0098	0.013	0.068
Share ULEVs	0.010	11,645	0.022	0	0.00056	0.0030	0.010	0.734
Vehicles per capita	48.25	11,645	731.53	0.039	0.34	0.50	0.68	13,649.70
ULEVs per capita	2.37	11,645	46.70	0	0.00023	0.0014	0.0052	2,013.64

Table: Summary statistics

Note: vehicle data from VEH0122 and VEH0134 from the DVLA. Commuting and population data from 2011 Census. Constructed variables computed by author.

Rapid rise in ULEVs in London



Rapid rise in ULEV share in London



Placebo Test

DiD for pre-announcement data

