Han, Chaeyeon, Uijeong Hwang, and Subhrajit Guhathakurta. 2024. "Can Thanksgiving Destinations Predict Climate Migration Patterns?" *Findings*, June. https://doi.org/10.32866/001c.117432.

RESILIENCE FINDINGS

Can Thanksgiving Destinations Predict Climate Migration Patterns?

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Keywords: Climate Migration, Climate Mobility, Family Ties, Social Ties, Disaster Planning, Urban Planning

https://doi.org/10.32866/001c.117432

Findings

This research explores the relationship between climate-induced migration destination choice and social ties in the US, using anonymized smartphone data from SafeGraph. It shows that Thanksgiving travel patterns correlate with relocations following Hurricanes Harvey, Irma, and Maria. Findings reveal a statistically significant positive correlation, suggesting that states with a greater change in visitors during Thanksgiving week compared to regular week are likelier destinations for post-disaster relocation, emphasizing social ties' crucial role in such decisions. This research highlights the need for urban planning and emergency management to consider the spatial distribution of social networks, which could inform evacuation strategies and disaster recovery policies.

1. Questions

Climate migration is rapidly increasing worldwide, largely attributed to extreme weather events, rising sea levels, and reduced agricultural yields. Climate change is expected to displace 250 million to 1 billion people between 2016 and 2050 globally (UNHCR 2016). In the United States, coastal cities in Florida are already experiencing population shifts due to sea level rise (Seeteram et al. 2023). Projections indicate that by 2100, sea level rise alone will displace 13 million coastal residents in the US (Robinson, Dilkina, and Moreno-Cruz 2020). In addition to coastal challenges, wildfires have displaced many residents in California (Bernstein 2020). Mega-size hurricanes, such as Hurricane Harvey, Irma, and Maria, displaced over 3 million people from affected communities in 2017, underscoring the increasing frequency and severity of natural disasters catalyzing climate migration in the US (Frank 2023; IDMC 2018).

Climate migration's social and economic impacts extend beyond the directly affected areas. Places that receive migrants are also subjected to changes in housing markets, insurance practices, and additional investments in infrastructure to accommodate migrants. For instance, 'climate gentrification' (Keenan, Hill, and Gumber 2018; Robinson, Dilkina, and Moreno-Cruz 2020) and shortages in affordable housing (Buchanan et al. 2020) arise from the increased demand for homes in safer regions due to the influx of migrants. In this context, understanding migration patterns is key for cities to anticipate better and prepare for infrastructure demands, altered social dynamics, and unprecedented economic impacts.

Previous studies suggest that disaster-affected individuals tend to relocate to areas where they have established social connections, especially with family, as these connections offer vital support and information (Chi 2020; Joarder and Miller 2013). Therefore, identifying social ties across regions can offer valuable information about the differential needs for emergency preparedness and climate adaptation investments in the receiving places (Black et al. 2011). Our research aims to identify the geography of the familial and social ties in the United States to test whether and to what extent social ties correlate with actual post-disaster migration patterns. The study utilizes trips made during Thanksgiving to detect kinship and familial relationships. In this paper, we address the following question:

Considering previous findings that social connections are a reliable indicator of relocation patterns after disasters, do the travel behaviors observed around Thanksgiving align with trends seen in post-disaster migrations?

2. Methods

2.1. Data

To analyze social connections, we have conducted an in-depth analysis of travel patterns during the Thanksgiving holiday, a time when most individuals visit their families. We employed SafeGraph data, which includes the weekly travel patterns of individuals with their anonymized smartphone data, to derive 1) visitors' residential location at the Census Block Group level and 2) information on the location and type of Points Of Interest (POI) visited. We then selected those POIs that people are likely to visit during family/friend visits (e.g., restaurants, entertainment, recreation, etc.) and excluded tourist attractions and parks to minimize data on non-familial travel. Our dataset encompasses 32,939 origin-destination patterns from the 2021 Thanksgiving period and a comparative non-Thanksgiving timeframe (two weeks before the same holiday).

2.2. Method

For each County-County pair, we calculated the change in visitor numbers during Thanksgiving week compared to those in a typical, non-holiday week. A positive change indicates an increase in visitors during Thanksgiving week, suggesting more social gatherings over usual travel behaviors.

We analyzed these patterns against observed post-disaster migration following hurricanes Harvey, Irma, and Maria, using maps derived from different studies - Hurricane Harvey's migration patterns were obtained from mobile GPS tracking data (Hong et al. 2021), Hurricane Irma's from survey data (Wong 2018), and Hurricane Maria's from social media data (Echenique and Melgar 2018).

Then, to investigate whether Thanksgiving travel patterns could predict post-hurricane migration, we examined the similarity between the rankings of relocation destinations after hurricanes and the rankings of Thanksgiving visitor increments from a typical week. We aggregated this data at the state level for the destinations. Figure 1 lists the origin counties of migrants for each hurricane event.

The correlation was assessed using Spearman's Rank Correlation Coefficient, a nonparametric measure that evaluates the strength and direction of association between two ranked variables without assuming a specific data distribution (Xiao et al. 2015). The coefficient values range from -1 to 1, and the coefficient of 0 suggests no association between the ranks of the two variables.

The formula for calculating the coefficient, r, is

$$r = 1 - \frac{6 \sum d_i^2}{N\left(N^2 - 1\right)},$$

Where N is the number of ranked observations and d is the rank differences for each pair of observations. For example, when the N is 6, the coefficient represents the correlation between the first six rankings from the migration and the Thanksgiving travel patterns. The null hypothesis for the significance testing is that there is no correlation between the two rankings ($r = 0$).

All three of the abovementioned studies identified areas where the evacuees primarily relocated to, leaving some states absent in the relocation data. To ensure the rankings were comparable in length, we excluded those states that did not appear in the relocation data from the Thanksgiving travel pattern list.

3. Results

First, we found a reasonably similar trend between the Thanksgiving travel and the actual post-hurricane migration patterns (Figure 1). This similarity was particularly pronounced following Hurricane Maria, where many Puerto Ricans relocated to states with established family connections, including New York, New Jersey, Florida, Texas, and California, as indicated by the Thanksgiving visitor changes map.

The Spearman's Rank Correlation Coefficient provides a quantitative measure of the relationship between the two variables. Across all three events, the correlation coefficient demonstrated a statistically significant positive correlation, with an increasingly strong relationship as the rank size increased (Figure 2). As expected from the maps, Hurricane Maria exhibited the highest correlation compared to Hurricanes Irma and Harvey. This pattern reflects the higher availability of shelters near the impacted areas following

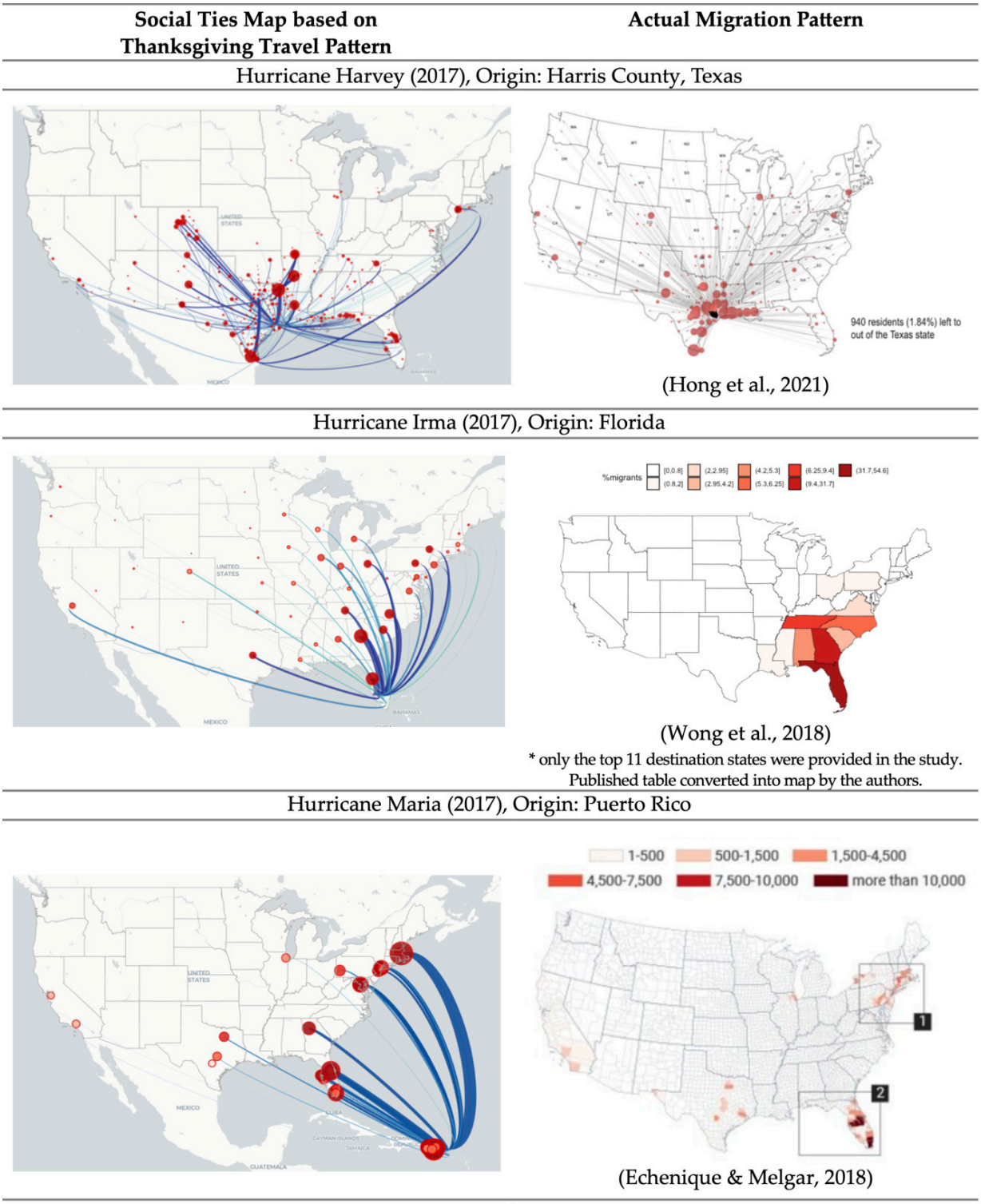

Figure 1. Comparison of Thanksgiving Visitor Patterns and Actual Post-Hurricane Migration Patterns (Published Maps)

* Red data points indicate destination. Stroke width reflects changes in Thanksgiving visitor numbers.

** According to a FEMA Fact Sheet (2022), the President declared nine counties as significantly affected by Hurricane Irma on September 10, 2017. These counties are Charlotte, Collier, Hillsborough, Lee, Manatee, Miami-Dade, Monroe, Pinellas, and Sarasota

Hurricanes Irma and Harvey that reduced the necessity for individuals to relocate to areas further away where they had familial connections (Hong et al. 2021; FEMA 2017, 2021).

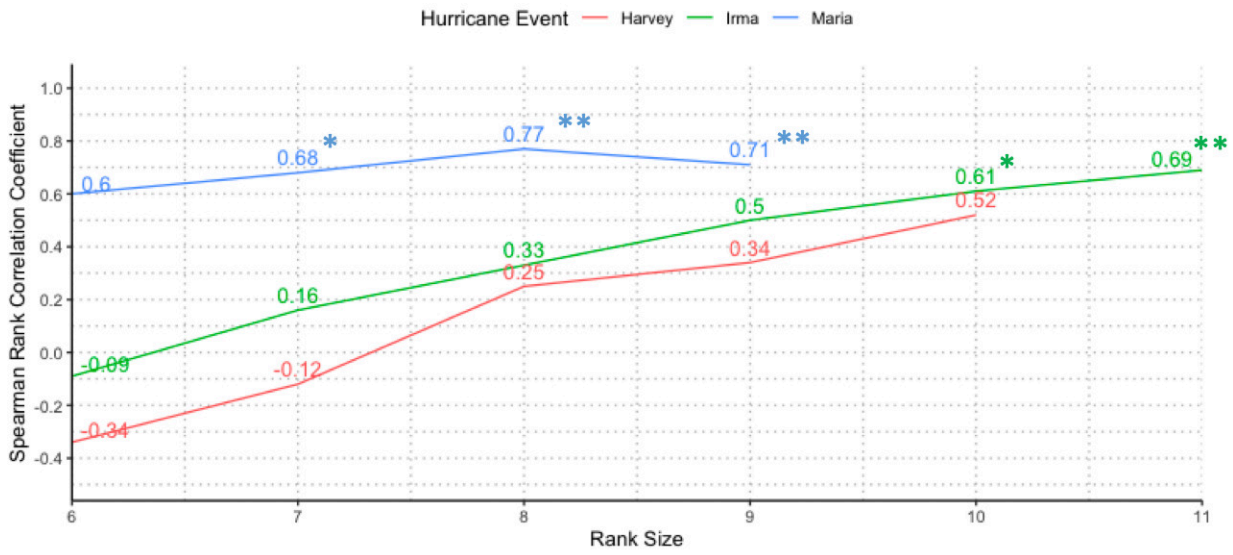

Figure 2. Spearman's Rank Correlation Coefficient by Rank Size

Note: 0.05 < p < 0.1: *, 0.01 < p < 0.05: **, p < 0.01 : ***

Table 1. Spearman's Rank Correlation Coefficient and 95% Confidence Intervals by Rank Size

Rank Size	Hurricane Maria				Hurricane Irma			
	r	p	CI lower	CI higher	r	p	CI lower	CI higher
6	0.60	0.21	0.10	0.86	-0.09	0.87	-0.40	0.24
7	0.68	0.09	0.31	0.87	0.16	0.73	-0.13	0.43
8	0.77	0.03	0.49	0.91	0.33	0.42	0.07	0.55
9	0.71	0.03	0.49	0.84	0.50	0.17	0.28	0.67
10	-	-	-	-	0.61	0.06	0.43	0.74
11	-	-	-	-	0.69	0.02	0.54	0.80
Rank Size	Hurricane Harvey							
	r	p	CI lower	CI higher				
6	-0.34	0.51	-0.57	-0.06				
7	-0.12	0.80	-0.36	0.13				
8	0.25	0.55	0.00	0.47				
9	0.34	0.37	0.13	0.52				
10	0.52	0.12	0.34	0.66				

The result suggests that the relocation patterns observed after hurricanes closely resemble the geography of social ties. This insight has important implications for urban planning and emergency management. By understanding the spatial distribution of social and family networks, planners can identify areas likely to see increased migration in response to disasters. Policy and planning can leverage this data to anticipate economic and social shifts in receiving areas, streamline the allocation of resources, and enhance support networks in evacuation zones. Furthermore, recognizing areas with

dense social and familial networks enables the formulation of policies that bolster these connections, potentially aiding in disaster recovery and community cohesion.

Submitted: March 27, 2024 AEST, Accepted: May 08, 2024 AEST

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SUPPLEMENTARY MATERIALS

Appendix

Download: https://findingspress.org/article/117432-can-thanksgiving-destinations-predict-climate-migration-patterns/attachment/226735.pdf