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Pollution, severe health conditions, and extreme right-wing ideology: A tale of three contemporary challenges

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ABSTRACT

By exploiting the microgeography of local air pollution at the 1km-by-1 km grid-level, we link local air quality to the voting intentions of a nationally-representative sample of 27,000 UK residents. We find a causal link between air pollution and support for far-right parties: a unit increase in pollution leads to a 3% rise in the probability to support these parties. These intentions are stronger for lung disease and cancer sufferers.

1. Introduction

According to the United Nations Environment Programme (UNEP), air pollution is one of the world's greatest health risks (UNEP, 2017). Consistent with this observation, epidemiological research suggests a profound link between pollution and various outcomes such as poor health and mortality (Dockery et al., 1993; Pope et al., 2009). Similarly, economic research also documents that pollution can reduce worker productivity, lower their income, and fuel criminal activity and conflict (Zivin and Neidell, 2012; Herrnstadt et al., 2021; Adetutu et al., 2023). Alongside these, the growing public awareness about pollution risk is stimulating a range behavioural reactions such as outdoor avoidance (Janke, 2014), the use of facemasks (Zhang and Mu, 2018), and more severely, suicide (Chen and Samet, 2017). Yet, there is an inexhaustible list of hitherto unexplored behavioural reactions linked to air pollution (Fuller et al., 2023).

Thus, this study adds a new dimension to the nascent literature on the behavioural effects of pollution by linking air quality to far-right political extremism. Our motivation is twofold. First, the world is presently witnessing disruptive emotional campaigns by social interest groups[1] and citizens, driven by the growing perception that policy-makers are not acting with sufficient urgency to tackle global warming (Daubanes and Rochet, 2019; Adetutu et al., 2023). Given the increasingly extreme[2] nature of these social agitations, political extremism is a plausible reaction to air pollution.

Second, we are also witnessing an upsurge in far-right populism. Over the last decade, far-right parties have systematically outperformed their left-wing counterparts, with unusually more committed bases, and larger vote shares in national elections (e.g., Brexit, Trump) (Van Dyck, 2021). Meanwhile, beyond its commonly highlighted determinants (e.g., immigration, economic crises, and cultural grievances), far-right extremism may well be stoked by a broader range of societal issues such as concerns about nature and health (Backhaus et al., 2019; Macklin, 2022). Against this backdrop, we hypothesise that pollution is a driver of far-right ideology.

We find that local air pollution drives the intention to vote for far-right parties, especially among lung disease and cancer sufferers. Furthermore, we show that most of these voters are protest voters

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[1] For example, "Just stop oil" and "Extinction Rebellion (XR)".
[2] For example: https://www.bbc.co.uk/news/uk-england-60951403

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motivated by disappointment and anger at their own party (i.e., the political centre).

2. Data

2.1. Individual-level intention to vote

Our panel spans 27,378 individuals across 11 waves covering the period January 2009 to May 2021. Our dependent variable captures the intention to vote for far-right parties across a nationally-representative sample of UK residents, derived from the Understanding Society Survey (USS). A dummy variable is constructed using the question "*If there were to be a general election tomorrow, which political party do you think you would be most likely to support*?". Following Funke et al. (2016), we code the support for extreme right parties as a binary variable that takes the value of 1 if respondents choose Democratic Unionist, UKIP and British National Party, and 0 otherwise.

2.2. Microgeographic pollution

Our key independent variable is a measure of local air pollution, obtained from the Department for Environment, Food & Rural Affairs (DEFRA). The raw pollution data is measured at the 1km-by1km grid level. It captures the annual average $PM_{2.5}$ pollution (in μgm^{-3}) which is generally recognised as a good proxy for many pollutants (Herrnstadt et al., 2021). Moreover, $PM_{2.5}$ has evolved into a key target of environmental regulation in advanced countries (DEFRA, 2017).

2.3. Matching USS to pollution information

The pollution data is at the 1 km grid level, while the USS survey contains information on respondents' residential locations at the Lower Layer Super Output Areas (LSOAs), a micro-spatial geographical unit across the UK.[3] To create the local pollution measure, we overlay the geo-coded grid-level pollution data with the USS LSOA location information, allowing us to compute the average pollution level across the 1 km grids within each LSOA (see Appendix for details). After dropping missing data across different variables, our sample contains 73,704 individual-year observations. Table 1 presents the descriptive statistics of our key variables.

3. Methodology

To investigate the effect of local air quality on the probability of the *ith* individual's intention to vote for far-right parties in period *t*, we propose a model:

$$\text{Prob}(Intention_{it} = 1) = f(Pollution_{it}, X_{it}, X_{rt}) \quad (1)$$

where $Intention_{it}$ is the dummy variable defined in Section 2.1 and $Pollution_{it}$ is annual average concentration of particulate matter defined in Section 2.2. X_{it} and X_{rt} are vectors of individual-level and regional control variables. These include respondents' demography (e.g., age, sex), socio-economic background (e.g., education, income), political persuasions (e.g., party affiliation), regional immigrant stock, and whether they suffer from two pollution-related health conditions: cancer and lung disease.

To identify the causal effect of pollution on $Intention_{it}$, the major challenge that we face is that LSOA-based pollution might be endogenous because respondents' residential location decision is a choice variable, causing potential selection bias. Hence, we employ atmospheric conditions (i.e., windspeed and rainfall) as instruments for $Pollution_{it}$. Our identifying assumption derives from well-established geophysical research showing that these atmospheric processes act as transport mechanisms (e.g., horizontal/vertical atmospheric movement and wet deposition) for the spatial diffusion of pollutants (Horton et al., 2014; Wang et al., 2016). Thus, the textbook and empirical economics treatment of location-based pollution recognises these processes as key determinants of pollution concentration (see Perman et al., 2011, p 149–151; Herrnstadt et al., 2021).

Finally, although it is almost impossible to confirm with certainty, we believe that the exclusion restrictions likely hold. This is because these atmospheric processes are mainly determined by nature and not due to the direct actions of survey respondents or their LSOAs. Moreover, it is very unlikely that individuals will directly base their intention to vote for far-right parties on meteorological conditions at 1 km grids around their residences.

4. Empirical findings

We present regression results in Table 2. In column (1), we fit a basic Probit model by regressing the intention to vote variable on $Pollution_{it}$ and the control variables.[4] We find a statistically significant positive relationship between the two. In column (2) we control for endogeneity of $Pollution_{it}$ with the control function approach. The endogeneity bias embodied in the pollution coefficient of column (1) is evident: controlling for endogeneity results in a much larger (nine-fold) positive pollution impact on $Intention_{it}$. Hence, the Probit estimate is markedly downwardly biased. Specifically, the endogeneity-corrected coefficient indicates that a unit increase in $PM_{2.5}$ concentration leads to a 0.9% ($p < 1\%$) rise in the intention to vote far-right.

In the first-stage regression (Table 3), the atmospheric coefficients are positive and statistically significant at the 1% level. Reassuringly, the F-statistic (i.e., 4613.77) far exceeds the rule of thumb critical value of 10, thus rejecting the null hypothesis that the instruments are weak. We further shed light on the wind instrument since strong winds may damage agricultural infrastructure and crop yields. Such outcomes might stoke economic discontent among farmers/rural voters and stimulate far-right support. Using an occupational dummy (agriculture=1 and 0 otherwise), we find that only 0.72% of sampled respondents are employed in the sector.[5] Reassuringly, neither the dummy nor its interaction with wind is statistically significant in our

Table 1
Summary statistics.

Variable	Mean	Std. Dev.	Min	Max
Right-wing intention (dummy)	0.024	0.154	0	1
PM 2.5 (μgm^{-3})	9.454	3.687	0.01	19.03

Notes: This table presents the descriptive statistics of our dependent variable and the main independent variable employed in our empirical analyses. The far right-wing intention dummy takes the value of 1 if respondents intend to vote for Democratic Unionist, UKIP, and British National Party, and 0 otherwise. PM 2.5 (μgm^{-3}) is the annual average concentration of particulate matter at the LSOA level. All other variables are defined in Appendix A.

[3] LSOAs have an average population of around 1000 people or 400 households. See: https://ukdataservice.ac.uk/app/uploads/censusgeography2022-10-18.pdf

[4] For robustness checks we also estimate a Linear Probability Model (LPM). Although it can suffer from heteroscedasticity, can provides probabilities outside the unit interval and does not accommodate a non-linear relationship between probability and underlying utility, it provides qualitatively stable and consistent results.

[5] This is consistent with the ONS' 0.8 % estimate. See https://www.ethnicity-facts-figures.service.gov.uk/work-pay-and-benefits/employment/employment-by-sector/latest/

Table 2
Empirical results.

Dep var >>	Intend to vote for a right-wing party		
	(1) Probit	(2) Probit endogeneity	(3) Probit endogeneity
Pollution	0.001***	0.009***	0.009***
	[0.000]	[0.000]	[0.001]
Age	0.001***	0.001***	0.001***
	[0.000]	[0.000]	[0.000]
Male gender	0.012***	0.011***	0.011***
	[0.001]	[0.001]	[0.001]
University degree	−0.010***	−0.010***	−0.010***
	[0.002]	[0.003]	[0.003]
A-Level	−0.001	0.001	0.001
	[0.002]	[0.002]	[0.002]
GCSE	0.009***	0.007***	0.007***
	[0.002]	[0.002]	[0.002]
Married	0.009	0.010	0.011*
	[0.006]	[0.006]	[0.006]
Single	0.010*	0.013**	0.014**
	[0.114]	[0.006]	[0.006]
Couple	0.015**	0.016**	0.017**
	[0.006]	[0.006]	[0.006]
Divorced	0.010	0.010	0.011*
	[0.006]	[0.008]	[0.007]
Separated	0.006	0.007	0.008
	[0.007]	[0.007]	[0.008]
Real income	−0.001*	−0.001**	−0.001**
	[0.000]	[0.000]	[0.000]
Political closeness	−0.029***	−0.025***	−0.025***
	[0.006]	[0.006]	[0.006]
Manual job	0.007***	0.008***	0.008***
	[0.001]	[0.001]	[0.001]
Local immigrants' share of pop.	−0.055***	−0.111***	−0.111***
	[0.006]	[0.009]	[0.009]
Cancer			−0.023
			[0.021]
Lung disease			−0.183*
			[0.103]
Pollution residuals		−0.009***	−0.009***
		[0.001]	[0.001]
Pollution × Cancer			0.003*
			[0.002]
Pollution × Lung disease			0.018**
			[0.009]
Log-likelihood	−8062.22	−7681.44	−7675.94
Observations	73,704	71,372	71,372
Individuals	27,378	26,505	26,505

Notes. This table presents the average marginal effects from the second-stage Probit regressions of individuals' intentions to vote for a far-right political party (dependent variable) on the annual average concentration of particulate matter at the LSOA level. A detailed definition and statistical description of all other variables are provided in the Online Appendix A. The sample covers the period January 2009 to May 2021. Standard errors are in parentheses and are clustered at the individual-level. * $p < 0.1$, ** $p < 0.05$ and *** $p < 0.01$.

supplementary analysis (see Appendix B).

The World Health Organization (WHO) estimates that, globally, over 90% of people live in areas with unhealthy air that increases the risk of lung diseases and cancers, leading to 4.2 million deaths globally each year (WHO, 2022). Hence, in column (3), we add two individual-level health conditions (i.e., emphysema and cancer) and their interaction terms with pollution. The marginal effect of pollution remains stable, retaining its qualitative and statistical properties. For individuals living with any type of cancer, a unit increase in pollution leads to an additional 0.3% increase in far-right voting intentions, albeit the interaction is only significant at the 10%-level. However, we find a much stronger 2% ($p < 5\%$) effect for lung disease sufferers. These findings suggest that the health conditions are plausible channels through which pollution amplify far-right extremism, with the total effect of pollution increasing the probability of extreme right support by 3%.

Table 3
First stage OLS results.

Dependent variable: Pollution	
Windspeed	0.570***
	[0.007]
Precipitation	0.001***
	[0.000]
All controls	yes
R-squared	0.145
No. of observations	71,372
Individuals	26,505
F-test of instrument	4613.77

Notes. This table presents the first-stage OLS regression results of the effect of instrumental variables (local windspeed and precipitation) on the local pollution variable. The dependent variable is the annual average concentration of particulate matter at the LSOA level. Windspeed is the annual average windspeed at the LSOA level (in mile per second) and precipitation is the annual total rainfall at the LSOA level (in millimetres). All control variables in Table 2 are included. Standard errors are in parentheses and are clustered at the individual-level. * $p < 0.1$, ** $p < 0.05$ and *** $p < 0.01$.

4.1. Robustness: accounting for voter sentiments

To rule out spurious correlation, we further probe the estimated positive effect of pollution on voting behaviour. Considering that far-right voters often convey anti-environmental and anti-establishment sentiments, we augment the model in Table 2 (column 3) with survey responses reflecting these two sentiments and their interactions with pollution. Table 3 shows a statistically significant positive effect for both sentiments, complementing the positive 'manual job' coefficient in Table 2 which implicitly captures the heightened fear of threats and sense of dislocation.[6] Even after adding the interaction terms (column 2), the pollution coefficient remains qualitatively stable. Two potential reasons are worth highlighting.

First, our findings suggest that right-wing voters that are more seriously affected by both pollution and immigration competition—and who therefore suffer poor health and productivity/income loss—are simply expressing their anger at the political centre for not protecting them, believing that the far-right will better support[7] them for nativist reasons. In essence, these respondents are protest voters motivated by factors other than the oft-cited reasons. To explore further channels, we also add the interaction term between pollution and a political closeness variable[8] in Table 4 to capture party affinity. As expected, respondents with stable party affiliations are less likely to vote far-right. However, when confronted with poor air quality, these respondents demonstrate a greater propensity to vote far-right (see the Pollution × Political closeness interaction in column 2). More specifically, the above interaction term suggests that, for the voter most likely belonging to another (centrist) political parties, a unit increase in $PM_{2.5}$ concentration raises their intention to vote far-right by 0.6%. This is in addition to the 1.2% pollution effect across all sampled respondents.

Second, we further exploit survey information on respondents with historical voting behaviour[9] but who intend to vote far-right. We find that 62% of them voted for other parties other than far-right parties

[6] Immigration mostly comprises of low-skilled workers. So, manual workers can be motivated by "ethnic competition" and anti-immigrant sentiment (Halikiopoulou et al., 2012).

[7] Such support could take the form of state welfare payments. Interestingly, an emerging expectation among far-right voters has been termed "Welfare Chauvinism" in which state support to immigrants should be limited in order to cater to 'deserving' natives (Schumacher and van Kersbergen, 2016; Chueri, 2022).

[8] This variable is a measure of party loyalty: Close to one political party than others (1-yes, 0-no).

[9] We identify party affiliation using the USS question "which political party closest to".

Table 4
Robustness.

Dep var: Intend to vote right-wing	(1)	(2)
Pollution	0.010***	0.012***
	[0.001]	[0.003]
Anti-environmental behaviour	0.001***	0.001
	[0.000]	[0.001]
Anti-establishment sentiment	0.011***	0.016***
	[0.002]	[0.005]
Political closeness	-0.057***	-0.103***
	[0.016]	[0.023]
Pollution × Anti-environmental behaviour		-0.000
		[0.000]
Pollution × Anti-establishment sentiment		-0.001
		[0.001]
Pollution × Political closeness		0.006***
		[0.002]
Log-likelihood	-2921.66	-2920.04
Observations	22,507	22,507
Individuals	9,366	9,366

Notes. This table presents the average marginal effects from the augmented second-stage Probit regressions of individuals' intentions to vote for a far-right political party (dependent variable) on the annual average concentration of particulate matter at the LSOA level. Anti-environmental behaviour is a composite index constructed from respondents' answers to 11 questions on respondents' pro-environmental behaviours. Anti-establishment sentiment is a four-scale measure of satisfaction with "the way democracy works in the country". Political closeness is a dummy variable that takes the value of 1 when a respondent is close to one political party than any others, zero otherwise. All previously used control variables are included. Smaller sample size is due to lower response rates to anti-environmental and anti-establishment survey questions. Standard errors are clustered at the individual-level. *$p < 0.1$, **$p < 0.05$ and ***$p < 0.01$.

during the last general election. Hence, it seems that these respondents are 'switching voters' expressing anger in the presence of high pollution. Our findings align well with recent research highlighting the challenge arising from ideological generalisations about far-right voters who are increasingly motivated by a range of protest vote drivers (Brils et al., 2022). Thus, our study has uncovered pollution as one of such drivers.

5. Conclusion

Using a nationally-representative sample of UK residents, we find that rising pollution increases the support for far-right parties, especially among lung disease and cancer sufferers. Given the rising joint incidence of pollution and political extremism, our results have implications for future socio-political outlook.

Data availability

The authors do not have permission to share data.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.econlet.2024.111648.

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