Health Externalities of India's Expansion of Coal Plants: Suggestive Evidence from a National Panel of 40,000 Households

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Motivation

Air pollution, from coal-burning power plants is emerging as a major public health concern in India.

- WHO estimates that air pollution contributes to 1/8th of all deaths globally.
- Coal fired plants generate 60.8% of all electricity in India & are rapidly expanding. Of 1200 new coal plants planned globally, 455 are expected to be built in India.

What are the health consequences of the expansion of coal plants in India?

Data & Methods

Dependent variable: **Reported morbidities (cough, fever, diarrhea)**.

Controls: Household and demographic controls, household electrification & kitchen fuel used.

Source: India Human Development Survey (IHDS) 2004-05 & 2011-12, a nationally representative panel of nearly 40,000 Indian households.

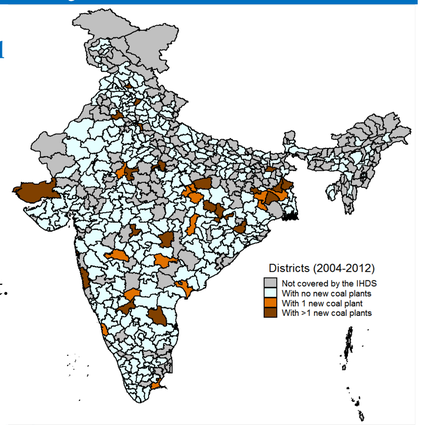
Independent variable: **the construction of coal & other power plants**, compiled at the district level.

Source: Central Electricity Authority of India administrative records.

Method: A fixed effect regression of change in coal plant at the district level on change in cough.

Summary Statistics

Figure 1: Map of districts with new coal plants built between 2004 & 2012 in IHDS districts



10.6% of the districts gained at least one coal plant.

Table 1: Summary Statistics

	2005 mean	s.e.	2012 mean	s.e.	*t*-test
independent variables					
dichotomized gained coal plant			.1063272	.0067085	15.84952
coal plants gained			.1964616	.0140891	13.94415
non-coal plants gained			.217802	.0233461	9.380707
dependent variables					
reported cough	.0984057	.0028484	.0826878	.0028609	-3.899443
reported fever	.4882303	.0055497	.6147234	.0054022	18.7389
reported diarrhea	.0455545	.0016483	.0282623	.0011429	-8.987626
control variables					
ln(consumption per capita)	9.589211	.0096092	9.908998	.0090714	47.63197
persons per household	5.847619	.0345305	4.86801	.0199853	-34.33857
urban	.2951922	.009198	.3176071	.0095499	6.574812
has electricity	.7637833	.0070615	.8697724	.0052065	21.95388
hours of electricity per day	15.19601	.1505935	15.0493	.1386512	-1.009544
separate kitchen	.5983905	.0063283	.5778051	.0066843	-3.449258
	n = 39,984		*n* = 39,984		

Notes: The t-test tests the hypothesis that the 2012 mean is equal to the 2005 mean.

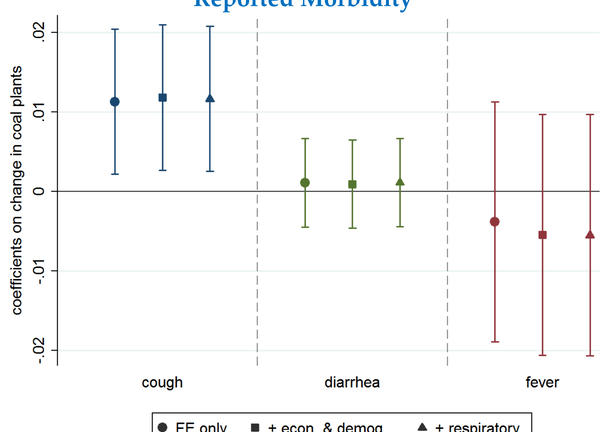
Between 2005 & 2012:

- Improvements in health & economic well being
- Average household consumption increased by 37.5%
- Reported cough declined 1.6 % points

Results

An additional coal plant is associated increases in cough, but not in diarrhea or fever, as we would expect.

Figure 2: Main Result: Regression Estimates of Association between Exposure to Coal Plants and Reported Morbidity



This result is robust to including economic & demographic controls or controls for improvement in cooking fuels.

- Estimates for change in cough are around .01, suggesting 1% more households reporting cough.
- In falsification tests using different outcome variables (reported diarrhea and fever), point estimates are near zero.
- No evidence that coal plants are associated with non-respiratory health outcomes.

OLS & Logit Estimates

Each additional coal plant added over this 7 year period was associated with a 1% more households reporting cough. Additional non-coal plants are not associated with an increase in cough.

Table 2: Robustness & Specificity of Regression Estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
model type:	OLS	OLS	OLS	OLS	OLS	OLS	OLS	logit
additional coal plants	0.0106†	0.0110†	0.0110†			0.0116†	0.0124*	1.15*
	(0.00640)	(0.00640)	(0.00632)			(0.00633)	(0.00613)	(0.05)
additional coal plants (top-coded)				0.0119†				
				(0.00653)				
dichotomized additional coal plant					0.0267*			
					(0.0131)			
additional non-coal plants						-0.00698**		
						(0.00234)		
additional coal plants × urban							0.0461**	
							(0.0162)	
PSU (village/place) fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
2012 fixed effect	-0.0178***							0.79***
	(0.00429)							(0.02)
urban × 2012 fixed effects		✓	✓	✓	✓	✓	✓	
ln (consumption per capita)		-0.00351†	-0.00408†	-0.00407†	-0.00412†	-0.00416†	-0.00401†	
		(0.00211)	(0.00240)	(0.00240)	(0.00241)	(0.00241)	(0.00240)	
full set of controls			✓	✓	✓	✓	✓	
n (households)	79,968	79,968	79,968	79,968	79,968	79,968	79,968	79,968
primary sampling units (places)	2,435	2,435	2,435	2,435	2,435	2,435	2,435	2,435

Notes:
† two-sided $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Columns 1 through 7 are OLS linear probability models; column 8 is a fixed effect logit model reporting the odds ratio.
Standard errors are clustered to reflect the survey design in columns 1 through 7, but should be interpreted with care in column 8 because classical standard errors are used.
In column 4, the independent variable is top-coded at a maximum of 4 additional coal plants between the IHDS survey rounds.
In column 7 both the coal plant independent variable and the urban indicator are demeaned to preserve comparability.

Conclusion

Indian districts that gained coal plants from 2005 to 2010 also experienced a relative increase in reported cough, suggesting health externality effects of coal plants.

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