Mine and Flow and Nothing Grow

Spatial Economics Project Pitch

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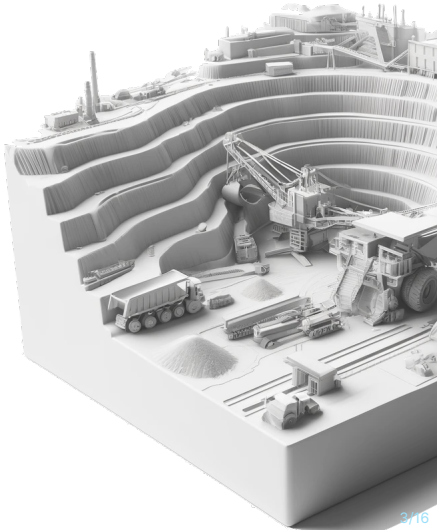
What Do We Want to Find Out?

Data

Empirical Framework

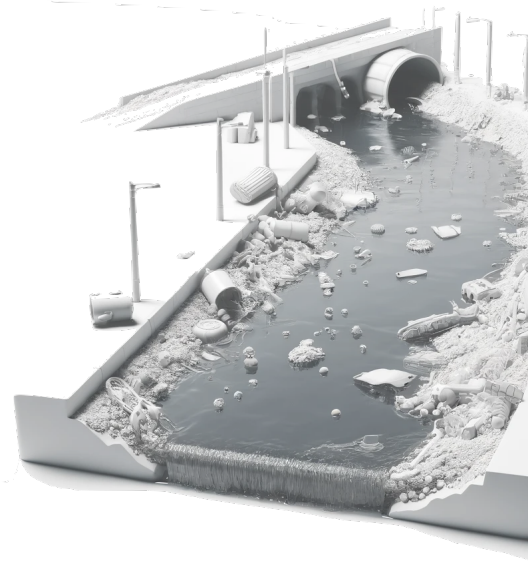
Metals Be Mine, Problems Be Thine

- The African **resource extraction** industry is thriving. Mining activity yields **economic benefits**.
- Mines also generate **negative externalities**, ranging from corruption (Berman et al., 2017) to air-pollution-induced declines in **agricultural productivity** (Aragón & Rud, 2015).
- We want to take a look on how **water pollution** affects **crop yields**.



How Does Pollution Travel?

- Mines pollute both the air in their surroundings and adjacent **water flows**.
- The pollutants enter the river at the mining site and **travel with the water**.
- What is the reason that you should not swim in the Danube *east* of Belgrade, the largest European city without wastewater treatment?
- Areas **downstream** are affected by pollution, but areas **upstream** should not!
- This gives us **treated** and **control** areas.



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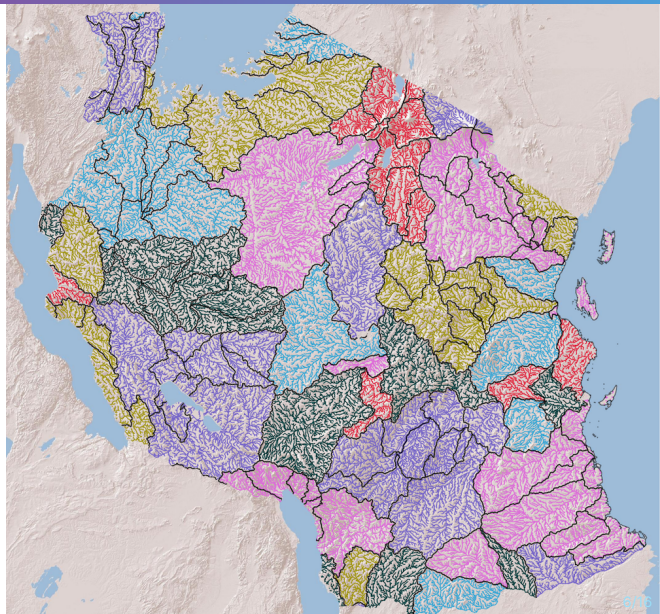
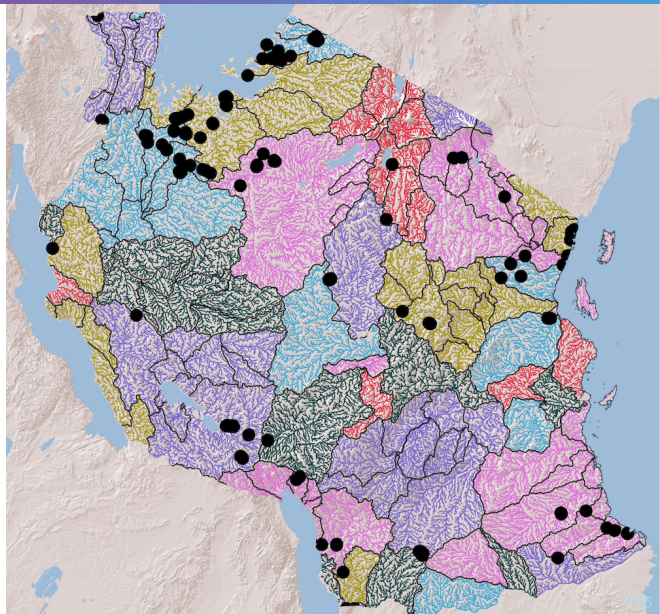
Highs, Lows, and Water Flows

- The **HydroBASINS** dataset from Lehner and Grill (2013) gives us information on where the water drains into in a given region.
- How do they know where water from any point on earth flows to?
- Water flows are predicted from **elevation data**, which stems from the Shuttle Radar Topography Mission.
- This map shows two different levels of **basins** along with **water flows** in them.



Excuse Me, Do You Know Where the Next Mine Is?

- We can now overlay **centroids of mines**, taken e.g. from Maus et al. (2022) or Kuschnig et al. (2024), over the river basin map.[1]
- How can we relate the basin data with mine locations?
- At the **lowest level**, basins are very granular.
- Basins are labeled according to a **coding system** which allows identification of **up-** and **downstream** basins.



[1] This map uses Kuschnig et al. (2024).

Crop Yields from Space

- To proxy **agricultural productivity** we can use:
  - Annual Maximum Cropland **NDVI/EVI** during growing season (Didan, 2015)
  - Copernicus Crop Yields (Copernicus Climate Change Service, 2020)
- We aggregate the proxy for agricultural productivity at the basin level

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The Baseline Regression

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

- m is the basin, d the district, and t the year.
- Y_{mdt} measures agricultural productivity.
- $NearMine_{mdt}$ is an indicator if a basin is in proximity to a mine.
- $Downstream_{mdt}$ indicates that the basin is downstream of a mine.
- X_{mdt} are a set of of geographic and socioeconomic controls.
- η_d are district fixed effects.

A (Spatial) Regression Discontinuity Design

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

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

- m is the basin, d the district, and t the year.
- Y_{mdt} measures agricultural productivity.
- $f(distance_{mdt})$ 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.
- X_{mdt} are a set of of geographic and socioeconomic controls.
- η_d are district fixed effects.

Identification

Following Cattaneo et al. (2020) and Singh (2022), we can then look at the jump in the conditional expectation of the outcome Y_m given the covariate (distance) X_m at the threshold *Mine*

$$\lim_{x \downarrow Mine} \mathrm{E}(Y_m \mid X_m = x) - \lim_{x \uparrow Mine} \mathrm{E}(Y_m \mid X_m = x)$$

which can be interpreted as the average causal effect of treatment at the discontinuity point

$$\tau_{SRD} = \mathrm{E}\Big[Y_m(1) - Y_m(0) \Big| X_i = Mine \Big]$$

Extensions

- We can **match** units based on rivers to compare units at the same river.
- We can expand our **notion of distance** by replacing $f(distance_{mdt}$ with $f(geolocation_{mdt})$ (Dell, 2010).
- We might need to control for the presence of **cities** and **factories** (sourced from Open Street Map?).
- We could use **survey data**.

Thank You!

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