IVM Institute for Environmental Studies

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# The impact of natural disasters on internal migration in the US – Two empirical approaches

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## Introduction

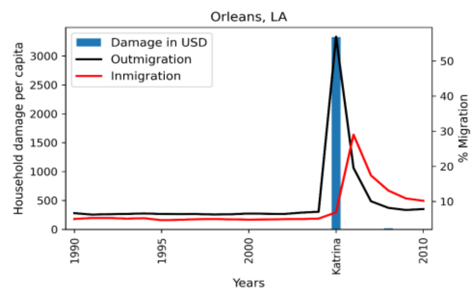
Over the past decades the yearly number of natural hazards with over a billion dollar in damages has been increasing in the US, in large part due to rising exposure and climate change. Well-known disasters include Hurricane Katrina in 2005, the 2008 California Wildfires or the 2008 Midwest Floods, which have led to billions of US dollars in damages, numerous fatalities, and large-scale population displacements.

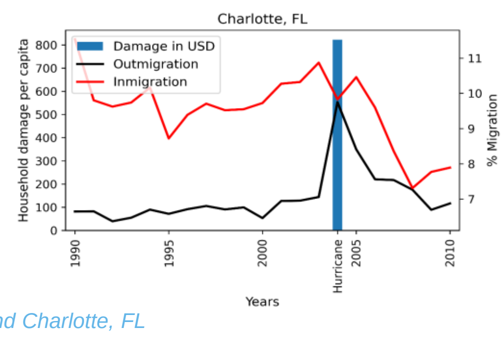
There are numerous studies on the impact of climate factors on migration that have resulted in a diversity of outcomes. Beine & Jeusette (2021) show that methodological choices explain a large part of the variety in results. They for example find that the type of dependent variable plays a crucial role in finding a significant impact of climate factors on migration. In this paper we want to explore this finding further by estimating two distinct econometric models with either migration flows or migration rates as dependent variable.

## Data

Internal Revenue Service (IRS) tax records give us yearly county-to-county migration flows in the US. From these flow data out- and in-migration rates can be constructed. Disaster damage data is obtained from FEMA.

$$\%\ out\text{-}migration\ rate = \frac{\#outflow}{\#nonmigrants + \#outflow} * 100 \qquad \%\ in\text{-}migration\ rate = \frac{\#inflow}{\#nonmigrants + \#outflow} * 100$$

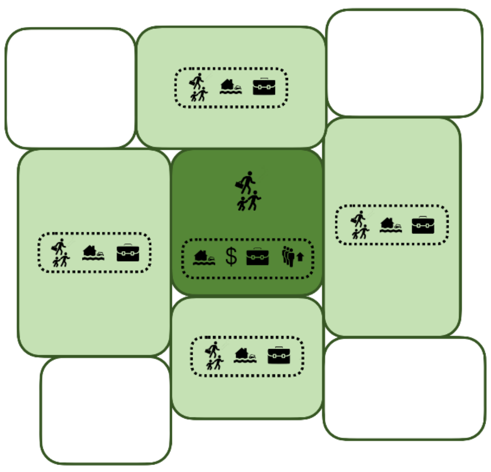


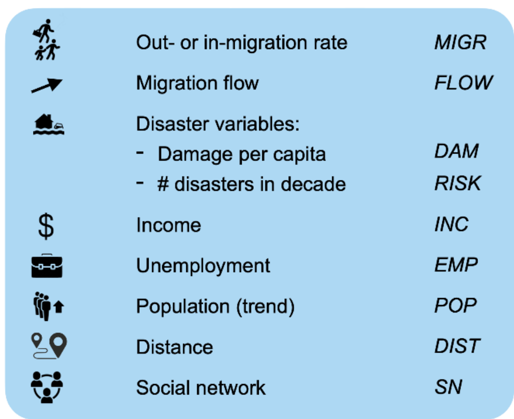

Migration rates and disaster damage in Orleans, LA and Charlotte, FL

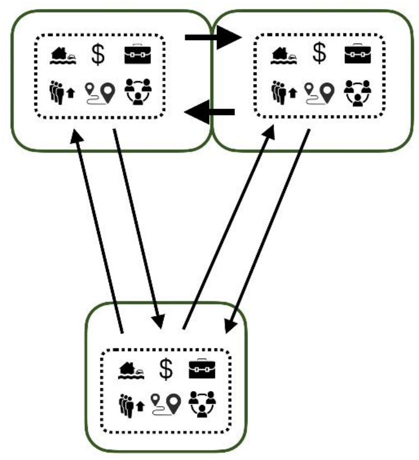
## Spatial Durbin (panel) model – migration rates

## Gravity model – migration flows



Graphical representation of spatial Durbin model



Graphical representation of gravity model

In the spatial Durbin model, migration rates in a county are affected by disasters, income, unemployment and population growth in the county itself, but also migration rates, disasters and unemployment in the neighboring counties. This way spatial correlation between geographic areas is taken into account. The equation below represents the econometric specification of the model.

$$MIGR_{i,t} = \alpha_i + \rho \sum_{j=1}^{N} w_{ij} MIGR_{j,t} + \beta_1 DAM_{i,t} + \beta_2 DAM_{i,t-1} + \beta_3 RISK_{i,t} + \beta_4 INC_{i,t} + \beta_5 EMP_{i,t}$$
$$+ \beta_6 POP_{i,t} + \theta_1 \sum_{j=1}^{N} w_{ij} DAM_{j,t} + \theta_2 \sum_{j=1}^{N} w_{ij} DAM_{j,t-1} + \theta_3 \sum_{j=1}^{N} w_{ij} EMP_{j,t} + \gamma_t + \epsilon_{i,t}$$

In the traditional gravity model, migration flows are explained by population in the origin county i and destination county j and the distance between the two counties. Here we also include income, unemployment and disaster variables. The equation below shows that we take the ratio of these variables.

$$FLOW_{ij,t} = \alpha + \beta_1 \ln\left(\frac{DAM_{j,t}}{DAM_{i,t}}\right) + \beta_2 \ln\left(\frac{DAM_{j,t-1}}{DAM_{i,t-1}}\right) + \beta_3 \ln\left(\frac{RISK_{j,t}}{RISK_{i,t}}\right) + \beta_4 \ln\left(\frac{DAM_{j,t}}{DAM_{i,t}}\right)$$
$$+ \beta_5 \ln\left(\frac{EMP_{j,t}}{EMP_{i,t}}\right) + \beta_6 \ln POP_{i,t} + \beta_7 \ln POP_{j,t} + \beta_{11} \ln DIST_{ij,t} + \epsilon_{ij,t}$$

## Results & Interpretation

| | Spatial Durbin model | | Gravity model | |
|---|---|---|---|---|
| | **OUTMIGR** | **INMIGR** | | **FLOW** |
| *DAM* | 0.00492** | -0.00071 | | -0.01569*** |
| $DAM_{-1}$ | 0.00091 | 0.00102 | | 0.00429 |
| *RISK* | 0.03743*** | -0.00173 | | -0.00462 |
| *INC* | -0.0192*** | 0.03590*** | | -0.06304*** |
| *EMP* | 0.04567*** | -0.04048*** | | -0.13694*** |
| *POPGR* | 2.43947*** | -0.55955 | | |
| Neighbor variables | | | Gravity variables | |
| *DAM* | 0.00208 | 0.00111 | $POP_i$ | 0.6022*** |
| $DAM_{-1}$ | 0.00084 | 0.00133 | $POP_j$ | 0.5391*** |
| *EMP* | -0.0248* | 0.00050 | *DIST* | -1.0627*** |
| *OUTMIGR* | 0.34713*** | 0.47647*** | | |

Estimated coefficients of the spatial Durbin model and the gravity model

In the spatial Durbin model, we see that if household damage per capita goes up from for example 0 to **1000 USD**, then the outmigration rate increases by **4.92**.
The estimates of the gravity model indicate that **people move from high to low damage counties**, but the year after the flow reverses, although this impact is not significant. Interestingly, people move from high income to low income counties. Maybe because living costs are not weighing up against higher income levels. We also see that people move from high unemployment counties to low unemployment counties.

## References

Beine, M., & Jeusette, L. (2021). A meta-analysis of the literature on climate change and migration. *Journal of Demographic Economics*, *87*(3), 293–344. https://doi.org/10.1017/dem.2019.22

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