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Consumer Purchasing Behavior Before, During and After a Natural Disaster:
The Case of Hurricane Harvey

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Thuy Floyd and Ariun Ishdorj

Overview

- Natural disasters cause widespread destructions and may change the consumers purchasing behavior.
- The study examines consumers' respond to Hurricane Harvey in both affected and neighboring counties, accounting for contributing factors.

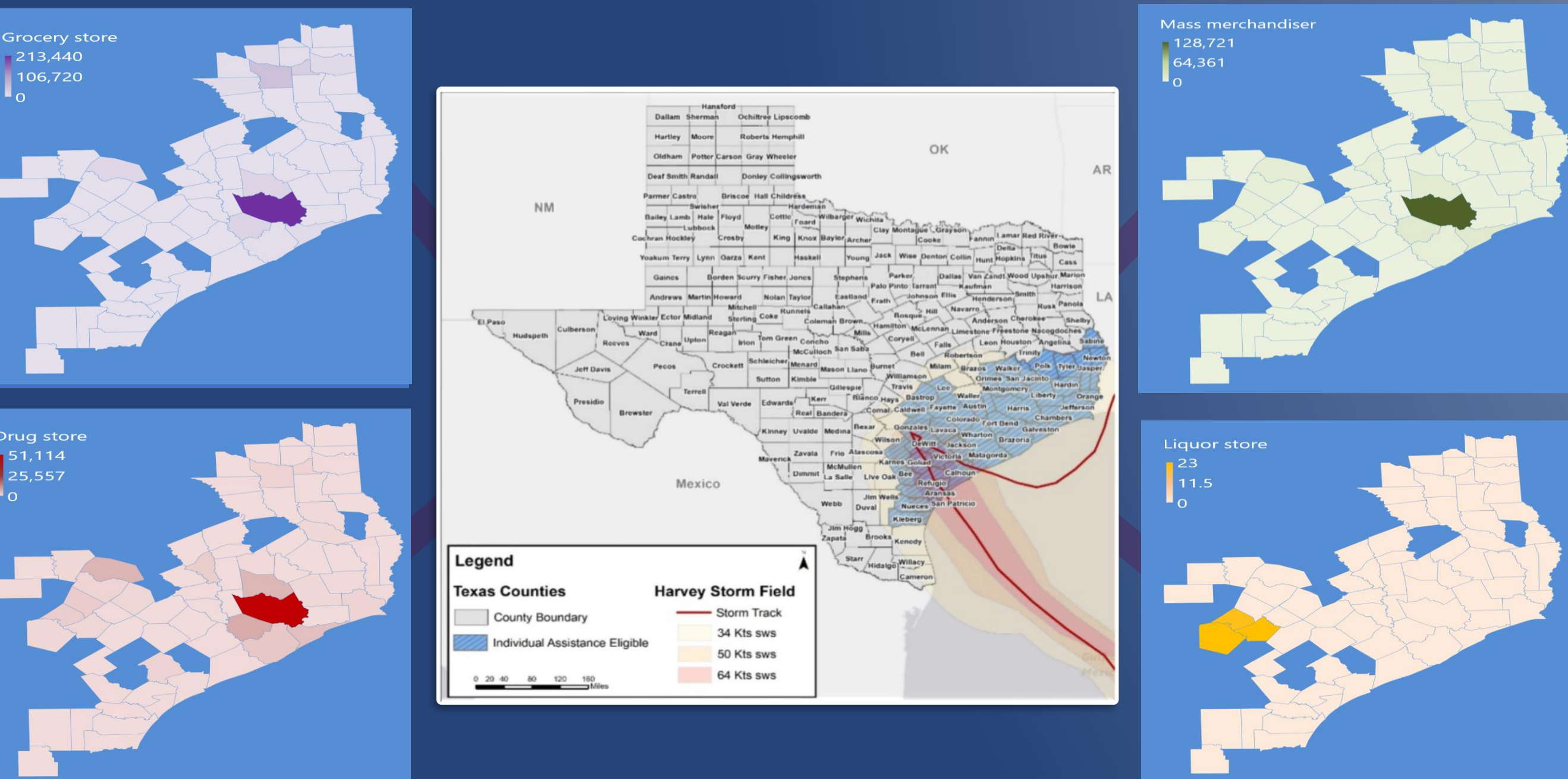
Objective

Investigate patterns, extent, and magnitude of changes in demand as well as factors affecting the demand for essential nonfood, perishable, and nonperishable food items before, during and after the 2017 Hurricane Harvey in Houston, TX and neighboring areas.

Data

- The retail-level Nielsen Scanner data is used in the analysis that prove weekly price and quantity information of nonfood and food items identified by a unique Universal Product Code (UPC) along with detailed product information. Household socioeconomic data were obtained from the US Census Bureau's American Community Survey.
- There are 44 counties that were declared as hurricane Harvey disaster zones in Texas by the US National Hurricane Center (NHC) and Internal Revenue Service (IRS), and 32 neighboring counties of the disaster covered areas.
- Time periods considered are: 5 weeks before, 2 weeks during and 5 weeks after Harvey.

Figure 1: Hurricane Harvey Path and Number of Stores



Methodology

The study uses the mixed effect semi-log model as following:

$$\ln V_{iwa} = \alpha_i + \beta_1 \text{Prior}_{iwa} + \beta_2 H_{iwa} + \beta_3 X_{iwa} + \beta_4 Y_{iwa} + \beta_5 H_{iwa} * X_{iwa} + \beta_6 H_{iwa} * Y_{iwa} + \gamma_{iwa} + \varepsilon_{iwa}$$

where, V_{iwa} is sale values for category i during week w in area a ; $\text{Prior}_{iwa} = 1$ if before Harvey; H_{iwa} is 2-week Harvey dummy; X_{iwa} is store characteristics; Y_{iwa} is demographic characteristics; γ_{iwa} is a monthly fixed effect term and error term ε_{iwa} .

Results

Table 1: Effects of Hurricane Harvey on Consumers Purchasing Behavior

	Affected Area			Nearby Area		
	Nonfood	Non Perishable	Perishable	Nonfood	Non Perishable	Perishable
Intercept	8.257* (0.891)	5.011* (0.264)	4.347* (0.698)	-0.027 (4.142)	5.351* (1.337)	11.424* (3.272)
Before Harvey	-0.201* (0.032)	-0.026* (0.009)	0.023 (0.018)	-0.28* (0.057)	-0.11* (0.018)	-0.036 (0.041)
During Harvey	-1.805 (1.900)	1.891* (0.624)	3.056** (1.61)	-11.787 (9.959)	-3.238 (3.244)	6.538 (7.719)
Month FEs	-0.079* (0.011)	0.013* (0.003)	0.049* (0.007)	-0.138* (0.021)	-0.047* (0.006)	-0.008 (0.015)
Store Channels						
Grocery Store^a	0.349* (0.014)	0.425* (0.004)	0.225* (0.008)	0.271* (0.071)	0.376* (0.038)	0.655* (0.094)
Drug Store	-0.023 (0.016)	-0.11* (0.005)	-0.082* (0.018)	0.544* (0.05)	-0.366* (0.033)	-0.05** (0.026)
Mass Merchandizer	0	0	0	0.510* (0.509)	-0.311* (0.032)	0
Demographics						
Black	3.48E-7* (5.98E-8)	4.26E-8** (1.85E-8)	1.61E-8 (6.00E-8)	-5.55E-7 (0.000)	-1.18E-6** (5.38E-7)	-2.02E-6 (1.52E-6)
White	-1.39E-8 (1.32E-8)	2.75E-8* (3.88E-9)	2.71E-8 (1.02E-8)	0.000* (4.77E-7)	-1.2E-6* (1.48E-7)	-1.2E-6** (4.9E-7)
Hispanic	-5.11E-8** (2.01E-8)	-1.19E-8** (6.24E-9)	3.51E-8 (1.89E-8)	-4.01E-7** (1.57E-7)	6.77E-7* (5.08E-8)	6.48E-7* (1.8E-7)
Income	-0.007* (0.001)	-0.004* (0.00)	-0.007* (0.001)	0.008** (0.005)	-0.007* (0.001)	-0.004 (0.003)
High School	-0.053* (0.008)	-0.037* (0.002)	-0.035* (0.006)	0.023 (0.038)	-0.034* (0.012)	-0.099* (0.031)
College	-0.049* (0.011)	-0.034* (0.003)	-0.019** (0.009)	0.025 (0.045)	-0.021* (0.015)	-0.097* (0.035)
Harvey * Stores						
H*Grocery	-0.418* (0.030)	-0.145* (0.009)	-0.183* (0.018)	0.253 (0.175)	-0.117* (0.091)	-0.102 (0.219)
H*Drug	0.064** (0.029)	-0.136* (0.011)	0.196* (0.039)	0.691* (0.114)	-0.098 (0.078)	0.000 (0.064)
H*Mass merchandise	0	0	0	0.558* (0.108)	-0.012 (0.077)	0
Harvey * Demographics						
H * Black	-3.09E-7** (1.24E-7)	1.62E-8 (4.35E-8)	1.71E-7 (1.34E-7)	-8.27E-7 (0.000)	-5.59E-7 (1.29E-6)	2.36E-6 (3.52E-6)
H * White	7.03E-8* (2.62E-8)	1.97E-8** (9.04E-9)	2.24E-8 (2.27E-8)	3.68E-7 (0.000)	-1.06E-7 (3.60E-7)	-1.7E-7 (1.17E-6)
H * Hispanic	5.98E-8 (4.24E-8)	-1.91E-8 (1.47E-8)	-8.72E-8 (4.31E-8)	4.47E-7 (3.71E-7)	2.46E-7** (1.22E-7)	-2.23E-7 (4.26E-7)
H * Income	0.005** (0.003)	0.001 (0.001)	0.000 (0.002)	0.009 (0.011)	0.002 (0.004)	0.000 (0.008)
H * High school	0.012 (0.016)	-0.017* (0.005)	-0.028** (0.014)	0.111 (0.091)	0.032 (0.03)	-0.057 (0.072)
H * College	0.028 (0.023)	-0.019** (0.008)	-0.036** (0.021)	0.116 (0.108)	0.035 (0.035)	-0.083 (0.085)
Observations	39,348	619,962	165,781	11,201	158,130	31,017
Adj. R-squared	0.09	0.08	0.03	0.14	0.03	0.02

Figure 2: Average Sales of Selected Products Before, During and After Hurricane Harvey

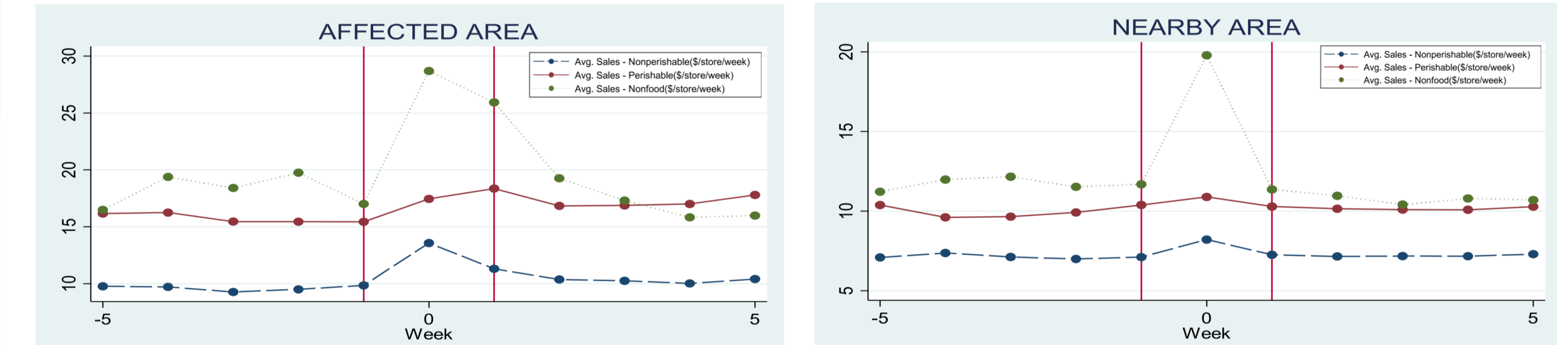


Table 2: Robustness Check

	AFFECTED AREA				NEARBY AREA			
	NON-FOOD		PERISHABLE		NON-FOOD		PERISHABLE	
Store-week Prior Harvey	2.52*	0.014	0.741*	-0.217*	2.221*	0.07	0.691*	-0.283
Store-week during Harvey	2.90*	0.396*	0.645*	0.322*	2.566*	0.414*	0.628*	0.301*
Store FEs	NO	YES	NO	YES	NO	YES	NO	YES
Month FEs	NO	NO	YES	YES	NO	NO	YES	YES
Observations	39,348	39,348	39,348	39,348	11,201	11,201	11,201	11,201
Adjusted R-squared	0.58	0.035	0.898	0.037	0.593	0.045	0.899	0.051
NONPERISHABLE								
Store-week Prior Harvey	1.775*	-0.050*	0.474*	-0.012**	1.559*	0.014*	0.458*	-0.054*
Store-week during Harvey	2.027*	0.202*	0.356*	0.213	1.655*	0.110*	0.242*	-0.091*
Store FEs	NO	YES	NO	YES	NO	YES	NO	YES
Month FEs	NO	NO	YES	YES	NO	NO	YES	YES
Observations	619,962	619,962	619,962	619,962	158,130	158,130	158,130	158,130
Adjusted R-squared	0.477	0.009	0.788	0.009	0.45	0.002	0.76	0.002
PERISHABLE								
Store-week Prior Harvey	1.982*	-0.077*	0.514*	0.012	1.725*	-0.023***	0.481*	-0.073**
Store-week during Harvey	2.124*	0.065*	0.230*	0.089*	1.785*	0.038**	0.183*	0.024
Store FEs	NO	YES	NO	YES	NO	YES	NO	YES
Month FEs	NO	NO	YES	YES	NO	NO	YES	YES
Observations	165,781	165,781	165,781	165,781	31,017	31,017	31,017	31,017
Adjusted R-squared	0.471	0.003	0.818	0.003	0.453	0.001	0.781	0.001

Discussion and Conclusions

- Overall, the demand for nonfood items, and perishable and nonperishable foods has significantly increased during the 12-week period of hurricane Harvey in included counties.
- The purchases from grocery stores increased in affected areas (between 25% and 53%) and nearby areas (between 31% and 93%). The nonfood item purchases from drug stores and mass merchandisers increased in neighboring counties, by 72% and 62%, respectively.
- In affected regions, during the 2-week landfall of Harvey, demand for nonperishable and perishable foods was increased by over 500% and 2,000%, respectively. The demand for all categories in nearby areas decreased during the two weeks of Harvey but was not statistically significant. This can be due to limited availability of these items caused by logistics in transportation, accessibility and supply disruption.
- In counties with higher mean income and education, the demand for food and nonfood items has decreased by about 5%. Race has marginal but significant effect on demand during Harvey.
- Robustness check shows that accounting for important factors can lead to precise and unbiased results.