1 Regression Discontinuity Design (RD)

- Consider a setting where treatment assignment $T = 1$ changes discontinuously based on an running variable W.
- Example: $T = 1$ if $W > w_0$, where w_0 is a threshold (age, income, deadlines, geography, etc).
- This assignment mechanism is non-random: it is a deterministic function of W, exactly opposite to randomization.
- However, treatment ($T = 1$) vs. control ($T = 0$) assignment near w_0 can be considered *as good as random* unde the assumption:
  - Both W and w_0 are **exogenous** (not manipulable by individuals). Check: Units near the threshold are **balanced** in other covariates.

RD in Practice

- For a small $c > 0$, compare outcomes just below and above the threshold:

$$\mathbb{E}[y_i \mid w_0 - c < W_i < w_0] = \mathbb{E}[y_i \mid w_0 < W_i < w_0 + c]$$

  - Focus on outcome differences around the cutoff.
- In linear RD estimation:

$$y_i = \alpha + \beta_i W_i + \gamma_i D_{W>w_0} + \delta X_i + \varepsilon_i$$

  - W_i: running variable
  - $D_{W>w_0}$: treatment indicator (jump at threshold)
  - X_i: covariates (optional)

2 Michalopoulos & Papaioannou, 2014

2.1 Research Question

Identify the causal effect of **formal institutions** on **economic development** while considering the role of **culture**?

2.2 Methodology

- **Ideal experiment**: Isolate institutional effects by comparing populations with **same ethnicity and culture** but subject to **different national institutions**. Ideally: want the effect of different institutions in othrwise identical contexts.
- **Identification Strategy**: Borders drawn by europeans have divided more than 200 ethnic groups in different states. If such borders are proven to be exogenous, then T and C group are comparabe and we can look, for every ethnic group, to the effect of the treatment = institutions, that is exogenously determined by the border. If the border was not random, eg best eu powers with best institutions took the best land and exported their institutions, we would have upward bias.

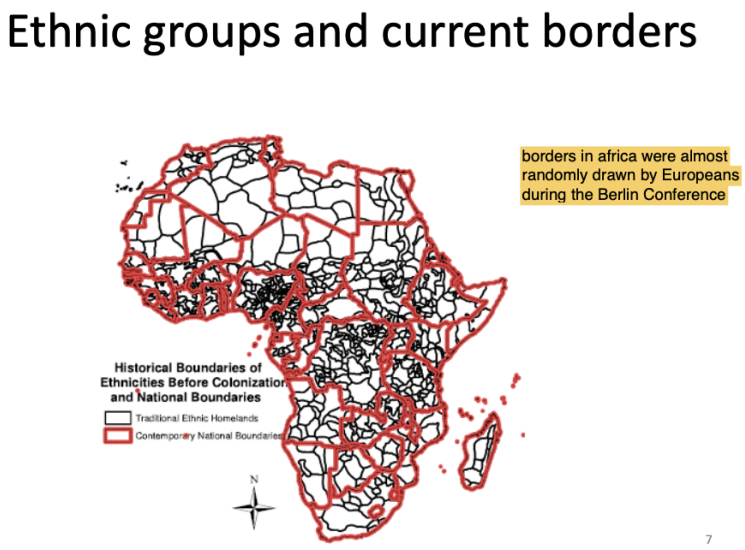
Data and Context

- **Ethnic homeland boundaries**: pre-colonial ethnic territories.
- **National borders**: post-colonial state boundaries.
- **Outcome variable**: light density (2007–2008) from satellite imagery (Proxy for local economic development)
- **Controls**
  - **Institutional Quality (IQL)**:
    - World Bank Governance Indicators: Rule of Law and Corruption Control Composite index etc.
    - ICRG risk of expropriation, executive constraints index, legal formalism

- **Other Covariates (Xs)**:
  - Distance to capital / coast
  - Elevation, surface area, malaria index
  - Agricultural land suitability
  - Diamond / oil presence
  - Population density in 2000

2.3 Validity of the Strategy: treatment assignment is random, no evidence of endogeneity

- **Historical argument**: Europeans did this randomly.



- **Balance checks**: balancing table of the treatment (institutions) based on the unobservables. They find no correaltion beween isnituional quality and differences in various characteristics (e.g. geography)
- **Robustness**: use of only **straight-line borders** (box count method by Alesina)

2.4 Methodological remark

- If the treatment is random, then OLS is already valid, that is, at least theoretically it is not strictly necessary to use the RD.
- While it is possible to argue that the assignment of a European nation to a border region is random, it is more difficult to claim that the assignment of the entire inner area of a territory is random. Even if Europeans lacked precise knowledge of the territory (and thus could not perfectly identify optimal border locations), it is likely that stronger nations attempted to secure better areas. For example, France — maybe also endowed stronger institutions— may have taken more prosperous regions. As a result, we may observe better institutions in richer areas today. This would justify the use of a regression discontinuity (RD) design. However, note that as the balancing test does not find anything the analysis above is unjustified.

Estimation Method 1: Group-Level Regression

$$y_{i,c} = \alpha_0 + \gamma \text{IQL}_c + \lambda_1 \log(\text{PD}_{i,c}) + \lambda_2 \log(\text{AREA}_{i,c}) + X'_{i,c}\Phi + a_i + \varepsilon_{i,c}$$

- i: ethnic group, c: country
- $y_{i,c}$: log(1 + light density) of group i in country c

- IQL_c: institutional quality (World Bank Governance Indicators)
- $\text{PD}_{i,c}$: population density
- $\text{AREA}_{i,c}$: land area of homeland
- $X_{i,c}$: other controls
- a_i: **ethnic group fixed effects**

Estimation Method 2: Pixel-Level Regression

$$y_{p,i,c} = \alpha_0 + \gamma \text{IQL}_c + \lambda_1 \log(\text{PD}_{p,i,c}) + \lambda_2 \log(\text{AREA}_{p,i,c}) + X'_{p,i,c}\Phi + a_i + \zeta_{p,i,c}$$

- $y_{p,i,c} = 1$ if pixel p is "bright"
- Linear probability model; pixel-level covariates

Estimation Method 3: Regression Discontinuity

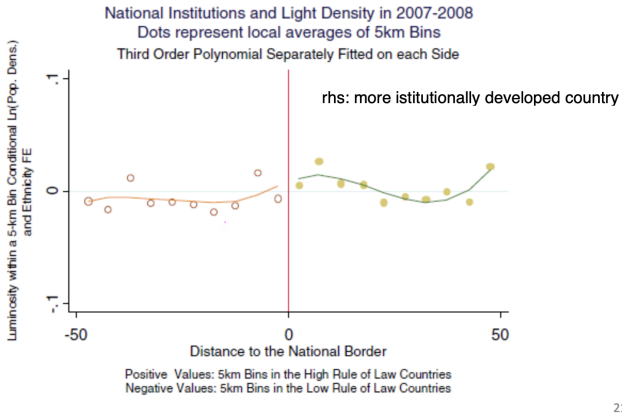
- Compare development outcomes **just across the border** w_0 for the same ethnic group.
- Units near w_0 (border) are "as good as randomly" assigned to different institutions.
- RD design isolates the causal effect of national institutions holding ethnicity and geography constant

$$y_{p,i,c} = \alpha_0 + \gamma \text{IQL}_c^{\text{High}} + f(\text{BD}_{p,i,c}) + \lambda_1 \log(\text{PD}_{p,i,c}) + \lambda_2 \log(\text{AREA}_{p,i,c}) + X'_{p,i,c}\Phi + a_i + \zeta_{p,i,c}$$

- $\text{BD}_{p,i,c}$: signed distance to the national border
- $f(\cdot)$: polynomial function of distance (varied specifications: linear, quadratic, cubic)
- $\text{IQL}_c^{\text{High}}$: dummy for high-institution quality country
- RD compares local means of outcomes near the border

Main Results

- No significant difference in economic development across sintituions, nor in the OLS nor in the RD case!!



- The paper challenges canonical view (Acemoglu et al.): formal institutions are not universally decisive for development in Africa; local traits and geography may dominate
- Heteroegneity: Effects diminish with **distance from capital cities**.
  - Suggests limited state enforcement in peripheral areas.
- Reinforces dual institutional structure: formal institutions dominate near capitals; informal/ethnic governance elsewhere.

Concerns and Limitations. RD SPECIFIC PROBLEMS

- Is w_0 truly exogenous?
- Ethnic fractionalization may affect outcomes.
- Even if w_0 is exogenous, **economic activity may be endogenous** to the border location. Tre problemi:
  - The insitutional effect is sensible to the distance from the capital! Borders are far away and the effect of good institutions may be muted. Likley, tis is due to instability and war close to the border, if the nation has to decide where to invest it does not do it close to the border. This is a clear contraddiction between the identification strategy (RD, looking close to the sdiscotninuity) and the fact that there is self-selection out of that area! YOU WANT THE EFFECT OF INSTITUTIONS AT THE BORDER, BUT THERE IS NO INSTITUTIONS AT THE BORDER.

Nota: True, the authors in the robustness section check when different w0 is associated with geography and other "structural covariates" (where the mountain is). BUT, this is a different argument.