Mines, Water Pollution, and Agricultural Productivity

Spatial Economics Project Presentation

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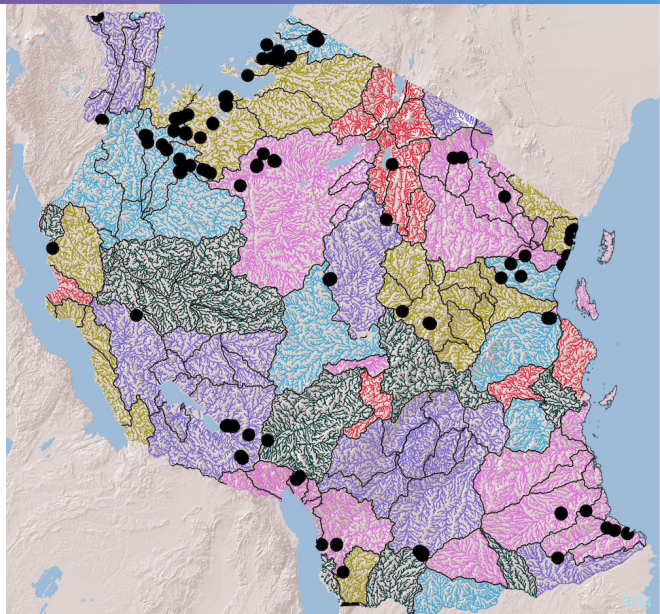
Recap

Data

First Results

The Idea

- We hypothesize that mines exert **negative effects on land fertility** via water pollution.
- This effect should only occur **downstream** of a mine, but not upstream.
- We have data on **river basins**, their flow order, (Lehner & Grill, 2013) and the location of **mines** (Maus et al., 2022).
- We can use annual maximum cropland **EVI** during growing season as a proxy for **agricultural productivity** (Didan, 2015).



The Specification(s)

$$Y_{imt} = \beta_1 f(distance_{imt}) + \beta_2 Downstream_{imt} + X_{imt} + \eta_m + \varepsilon_{imt} \quad (1)$$

$$Y_{imt} = \beta_1 f(distance_{imt}) + \beta_2 Downstream_{imt} + \beta_3 f(distance_{imt}) \times Downstream_{imt} + X_{imt} + \eta_d + \varepsilon_{imt} \quad (2)$$

- Y_{imt} measures agricultural productivity.
- $f(distance_{imt})$ measures the distance of the basin's centroid to the nearest mine at the river. (We currently use distance plus distance squared as distance function.)
- $Downstream_{imt}$ indicates that the basin is downstream of a mine.
- *i* is the basin, *m* the related mine basin, and *t* the year; X_{imt} are a set of of geographic and socioeconomic controls (which are presently still absent from the result tables we will show later on); η_m are mine fixed effects.

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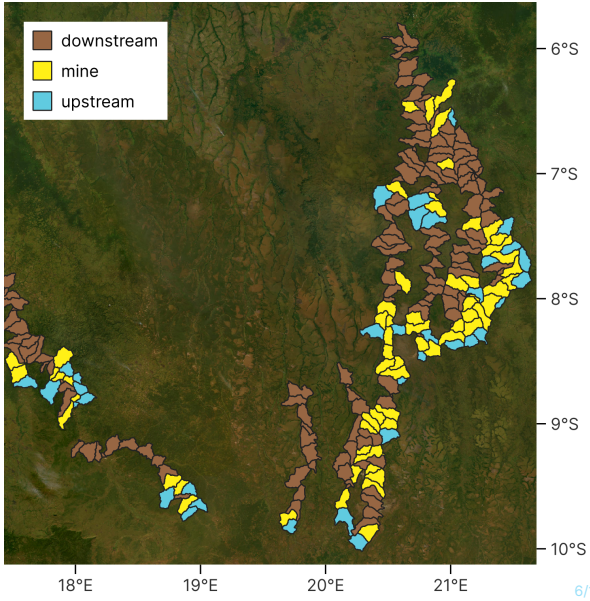
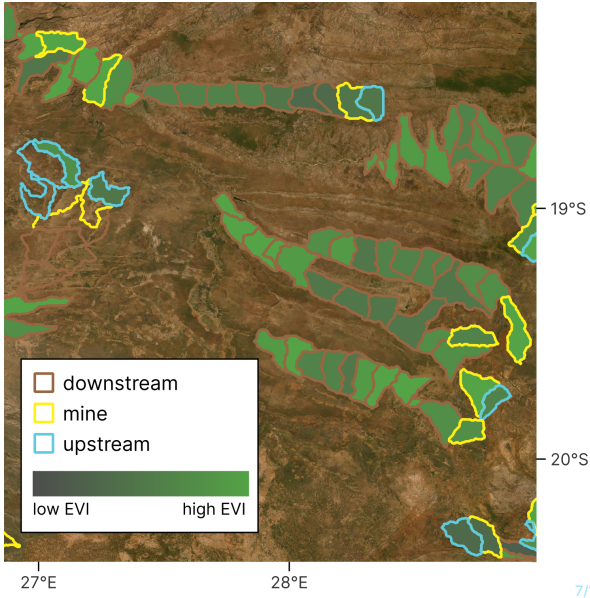
Identifying Upstream and Downstream Basins

- The map on this slide serves as an example and depicts the situation around some mines in northern Angola.
- We can see that mines tend to be located
  (a) in **clusters**, and
  (b) close to where river paths **originate**.
- This means that there are much fewer **upstream basins** than there are **downstream basins**.



Identifying how Fertile a Basin Is

- The map on this slide serves as an example and depicts the situation around some mines in Zimbabwe.
- The greener the fill color of a basin is, the higher its **EVI** (i.e., the more fertile it is).
- From an **eyeball econometrics** point of view, we should see basins getting greener the farther downstream they are.
- Here, this seems to be the case. (In many other locations, it doesn't seem that way.)



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(Very) Preliminary Results

Dependent Variables:	log(max_cropland_EVI)	log(max_EVI)	log(max_cropland_EVI)	log(max_EVI)
Model:	(1)	(2)	(3)	(4)
Variables				
distance	4.27×10^{-8}	-8.2×10^{-7}***	-3.08×10^{-6}***	-2.86×10^{-7}
	(3.08×10^{-8})	(3.75×10^{-8})	(3.13×10^{-7})	(1.97×10^{-7})
distance square	9.31×10^{-13}***	3.76×10^{-12}***	1.38×10^{-11}***	1.73×10^{-11}***
	(2.33×10^{-13})	(3.67×10^{-13})	(4.18×10^{-12})	(3.6×10^{-12})
downstream	-0.0065***	-0.0187***	-0.0425***	-0.0092***
	(0.0015)	(0.0007)	(0.0029)	(0.0016)
distance × downstream			3.16×10^{-6}***	-5.56×10^{-7}***
			(3.06×10^{-7})	(1.93×10^{-7})
I(distance2) × downstream			-1.3×10^{-11}***	-1.35×10^{-11}***
			(4.15×10^{-12})	(3.66×10^{-12})
Fixed-effects				
year	Yes	Yes	Yes	Yes
as.factor(mine_basin)	Yes	Yes	Yes	Yes
Fit statistics				
Observations	126,298	199,058	126,298	199,058
R^2	0.75693	0.89025	0.75713	0.89028
Within R^2	0.00057	0.00567	0.00136	0.00591

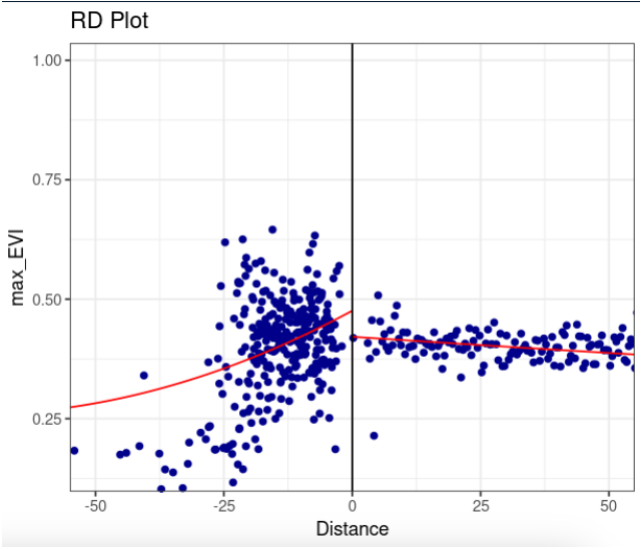
Clustered (year) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

(Very) Preliminary Results

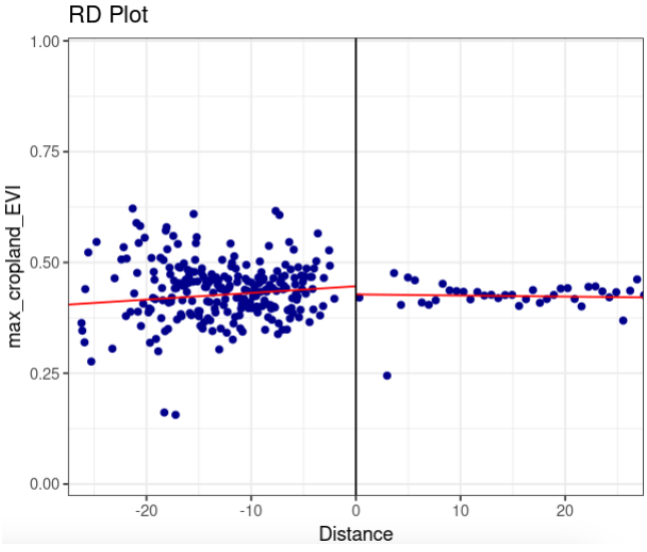
Dependent Variables: Model:	max_cropland_EVI (1)	max_EVI (2)	max_cropland_EVI (3)	max_EVI (4)
Variables				
distance	5.44×10^{-8}***	-1.53×10^{-7}***	-9.24×10^{-7}***	-1.73×10^{-7}**
	(1.19×10^{-8})	(7.51×10^{-9})	(1.14×10^{-7})	(6.27×10^{-8})
distance square	2.44×10^{-13}***	9.34×10^{-13}***	3.38×10^{-12}**	5.4×10^{-12}***
	(7.38×10^{-14})	(4.38×10^{-14})	(1.46×10^{-12})	(9.92×10^{-13})
downstream	-0.0025***	-0.0050***	-0.0140***	-0.0044***
	(0.0006)	(0.0003)	(0.0011)	(0.0005)
distance × downstream			9.92×10^{-7}***	1.53×10^{-8}
			(1.12×10^{-7})	(6.42×10^{-8})
I(distance2) × downstream			-3.17×10^{-12}**	-4.46×10^{-12}***
			(1.45×10^{-12})	(1.01×10^{-12})
Fixed-effects				
year	Yes	Yes	Yes	Yes
as.factor(mine_basin)	Yes	Yes	Yes	Yes
Fit statistics				
Observations	126,298	199,110	126,298	199,110
R^2	0.75002	0.90233	0.75021	0.90234
Within R^2	0.00086	0.00511	0.00165	0.00528

Clustered (year) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Spatial RDD Plot



Spatial RDD Plot



Thank You!

References I

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