Resource Extraction and Infant Health: Evidence from Colorado

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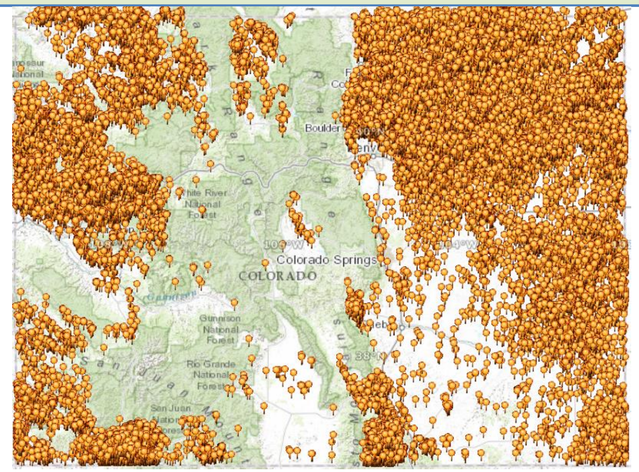
Oil and Gas Development in Colorado

- Long History of Oil and Gas Development ; first commercial well drilled in 1862
- Most wells today are hydraulically fractured (9 out of 10 on shore wells)
- A well takes 3-4 months on average to drill
- Wells require between 1000-2000 truck trips (diesel exhaust) (ALL Consulting, 2010)
- Sparse info regarding environmental consequences due to regulatory exemption
- Drilling operations produce measurable air pollution (NOx, VOCs, PM, CO, SO2, BTEX), toxic solvents and Polycyclic aromatic hydrocarbons (Colborn et al. 2012)
- Of the chemicals used in the process, approximately 40-50% could affect the brain/nervous system, immune and cardiovascular systems, and the kidneys; 37% could affect the endocrine system; and 25% could cause cancer and mutations. (Colborn et al. (2011)

Pollution and Infant health

-Studies have linked reductions in air pollution with reductions in infant mortality and the prevalence of low birth weight (see Currie et al 2011 for discussion)
- Hill (2012) found increases in overall prevalence of low birth weight for infants exposed to shale gas development in Pennsylvania



Locations of Oil and Gas Wells in Colorado

Research Questions

- What is the impact of oil and gas development on human health?

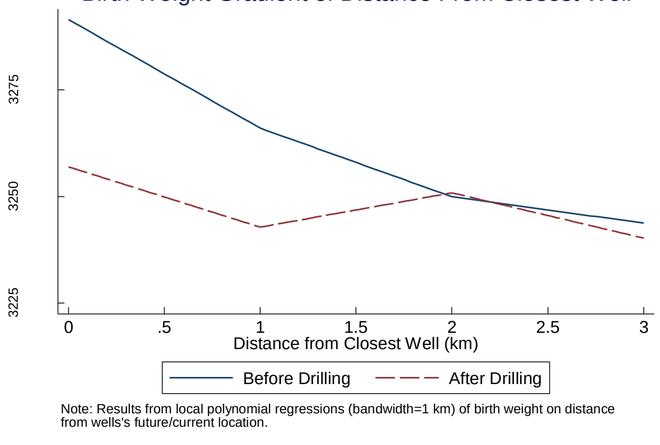
Infant Health Measures:
Term Birth Weight – birth weight for babies who reach full term (>37 weeks)
Gestation Length- measured in weeks of gestation
Premature birth - estimated gestation length less than 37 weeks
Low birth weight (LBW) - birth weight below 2,500 grams

Data

- Geocoded detailed Colorado Vital Statistics Natility Records (2000-2011)
- Geocoded Colorado Oil and Gas Conservation Commission Well and Permit data

Research Design

-"Treatment" defined as mothers living 1 km from a well differencing out those who live 1-2 km before and after drilling
"Control" defined as mothers living 2-5 km from a well
-Identifying Assumption : In the absence of the treatment, the characteristics of mothers nearest to drilling operations change over time similarly to those of mothers who live slightly further away, but exposure is likely to diminish with proximity



Note: Results from local polynomial regressions (bandwidth=1 km) of birth weight on distance from wells's future/current location.

Estimation Strategy: Difference–In–Difference estimator

b_3 =coefficient of interest

$$Outcome_{it} = a + b_1 closest1km_{it} + b_2 closest2km_{it} + (b_3 closest1km_{it} + b_4 closest2km_{it}) * Post_{it} + b_6 X_{it} + \alpha_j + \delta_t + \alpha_j * \delta_t + \varepsilon_{it}$$

Where
i= individuals; t=time
$Outcome_{it}$ is Term Birth Weight, Gestation, LBW, Prematurity
$Closest1km_{it}$ indicator equal to one if the mother resided 1km from well
$Post_{it}$ is an indicator equal to 1 if birth occurred post-drilling
X_{it} vector of mother characteristics
α_i are county fixed effects
δ_{it} are birth month and year dummies

Table 1: Summary Statistics For Difference-in-Difference Sample

	Sample Means		T-Stat
	Within 1km	Within 2km	of Diff
Characteristics of Birth			
Birthweight	3299.98	3276.47	2.43*
Gestation Length	38.86	38.83	0.89
Premature	0.07	0.07	-1.99*
Low birth weight (LBW)	0.06	0.06	-1.17
Female Child	0.48	0.49	-1.23
Mother's Demographic Characteristics			
Age	27.50	26.67	7.59***
Education	13.77	13.40	5.20***
White	0.955	0.949	1.75
Black	0.004	0.009	-3.76***
Hispanic	0.306	0.384	-9.04***
Smoked during pregnancy	0.067	0.082	-3.15**
Drank alcohol during pregnancy	0.007	0.008	-1.17
Married	0.770	0.741	3.67***
Previous Risky Pregnancy	0.204	0.200	0.51
Parity	2.082	2.043	1.85
Sample Size	6448	5633	

Acknowledgements

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Table 2: DD Estimates of the Effect of Drilling on Infant Health by Proximity, Colorado 2000-2011

	Term Birth Weight	Gestation	LBW	Premature
	(2)	(4)	(6)	(8)
Sample Mean:	3245.12	38.69	0.08	0.09
All observations within 5 km of any well type				
Within 1 km * post-drilling	-30.01***	-0.0999**	0.0131***	0.0172***
Sample Size	20,620	22,206	22,208	22,206
R2	0.095	0.050	0.055	0.046
Maternal Characteristics	yes	yes	yes	yes

*** p<0.01; ** p<0.05; * p<0.10

Results and Discussion

-Exposure to drilling has adverse impacts on human health

-Exposure to Any Type of Drilling in Colorado Reduces Health Endowment at Birth

- Reduced term birth weight by 30 grams and gestational period by 1/10th of a week on average
- Increased incidence of LBW by 1.31 percentage points, or overall prevalence of LBW increased by 21.8% (base= 6.0%)
- Increased incidence of premature birth by 1.72 percentage points, or overall prevalence by 24.5% (base=7.0%)

-For comparison, Currie et al (2009) find that smoking in utero increases LBW prevalence by 0.018 percentage points on a baseline of 0.089 in NJ

-Differences between mother's characteristics at 1 and 2 km from a well head are not very economically significant; most go the direction of better health close to the well head (mother's within 1 km of a well head are better educated, less black, less Hispanic, less likely to smoke during pregnancy and more likely to be married, on average)

-Across multiple specifications results are consistent in sign and statistical significance

-Health at birth is a useful predictor of important future outcomes such as earnings, education, and disability and there is increasing evidence of intergenerational transmission of poor infant health at birth (Currie 2011).

-These results indicate that more research on drilling operations and environmental/health impacts is warranted.

References

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