Mines

The local wealth and health effects of mineral mining in developing countries

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Why we study the local welfare impacts of mining

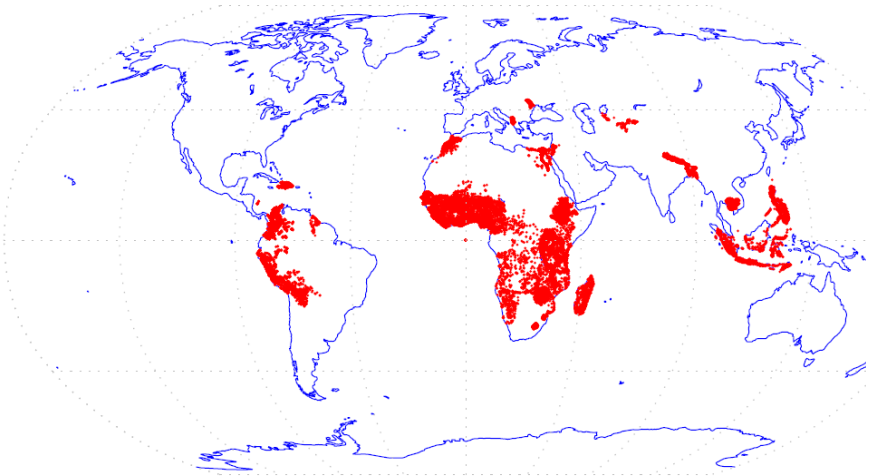
Prior literature

- **Nascent economics literature on local effects of mining.**
  - Aragon and Rud (AEJ 2013; WP 2013), Kotsadam and Tolonen (WP 2013), Wilson (JHealthEcon 2012).
  - Some high-profile papers use mining to study other objects of interest: Acemoglu et al. (2013), Dell (2010), Dube and Vargas (2013), Monteiro and Ferraz (2009).
- **Sister literature on industrial pollution – though few in developing countries.**
- **Some high-quality longitudinal case studies of health impacts** near individual smelters in rich countries.
- **Lots of knowledge on environmental pollution near mines, and on the toxic effects of pollutants.**
- **This paper:**
  - Explicitly consider health-wealth trade-off due to major industry in developing countries;
  - Large sample, rather than LATE from case studies.

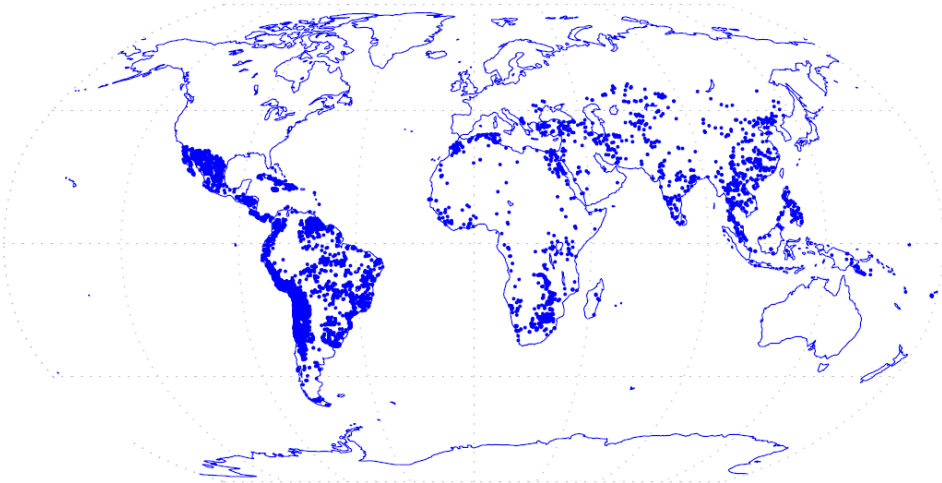
Data

- **All geocoded DHS surveys:** 47 countries, 111 surveys since 1986, 1.2m households;
- **USGS mining data:** location and characteristics of 36,000 mines, legacies, deposits and smelters;
- **Market intelligence data:** two sets of production panels for about 800 mines in DHS countries.
- **Matched data:** 44 countries, about 170,000 households near 800 mines.
- DHS are repeated cross-sections; convincing tests require some thought.

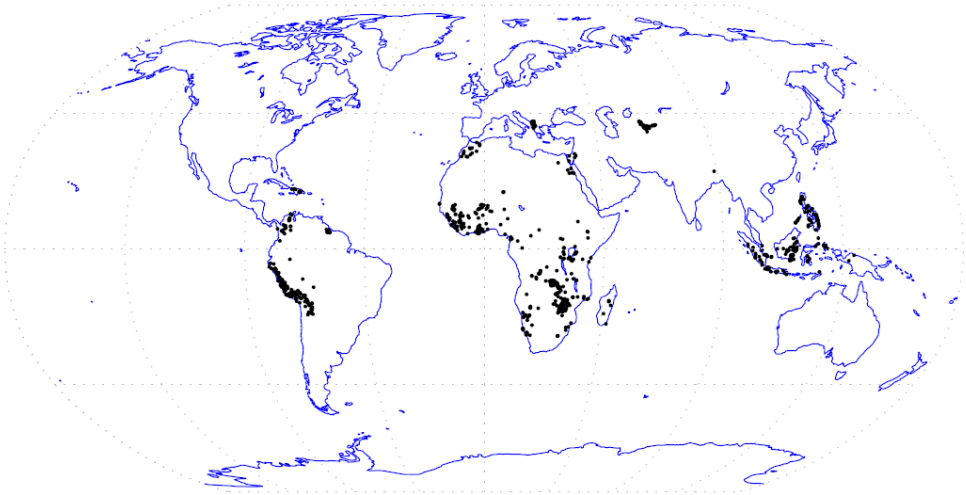
DHS clusters



USGS MRDS mines and mineral deposits

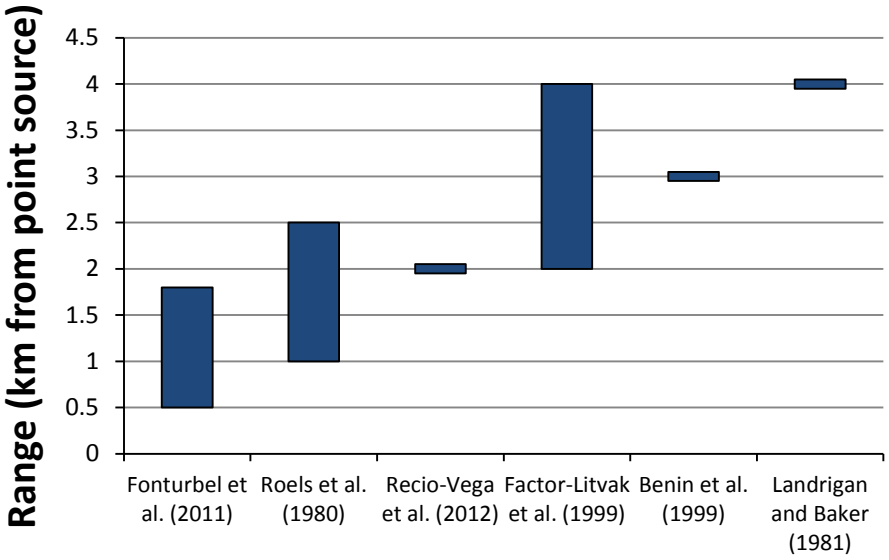


RMD mines

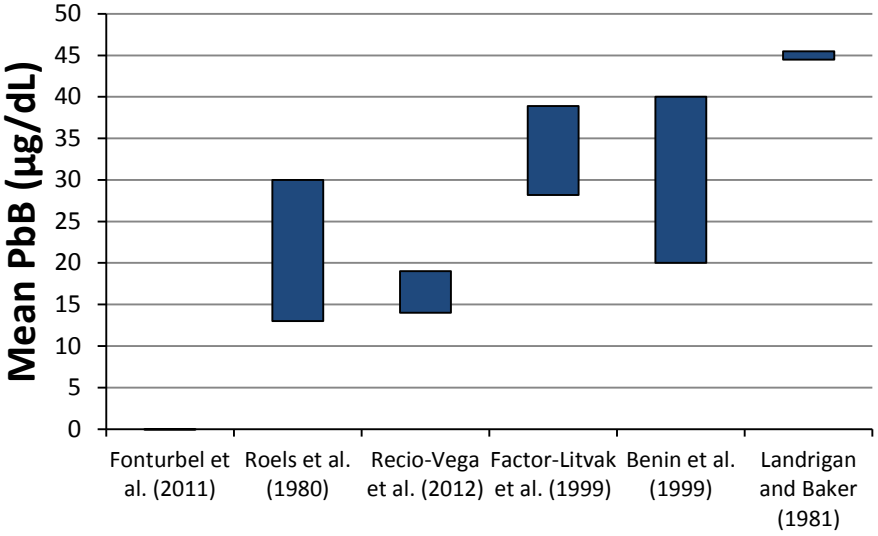


Where should we look for health effects, and which effects might we expect?

Range of high exposure to lead around smelters



Mean blood lead in children in high exposure range (µg/dL)



- Look in the direct vicinity of mines (≤ 5km)
- Expect particularly effects of lead (and other metal) exposure observable in our data: anemia, and growth effects.

Empirical models

Baseline cross-sectional and pseudo panel model (OLS version)

$$y_i = \beta_1 close_j + \beta_2 X_i + \gamma_{mine-year} + \epsilon_i$$

$$y_{i(t)} = \beta_1 close_j + \beta_2 operating_{j(t-\tau)} + \beta_3 close_j * operating_{j(t-\tau)} + \beta_4 X_{i(t-\tau)} + \gamma_{mine} + f(t) + \epsilon_{i(t)}$$

Households *i* in sampling cluster *j* observed at times *t* and *t-τ*. *Close* clusters are within 5km of a mine. An *operating* mine reported non-zero output. Sample restricted to clusters within 20km.

Tailored difference-in-difference tests

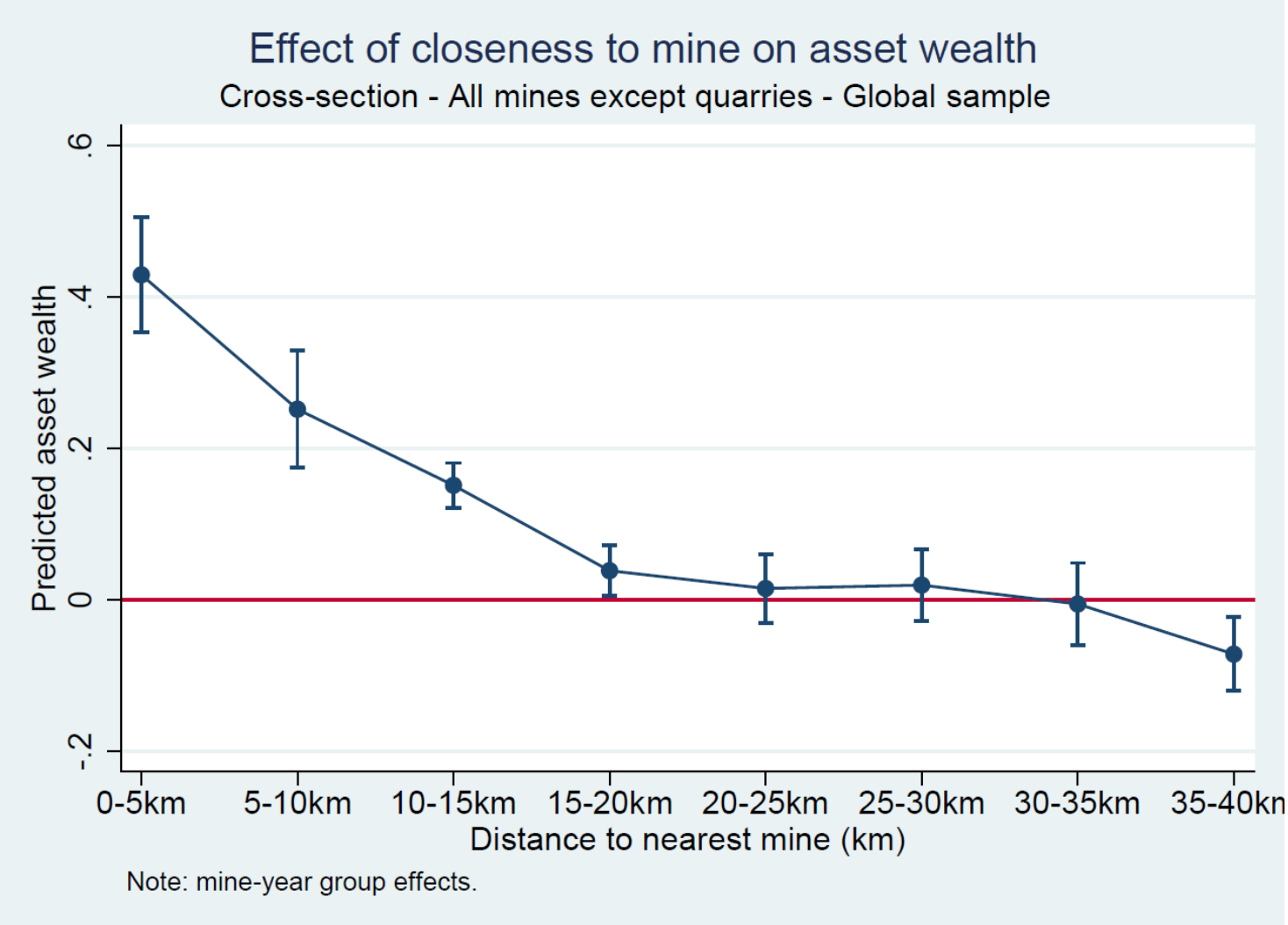
- **Mine types** associated with specific pollutants and health impacts – *close* interacted with *mine type;*
- **Maternal Hgb recovery** – *close* interacted with *pregnant or postpartum;*
- *In utero* exposure in **children born to migrants** – *close* interacted with *conceived after move.*

Wealth results

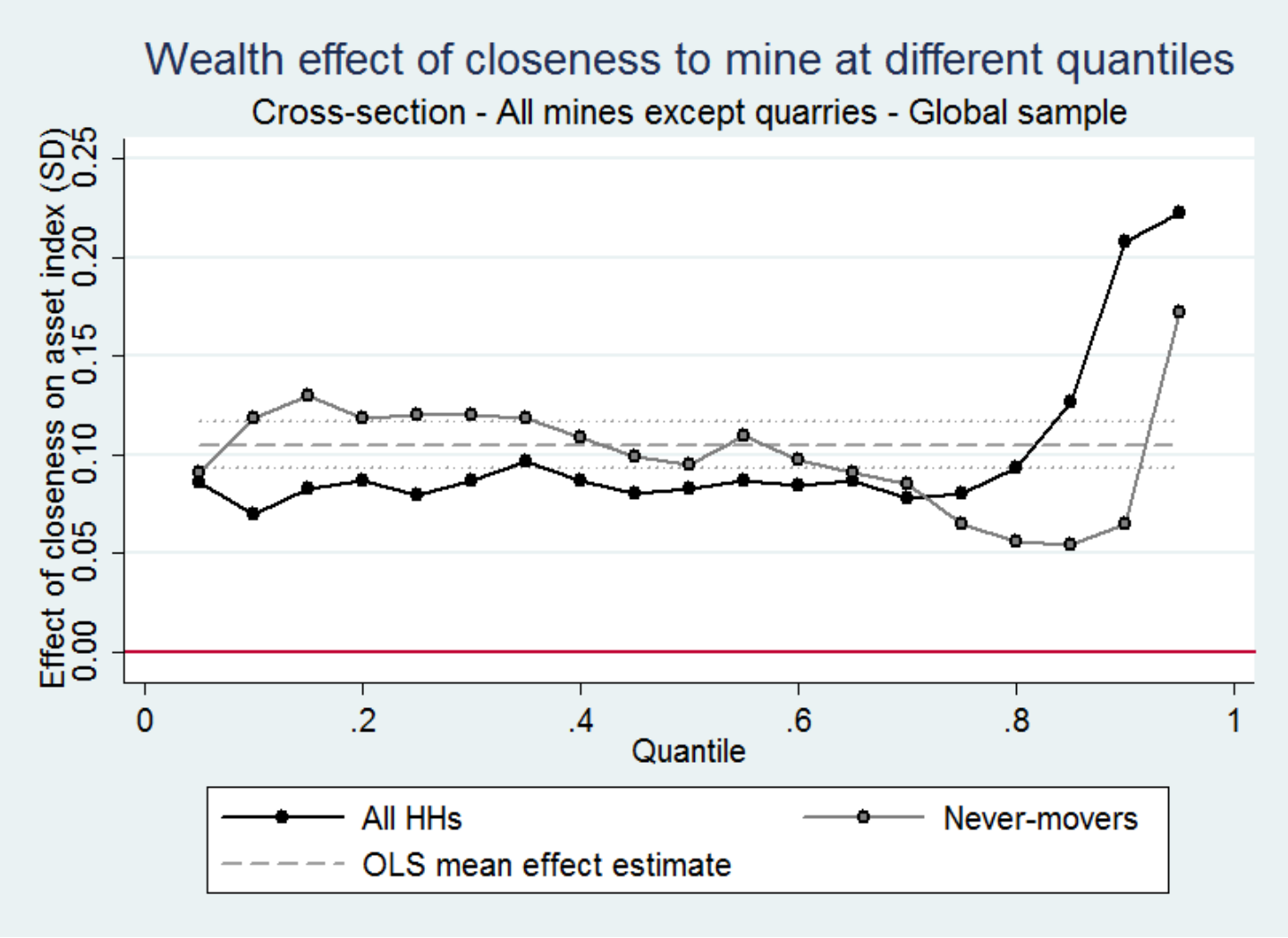
Mining communities are wealthier in the long run and medium term

	Asset factor index	
	(1)	(2)
HH close to mine	**0.105*** **	-0.113
	(0.035)	(0.089)
Mine operating		-0.0296
		(0.0348)
Mine operating * HH close (DiD)		**0.262*** **
		(0.0958)
N	90,319	22,579
Mine*years	1,562	
Mines		218
FE	Mine*year	Mine
Time effects		Country*year

Spatial pattern of long-run wealth effects



Gains across the wealth distribution



Health results

Women living near mines have lower Hgb…

	Altitude-adjusted hemoglobin (g/dL)		Anemia incidence	
	(1)	(2)	(3)	(4)
HH close to mine	**-0.0863****	0.396***	**0.0262****	-0.107***
	(0.0438)	(0.146)	**(0.0126)**	(0.0292)
Mine operating		0.0852		-0.0277
		(0.136)		(0.0309)
Mine operating * HH close (DiD)		**-0.330***		**0.0966****
		(0.173)		**(0.0390)**
N	38,217	9,845	36,225	9,845
Number of groups	934	122	934	122
FE	Mine*year	Mine	Mine*year	Mine
Time effects		Country*year		Country*year

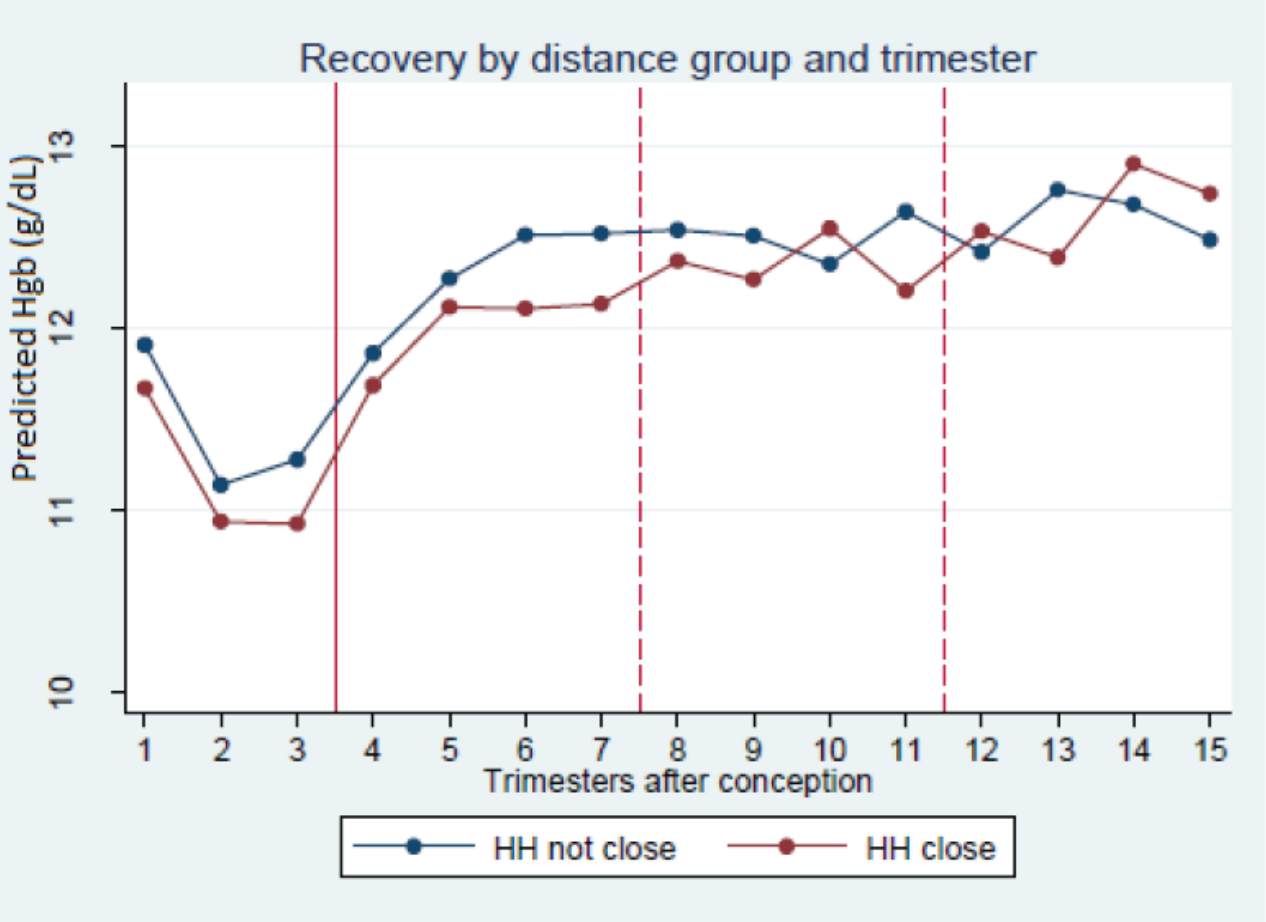
… but only near mines where 'heavy metal' contamination is expected

	Altitude-adjusted hemoglobin (g/dL)	
	(1)	(2)
HHs within 5 km	-0.0863**	-0.0317
	(0.0438)	(0.0533)
HHs within 5 km of a 'heavy metal' mine (DiD)		**-0.192****
		(0.0944)
Other interactions		
N	38,217	38,217
Mines	934	934

Definition of a 'heavy metal' mine:

- Lead is being mined; or
- Lead, while not targeted, is known to be present in ore; or
- There is no information on trace metal content, and any two of the metals copper, gold, silver, and zinc are being mined.

Maternal Hgb recovery follows a characteristic pathological pattern



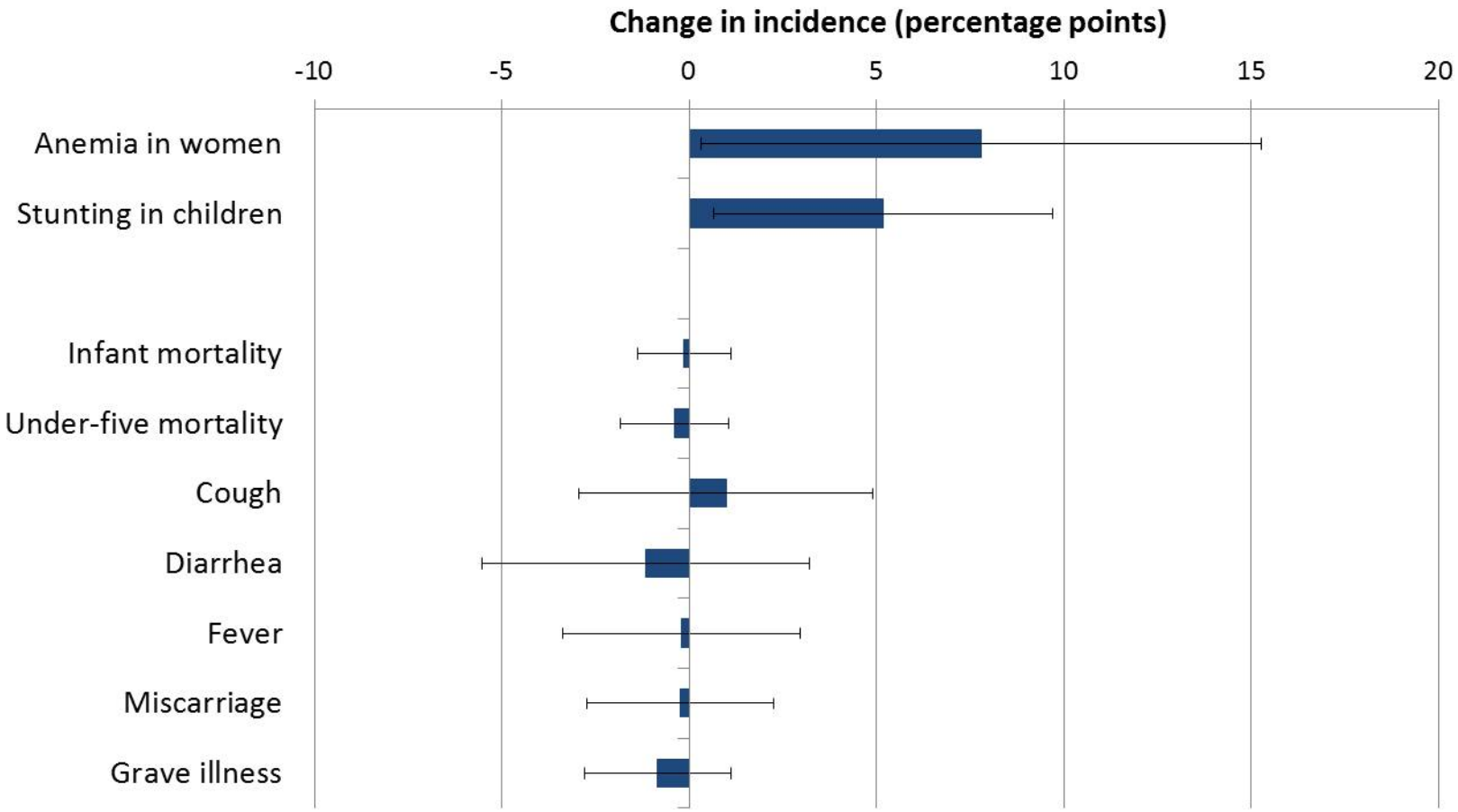
Maternal Hgb recovery follows a characteristic pathological pattern

	Altitude-adjusted hemoglobin (g/dL)		Asset index (falsification)
	Baseline	Placebo treatment	
	(1)	(2)	(3)
Pregnancy and infancy	-0.581***	-0.537***	-0.0665**
	(0.0627)	(0.0947)	(0.0326)
HH close to mine	-0.0646		0.0678
	(0.0910)		(0.0509)
Pregnancy and infancy * HH close (DiD)	**-0.209***		**-0.0291**
	(0.113)		**(0.0631)**
Placebo - HH in lowest wealth quintile		-0.210*	
		(0.109)	
Pregnancy and infancy * placebo		**-0.0288**	
		(0.103)	
Number of women	4,305	5,291	4,221
Number of groups	151	123	150

Children exposed *in utero* are more likely to be stunted

	Stunting		
	(1)	(2)	(3)
HH close to mine	-0.0483*	-0.0371	-0.0442
	(0.0250)	(0.0269)	(0.0271)
Mine operating during pregnancy	0.00109		0.00584
	(0.0174)		(0.0230)
Mine operating during pregnancy * HH close	**0.0517***		**0.0793***
	(0.0275)		**(0.0421)**
Mine operating in birth year		-0.00779	-0.00819
		(0.0196)	(0.0259)
Mine operating in birth year * HH close		**0.0362**	**-0.0330**
		(0.0287)	**(0.0437)**
Observations	11,654	11,654	11,654
Number of mines	200	200	200

Specific health problems prevail – but no evidence on general ill health



Note: DiD coefficients with 90% confidence intervals shown. Mine fixed effects and country-year effects.

Summary

Across some 44 developing countries, compared to their peers, **residents of mining communities** …

- … **enjoy meaningful economic benefits** (0.1-0.3 σ increase in asset wealth);
- … and are **not generally less healthy**.
- However, they bear **a specific health burden of anemia and stunting** (3-9 and five percentage point increases, respectively);
- … by far **the strongest effects on Hgb result near mines where lead contamination is to be expected**;
- … and **recovery from blood loss after pregnancy is particularly affected**.

Thank you