Climate Change Induced Migration: A Gravity Model Approach

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Climate change is expected to trigger an increase in migratory movements and displacement both within and across countries. The World Bank (2018)[1] estimates that more than 140 million will people move within their countries' borders by 2050 due to climate change, however, there are no reliable estimates of climate induced bilateral migration. In this paper, we use a Poisson Pseudo-Maximum Likelihood estimator to investigate the impact of both gradual and extreme climatic stressors on bilateral migration across countries. Furthermore, for the first time to our knowledge, we provide projections of bilateral migration between countries due to future climate change. Along with mean temperature and precipitation, we include sophisticated extreme events indicators such as the 90th percentile of precipitation distribution and the Standardized Precipitation Index (SPI).

$$\ln\left(\frac{M_{ij,t}}{N_{ii,t}}\right) = \sum_{a=1}^{A} \beta_a C_{i,t} + \sum_{b=1}^{B} \beta_b C_{i,t} * Poor + \alpha \ln(dist_{ij}) + \gamma Contig_{ij} + \delta CommonL_{ij} + \zeta CommonCO_{ij} + \kappa dAEZ_{ij} + \phi_i + \phi_{jt} + \theta_i t + \theta_i t^2 + \varepsilon_{ij,t}$$

where $M_{ij,t}$ is net emigration flows from *i* to *j* in the decade beginning with year t, $N_{ii,t}$ is the population in the origin country *i* in year t, $C_{i,t}$ are climate variables interacted with a country being poor (Poor). We also control for geographical distance, contiguous country borders, dummy for common language, dummy for sharing same past colonial history. ϕ_i is origin fixed effect, ϕ_{jt} is the destination-decade fixed effect, ϕ_{rt} and ϕ_t are flexible origin country-specific time trends and their squared ($\theta_i t + \theta_i t^2$) capturing slowly changing factors within the country of origin.

Our climatic data comes from the Global Land Assimilation System (GLDAS v2), this is a re-analyzed gridded climatic dataset, with 1°×1° spatial and 3-hourly temporal resolution. We begin with the gridded data 3-hourly data and compute the various aggregated indicators at the country-year level. We use population weights from GPW (v3) for aggregation into country-year averages. These indicators are included for both origin and destination countries and are further segregated by low and high-income countries.

Our results suggest that increase in extreme precipitation and drought (measured by 6-month SPI) in the origin countries increases migration. We also find evidence for the *poverty trap* argument, suggesting that people in poor countries are unable to migrate despite climate change due to lack of resources to do so. In the next step, we combine our econometric estimates with a multi-model mean of future climate scenarios from all the nineteen Global Circulation Models from CMIP5. Our results suggest that approximately 3.2% of the world population will migrate by mid-century under unmitigated climate change (RCP8.5). Costa Rica, Panama, and Guatemala will have the highest share of their population migrating.

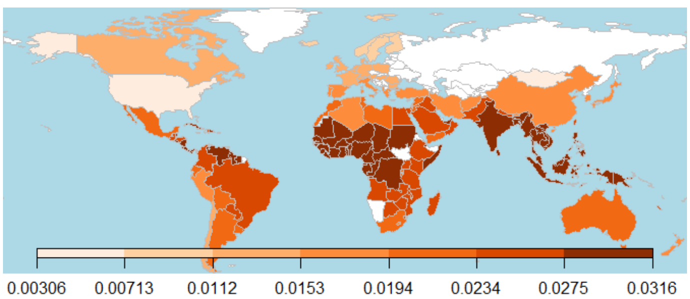

Figure 1: Migration Inflow by Country: Mid-century (RCP 8.5)

[1] Rigaud et al. (2018). Groundswell: Preparing for Internal Climate Migration. World Bank, Washington, DC.

This paper analyses the impact of climate change on bilateral migration using a Gravity model approach and indicators for both gradual and extreme climatic stressors. We find that extreme climatic changes (both extreme wet and extreme dry events) increases out-migration. We are also the first to provide an estimate of bilateral migration among countries; our results show that unmitigated climate change will result in more than 3% of the global population moving by mid-century.