Multi-Scale Migration Network Analysis

Evidence on Origin-Destination (OD) Flows, before and after Hurricane Harvey, Texas

Center for Hispanic Housing Studies

Funded by U.S Department Housing Development

Tarlan Pourmostaghimi [1]*, Dr. Shannon Van Zandt [1], Dr. Walter Gillis Peacock [1]

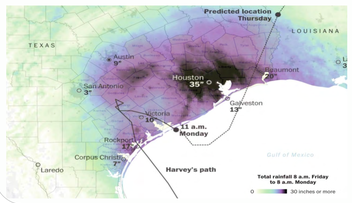
[1] Hazard Reduction and Recovery Center, Texas A&M University | *Correspondence: Tarlanpm@tamu.edu

Texas A&M University
Hazard Reduction & Recovery Center

Overview

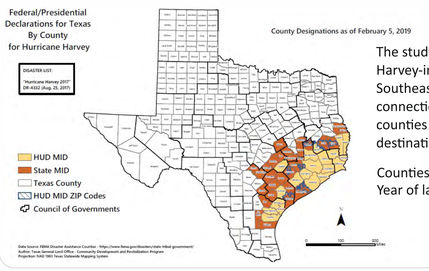
In August 2017, Hurricane Harvey became one of the costliest disasters in U.S. history, flooding the Houston metropolitan region and 49 federally-declared Texas counties. They shape **household decisions to stay, return, or relocate.** These choices are central to **disaster recovery** and **climate adaptation** because they influence who remains exposed to risk, who moves, and which communities absorb recovery pressures. This study asks one guiding question, examined at five connected scales:

Did Hurricane Harvey change the migration patterns of impacted counties - and if so, at what scale did that change happen?



Hurricane Harvey: path & rainfall map

Study Area



State of Texas

The study focuses on the Hurricane Harvey-impacted region in Southeast Texas and its migration connections with other Texas counties and out-of-state destinations.

Counties declared disaster areas:**49**
Year of landfall and impact: **2017**

Data Source & Period

The analysis uses IRS county-to-county migration flow data based on tax-filing households. The pre-Harvey baseline covers **2014–2016**, and the recovery period covers **2018–2020**.

2014–2016 Pre-Harvey Baseline → **2017** Harvey Year → **2018–2020** Recovery Period

49 Number of Harvey-impacted Counties

Inflow	Outflow	Counting unit
Movement INTO a focus county	Movement OUT OF a focus county	How a move is counted
Origin = anywhere in the U.S. Destination = one of the 49 impacted counties	Origin = one of the 49 impacted counties Destination = anywhere in the U.S.	N1 = returns filed ~ households migrated

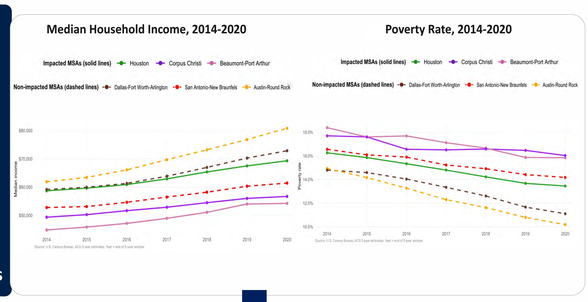
Who counts as a migrant?

This study counts only **cross-county moves** (origin FIPS not equal to destination FIPS). A household that moved within the same county is treated as a non-migrant, consistent with the IRS definition, which classifies same-county moves as non-migration.

Multi - Scale Analysis

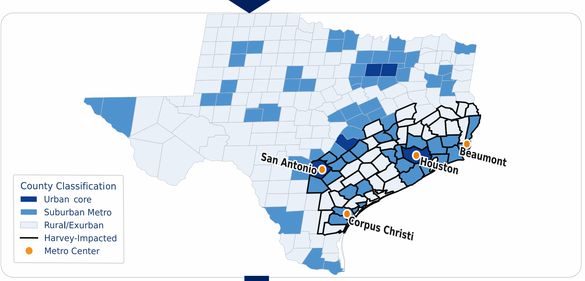
1 Metropolitan Statistical Area Features

- Income
- Race/Ethnicity
- Household Size
- Poverty Rate
- Unemployment Status



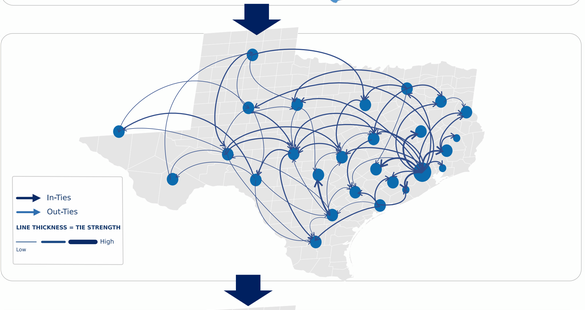
2 County Tiers

County Classification and Harvey Impacted Region



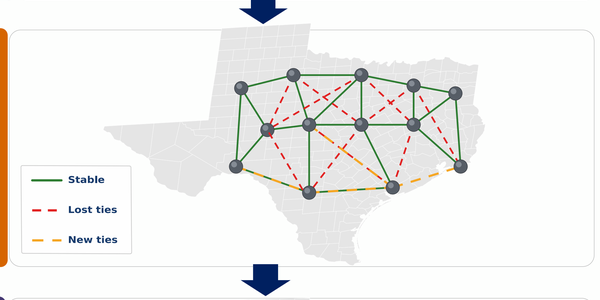
3 Inter County Ties

Migration Flows Between Counties
In-Ties: Send to Harvey Region
Out-Ties: Receivers From Harvey Region



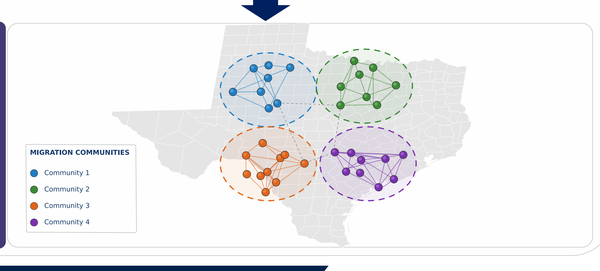
4 Network Stability Ties Stability & Change

Common Ties: Stable
Lost-Ties: Pre-Harvey
New-Ties: Post-Harvey



5 Community Detection (Origin-Destination)

Detect Communities
Identify Restructuring
Uncover Key Origin & Destination Groups



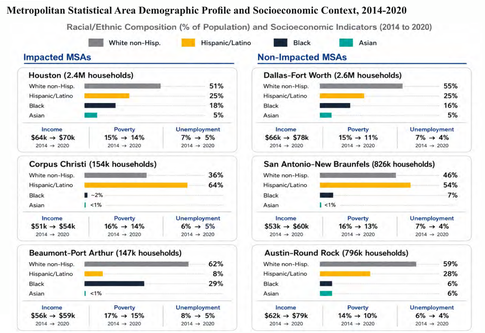
Research Implication

- **Protect receiving communities:** Assess whether suburban and exurban counties absorbing post-disaster inflows have sufficient affordable housing, services, and local capacity.
- **Flag at-risk peripheries:** Rural/exurban counties showed greater tie disruption, suggesting a need for targeted recovery support in lower-resource areas.
- **Pre-position aid along migration corridors:** Persistent ties can help agencies anticipate where displaced households are likely to move before demand peaks.

Findings

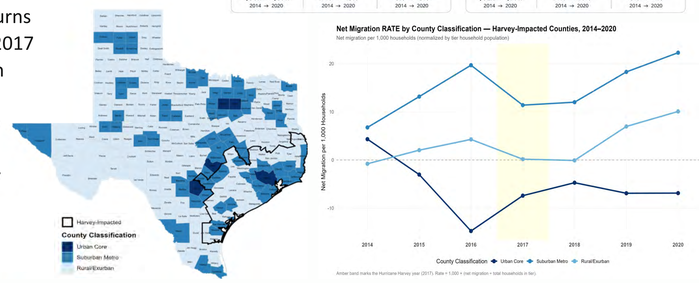
1

- All six metros share the same broad trajectory: rising incomes, falling poverty, and unemployment across the period. Harvey did not visibly bend these slow-moving economic indicators.
- Harvey did not visibly bend these slow-moving economic indicators, which is exactly why the migration network, not the economy, is where the disaster signal must be sought.



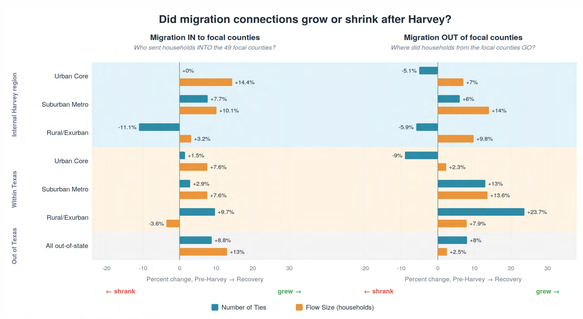
2

- Harris County's net migration turns sharply negative around 2016-2017 - households leaving faster than arriving.
- Suburban metro counties climb steadily upward, gaining households across the recovery period.
- Rural/exurban areas after 2018 gained more households.



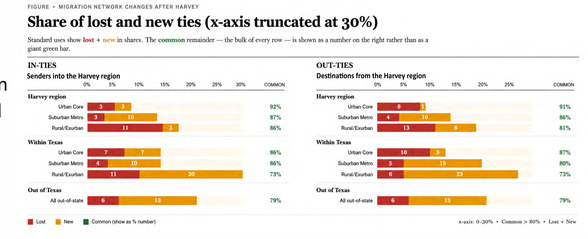
3

- The Harvey region became more connected to out-of-state counties and strengthened urban/suburban inflow channels. Impacted rural/exurban in-ties declined even as flows slightly increased.
- Out-migration expanded toward non-impacted suburban and rural/exurban Texas counties, while out-of-state flow volume grew only modestly.



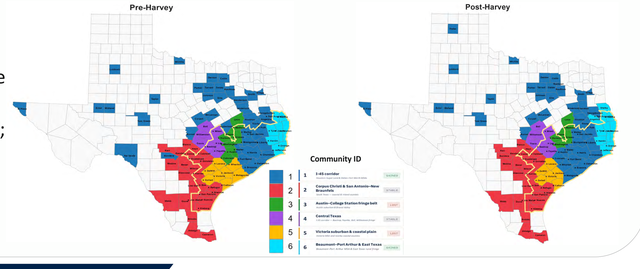
4

- Most migration ties remained stable, indicating strong network persistence after Harvey.
- Disruption was concentrated in rural/exurban and out-of-state connections, where lost and new ties formed a larger share.
- Overall, Harvey reshaped the network selectivity rather than causing system-wide collapse.



5

- Six matched migration communities persisted from pre- to post-Harvey.
- There was no wholesale collapse of the regional migration system.
- The Houston-Dallas corridor expanded; the Beaumont-East Texas community strengthened rural ties. The Austin fringe lost connections. Change was community-specific.



Conclusion

- **Harvey amplified**, not created — it accelerated a pre-existing urban-to-suburban redistribution already latent before 2017
- **Network reorganization** — the urban core consolidated losses, suburbs expanded, rural counties redirected outward
- **Migration as autonomous climate adaptation** — households redistributed across the risk landscape without policy guidance, shifting recovery burden onto unprepared receiving communities.
- **Structural vulnerability is the lasting legacy** — fragmented communities, particularly the Victoria coastal cluster, lost the internal connectivity needed to absorb the next shock.