

Online Appendix for: “The Effect of Open-Air Waste
Burning on Infant Health: Evidence from Government
Failure in Lebanon”

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1 Appendix Figures

Figure A1: Map of Lebanon



- Notes: The garbage crisis and the abrupt closure of the Naameh landfill mainly affected garbage management in the governorates of Mount Lebanon and Beirut. The governorates of Beirut and Mount Lebanon are home to more than half of the Lebanese population—more than 2 million individuals—and contain seven districts: Beirut, Jbail, Kesrouan, El Metn, Baabda, Aley and Chouf.

Figure A2: Timeline of events surrounding the Lebanese garbage crisis

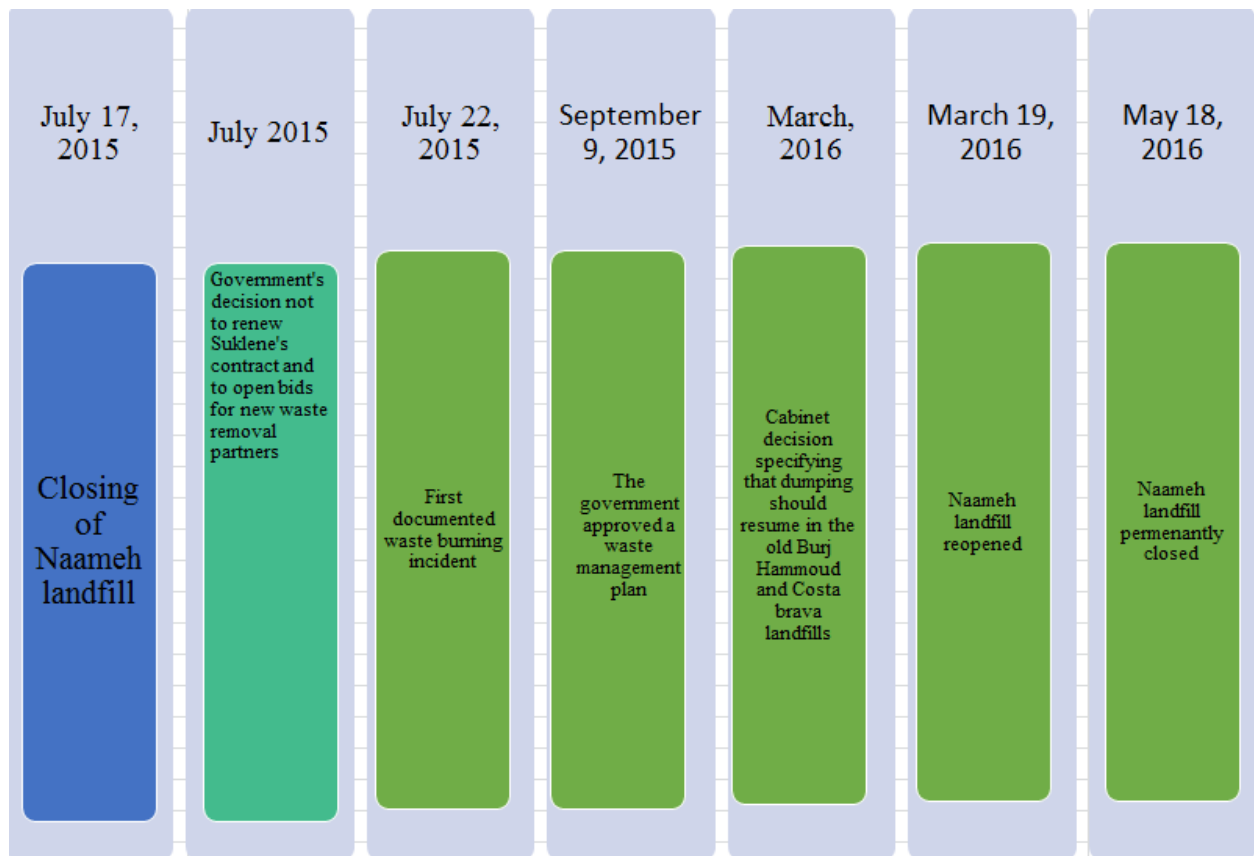
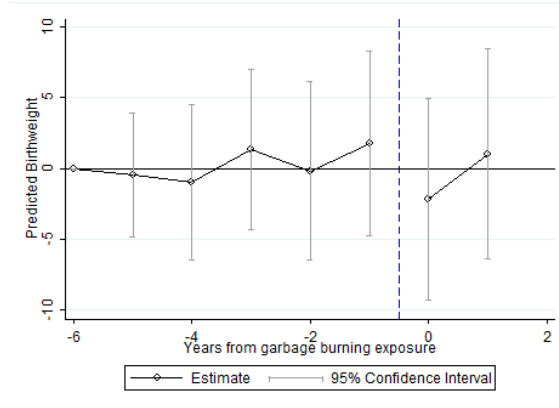


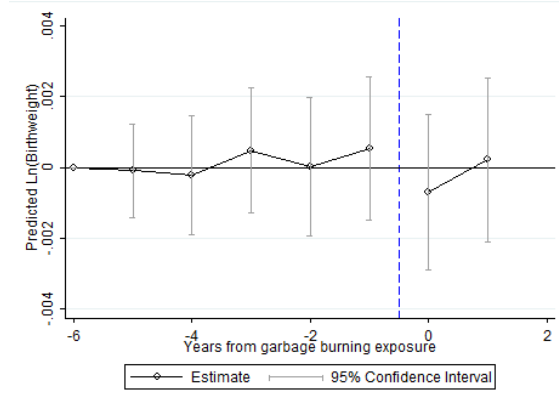
Figure A3: Incident of Trash Burning Near Residential Area in Beirut



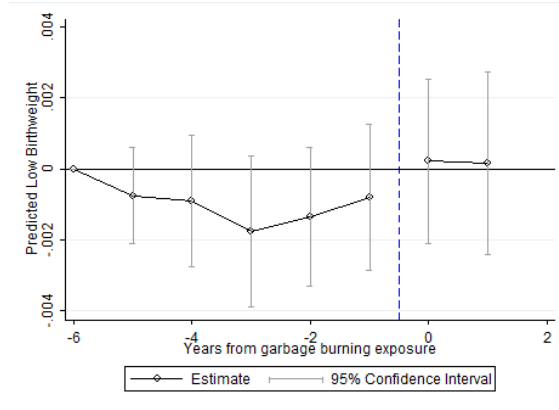
Figure A4: Dynamic leads and lags for predicted outcomes



(a) Predicted Birthweight



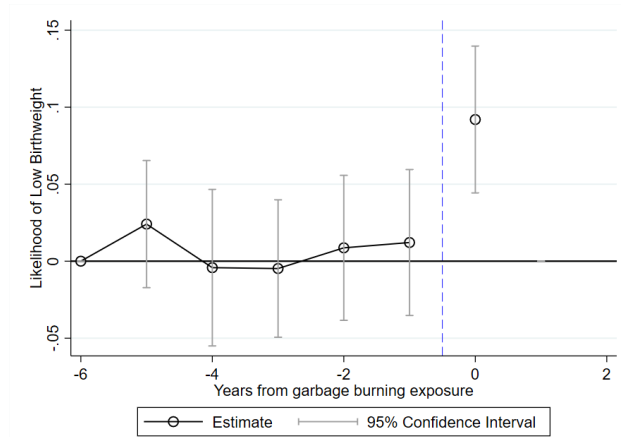
(b) Predicted Log Birthweight



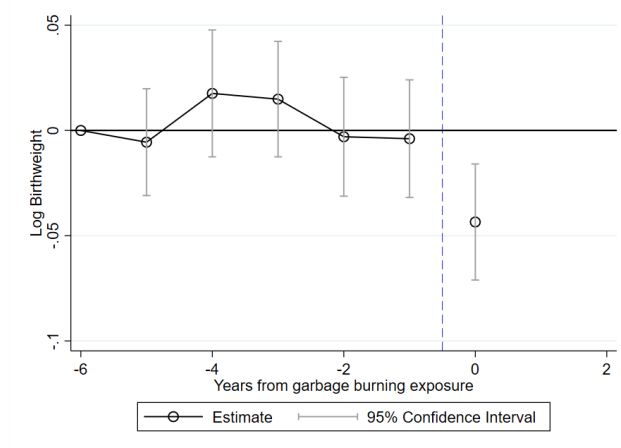
(c) Predicted Low Birthweight

- Notes: Each figure above shows coefficients from an event study that includes neighborhood and year fixed effects, and where the excluded time period is six or more years prior to the start of a burn in a specific region. Event t is defined at the neighborhood level and denotes a birth in time period t relative to the event of a first identified burn in region r . Thus, women at $t=0$ gave birth within the first nine months after the first post-crisis fire in her neighborhood, while women at $t = -1$ gave birth in the one year prior to the first post-crisis burn in her neighborhood. All predicted outcomes are based on our baseline covariates: Baby gender, maternal age, log number of births and private insurance status.

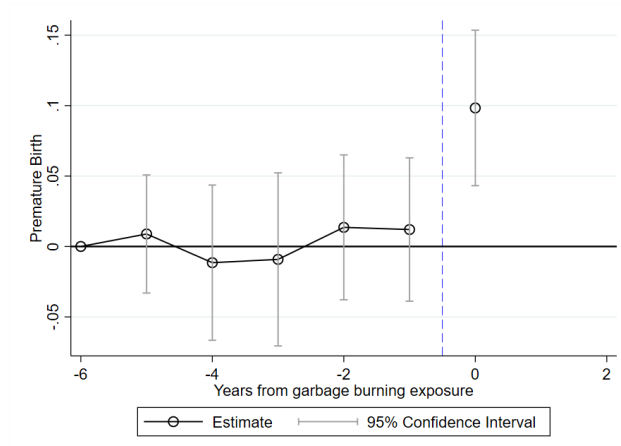
Figure A5: Dynamic event study figures with one post-period



(a) Low birth weight likelihood leads and lags



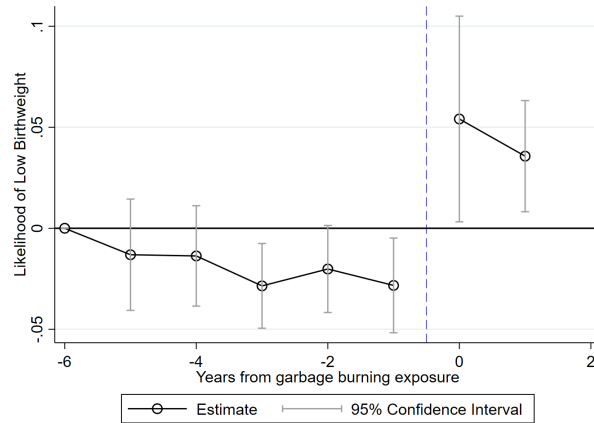
(b) Log birth weight leads and lags



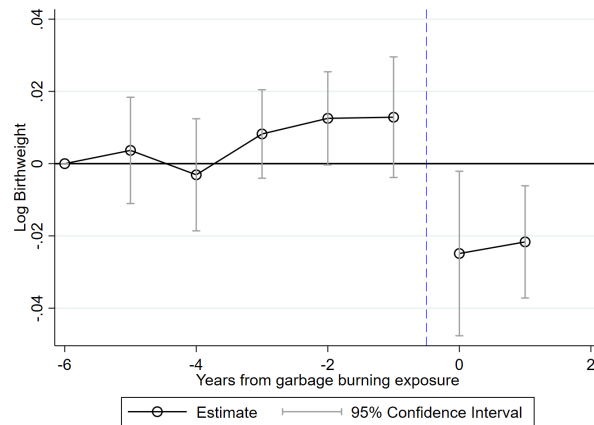
(c) Premature birth likelihood leads and lags

- Notes: The above figure shows coefficients from an event study that includes neighborhood and year fixed effects, and where the excluded time period is six or more years prior to the start of a burn in a specific region. Event t is defined at the neighborhood level and denotes a birth in time period t relative to the event of a first identified burn in region r . Thus, women at $t=0$ gave birth within the first nine months after the first post-crisis fire in her neighborhood, while women at $t = -1$ gave birth in the one year prior to the first post-crisis burn in her neighborhood.

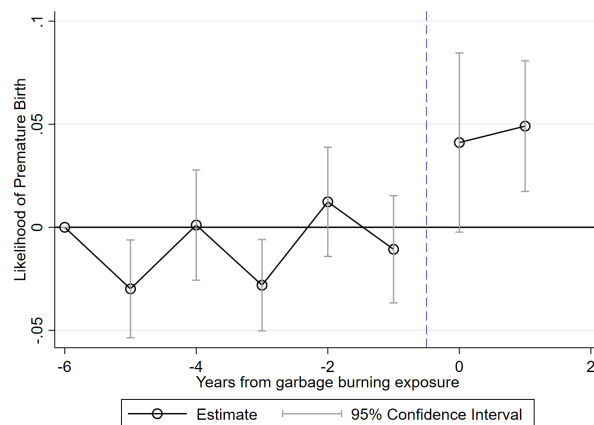
Figure A6: Static event study figures



(a) Low birth weight likelihood leads and lags



(b) Log birth weight leads and lags



(c) Premature Birth Likelihood leads and lags

- Notes: The above figure shows coefficients from an event study where the excluded time period is six or more years prior to the start of burns. Event t is defined at the country level and denotes a birth in time period t relative to the event of July 1, 2015 (i.e. the start of the crisis) for women residing in neighborhoods where any burning occurred. Thus, women at $t=0$ gave birth within the first nine months after the first post-crisis fire in the country, while women at $t = -1$ gave birth in the one year prior to the first post-crisis burn in the country.

2 Appendix Tables

Table A1: Pollutants and health hazards from open-air waste burning

Pollutant	Global Emissions of Pollutant Due to Open Burning (Kg/year)	Percent of Total Global Emissions of Pollutant Due to Open Burning	Potential Serious Health Impacts
Carbon Dioxide (CO ₂)	1.4 Trillion	5%	<ul style="list-style-type: none"> • Cardiorespiratory failure • Climate change associated risks
Methane (CH ₄)	3.6 Billion	1%	<ul style="list-style-type: none"> • Respiratory arrest • Climate change associated risks
Carbon Monoxide (CO)	37 Billion	7%	<ul style="list-style-type: none"> • Ataxia • Seizures
Coarse Particulates (PM ₁₀)	12 Billion	24%	<ul style="list-style-type: none"> • Lung cancer • Respiratory disease • Heart failure • Birth outcomes
Fine Particulates (PM _{2.5})	10 Billion	19%	<ul style="list-style-type: none"> • Lung cancer • Respiratory disease • Heart failure • Birth outcomes
Black Carbon (BC)	632 Million	11%	<ul style="list-style-type: none"> • Lung cancer • Respiratory disease • Heart failure • Birth outcomes
Organic Carbon (OC)	5.1 Billion	43%	<ul style="list-style-type: none"> • Lung cancer • Respiratory disease • Heart failure • Birth outcomes
Polycyclic Aromatic Hydrocarbons (PAH)	334 Million	39%	<ul style="list-style-type: none"> • Skin, bladder and lung cancer • Poor cognitive development
Benzene	875 Million	25%	<ul style="list-style-type: none"> • Chromosomal mutations • Acute myeloid leukemia
Hydrochloric Acid (HCL)	3.5 Billion	39-58%	<ul style="list-style-type: none"> • Respiratory issues • Glaucoma and cataracts

- *Source:* Wiedinmyer, Yokelson, and Gullett (2014)

Table A2: The effect of exposure to waste burning on infant birth outcomes based on size of area where waste was burned

	(1)	(2)	(3)	(4)
Panel A: Low birth weight				
Treatment estimate	0.022** (0.009)	0.022** (0.009)	0.022** (0.009)	0.047** (0.023)
Panel B: Birth weight				
Treatment estimate	-34.481*** (11.928)	-33.338*** (11.763)	-32.759*** (11.695)	-90.061* (49.854)
Panel C: Log birth weight				
Treatment estimate	-0.012*** (0.004)	-0.012*** (0.004)	-0.011*** (0.004)	-0.030* (0.016)
Panel D: Gestational age				
Treatment estimate	-0.092*** (0.034)	-0.085** (0.035)	-0.082** (0.035)	-0.115 (0.124)
Panel E: Premature birth				
Treatment estimate	0.010 (0.007)	0.009 (0.007)	0.008 (0.007)	0.017 (0.031)
Panel F: Small for gestational age				
Treatment estimate	0.018* (0.009)	0.018* (0.009)	0.017* (0.009)	0.066** (0.029)
Year Fixed Effects	Yes	Yes	Yes	-
Neighborhood Fixed Effects	Yes	Yes	Yes	-
Month Fixed Effects	Yes	Yes	Yes	-
Individual Controls	No	Yes	Yes	Yes
Weather Controls	No	No	Yes	Yes
Neighborhood-by-Year Fixed Effects	No	No	No	Yes
Neighborhood-by-Month Fixed Effects	No	No	No	Yes
Date of Birth Fixed Effects	No	No	No	Yes
Observations	6,531	6,531	6,531	6,531

Note: Each cell represents a separate regression. Treatment in the above regressions is defined as “number of open air waste burns mothers were exposed to during pregnancy per square kilometer of area”. Individual Controls consist of baby gender, insurance status and maternal age. Weather controls consist of temperature, humidity, rain volume as well as north and east wind patterns. Standard errors clustered at the neighborhood level and reported in parentheses. *** p < 0.01 ** p < 0.05 * p < 0.1