Mines, Water Pollution, and Agricultural Productivity

Spatial Economics Project Presentation

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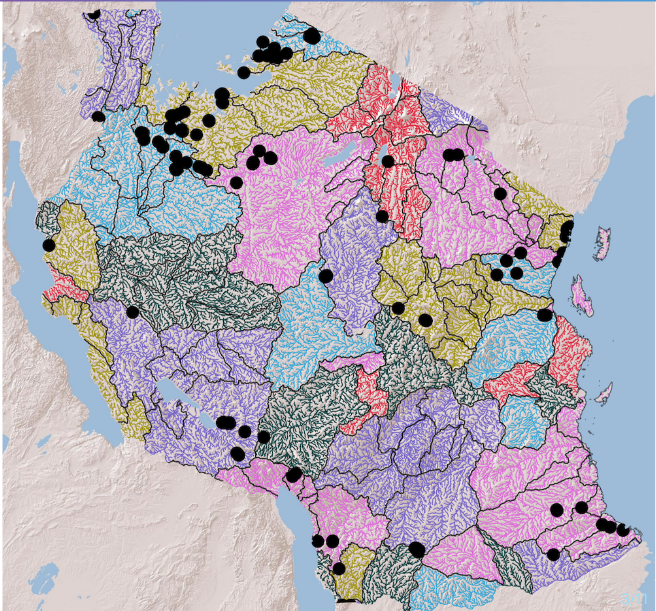
Recap

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)

$$Y_{mdt} = \beta_1 NearMine_{mdt} + \beta_2 Downstream_{mdt} + X_{mdt} + \eta_d + \varepsilon_{mdt} \quad (1)$$

$$Y_{mdt} = f(distance_{mdt}) + Downstream_{mdt} + X_{mdt} + \eta_d + \varepsilon_{mdt} \quad (2)$$

$$Y_{mdt} = f(distance_{mdt}) + f(distance_{mdt}) \times Downstream_{mdt} + X_{mdt} + \eta_d + \varepsilon_{mdt} \quad (3)$$

- Y_{mdt} measures agricultural productivity.
- $NearMine_{mdt}$ is an indicator if a basin is in proximity to a mine.
- $f(distance_{mdt})$ measures the distance of the basin's centroid to the nearest mine at the river.
- $Downstream_{mdt}$ indicates that the basin is downstream of a mine.
- m is the basin, d the district, and t the year; X_{mdt} are a set of of geographic and socioeconomic controls; η_d are district fixed effects.

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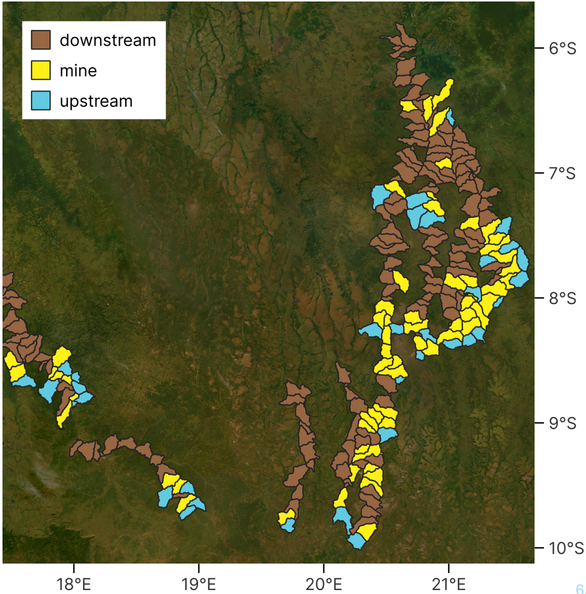
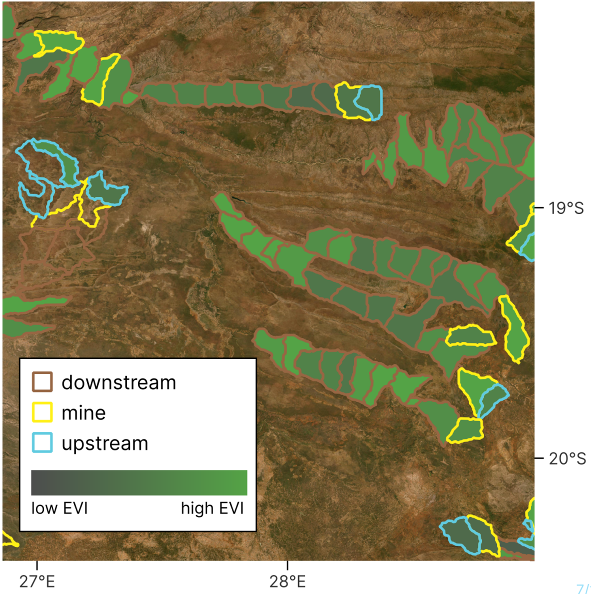
Identifying Upstream and Downstream Basins

- The map on this slide serves as an example and depicts the situation around some mines in northern Angola.
- 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**.
- 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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Disclaimer

Disclaimer: The results presented on the following slide(s) are very preliminary and *will* change before the presentation. There are also still one or two issues with the data (making results unreliable) that we are presently still working on. So please refer to the current version of the slide set, which is available at https://github.com/maxmheinze/spatial/blob/main/project/presentation/slides.pdf

(Very) Preliminary Results

Dependent Variables:	max_cropland_EVI	max_EVI	max_cropland_EVI	max_EVI
Model:	(1)	(2)	(3)	(4)
Variables				
distance	$1.35 \times 10^{-7***}$	$-1.04 \times 10^{-7***}$	$9.8 \times 10^{-8***}$	$-7.95 \times 10^{-8***}$
	(1.41×10^{-8})	(8.79×10^{-9})	(1.5×10^{-8})	(1.1×10^{-8})
distance square	4.86×10^{-14}	$5.78 \times 10^{-13***}$	$1.05 \times 10^{-13***}$	$2.2 \times 10^{-13***}$
	(3.84×10^{-14})	(2.48×10^{-14})	(3.44×10^{-14})	(2.15×10^{-14})
downstream	-0.0004***	-0.0014***	-0.0019***	-0.0011***
	(8.86×10^{-5})	(6.21×10^{-5})	(0.0003)	(0.0001)
distance × downstream			$4.95 \times 10^{-8***}$	$-3.06 \times 10^{-8***}$
			(8.83×10^{-9})	(5.06×10^{-9})
I(distance2) × downstream			$-7.87 \times 10^{-14**}$	$4.42 \times 10^{-13***}$
			(3.5×10^{-14})	(2.67×10^{-14})
Fixed-effects				
year	Yes	Yes	Yes	Yes
as.factor(mine_basin)	Yes	Yes	Yes	Yes
Fit statistics				
Observations	379,086	589,534	379,086	589,534
R^2	0.67812	0.88584	0.67813	0.88587
Within R^2	0.00210	0.00220	0.00214	0.00249

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

Thank You!

References I

Didan, K. (2015). MOD13Q1 MODIS/Terra Vegetation Indices 16-Day L3 Global 250m SIN Grid V006. https://doi.org/10.5067/MODIS/MOD13Q1.006

Lehner, B., & Grill, G. (2013). Global river hydrography and network routing: baseline data and new approaches to study the world's large river systems. *Hydrological Processes*, *27*(15), 2171–2186. https://doi.org/10.1002/hyp.9740

Maus, V., da Silva, D. M., Gutschlhofer, J., da Rosa, R., Giljum, S., Gass, S. L. B., Luckeneder, S., Lieber, M., & McCallum, I. (2022). *Global-scale mining polygons (Version 2)* (Dataset). PANGAEA. https://doi.org/10.1594/PANGAEA.942325