Particulate Matter and Labor Supply: Evidence from Mexico City

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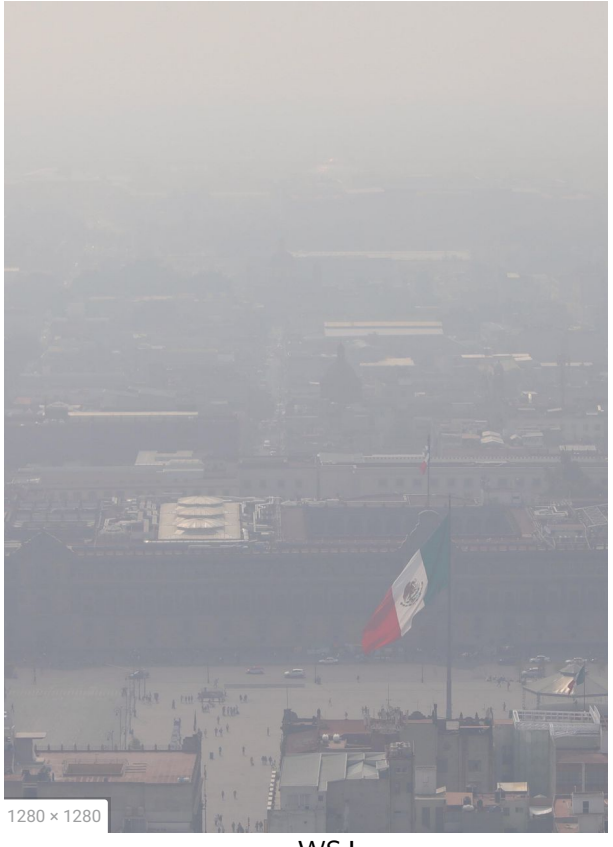
Introduction

- Exposure to PM2.5 has negative S-T and L-T health impacts
- **If exposure labor $>$ exposure leisure $\rightarrow$Trade-off: health vs. income**
- Workers with income closely linked to hours worked:
  low income, informal, etc.



source: WSJ.com

Preview of Results

Estimate the S-T response of labor supply and hospital admissions for respiratory diseases to PM2.5

Preview of Results:

- PM 2.5 has a **negative**, non-linear effect on labor supply
- PM 2.5 has **positive**, non-linear effect on hospital admissions for respiratory diseases
- Relative to formal workers, informal workers reduce hours worked less on days with high PM2.5 and compensate less over the following days
  $\rightarrow$ **informal workers have larger negative impacts on health and income**
- Income constraints likely to play a role: smaller reductions in labor supply when previous days had high PM2.5

Particulate Matter and Health

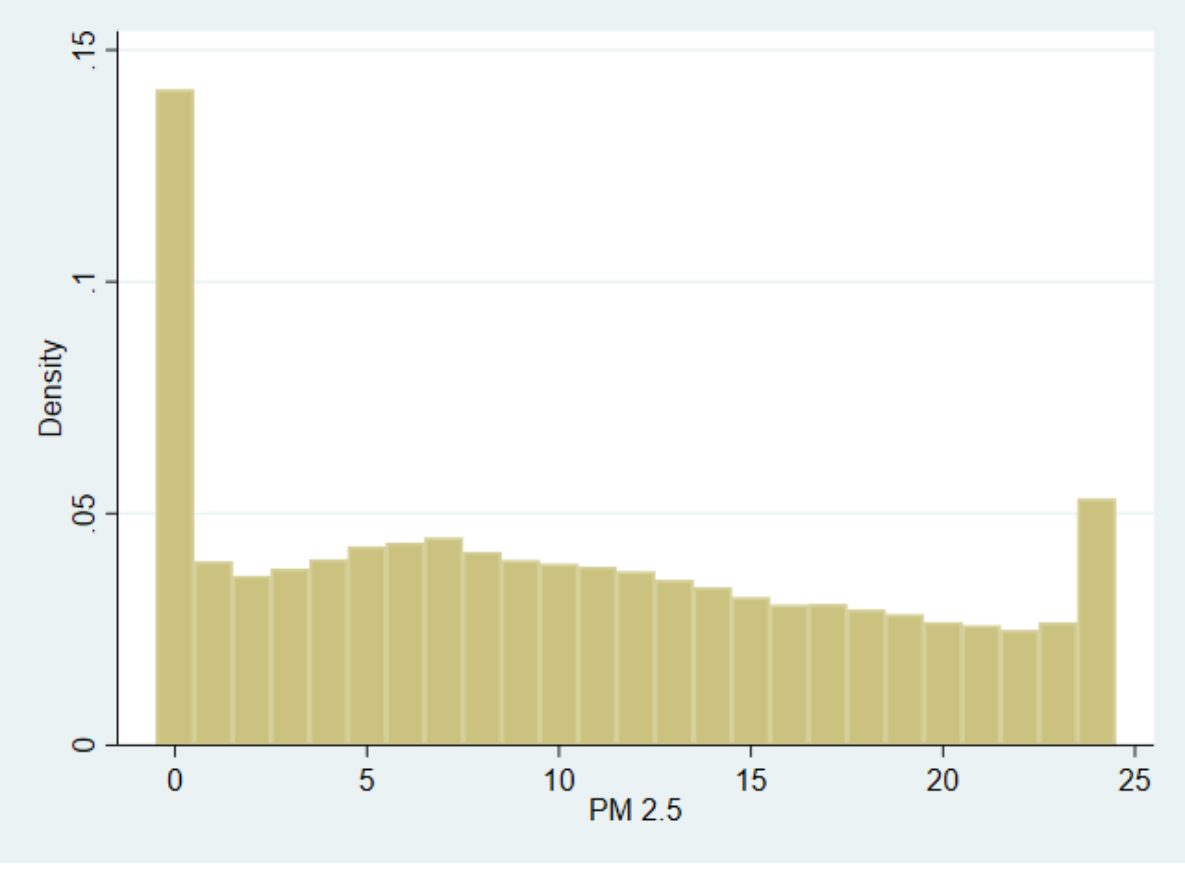
Particulate Matter:

- Particulate matter is causally linked to respiratory and cardiovascular disease and mortality (U.S. EPA, 2009)
- Short-term and long-term exposure can have serious health impacts (Anderson et al, 2012; Crouse et al., 2015; Cesaroni et al., 2014; Lin et al., 2002; Tertre et al., 2002;)

Fine Particulate Matter (PM2.5):

- Fine PM has stronger and broader health impacts than coarser PM (Bell et al., 2014; Pope and Douglas, 2006)

Particulate Matter in Mexico City



In study sample, mean number of hours above WHO PM 2.5 Air Quality Guideline: 10.1 hours

Sources of Data

1. Labor supply data: National Survey of Occupation and Employment (ENOE) collected by INEGI
2. Hospitalizations data: Automated Subsystem of Hospital Expenditures from Secretary of Health
3. Air pollution and weather data: Ground monitoring stations network available from SEDEMA
4. Precipitation data: CHIRPS from University of California Santa Barbara

Air Pollution Variables

	PM 2.5	PM 10
	(1)	(2)
Interim Target 1 (IT1)	75	150
Interim Target 2 (IT2)	50	100
Interim Target 3 (IT3)	37.5	75
Air Quality Guideline (AQG)	25	50

Notes: PM 2.5 and PM 10 are measured in $\mu g/m^3$ (WHO, 2005).

Baseline Regression Model: Labor Supply

$$y_{ilm,tw} = \alpha_m + \phi_w + \beta PM2.5_{lm,tw} + \gamma X_{ilm,tw} + \epsilon_{ilm,tw}$$

Where unit of observation is:

- Individual i
- Who resides in locality l
- Of municipality m
- On day t
- That falls within week w

Time-varying controls:

- Maximum temperature in locality l
- Precipitation in municipality m and it's square
- Day of week FE
- Age and it's square
- Gender
- Years of schooling and it's square

Baseline Regression Model: Hospital Admissions

$$y_{hm,tcy} = \alpha_m + \phi_{cy} + \beta PM2.5_{lm,tcy} + \epsilon_{hm,tcy}$$

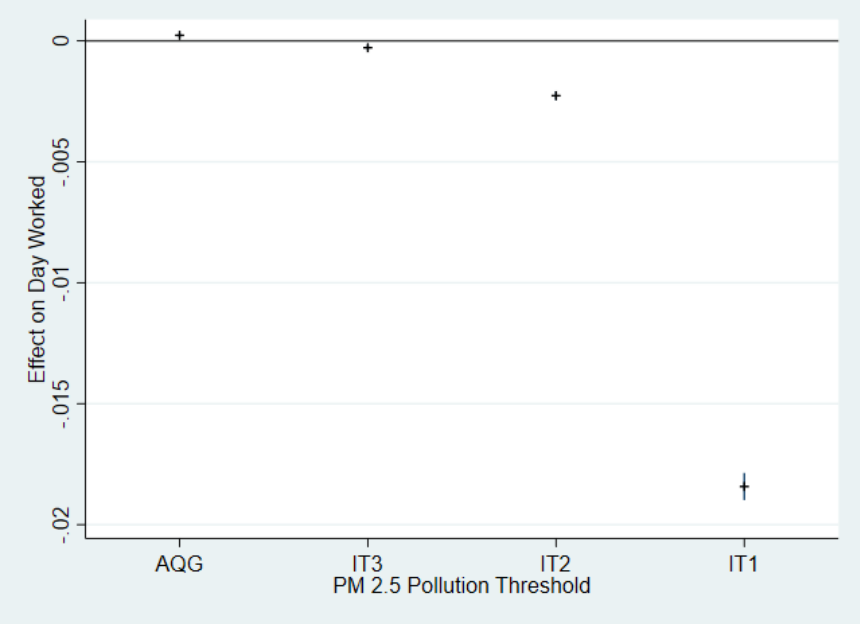
Where unit of observation is a hospital admission in:

- Hospital h
- Located in locality l
- Of municipality m
- On day t
- Within month m
- In year y

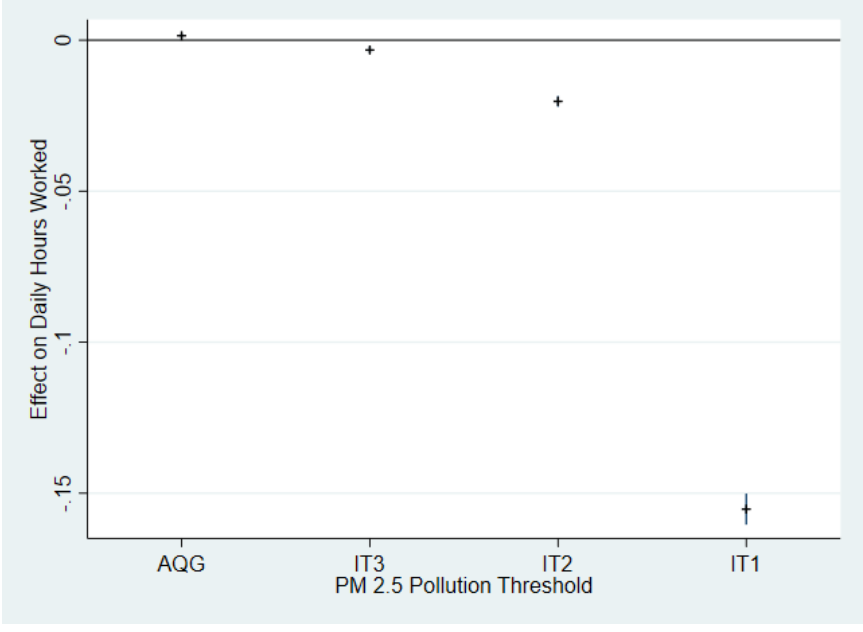
Restrict sample to exclude admissions related to pregnancy or child birth

PM2.5 and Labor Supply: Negative, Non-Linear Relationship

Panel A: Worked Day

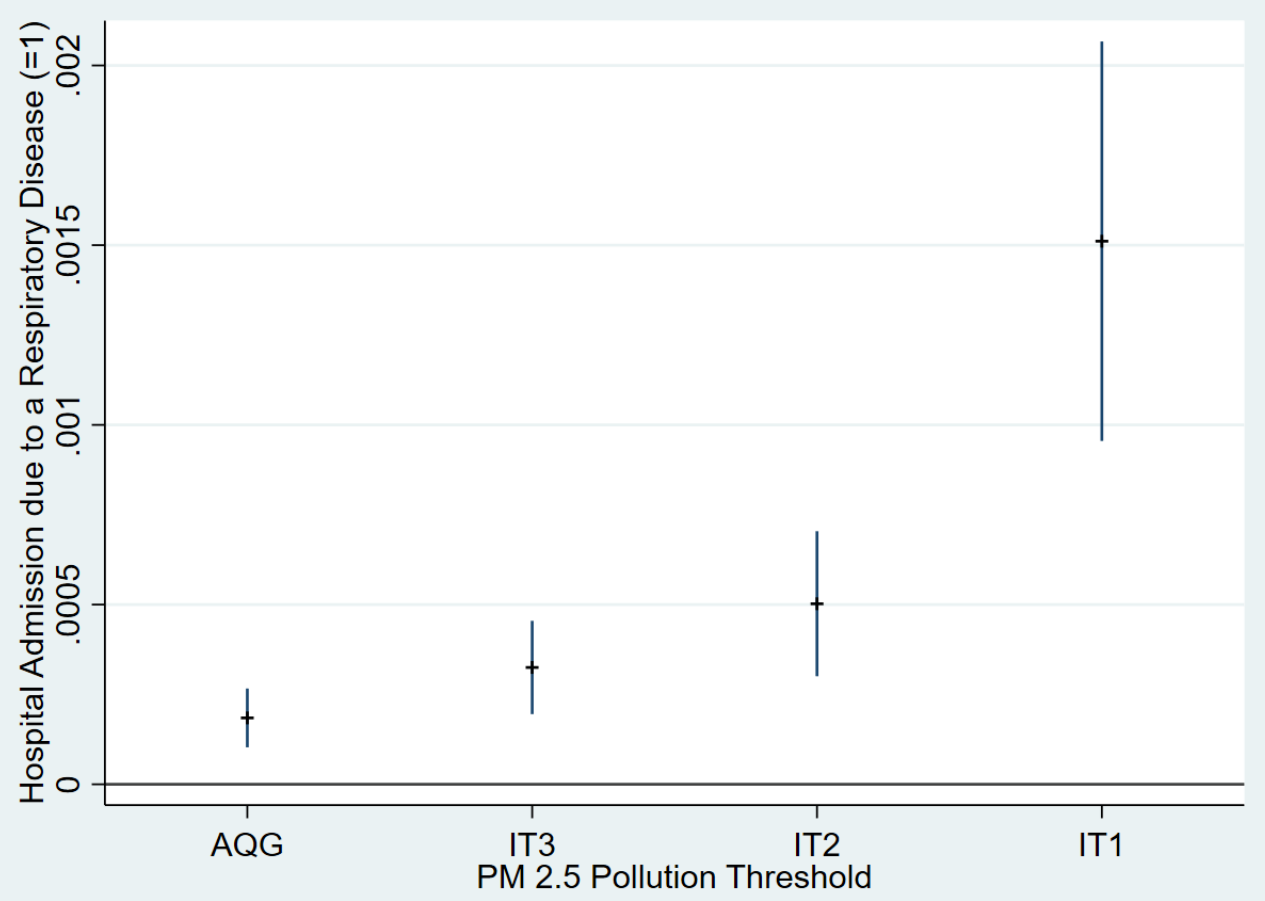


Panel B: Daily Hours Worked



Table

PM2.5 and Hospital Admissions: Positive, Non-Linear Relationship



Table

PM2.5 and Labor Supply: Heterogeneity by Employment Characteristics/Status

	Daily Hours Worked				
Characteristic	-0.569***	-0.624***	-0.139***	0.117***	-0.391***
	(0.005)	(0.006)	(0.005)	(0.008)	(0.014)
Hours Above PM2.5 IT1	-0.183***	-0.168***	-0.166***	-0.169***	-0.212***
	(0.004)	(0.003)	(0.004)	(0.004)	(0.016)
Characteristic x Hours Above PM2.5 IT1	0.049***	0.051***	0.024***	0.027***	0.030*
	(0.006)	(0.007)	(0.006)	(0.006)	(0.018)
Characteristic	Informal	Self Employed	Non-wage Employee	Low Education	Low Income
N	2,232,239	2,232,239	2,232,032	2,232,239	391,276

PM2.5 and Hospital Admissions: Heterogeneity by Share of Informality

	Respiratory Disease (==1)	
Hours Above PM2.5 IT1	-0.0027	0.0004
	(0.0021)	(0.0007)
Hours Above PM2.5 IT1 x Share Informality	0.0073**	
	(0.0037)	
Hours Above PM2.5 IT1 x Share Informality Q2		0.0010
		(0.0008)
Hours Above PM2.5 IT1 x Share Informality Q3		0.0005
		(0.0011)
Hours Above PM2.5 IT1 x Share Informality Q4		0.0023**
		(0.0011)
Method	Controls	Controls
N	1,290,481	1,290,481

PM2.5 and Labor Supply: Weekly-Level

	Weekly Hours Worked			
	Formal Workers		Informal Workers	
Hours Above PM2.5 IT1	-0.058*	-0.078**	-0.088**	-0.093***
	(0.035)	(0.034)	(0.035)	(0.035)
Method	Baseline	Occupation Controls	Baseline	Occupation Controls
N	159,348	159,348	180,084	180,084

PM2.5 and Hospital Admissions: Weekly Level

	Respiratory Disease (==1)
Hours Above PM2.5 IT1	0.0011***
	(0.0003)
Mean Hours Above PM2.5 IT1 Prior Week	0.0030***
	(0.0011)
Method	Prior Week
N	1,292,219

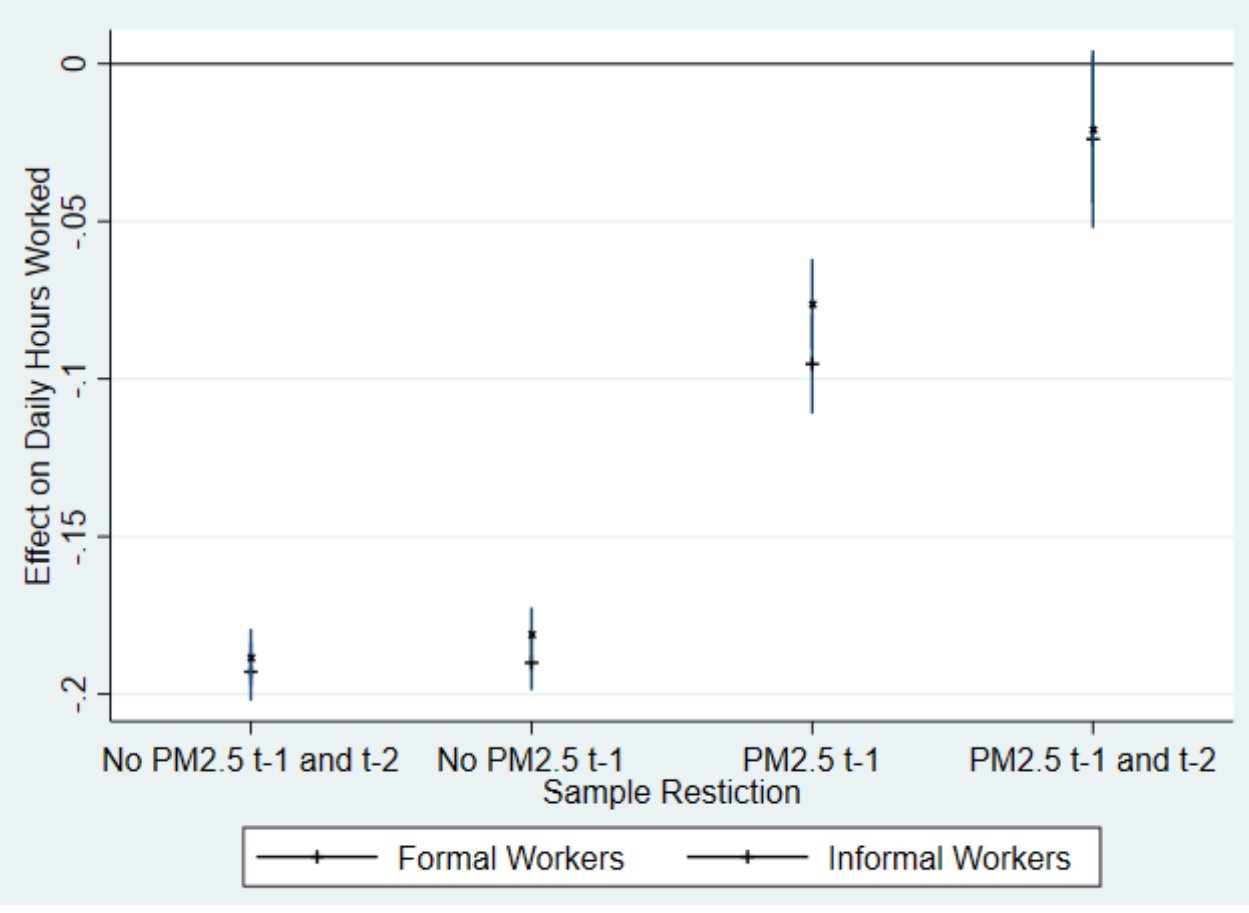
Summary of Results

Informal workers suffer greater impacts of high PM2.5 than formal workers:

1. Exposure to PM2.5 and negative health impacts
2. Labor supply and income losses

Income constraints may be playing an important role in workers' decisions

Role of Income Constraints: Consecutive Days with High PM2.5



Policy Implications

- Impacts to labor supply are another externality of PM2.5
  - Strong non-linear relationships implies focus on policies to decrease peaks of PM2.5
  - Large impacts imply even costly policies to reduce PM2.5 are worthwhile
- Health and labor supply impacts of PM2.5 are largest for workers with lower and more uncertain income
  - Distributional implications
  - Programs to support the health and income of informal and low SES workers

THANK YOU!

Robustness and Falisification Tests

1. Robustness and falsification tests for daily hours worked Table
2. Daily hours above WHO IT1 and daily hospital admissions for digestive and circulatory diseases Figure

PM2.5 and Labor Supply

	Day Worked		Daily Hours Worked	
Hours Above PM2.5 IT1	-0.018***	-0.018***	-0.155***	-0.155***
	(0.000)	(0.000)	(0.003)	(0.003)
Method	Baseline	Occupation Controls	Baseline	Occupation Controls
N	2,232,239	2,232,239	2,232,239	2,232,239

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PM2.5 and Hospital Admissions for Respiratory Disease

	Respiratory Disease (==1)	
Hours Above PM2.5 IT1	0.015***	0.013***
	(0.0003)	(0.0003)
Method	Baseline	Controls
N	1,302,701	1,291,703

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Robustness and Falsification Tests Table: Labor Supply

	Daily Hours Worked								Usual Daily Hours Worked
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Hours Above PM2.5 IT1 Threshold	-0.199***					-0.272***	-0.217***	-0.154***	0.002
	(0.004)					(0.057)	(0.047)	(0.003)	(0.007)
Hours Above PM10 IT1 Threshold		-0.085***	-0.091***						
		(0.003)	(0.003)						
Max Hours Above PM25-PM10 IT1 Threshold				-0.108***					
				(0.003)					
Min Hours Above PM25-PM10 IT1 Threshold					-0.166***				
					(0.005)				
Lead Hours Above PM2.5 IT1 Threshold								-0.006**	
								(0.003)	
Method	PM2.5	PM10	PM10 - Indiv. FE	Max IT1 PM2.5-PM10	Min IT1 PM2.5-PM10	IV	IV - Indiv. FE	Lead	Usual Hours
Sample	Weekdays	Full	Full	Full	Full	Full	Full	Full	Weekdays
N	1,593,422	2,328,400	2,328,369	2,338,133	2,338,133	2,224,744	2,224,708	2,230,682	152,784
R2	0.074	0.283	0.475	0.283	0.283	0.279	0.324	0.285	0.042

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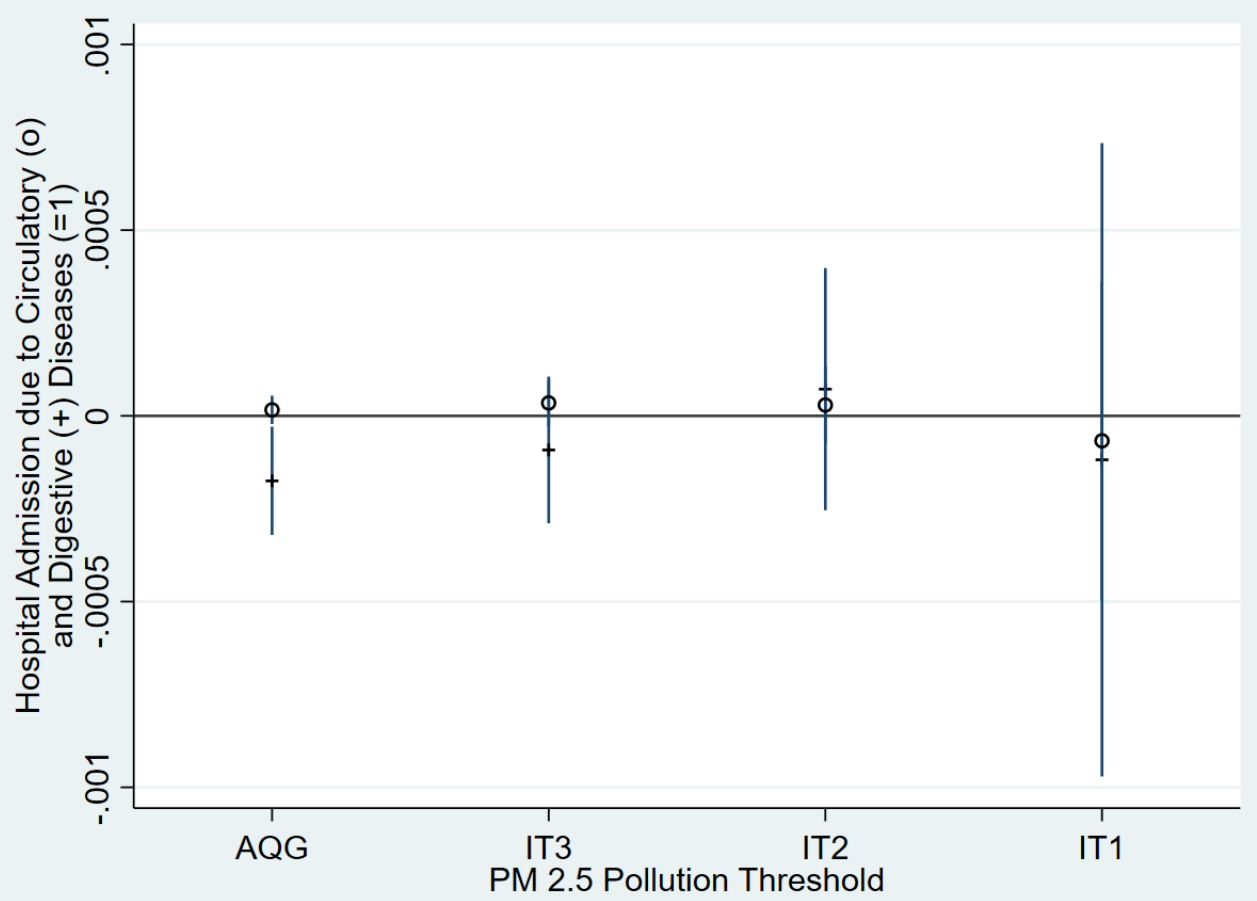
Falsification Figure: Hospital Admissions for Digestive and Circulatory Diseases



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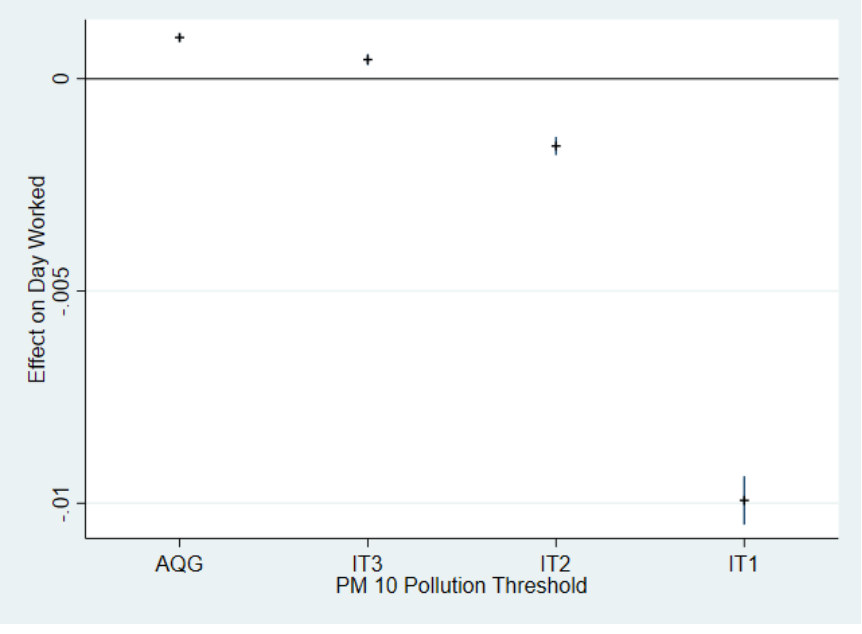
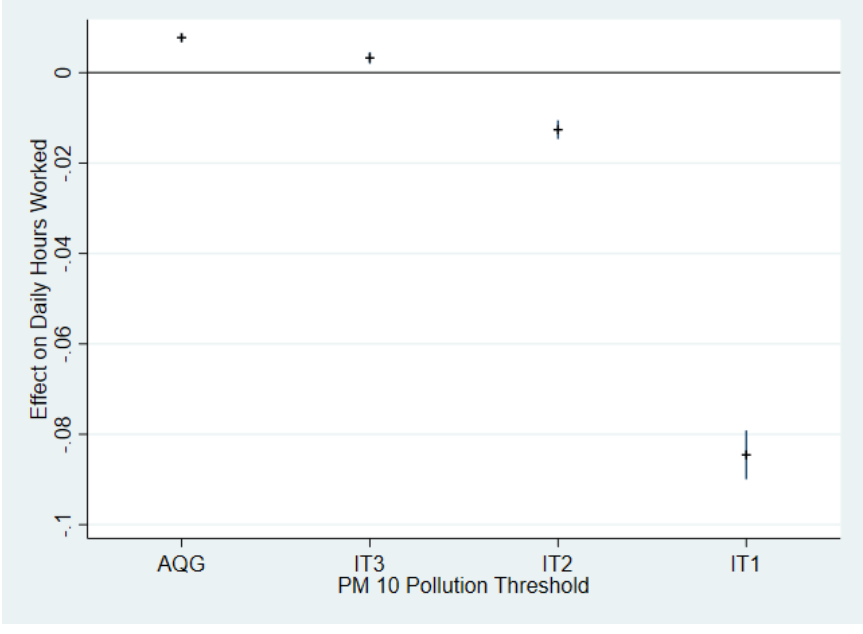
Negative Non-Linear Relationship

Panel A: Worked Day



Panel B: Daily Hours Worked



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WHO Thresholds

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