

Early-life environment and human capital: evidence from the Philippines

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ONLINE APPENDIX

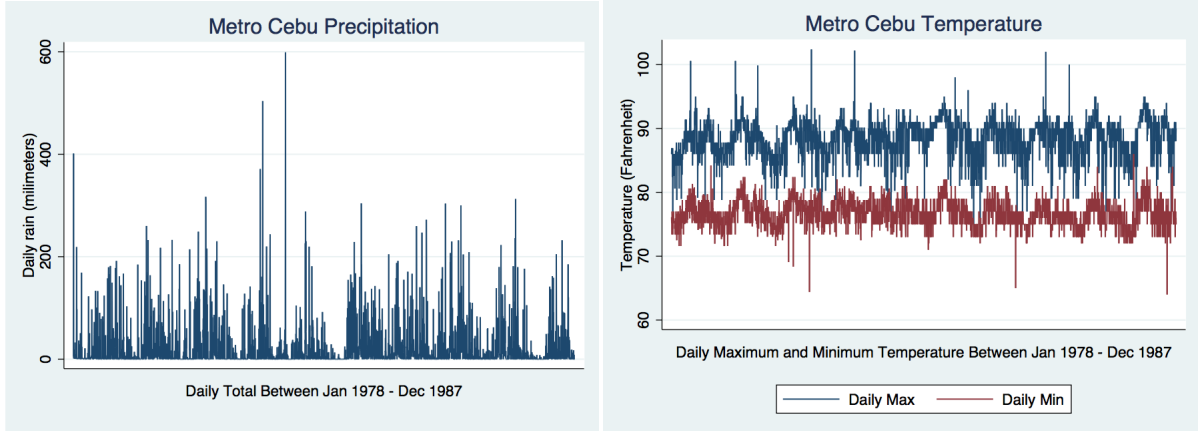


Figure A1. Daily measures of total precipitation and maximum/minimum temperatures in Metro Cebu, 1978-1987.

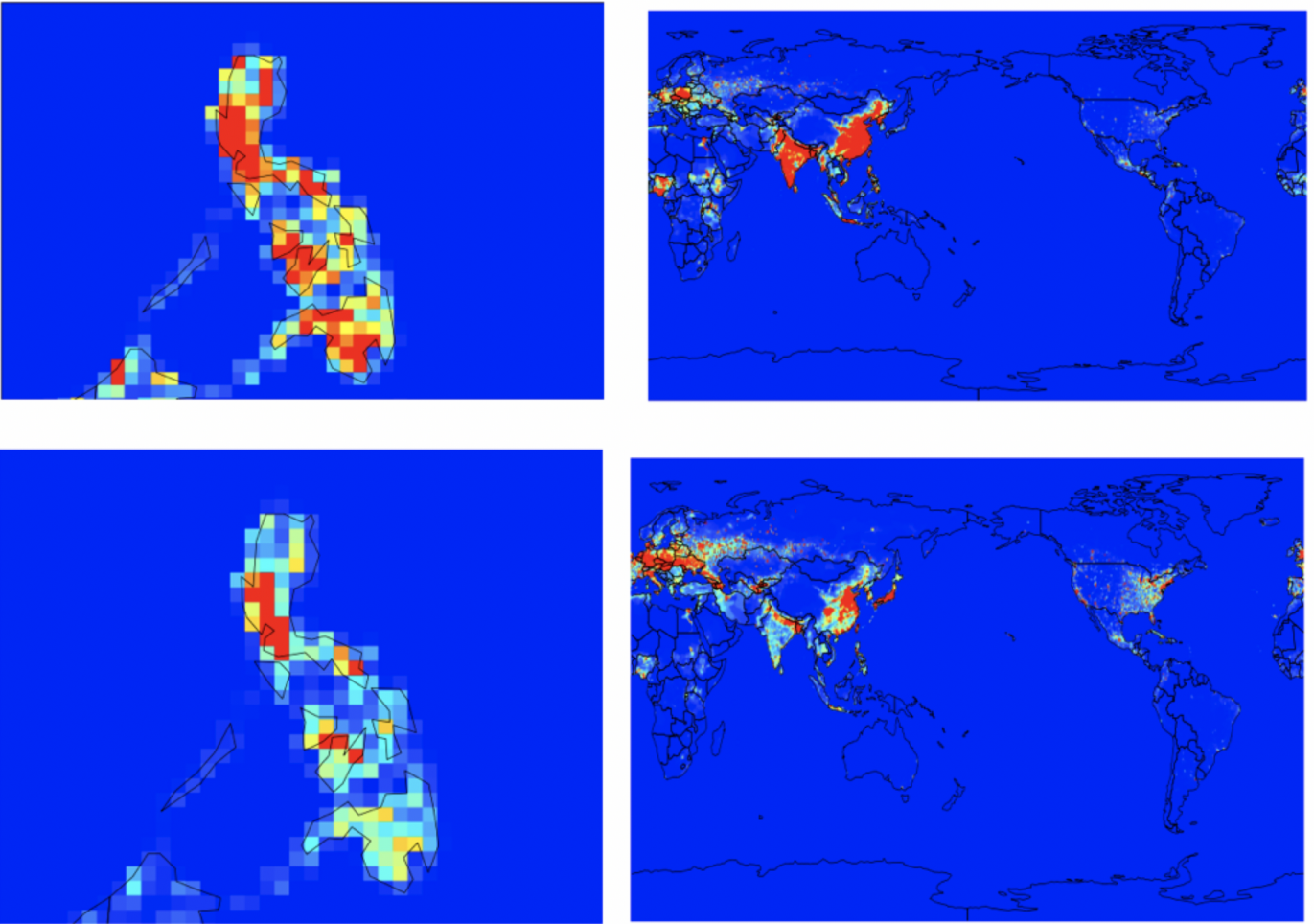


Figure A2. Maps of the Philippines (left) and world (right) from an example sector (residential/commercial). Top row: RETRO carbon monoxide emissions. Bottom row: RETRO ozone precursor emissions.

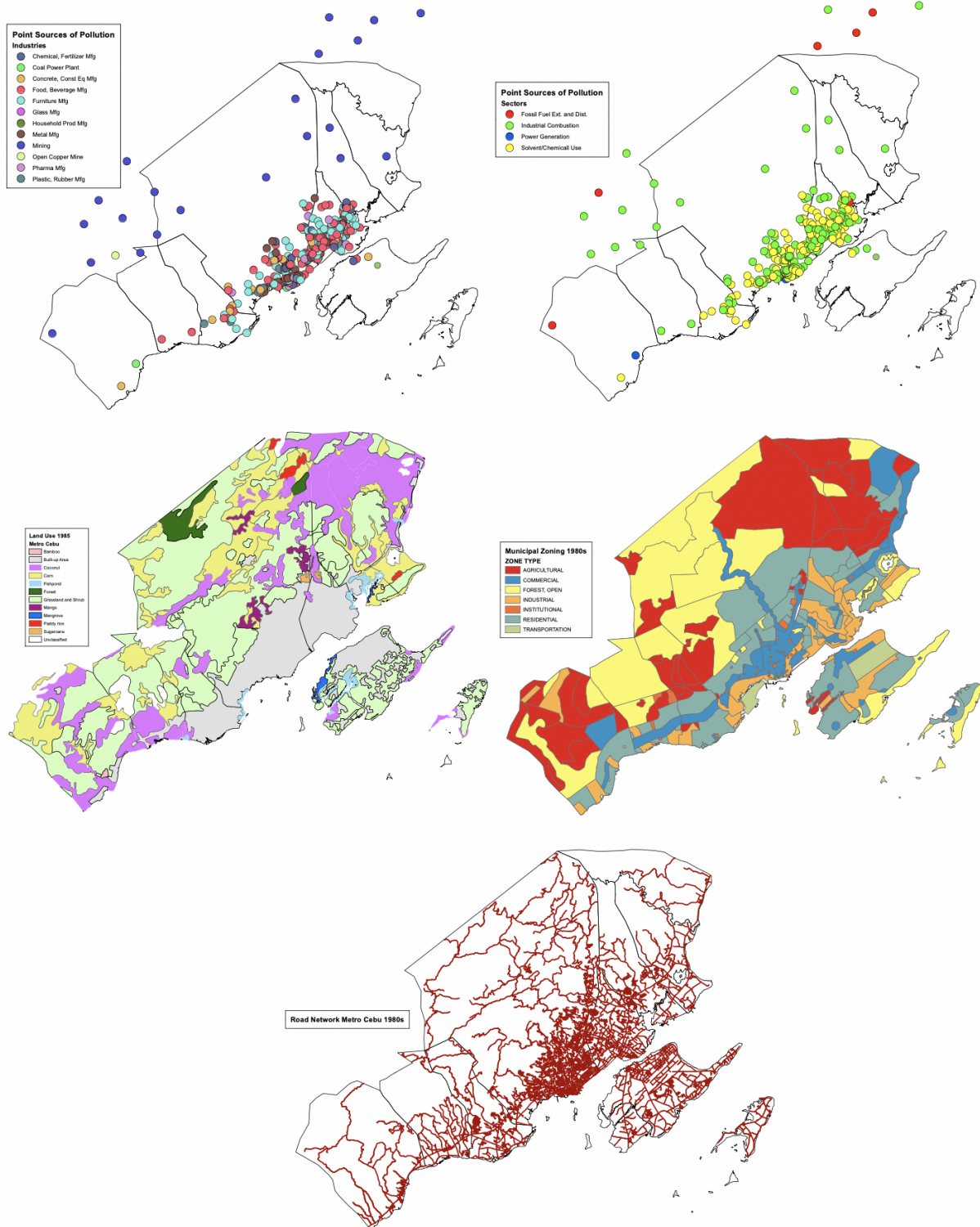


Figure A3. Maps of point and non-point sources of pollution. Top row: point sources by industry (left) and pollutant type (right). Middle row: land use in 1985 (left) and zoning in 1980s (right). Bottom row: road network in 1980s.

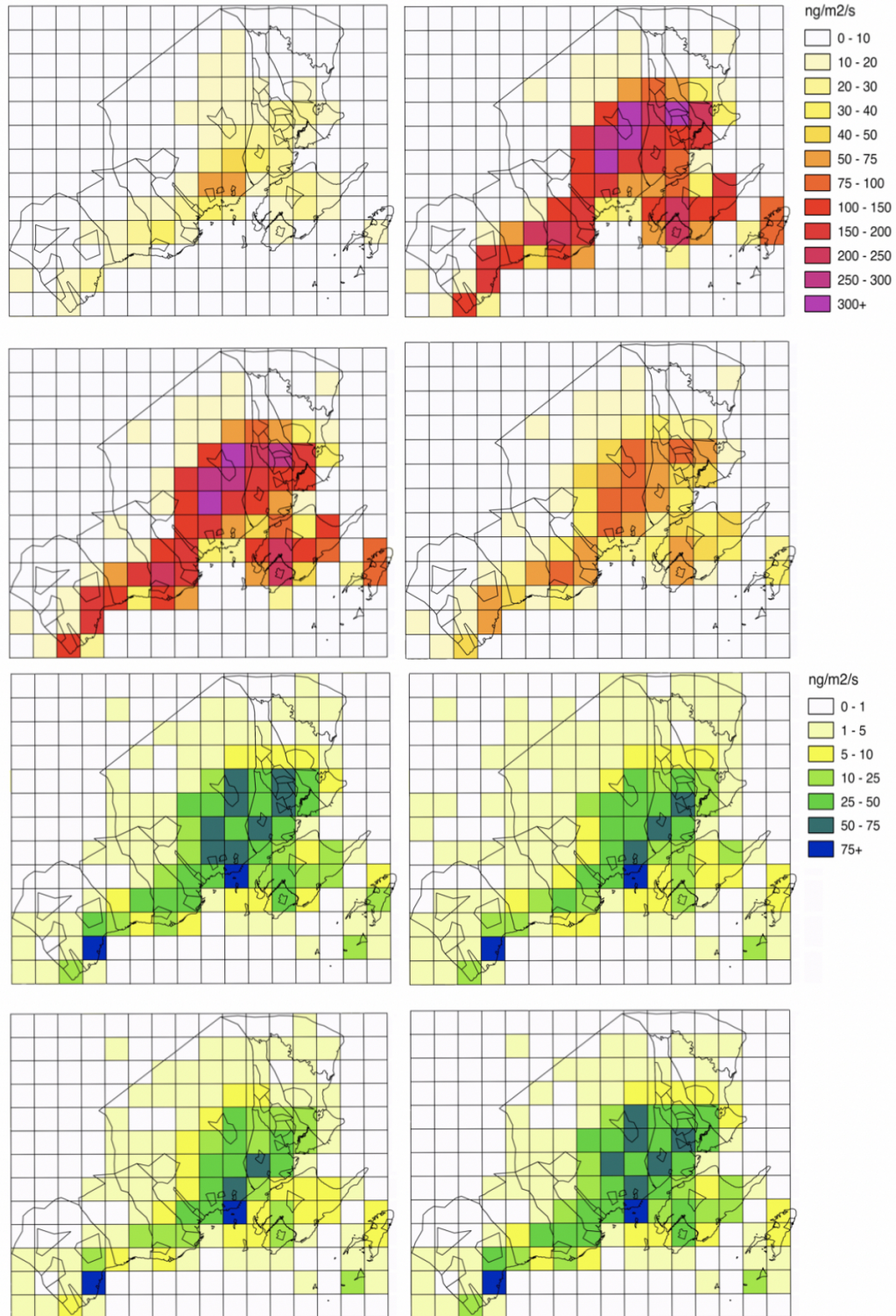


Figure A4. \hat{E}_{mjq} : maps of estimated CO (top 2 rows, red scale) and estimated O_3 (bottom 2 rows, green scale) emissions by micro-environment for each quarter (Q1 top left, Q2 top right, Q3 bottom left, Q4 bottom right) of a selected year.

Table A1. Correlation matrix of pollutant types

	Carbon monoxide	Nitrogen oxides	Volatile organic compounds
<hr/> <i>Fetal Exposures</i>			
Carbon monoxide	1		
Nitrogen oxides	0.05	1	
Volatile organic compounds	-0.068	0.422	1
<hr/> <i>Fetal and First Year Exposures</i>			
Carbon monoxide	1		
Nitrogen oxides	0.069	1	
Volatile organic compounds	-0.062	0.421	1
<hr/> <i>Fetal and First Two Year Exposures</i>			
Carbon monoxide	1		
Nitrogen oxides	0.07	1	
Volatile organic compounds	0.061	0.421	1

Notes: Data from RETRO emissions database. Volatile organic compounds here is a combination of benzene, toluene and xylene. The 3 pollutants listed here are combined to 2 in the analysis (CO and O3) based on the high correlation seen here between NOx and VOCs, as well as principle component analysis, and basic understanding that the interaction between NOx and VOCs in sunlight produce ozone.

Table A2. Emissions in Cebu compared to other cities

	Mean quarterly emissions (1982-1986), ng/m ² /s			
	Q1	Q2	Q3	Q4
<i>Cebu, Philippines</i>				
Carbon Monoxide (CO):	1,461.80	9,334.19	7,521.09	1,378.73
Ozone (O3):	1,012.09	1,147.94	1,111.45	1,031.83
Comparably Sized Cities				
<i>Kanpur, India</i>				
Carbon Monoxide (CO):	2,617.47	1,255.00	798.72	2,393.26
Ozone (O3):	991.94	1,373.35	1,315.72	860.71
<i>San Diego, United States</i>				
Carbon Monoxide (CO):	7,197.12	7,841.40	7,649.59	7,666.75
Ozone (O3):	1,753.17	1,778.15	1,815.97	1,701.74
Other Developing Country Cities				
<i>Manila, Philippines</i>				
Carbon Monoxide (CO):	45,685.55	24,067.69	16,649.71	42,286.77
Ozone (O3):	2,506.12	3,471.03	3,321.27	2,177.36
<i>Rio de Janeiro, Brazil</i>				
Carbon Monoxide (CO):	2,180.82	3,381.90	3,452.79	2,563.32
Ozone (O3):	6,800.00	5,968.92	6,297.22	6,671.63

Notes: Emissions come from the .5x.5 latitude-longitude grid of RETRO emissions dataset.

Table A3. RETRO emissions by source type and sector

	Mean and Standard Deviation of monthly average emissions in ng/m ² /s				
	1982	1983	1984	1985	1986
<i>Point Sources:</i>					
<i>Carbon Monoxide (CO):</i>					
Industrial Combustion	7.58 (0.32)	10.09 (0.43)	9.31 (0.39)	9.20 (0.39)	8.39 (0.35)
Power Generation	5.79 (0.51)	6.25 (0.55)	5.56 (0.49)	5.34 (0.47)	4.45 (0.39)
<i>Ozone (O3):</i>					
Industrial Combustion	48.38 (2.05)	55.97 (2.37)	47.75 (2.02)	44.27 (1.87)	42.90 (1.81)
Power Generation	144.95 (12.79)	153.73 (13.57)	136.32 (12.03)	130.53 (11.52)	116.82 (10.31)
Manufacturing with Solvents/Chemicals	130.63 (3.53)	134.19 (3.63)	127.09 (3.44)	126.30 (3.41)	132.35 (3.58)
Fossil Fuel Extraction and Distribution	2.11 (0.30)	2.06 (0.29)	1.78 (0.25)	1.58 (0.23)	1.74 (0.25)
<i>Non-Point Sources:</i>					
<i>Carbon Monoxide (CO):</i>					
Agricultural	626.19 (134.17)	626.19 (134.17)	626.19 (134.17)	626.19 (134.17)	626.19 (134.17)
Residential and Commercial	3410.20 (3,784.55)	3473.62 (3,854.92)	2690.85 (3,441.97)	2742.77 (3,508.38)	2783.86 (3,560.94)
Shipping	0.05	0.05	0.05	0.05	0.05

	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Road and Other Land Transportation	1433.70	1428.80	1346.07	1313.06	1421.12
	(58.87)	(58.67)	(55.27)	(53.91)	(58.35)
<i>Ozone (O3):</i>					
Agricultural	114.50	114.50	114.50	114.50	114.50
	(25.01)	(25.01)	(25.01)	(25.01)	(25.01)
Residential and Commercial	384.85	391.94	372.49	363.57	372.28
	(136.35)	(138.86)	(131.97)	(128.81)	(131.90)
Shipping	0.59	0.54	0.53	0.54	0.57
	(0.02)	(0.01)	(0.00)	(0.01)	(0.01)
Road and Other Land Transportation	181.72	179.96	167.20	160.59	167.98
	(7.46)	(7.39)	(6.86)	(6.59)	(6.90)
Waste Disposal	50.54	51.67	49.97	58.16	63.46
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
<i>Total Emissions:</i>					
Carbon Monoxide	5483.52	5544.99	4678.03	4696.61	4844.06
	(3,811.65)	(3,881.72)	(3,521.69)	(3,587.23)	(3,642.61)
Ozone	1058.27	1084.57	1017.63	1000.05	1012.60
	(134.63)	(138.09)	(130.07)	(126.58)	(128.10)

Notes: Monthly emissions come from the .5x.5 latitude-longitude grid of RETRO emissions dataset covering the province of Cebu.

Table A4. Differences by season of birth, urban/rural residence, and attrition status in observable parental and household characteristics

Household Characteristics	Season of Birth:		T-test P-value	Urban	Rural	T-test P-value	Never Attritors	Temporary Attritors	Permanent Attritors
	Amihan	Birth: Habagat							
Mother's education: primary or less	0.55 (0.50)	0.54 (0.50)	0.60	0.48 (0.50)	0.76 (0.42)	0.00***	0.58 (0.50)	0.49 (0.50)	0.46 (0.50)
Mother's height (cm)	150.61 (5.09)	150.67 (5.05)	0.74	150.70 (4.98)	150.48 (4.99)	0.29	150.52 (4.91)	150.95 (5.39)	150.86 (5.04)
Mother's tricep skin fold thickness (mm)	12.07 (3.77)	12.26 (3.76)	0.17	12.46 (3.81)	11.16 (3.22)	0.00***	12.10 (3.63)	12.11 (3.72)	12.34 (3.96)
Mother's arm circumference (cm)	24.55 (2.36)	24.67 (2.36)	0.15	24.71 (2.39)	24.25 (2.13)	0.26	24.57 (2.27)	24.44 (2.39)	24.73 (2.45)
Mother consumes pre-natal vitamins	0.55 (0.50)	0.62 (0.49)	0.00***	0.62 (0.49)	0.45 (0.50)	0.00***	0.56 (0.49)	0.61 (0.49)	0.62 (0.49)
Mother smokes during pregnancy	0.15 (0.36)	0.13 (0.34)	0.19	0.13 (0.34)	0.20 (0.40)	0.00***	0.15 (0.36)	0.15 (0.34)	0.13 (0.34)
Father's education: primary or less	0.52 (0.50)	0.49 (0.50)	.06*	0.76 (0.50)	0.43 (0.43)	0.00***	0.52 (0.50)	0.48 (0.50)	0.38 (0.49)
Per capita household income (pesos/month)	256.36 (328.66)	247.49 (281.00)	0.43	281.80 (332.36)	167.94 (194.15)	0.00***	244.17 (303.07)	269.95 (327.30)	278.48 (312.05)
Household rental amount (per month)	94.69 (115.49)	92.36 (110.24)	0.57	103.07 (135.65)	66.69 (37.29)	0.00***	90.22 (118.58)	103.14 (133.03)	102.55 (122.41)
Sanitary conditions (scale 0-1)	0.50 (0.23)	0.50 (0.23)	0.74	0.55 (0.26)	0.46 (0.17)	0.00***	0.49 (0.23)	0.52 (0.22)	0.51 (0.22)
Household solid-fuel use	0.82 (0.38)	0.84 (0.37)	0.22	0.79 (0.41)	0.97 (0.17)	0.00***	0.86 (0.35)	0.80 (0.39)	0.75 (0.43)
Ever permanently attrit from the sample	0.26 (0.44)	0.26 (0.44)	0.73	0.27 (0.44)	0.16 (0.37)	0.00***			

<i>Observations (N):</i>	1838	1284	2385	737	2151	573	814
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Notes: Significance indicated by *** 1%, ** 5%, *10%

Table A5. Scaling factors by sector and quarter

Pollutant by quarter	Point source power gen.	Point source industrial comb.	Non-point source res. and comm.	Non-point source land trans.	Non-point source agr. and unused land	Non-point source shipping	Point source mfg with chems	Point source fossil fuel ext/dist	Non-point source waste disposal
CO Quarter 1	1.577*** (0.037)	0.059*** (0.002)	0.009 (3.171)	106.356*** (3.195)	0.387*** (0.013)	0.005*** (0.000)			
CO Quarter 2	1.363*** (0.052)	0.054* (0.003)	46.503*** (4.484)	115.506** (4.518)	0.426** (0.018)	0.005*** (0.000)			
CO Quarter 3	1.322*** (0.052)	0.054* (0.003)	42.042*** (4.484)	114.251* (4.518)	0.549*** (0.018)	0.005*** (0.000)			
CO Quarter 4	1.519 (0.052)	0.057 (0.003)	10.034** (4.484)	111.711 (4.518)	0.556*** (0.018)	0.005*** (0.000)			
O3 Quarter 1	39.238*** (0.968)	0.323*** (0.008)	3.522*** (0.080)	13.287*** (0.432)	0.079*** (0.001)	0.058*** (0.001)	0.734*** (0.008)	0.328*** (0.007)	26.907*** (0.524)
O3 Quarter 2	33.910*** (1.369)	0.297** (0.012)	2.086*** (0.114)	14.431** (0.611)	0.117*** (0.002)	0.058*** (0.002)	0.753* (0.011)	0.249*** (0.010)	26.907*** (0.742)
O3 Quarter 3	32.898*** (1.369)	0.297** (0.012)	1.608*** (0.114)	14.274* (0.611)	0.081 (0.002)	0.058*** (0.002)	0.760** (0.011)	0.249*** (0.010)	26.907*** (0.742)
O3 Quarter 4	37.803 (1.369)	0.313 (0.012)	3.283** (0.114)	13.956 (0.611)	0.074*** (0.002)	0.057*** (0.002)	0.738 (0.011)	0.328 (0.010)	26.907*** (0.742)

Notes: For point sources the estimates are in terms of number of polluters. For non-point sources the estimates are in terms of square kilometers. Significance levels are indicated by *** 1%, ** 5%, *10%.

Table A6. Example First Stage: CO exposure during pregnancy

	Interactions									
	CO	Num. Industrial	Num. Power Generation	Num. Mfg. Solvents/ Chemicals	Num. Fossil Fuel Extraction	Area Agriculture (std.)	Area Res./Com. (std.)	Area Road/Transport (std.)	Area Waste (std.)	Area Shipping (std.)
<i>Extreme Values</i>										
Temperature (>90% of distribution)	2.829*** (1.015)	0.017 (0.343)	3.224*** (0.651)	0.043 (0.283)	-0.406** (0.185)	3.112*** (0.763)	-0.864 (2.220)	-0.285 (0.890)	3.551*** (0.934)	-0.088 (0.551)
Temperature (<10% of distribution)	0.123*** (0.023)	0.183 (0.272)	-3.412** (1.694)	0.038 (0.221)	-1.428 (2.389)	-1.167** (0.544)	-3.599*** (0.485)	-2.563*** (0.649)	1.349 (1.072)	0.340 (0.380)
Precipitation (>90% of distribution)	-2.942*** (0.928)	-0.216* (0.116)	0.191 (0.917)	0.075 (0.094)	0.270 (0.599)	-2.301*** (0.227)	1.298*** (0.129)	-0.742*** (0.281)	-1.167*** (0.441)	-0.023 (0.231)
Precipitation (<10% of distribution)	0.806*** (0.201)	0.067 (0.048)	1.583*** (0.387)	-0.074* (0.039)	3.350*** (1.083)	0.157 (0.115)	0.091 (0.082)	0.747*** (0.139)	-0.313* (0.167)	0.043 (0.120)
Wind Speed (>90% of distribution)	5.623*** (0.616)	0.002 (0.078)	0.225 (0.492)	0.651*** (0.174)	-0.053 (0.065)	-0.283 (2.945)	1.257* (0.717)	0.158 (0.227)	-0.123 (0.249)	-0.215 (0.147)
Humidity (>90% of distribution)	6.504*** (1.142)	-0.048 (0.360)	4.520*** (0.695)	0.030 (0.299)	-2.389 (3.059)	-0.571 (0.706)	3.056 (2.253)	0.829 (1.296)	0.065 (1.194)	-0.761 (0.604)
Humidity (<10% of distribution)	-2.447 (2.277)	-0.365 (0.396)	-1.618** (0.822)	0.372 (0.330)	0.019 (3.462)	0.275 (0.877)	-2.110 (2.495)	-0.791 (1.140)	-0.249 (1.335)	0.338 (0.837)
<i>Difference from Seasonal Averages</i>										
Precipitation (std.)	0.426*** (0.101)	-0.012*** (0.004)	0.082** (0.033)	-0.001 (0.003)	0.109*** (0.036)	-0.051*** (0.007)	0.007* (0.004)	0.047*** (0.007)	-0.052*** (0.018)	-0.015*** (0.005)
Wind Speed (std.)	0.163*** (0.016)	0.000 (0.001)	0.005 (0.009)	-0.001 (0.001)	0.002 (0.012)	-0.006** (0.003)	0.014*** (0.003)	0.005 (0.004)	0.001 (0.004)	0.001 (0.003)
Temperature (std.)	-0.071*** (0.010)	-0.009** (0.004)	0.036 (0.024)	0.005* (0.003)	0.073** (0.032)	-0.018*** (0.006)	-0.068*** (0.006)	0.003 (0.008)	-0.035** (0.017)	0.004 (0.006)

Humidity (std.)	0.024*** (0.009)	0.012** (0.005)	-0.037 (0.034)	-0.003 (0.004)	-0.111*** (0.041)	0.054*** (0.008)	0.041*** (0.007)	-0.016* (0.010)	0.040** (0.020)	-0.009 (0.008)
Standard Controls:	Yes									
Observations:	3,061									
Partial F-Statistic:	94.292									

Notes: These estimates are for the first stage corresponding to CO exposures occurring during pregnancy. The first stages corresponding to O3 and to other exposure windows (from conception to age 1 and from conception to age 2) are not shown here. First stage regressions also include the full set of control variables. The partial F-statistic does not include the control variables. Standard errors are clustered at the barangay (smallest administrative district) and birth quarter level. Significance levels are indicated by *** 1%, ** 5%, *10%.