Insurance, Disaster Exposure and Household Migration as Climate Adaptation.

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Abstract:

This paper studies whether flood insurance and disaster-finance institutions shape household migration as a climate adaptation margin after localized flood exposure. I build a U.S. census block-group-level panel from 2011 to 2019 that combines annual migration flows with satellite observed flood inundation maps from the Global Flood Database, NFIP insurance measures, FEMA flood zone designations, NOAA disaster information, and ACS neighborhood characteristics. The block-group scale is a central contribution, since much of the existing disaster-migration literature relies on coarser state-, county-, or metro-level geography. The empirical design uses nearby queen-contiguous neighborhoods as local controls combined with pre-flood differences in NFIP insurance penetration and exploits within flood event variation in satellite observed inundation intensity across block groups. I split the sample into high, medium and low NFIP penetration terciles and estimate separate event studies for each group to test whether insured neighbourhoods respond differently to the same flood shock. Preliminary wildfire analysis using MTBS burn perimeters find a precise null effect of severe wildfire on out migration, motivating the focus on floods where an insurance mechanism exists through the NFIP. The paper asks whether financial protection through flood insurance anchors households in place or facilitates relocation.

Background:

Climate-related disasters affect households not only through physical damage, but also through the balance-sheet constraints that shape their ability to respond. A growing literature studies the financial consequences of disasters through debt distress, mortgage outcomes, insurance costs while other literature examines migration as an adaptation response. This paper connects those literatures by studying whether financial protection changes household migration after localized flood exposure. The main question is whether NFIP insurance coverage facilitates exit from risky locations or instead stabilizes households in place, effectively crowding out migration as a form of private self-protection.

Literature Gap:

Existing research shows that disasters affect household balance sheets, debt, mortgage adjustment, and migration, but these literatures remain only partially connected. Household-finance papers focus primarily on debt, delinquency, and mortgage outcomes after disasters, rather than on migration as an adjustment margin. For example, Gallagher and Hartley (2017) show that flooding affects household debt and that flood insurance payouts can shape post-disaster mortgage adjustment, but migration is not the central object of the analysis. Migration papers, meanwhile, show that migration responses differ across disaster types and that public mitigation and disaster assistance may offset private incentives to leave risky areas. Boustan, Kahn, and Rhode, (2012) explicitly argue that government protection can crowd out private self-protection and document that migration responses differ across floods and tornadoes. Peralta and Scott (2024) show that NFIP availability increases population in flood-prone communities by approximately five percent, driven primarily by existing residents choosing to remain when flood insurance becomes available rather than by new in-migration. Deryugina, Kawano, and Levitt (2018) document large and persistent displacement effects from Hurricane Katrina but surprisingly transitory effects on income. McConnell et al. (2021) find that wildfire effects on migration and borrowing are measurable but modest compared to hurricanes, and that effects are concentrated in the most destructive fires. Kousky (2019) argues that more evidence is needed on how insurance design, take-up, pricing, and broader disaster-loss financing arrangements shape adaptation and recovery outcomes. This leaves an important gap: the literature has not yet directly tested whether flood insurance moderates the migration response to realized flood events at the neighborhood level, using actual measures of both flood exposure and insurance coverage.

Data:

Migration data: The project is built around a census block-group panel for the United States from 2011 to 2019. The main outcomes are annual out-migration, in-migration, and net migration flows constructed from the Agostini et. al., 2025 novel migration data, which provide origin-destination migration counts at the block group level constructed by reconciling high-resolution proprietary address records (Infutor) with Census constraints via iterative proportional fitting.

Flood exposure: To measure local flood disaster exposure, I assemble flood exposure data from multiple sources at different spatial resolutions. The primary flood shock measure comes from the Global Flood Database (Tellman et al., 2021), which provides satellite-observed flood inundation maps at 250-meter resolution for flood events worldwide from 2000-2018. Each pixel is classified as flooded or non-flooded using MODIS satellite imagery, with permanent water bodies masked out. I identify 24 U.S. flood events during 2011-2018 with satellite inundation maps. For each event, I intersect the flood raster with block-group polygons to compute the share

of each block group that was actually inundated, constructing a continuous, temporal, block-group-level flood shock variable. I supplement this with the Dartmouth Flood Observatory (DFO) flood event archive, which provides dated flood polygons for 98 U.S. events during 2011-2019, offering broader event coverage as a robustness check. Additionally, I have processed FEMA National Flood Hazard Layer (NFHL) maps for all 50 states and D.C., computing each block group's share of area in Special Flood Hazard Areas (SFHA) and a zone-specific risk score ranging from 0 (undetermined) to 4 (coastal high risk). These static flood zone measures characterize baseline physical flood exposure and are used as pre-determined controls.

Wildfire exposure. For wildfires, I use Monitoring Trends in Burn Severity (MTBS) perimeter data provided by the U.S. Geological Survey and the USDA Forest Service to identify block groups exposed to wildfire activity and to construct measures of burned area and burn severity at block-group level.

Hurricane exposure. For hurricanes, I use HURDAT2 track data together with storm wind radii to construct block-group-level hurricane exposure measures based on local storm intensity.

Insurance data. The project incorporates flood insurance information from the National Flood Insurance Program (NFIP). Using NFIP policy and claims microdata, I construct block-group-level measures of the local insurance environment including policy penetration (policies per housing unit), coverage, premiums, claims incidence, and claims-based loss exposure. These variables are central to the paper's household-finance mechanism.

Neighborhood characteristics. I merge block-group covariates from the American Community Survey using the 2011–2015 and 2015–2019 five-year files. These data provide information on housing stock, tenure, income, education, poverty, rent, home values, labor-market conditions, and racial composition. I also construct local spatial control groups using block-group queen contiguity based on polygon adjacency.

Empirical Strategy:

The paper's empirical setting is the United States at the census block-group level from 2011-2019. I exploit within-flood-event variation in satellite-observed inundation intensity across block groups. For each flood event in the Global Flood Database (GFD), I compute the share of each block group that was inundated (ShareFlooded), constructing an intensity treatment variable that varies across block groups within the same flood event. This is analogous to the MTBS burn perimeter approach used in wildfire research: just as MTBS identifies which specific areas burned, the GFD satellite maps identify which specific areas flooded in a given event. The event study specification is:

$$Outflow_{i,t} = \sum_{k=-3,k\neq-1}^{3} \beta_k . 1[t - t_e^* = k] . Shareflooded_{i,e} + \alpha_i + \delta_t + \epsilon_{i,t} \quad (1)$$

where $Outflow_{i,t}$ is the number of people moving out of block group i in year t, $Shareflooded_{i,e}$ is the intensity variable constructed from the GFD tiff, $1[t - t_e^* = k]$ are the flood event time dummies, and α_i and δ_t are block-group and year fixed effects. To test the insurance mechanism, I split the sample into three groups based on pre-flood NFIP penetration (high, medium, low terciles) and estimate separate event-study specifications for each group. If flood insurance anchors households, the high-penetration group should show less out-migration after the same flood shock than the low-penetration group. NFIP penetration is used as a sample splitter rather than an interaction term, which sidesteps endogeneity concerns about selection into insurance. The resulting impulse response functions are compared to assess whether the migration response differs by insurance coverage.

Preliminary Results:

Wildfire analysis. Preliminary analysis focused on severe wildfire exposure using MTBS burn perimeters intersected with block groups. A key empirical finding is that the identification strategy in control-group construction performs well: raw neighboring controls constructed through queen contiguity do not differ systematically from exposed neighborhoods on baseline mobility and neighborhood characteristics and propensity score reweighting materially improves covariate balance. Table 1 reports baseline balance between treated and weighted control block groups across key demographic, housing, and migration characteristics, with small differences supporting the credibility of the comparison design. Event-study estimates show clean pre-treatment trends in out migration validating the parallel trends assumptions. However, post-treatment estimates are small and statistically insignificant. Severe wildfires do not cause detectable out-migration at the block group level. This null result is robust and informative: wildfire, which lacks a federal insurance program analogous to the NFIP, may not generate measurable migration responses. This motivates the paper's focus on floods, where the NFIP provides a direct insurance mechanism that may shape the migration margin.

Table 1: Balance of Baseline Characteristics Across Treated and Control Groups

Variable	Treated Mean	Weighted Control Mean	Difference
Log outflow	7.038	7.020	0.019
Log inflow	7.104	7.087	0.017
Housing units	724.042	725.784	-1.743
Median income	72,374.839	72,473.029	-98.190
Median home value	391,983.429	399,048.983	-7,065.554
Percent owner-occupied	0.773	0.775	-0.002
Percent white	0.839	0.840	-0.001

Percent vacant	0.187	0.193	-0.006

Note: Differences are reported as treated mean minus weighted control mean.

Flood data construction. I have processed FEMA National Flood Hazard Layer maps for all US states and D.C., computing block-group-level flood zone risk scores and SFHA shares for over 200,000 block groups. I have also constructed the satellite-observed flood inundation variable from the Global Flood Database for 24 U.S. flood events during 2011–2018, and assembled DFO flood polygon data for 98 events during 2011–2019. Descriptive maps of NFIP penetration terciles show strong geographic variation, with high penetration concentrated along the Gulf Coast, Eastern Seaboard, and major river systems, and low penetration in interior and mountain states. Flood regressions using the satellite-observed shock are forthcoming.

Contribution:

The project contributes to the literature on the intersection of migration as a form of climate adaptation, household finance and insurance. Rather than treating migration only as distress or displacement, the paper studies migration as a financial adjustment margin that may depend on pre-existing financial protection. Existing household finance papers on disasters emphasize debt and mortgage outcomes but do not follow the migration margin; migration papers document heterogeneous responses across disaster types but lack the insurance mechanism; and institutional work on disaster insurance has not directly measured behavioral adjustment in the form of residential mobility. By bringing these strands together in a unified block-group panel with satellite-observed flood exposure and block group level insurance measures, the project provides evidence on whether disaster-finance environments shape who can move after local climate shocks. The findings speak directly to ongoing policy discussions around Federal Disaster Assistance & Management and NFIP reforms, FEMA adaptation incentives, and the design of insurance programs that may inadvertently discourage efficient reallocation away from climate risk.