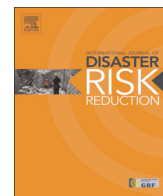




Contents lists available at ScienceDirect

## International Journal of Disaster Risk Reduction

journal homepage: [www.elsevier.com/locate/ijdr](http://www.elsevier.com/locate/ijdr)

## Hurricane Wilma, utility disruption, and household wellbeing

Chiradip Chatterjee<sup>a</sup>, Pallab Mozumder<sup>b,\*</sup><sup>a</sup> Department of Economics and Geography, University of North Florida, Jacksonville, FL 32224, United States<sup>b</sup> Department of Earth & Environment, Department of Economics and Social Science Laboratory, International Hurricane Research Center, Florida International University, Miami, FL 33199, United States

## ARTICLE INFO

## Article history:

Received 17 July 2015

Received in revised form

15 September 2015

Accepted 15 September 2015

## Keywords:

Hurricane

Critical infrastructure

Utility disruption

Household wellbeing

Risk mitigation

## ABSTRACT

Hurricanes with drenching rains and gusty winds bring down power lines and other critical infrastructures, and grind a region's economy to a halt. Consequently, the disruption of public utility services (e.g., water supply, electricity and telephone) and the suspension of local economic activities (e.g., transportation and local businesses) result in significant losses for households' wellbeing. On the other hand, hurricane preparation, for example mitigation measures targeted to reduce wind related damages (e.g., shutters, hurricane resistant windows and doors) and alternative resources for dealing with emergency situations (e.g., electric generator and hurricane supplies) could help reduce the post-disaster impacts. Based on data collected through a household survey right after Hurricane Wilma (2005), we have analyzed the survey responses using ordered logistic estimation approach and have found the evidence of effectiveness of household-level hurricane preparations. We have found that interruptions in electricity and water supply are the major drivers behind the reported losses of households' wellbeing. Results also show evidence of the benefit of hurricane shutters and generators in reducing the adverse impacts of Hurricane Wilma in South Florida. Our findings imply that significant investment in rapid restoration of public utility services following a natural disaster is instrumental in South Florida and beyond.

© 2015 Published by Elsevier Ltd.

## 1. Introduction

While storm-induced losses are skyrocketing, investment in natural hazard mitigation activities for promoting resilience is seen to be highly efficient from the economic perspective [1–3]. The relevant research questions are what factors affect efficient mitigation measures to enhance community resilience, and how to promote these behaviors and processes to hedge against disaster shocks. In this study we focus on a relatively under investigated area of households' coping behavior due to utility disruption following a major hurricane event. More specifically, we look into the household level impacts and coping behavior to reduced supply of critical public utility services in the aftermath of Hurricane Wilma. While there are a few micro-scale studies that investigate the recovery performances of business entities after a major natural disaster [4–6], much less focus has been devoted to household recovery processes. We have analyzed the role of utility disruption on post-hurricane household impacts, and subsequent coping and adaptation behavior at a finer scale with granular survey data collected after Hurricane Wilma.

Hurricane Wilma was one of the six hurricanes in the record-breaking hurricane season of 2005. It was the second most destructive hurricane of 2005 after Hurricane Katrina. Hurricane Wilma was the fourth category-five hurricane (sustained winds greater than 157 mph), and also the most intense tropical cyclone ever recorded in the Atlantic Basin [7]. On October 15th 2005, a tropical depression formed in the Caribbean near Jamaica. Soon it started to intensify and eventually became a named hurricane (Hurricane Wilma) on October 18th. In the next 24 h Hurricane Wilma became a category five hurricane with wind speed of 185 mph (295 km/h) and made several landfalls. The most destructive effect of Hurricane Wilma was felt in the Yucatán Peninsula of Mexico, Cuba, and in the state of Florida. At least 63 deaths were reported and the damages were estimated at over \$28.9 billion (\$20.6 billion in the US; 2005 US dollars). The extent of the damages placed Hurricane Wilma among the top five costliest hurricanes ever recorded in the Atlantic and the third costliest storm in U.S. history. This event had severe impact on the critical infrastructure in South Florida. It crippled the backbone of the Florida Power and Light's (FPL) electrical grid network. Approximately 3.2 million of FPL's 4.3 million customers were without power. The damage inflicted by Hurricane Wilma on FPL's electrical grid was especially severe in the highly populated counties of South Florida, i.e., Broward, Miami-Dade, and

\* Corresponding author. Fax: +1 305 348 1731.

E-mail address: [mozumder@fiu.edu](mailto:mozumder@fiu.edu) (P. Mozumder).

Palm Beach.<sup>1</sup> Several areas in these counties also lost water supply, though most had it restored within two days.

Researchers at the International Hurricane Research Center (IHRC, Miami, Florida) conducted a telephone survey immediately after the landfall of Hurricane Wilma (November 13–20, 2005). A total of 612 respondents were selected randomly from a list of the registered voters of South Florida. They were also asked to document their hurricane preparation and the impact of Hurricane Wilma. Using a random utility model (RUM), we have analyzed the reported loss in households' wellbeing due to disruptions in public utility services and property damages inflicted by Hurricane Wilma. The survey included responses regarding the following: hurricane damages, mitigation measures (i.e., shutter), disruption and restoration of public utility services (i.e., electricity, water, generator, and hurricane supplies), race, gender, residence, income, evacuation, shelter, and hurricane relief. The estimation result shows that disruption in electricity and water supply are the most significant factors behind the losses in households' wellbeing. The evidence indicates that hurricane shutters significantly reduce that loss, and the availability of an electric generator may contribute in reducing the loss of households' wellbeing. The evidence also shows that the allocation of funds for disaster relief was inadequate. Above all, to our knowledge this is the first study investigating the role of hurricane preparation and utility disruption on the loss of households' wellbeing following a hurricane event.

## 2. Background

Natural disasters, such as hurricane, are fundamental reflections of how societies structure themselves. The magnitude of disaster impacts increases incrementally with the marginalization of populations who are forced (or choose) to settle in areas that are susceptible to the wrath of nature. Major disasters can cause severe disturbance, trauma, and loss for individuals, families, and communities [8–10]. Surviving a natural disaster comes at a cost of shock, when survivors face numerous losses and have to put their lives and homes back together [11].

Researchers have long been studying factors that determine individual resiliency to such disaster loss [12]. Resilience is the ability of a system to absorb shocks, damages and discomforts [13,14]. Family resiliency depends upon adaptation measures, which either reduce the vulnerability to catastrophic losses, or improve the resilience by building shock-absorbing buffers to avoid post-disaster suffering [15–18]. It has been found that an individual's ability to cope up with the extreme stress in the post-disaster period largely depends on which resources are lost and which are still accessible [19]. Factors to individual resiliency include loss of physical resources, loss of roles, loss of loved ones, loss of hopes and dreams for the future, community resources and response, and one's ability to work through the grief process [20].

Studies have shown that substantial property loss causes greater negative psychological affects [21,22]. Losing a home and having to relocate are major impetuses of post-disaster stress [23] and increases the risk of depression and other forms of psychological disorder [24]. Beside structural damages and property loss, local trade and tourism lose substantial amounts of business in the post-disaster phase due to evacuation and out-migration, loss of consumer base, and staffing issues [5]. Most socio-economic and business activities depend on the uninterrupted supply of energy, telecommunications, transportation, financial, and other critical

services. The interdependent nature of these critical infrastructures leads to cascading effects throughout the network [25,26] and it is common for people not to be able to access many necessary services and resources vital to their survival during and after a disaster [11,27]. Therefore, researchers have emphasized the role of social and community resources available to disaster victims. The availability of community resources is often claimed to be more important than the actual event in predicting individuals' psychological response [19].

According to Freedy et al. [28], the loss of resources, daily routine, a sense of control, possessions, and social support is associated with elevated levels of acute psychological distress or loss of wellbeing. The experience of surviving a natural disaster can linger and manifest into other psychological problems [9,29,30]. While researchers in the psychology realm have been studying factors that relate to individual resiliency, there has been a recent shift to focusing on what makes a family resilient [12].

Adaptation is considered to be the different behavioral and structural adjustments in social and ecological systems to increase resilience [31]. Adaptation behavior and mitigation measures to reduce damages (e.g., hurricane preparedness, evacuation planning, setting up shutters, hurricane resistant windows, doors etc.), and alternative resources available during emergency situations (e.g., electric generator and hurricane supplies) may potentially reduce the impacts [32,33]. These processes can make a difference in facilitating expedited recovery at the household level leading to enhanced resilience at the community level. However, most of the existing literatures focus on these issues either from engineering perspectives or from regional and macroeconomic perspectives [32,34–37]. Relatively few studies look into these impacts and subsequent coping and adaptation behavior at a micro-scale.

People often fail to recognize the benefit of adaptive measures and preparation in acting efficiently against low-probability but high-consequence events such as hurricanes [38,39]. Studies show that household disaster preparation which is largely driven by the perceptions of hurricane risk, are shaped by their location, income and ethnicity, among other things [40–44]. However, the literature that focuses on recovery from disaster damages, particularly on the restoration of public utility services and the related choice of mitigation measures and hurricane preparation, is very limited [45–48]. The focus of most studies on this topic is either from an engineering perspective or from broader regional and macro perspectives. For example, Tian and Li [37] have developed a system dynamics model based on a region prone to hurricanes (i.e., Miami-Dade County, USA) and have tested scenarios for different power poles maintenance strategies. They found that the variation of wind speed due to extreme events like hurricanes produces a negative impact on the cost-effectiveness of different strategies and suggested mitigation measures by selecting different types of electrical poles and optimal timing for replacement. Similarly, Nateghi et al. [34] and Reed et al. [36] analyzed the likelihood power outages during hurricanes and expected damages due to power supply disruption and the benefit of its restoration.

There is an evident gap between micro and macro level policy analyses. While the micro level studies focus on risk perception of households', macro level analyses have mostly targeted system requirements on a broader scale. With the evidence from Hurricane Wilma, this is the first paper that bridges the gap between micro and macro level analysis. Here in this study, we have conducted a household level analysis of the impact of utility disruption and the effectiveness of mitigation measures. A major driver of post-hurricane stress has often been the disruption in utility services, such as, electricity, water supply, and telecommunication [48,49]. Our study attempts to explain both losses and recovery performances affected by the extent of utility disruption and also the benefit of mitigation measures at the household level.

<sup>1</sup> For detailed information, please see the redevelopment plan of Palm Beach County, Florida, prepared by the Treasure Coast Regional Planning Council and Continental Shelf Associates, Inc. The document is available at: [www.pbcgov.com/dem/publications/pdf/pdrp\\_AUG\\_06.pdf](http://www.pbcgov.com/dem/publications/pdf/pdrp_AUG_06.pdf).

Download English Version:

<https://daneshyari.com/en/article/7472888>

Download Persian Version:

<https://daneshyari.com/article/7472888>

[Daneshyari.com](https://daneshyari.com)