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ABSTRACT. In 2011, significant tornado outbreaks occurred throughout the United States. The property damage from these tornadoes was record breaking at over $28 billion. The impact of these tornadic events on the lodging industry, however, was not as extreme and in some instances was financially beneficial. This study evaluated the revenue implications of severe tornado events on the lodging industry. Using data provided by the National Oceanic and Atmospheric Administration (NOAA) and Smith Travel Research (STR), the lodging industries of 17 counties impacted by either EF4 or EF5 (enhanced Fujita scale) tornadoes were analyzed. Results indicated that the lodging operations in all 17 counties experienced an occupancy percentage increase for multiple days after tornado events. Only five counties experienced significant increases in average daily rate (ADR) for seven days following tornado events. All but one county experienced increases in revenue per available room (RevPAR) following tornado events. This suggests that gains in RevPAR were influenced more by increased occupancy opposed to inflated room rates.

INTRODUCTION

The 2011 tornado season was one of the most destructive and active years on record with over 1,690 tornadoes reported (NOAA National Climatic Data Center, 2012). In a two-month time frame, 45 counties experienced an extreme tornado event. Of these counties, 39 experienced an EF4 tornado with wind gusts ranging from 166–200 mph, and six experienced an EF5 tornado with wind gusts in excess of 200 miles per hour (NOAA Storm Prediction Center, 2011a). Interestingly, most of these extreme tornadoes occurred within a week's time. The greatest number of EF4 and EF5 tornadoes occurred on April 27, 2011, when 35 counties experienced at least one tornadic event. Less than a month later, the Jasper County town of Joplin, Missouri, experienced one of the most devastating tornadoes on record. The EF5 tornado that hit this city caused over $3 billion in damages and 158 fatalities (NOAA National Climatic Data Center, 2011). In total, the 2011 tornado season caused $28 billion in damages and 551 fatalities (NOAA National Climatic Data Center, 2011). The devastating costs and damages from these events stunned not only those in the path of these storms, but also those who provided basic needs like shelter following the disasters.

The potential damage and loss caused by tornadoes and other natural disasters is a concern for many in the lodging industry. In fact, companies such as Carlson, Hilton, and Wyndham all note natural disasters as a threat to their organization's performance in formal strengths, weaknesses, opportunities, and threats (SWOT) analysis documents (DATA MONITOR: Carlson Companies, Inc., 2011; DATAMONITOR: Hilton Worldwide, 2011; DATAMONITOR: Wyndham Worldwide Corporation, 2011). These concerns have proven true for a number of hotel companies. For

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example, in 1999, five hotel properties were severely damaged when an F5 tornado (Fujita scale) ripped through the Oklahoma City area (Whitford, 1999). In 2008, both the Omni Hotel at CNN Center and the Westin Peachtree Plaza Hotel suffered significant property damage as well as loss of convention business when an EF2 tornado hit Atlanta's business district (USA Today, 2008). More recently, 11 hotel properties in Branson, Missouri, were heavily damaged during the February 29, 2012, "leap day" tornado. The largest property impacted by this storm was the Hilton Branson Convention Center which sustained significant damage to 214 of its 294 rooms and over $3 million in damages to its convention center (Fivecoat-Campbell, 2012). In total, the hotel general manager estimated that the property suffered $20 million in damages (Serlen, 2013).

Although a natural disaster can have devastating consequences for a community as a whole, the lodging industry may be able to realize positive performance opportunities in these situations. The type of natural disaster, however, influences the likelihood of such opportunities being realized. For example, O'Neill (2005) found that Hurricanes Katrina and Rita had negative impacts on hotel-room demand and inventory along the Gulf Coast. Hotels in other areas of the United States, however, experienced positive effects and improved value per room because they were able to absorb the group business that Gulf Coast hotels could no longer serve. This is not to say that local lodging markets do not experience positive gains from natural disasters. Hennis (2012) notes that hurricanes tend to have negative short-term and long-term effects on the localized lodging segment, whereas tornadoes often "have a positive impact on the local and regional hotel markets" (Hennis, 2012, p. 1).

The present study focuses on the localized impact of tornadoes and seeks to contribute to the body of knowledge in this area in two ways. First, the study expands on similar research by examining the revenue impact a natural disaster other than a hurricane may have on the lodging industry and concentrates solely on the localized implications of such events. Second, this research investigates the notion of tornadoes having a positive influence on the local hotel market by examining the events' impacts on counties of varying populations.

PURPOSE OF THE STUDY

Although severe tornado events may cause economic loss for a community as a whole, the lodging industry may actually see financial gains from such events. Thus, the purpose of this study is to evaluate the immediate revenue impact a local lodging industry experiences following severe EF4 and EF5 tornado events. To better understand a tornado's immediate implications, three key lodging performance indicators—occupancy percentage, average daily rate (ADR), and revenue per available room (RevPAR) are examined. Of particular interest is the degree to which hotels note revenue and performance gains and the driving force behind these gains—increases in occupancy or increases in room rates charged. The following research questions provide the framework for this study:

Research Questions

1. Are there significant differences in a county's occupancy percentage in the seven days following a severe tornado event?
2. Are there significant differences in a county's ADR in the seven days following a severe tornado event?
3. Are there significant differences in a county's RevPAR in the seven days following a severe tornado event?

LITERATURE REVIEW

Tornado Strength Classifications

To understand what is considered a severe tornado event, it is important to have fundamental knowledge of the system used to classify tornado strength and corresponding damage. The most widely known tornado classification model in the United States was

the Fujita scale or F-scale. Created and introduced in 1971 by Dr. T. Theodore Fujita, this scale *estimated* a tornado's wind speed by the level of damage caused (NOAA Storm Prediction Center, 2011b). The F-scale ranged from F0-Gale to F5-Incredible and was the primary means of creating the database that defined every tornado event in the United States, including those that occurred prior to the scale's implementation in 1971. Information gathered from newspaper articles and photographs was used to classify historical tornado events from 1950 to 1971.

Over the years, the F-scale revealed a number of deficiencies in the classification system. To address these deficiencies, a team led by Texas Tech University's Wind Science and Engineering Research Center revised the system and constructed the Enhanced Fujita (EF) scale (NOAA Storm Prediction Center, 2011b). In 2007, the EF-scale was adopted and replaced the previous F-scale (NOAA National Climatic Data Center, 2008). Both scales use a tornado severity rating consisting of six numerical categories that range from 0 (the least severe) to 5 (the most severe). The EF-scale, however, also uses a list of 28 types of structures and vegetation as damage indicators to more accurately categorize a tornado's strength (Wind Science and Engineering Center, 2006). Each of the 28 indicators corresponds with varying degrees of damage. Once a damage indicator is selected, the estimated wind speed is determined and an EF-scale score (EF0-EF5) is assigned. The goal is to assign an EF-scale category based on the highest wind speed estimated in the tornado's path (Wind Science and Engineering Center, 2006).

The National Weather Service (NWS) is the only federal agency with the authority to provide official tornado EF-scale ratings (National Weather Service, 2008). Trained NWS personnel identify damage indicators, evaluate the structural or vegetative material, and match each with one of the corresponding degrees of damage. They then make a judgment with regard to whether the wind speed required to cause the damage is higher or lower than the expected speed for the particular degree of damage caused. This process is completed for several structures before a final EF rating is determined (National Weather Service, 2008).

Natural Disaster's Impacts on the Hospitality Industry

Natural disasters have had an increasingly profound effect on the hospitality industry. Hall (2010) argues that the effects of natural disasters on the industry are not necessarily tied to an increase of such events but, instead, are a result of tight linkages that exist between the global economy, transportation systems, and communication networks. These factors are now so closely intertwined "that when one destination or region has been affected (by a natural disaster) ...the impacts can reverberate through the entire system" (Hall, 2010, p. 401). Freed (2010) notes that the media plays an important role in how the world views the impact of a natural disaster. In Freed's discussion about the impact of the British Petroleum oil spill in the Gulf Coast, he suggests that the media portrayed the entire coast as contaminated with oil, when in reality it was not; this perceived image, however, resulted in a decline in tourism traffic.

The impact of such disasters can be negative for some and positive for others. After Hurricanes Dennis, Floyd, and Irene ravaged the East Coast, Chandler (2004) estimated that the North Carolina lodging industry realized room revenue losses of $96.3 million in just a two-month period. Conversely, Taylor (2005) suggests that Hurricane Katrina produced a number of positive effects for the lodging industry. Hotel properties in the area that were either undamaged or able to quickly reopen fared well after the storm, because they were able to accommodate Katrina emergency responders; additionally, properties outside the damaged area were able to absorb some of the meeting and convention business that could no longer be serviced by hotels and convention spaces impacted by the storm.

A natural disaster does not necessarily mean people will stop traveling. Instead,

individuals may choose alternative destinations. In 2004, a tsunami devastated the coasts of Indonesia, Sri Lanka, South India, Thailand, and other countries located along the Indian Ocean coastline. Although some areas of Asia were significantly damaged by the tsunami, it did not prevent residents in other regions of the affected countries from traveling. In fact, Zhang (2005) suggests that a redistribution of outbound tourists occurred after the tsunami. Chinese tourists continued to travel but selected destinations other than the Indian Ocean coastline. Additionally, an increase in the price of tourist products occurred as rapid demand for alternative travel destinations transpired (Zhang, 2005).

In the United States, the casino town of Tunica, Mississippi, experienced both the highs and lows that can come with natural disasters. Following Hurricane Katrina, the casinos and hotels in the area realized an influx of visitors as guests shifted their business away from the damaged Gulf Coast casinos to establishments in Tunica (Anderer, 2012). This shift provided Tunica casinos the opportunity to realize record revenues in 2007. Then, in 2011, Tunica experienced a negative situation as the result of a natural disaster. The flooding of the Mississippi River diverted casino and hotel business away from Tunica and redistributed it to other casinos in the south. Tunica is now struggling to regain market share, because gamblers became accustomed to patronizing other establishments while the town's casinos were closed (Anderer, 2012).

Recovery after a Natural Disaster

The ability of a business to recover from a natural disaster's impact is, to some extent, determined by its strength in four areas. Zhang, Lindell, and Prater (2009) propose four dimensions of business vulnerability that influence the ability of a business to recover. These dimensions include (a) capital vulnerability, (b) labor vulnerability, (c) supplier vulnerability, and (d) customer vulnerability. Zhang et al. suggest that hospitality businesses fare particularly well when overcoming customer vulnerability, because they are often a part of recovery-related businesses. These types of businesses may experience sales loss immediately following a natural disaster but can quickly realize demand increases as disaster response efforts begin.

In a similar study, Sydnor-Brusso, Stafford, Tews, and Adler (2011) suggest the presence of three types of capital stocks—physical, human, and social—are vital for job continuity in communities impacted by a natural disaster. Communities that possess higher levels of these three capital stocks tend to be more resilient after a natural disaster than their counterparts, which have low levels of these capital stocks. Sydnor-Brusso et al. (2011) found that approximately 25% of a community's ability to preserve the number of hotel jobs following a natural disaster was positively explained by the percentage of college-educated residents over the age of 25 (human capital) and the percentage of religious organizations (social capital) present. This suggests that communities with higher percentages of these two capital stocks are more likely to retain the number of hotel jobs after a disaster occurs. Interestingly, this same study suggests that the resiliency of hospitality jobs in a community is not significantly impacted by the number of disasters that occur or the level of damage caused.

The human resource factor may be one of the most critical factors in a hotel's ability to sustain operations following a natural disaster. In a study of New Orleans hotel operators, participants indicated that human resource concerns provided the greatest number of challenges following Hurricane Gustav (Lamanna, Williams, & Childers, 2012). Of the hoteliers surveyed, 42% reported that they did not have the minimum number of employees needed to offer full guest services after the storm.

These natural disasters and the resulting negative and positive consequences for the lodging industry create a situation to consider. The degree to which natural disasters impact a community's lodging sector is influenced by the type of event that occurs as well as the resources available to recover after an event

has occurred. To further the discussion, this study adds to the body of natural disaster research by focusing on the revenue implications tornadoes have on the local lodging industry.

METHODOLOGY

Data for this study was acquired from two different sources. The severe weather database file provided by the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service Storm Prediction Center was used to identify counties in the United States that were impacted by EF5 and EF4 tornadoes in 2011. In total that year, 45 counties were hit by either EF5 or EF4 tornadoes (NOAA Storm Prediction Center, 2011a). Once the impacted counties were identified, the Federal Information Processing Standards codes (FIPS codes) for each county and state were submitted to Smith Travel Research (STR) to obtain the 2010, 2011, and 2012 daily lodging performance data of each county. STR requires a minimum of four properties in a county to submit data before the overall lodging performance information can be reported. Only 17 of the 45 counties impacted by either EF5 or EF4 tornadoes met this requirement. Therefore, these 17 counties serve as the focus of this study. A review of previous research indicates that the use and matching of the NOAA database and the STR database differentiate this work from previous studies.

The next step in this study was to use descriptive statistical analyses to examine the lodging performance data of the 17 counties of interest. First, operating ratios seven days before, the day of, and seven days after each 2011-tornado event were plotted. The operating ratios include the daily occupancy percentages, ADRs, and RevPARs. The two-standard deviation band method was then performed for the counties' occupancy percentage, ADR, and RevPAR to detect any statistically significant differences in the operating ratios after the tornado events. This was accomplished by computing the baseline mean of each ratio seven days prior to the tornado event and then calculating two standard deviations from the mean. Operating ratios of more than two standard deviations from the baseline mean after the tornado were considered statistically significant (Nourbakhsh & Ottenbacher, 1994). Operating ratio baselines for the corresponding time periods in 2010 and 2012 were computed in the same manner and used for comparison.

RESULTS AND FINDINGS

Demographics

Of the 17 counties examined, six counties had populations of fewer than 100,000, eight counties had populations ranging between 100,000–200,000, and three counties had populations of 300,000 or greater. The seasonality of lodging business varied slightly among the counties. The majority of the counties were in the shoulder season when the tornado events occurred. Only Dekalb County, Alabama; Canadian County, Oklahoma; and Blount County, Tennessee were in peak season when impacted by the tornado events.

A review of the room-supply data before and after the tornado event revealed that only four counties experienced changes in supply. St. Louis County, Missouri, experienced a one-day decrease in room inventory after the tornado on April 22, 2011; Hamilton County, Tennessee, experienced a .5% decrease in room supply; and Catoosa County, Georgia, had a 37.2% decrease in room supply after the April 27, 2011, tornadoes. Jefferson County, Alabama, actually added room supply the same day (April 27, 2011) the tornado occurred there. Table 1 summarizes the demographic data for each county.

Occupancy Percentage

Most of the counties experienced at least one day of statistically significant occupancy increases in the seven days following a severe tornado (see Table 2). Chamber County, Alabama, and Canadian County, Oklahoma, were the only two counties that did not realize any significant increases in occupancy after the tornadoes. However, 12 counties experienced 5 or more days of significant occupancy increases immediately after a severe tornado.

TABLE 1. Summary of Demographic Data

County	2011 Population Estimate	Date of Tornado	Tornado Strength	Seasonality of Lodging Business	Room Supply Before Tornado	Room Supply After Tornado
Calhoun Co, AL	117,797	April 27, 2011 (Wednesday)	EF4	Shoulder season	1,922	1,922
Chamber Co, AL	33,939	April 27, 2011 (Wednesday)	EF4	Shoulder season	282	282
DeKalb Co, AL	71,375	April 27, 2011 (Wednesday)	EF5	Peak season	417	417
Etowah Co, AL	104,303	April 27, 2011 (Wednesday)	EF4	Shoulder season	1,266	1,266
Jefferson Co, AL	658,931	April 27, 2011 (Wednesday)	EF4	Shoulder season	**13,561**	**13,672**
Morgan Co, AL	119,953	April 27, 2011 (Wednesday)	EF5	Shoulder season	1,915	1,915
St. Clair Co, AL	84,398	April 27, 2011 (Wednesday)	EF4	Off season	417	417
Tuscaloosa Co, AL	197,211	April 27, 2011 (Wednesday)	EF4	Shoulder season	3,080	3,080
Catoosa Co, GA	64,530	April 27, 2011 (Wednesday)	EF4	Off season	**582**	**365**
Jasper Co, MO	118,435	May 22, 2011 (Sunday)	EF5	Shoulder season	2,329	2,329
St. Louis Co, MO	998,692	April 22, 2011 (Friday)	EF4	Shoulder season	**16,924**	**16,765** *(1 day only)*
Canadian Co, OK	119,492	May 24, 2011 (Tuesday)	EF5	Peak season	960	960
Blount Co, TN	123,901	April 27, 2011 (Wednesday)	EF4	Peak season	2,011	2,011
Bradley Co, TN	100,055	April 27, 2011 (Wednesday)	EF4	Shoulder season	1,511	1,511
Hamilton Co, TN	340,855	April 27, 2011 (Wednesday)	EF4	Off season	**8,563**	**8,518**
McMinn Co, TN	52,508	April 27, 2011 (Wednesday)	EF4	Shoulder season	663	663
Monroe Co, TN	44,882	April 27, 2011 (Wednesday)	EF4	Shoulder season	654	654

Note. Sources for demographic data include United States Census Bureau (2013), NOAA Storm Prediction Center (2011a), and Smith Travel Research.

TABLE 2. 2011 Daily Occupancy Percentage Seven Days after Severe Tornado Events

County	Mean 7 Days Before	Baseline (Mean + 2 Std. Dev.)	Day of	1 Day After	2 Days After	3 Days After	4 Days After	5 Days After	6 Days After	7 Days After
Calhoun Co, AL	46.42	**62.67**	76.64*	86.73*	92.61*	92.30*	76.43*	80.75*	75.81*	69.67*
Chamber Co, AL	33.23	**52.20**	48.58	41.13	35.82	38.30	19.15	36.17	41.49	33.69
DeKalb Co, AL	41.08	**61.77**	55.16	44.12	50.36	94.96*	88.01*	93.05*	94.48*	94.24*
Etowah Co, AL	38.42	**51.93**	73.38*	90.44*	96.29*	94.79*	80.33*	79.15*	72.83*	74.09*
Jefferson Co, AL	47.68	**69.88**	85.33*	90.80*	93.79*	95.38*	83.10*	95.20*	96.56*	97.18*
Morgan Co, AL	46.88	**68.10**	54.88	41.25	70.70*	80.57*	73.37*	80.05*	85.43*	83.71*
St. Clair Co, AL	39.29	**57.97**	82.49*	85.37*	91.61*	94.48*	94.96*	96.16*	97.60*	89.45*
Tuscaloosa Co, AL	46.56	**63.54**	55.03	72.66*	86.10*	89.32*	89.64*	93.80*	94.16*	94.68*
Catoosa Co, GA	45.12	**58.68**	79.21*	N/A	N/A	94.85*	86.85*	82.74*	85.75*	81.10*
Jasper Co, MO	55.08	**73.76**	39.03	65.31	76.73*	85.44*	87.51*	89.87*	93.52*	86.86*
St. Louis Co, MO	59.64	**80.11**	57.84	54.89	42.23	62.73	72.21	79.31	75.84	85.20*
Canadian Co, OK	79.20	**88.27**	83.54	83.96	84.69	81.88	86.56	66.98	62.71	81.04
Blount Co, TN	43.79	**61.81**	60.32	68.08*	67.48*	74.89*	47.14	59.17	64.30*	68.42*
Bradley Co, TN	44.39	**63.80**	64.79*	73.66*	78.62*	70.68*	57.64	62.94	67.90*	68.17*
Hamilton Co, TN	52.15	**72.04**	81.37*	88.06*	90.23*	90.34*	78.20*	82.16*	82.75*	84.08*
McMinn Co, TN	55.98	**69.32**	66.67	72.55*	77.53*	70.14*	49.92	57.01	61.24	64.56
Monroe Co, TN	56.60	**70.80**	68.35	71.41*	74.92*	70.03	53.67	59.33	60.24	61.77

Note. *Statistically significant at two standard deviations from the baseline mean.

Of these 12 counties, seven had significant increases in occupancy all 7 days after the tornadoes. These increases in occupancy appear to be unique to 2011, because similar trends were not found in the comparable data for 2010 and 2012.

Average Daily Rate

Although significant occupancy increases were seen in many of the counties examined, a tornado event did not necessarily have the same impact on ADR (see Table 3). Of the 17 counties considered, seven counties did not experience any significant increases in ADR, and three counties had only 1 day of significant ADR increases in the 7 days after tornadoes. Five of the counties did see significant ADR increases for 5 or more days after tornadoes. Tuscaloosa County, Alabama; Jasper County, Missouri; and Catoosa County, Georgia, had significant increases in ADR on each of the seven days after the tornado events. The ADR increases in these counties were $10 to $14 above the ADR mean for the 7 days before the tornadoes occurred. The significant ADR increases that occurred in 2011 seem to have been influenced by the tornado events, because similar significant increases in ADRs were not detected in the 2010 and 2012 comparable data.

Revenue Per Available Room

As noted in Table 4, all counties but one had at least 1 day where significant RevPAR increases were realized in the 7 days following a tornado. Chamber County, Alabama, was the only county not to have any significant RevPAR increases immediately after the tornado occurred. Twelve counties, however, did experience significant RevPAR increases for 5 or more days after tornadoes. Of these 12 counties, nine saw significant increases in RevPAR for all 7 days after tornadoes. The increases in RevPAR also seem to be influenced by the tornado events and are unique to 2011, because similar results were not observed in the 2010 and 2012 comparable data.

DISCUSSION AND IMPLICATIONS

Although severe tornado events can have devastating implications for the overall economic well-being of a community, the lodging industry may, in fact, experience positive financial benefits (Hennis, 2012). All of the counties in this study did experienced some level of occupancy percentage increases in the days following severe tornado events compared with the previous week's mean. A majority of the counties experienced multiple days of significant increases in occupancy. Clearly, these occupancy increases can be a result of displaced residents seeking a place to stay, but they are also influenced by members of government, private, and volunteer agencies, who travel to these devastated areas to provide assistance to residents; and members of the media, who cover the aftermath of tornadoes on site.

Although all of the counties realized some increase in occupancy after tornado events, the same was not true for the ADR. The majority of the counties experienced, at most, 1 day of significant increases in ADR. This suggests that price gouging was either nonexistent or was kept to a minimum in the days following the tornadoes. The steady ADR may be influenced by emergency service providers, such as FEMA, who have previously negotiated contracts specifying the maximum room rates that can be charged, thereby reducing a hotelier's ability to drastically increase the rate. Additionally, legal concerns related to price gouging may also influence hoteliers' willingness to significantly increase the rates charged for rooms.

Many of the counties in this study experienced multiple days of significant increases in RevPAR following the tornado events. The results of the occupancy percentage and ADR analysis suggest that the increases in RevPAR were driven by increases in occupancy, opposed to inflating the rates charged for rooms. Because price gouging in any industry is a concern after a natural disaster, the fact that hotels in the counties impacted by severe tornadoes realized revenue growth through increases in occupancy instead of ADR bodes well for the reputation of the lodging industry.

TABLE 3. 2011 ADR Seven Days after Severe Tornado Events

County	Mean 7 Days Before	Baseline (Mean + 2 Std. Dev.)	Day of	1 Day After	2 Days After	3 Days After	4 Days After	5 Days After	6 Days After	7 Days After
Calhoun Co, AL	61.67	**74.66**	65.09	65.14	63.12	63.35	64.30	66.88	67.32	66.40
Chamber Co, AL	63.43	**70.12**	67.30	65.78	62.60	62.72	65.65	70.47*	69.69	65.79
DeKalb Co, AL	73.11	**77.74**	75.60	72.86	75.27	76.64	76.03	72.55	74.95	74.79
Etowah Co, AL	55.79	**64.32**	57.94	69.22*	63.98	65.14*	65.80*	66.66*	65.80*	67.04*
Jefferson Co, AL	75.36	**91.99**	84.27	84.33	82.45	83.74	82.41	86.49	88.49	90.04
Morgan Co, AL	63.55	**70.36**	68.71	63.91	71.95*	71.04*	69.40	71.48*	70.94*	69.35
St. Clair Co, AL	68.97	**74.63**	73.76	73.24	73.06	72.72	75.95*	71.72	73.57	74.15
Tuscaloosa Co, AL	62.43	**68.86**	64.62	69.47*	72.65*	71.12*	69.94*	72.21*	70.67*	71.77*
Catoosa Co, GA	62.73	**65.74**	66.18*	N/A	N/A	72.81*	76.81*	75.41*	74.45*	72.78*
Jasper Co, MO	66.76	**74.04**	67.91	74.96*	75.97*	75.62*	74.15*	76.77*	74.41*	75.79*
St. Louis Co, MO	77.58	**91.84**	65.47	66.03	67.03	80.59	83.93	83.88	79.96	72.83
Canadian Co, OK	64.87	**68.74**	66.33	66.50	67.50	67.70	69.26*	64.78	63.58	62.60
Blount Co, TN	66.83	**75.69**	70.22	71.00	63.87	64.67	63.05	73.24	73.34	73.18
Bradley Co, TN	59.94	**63.48**	61.30	66.27*	62.14	65.62*	63.15	63.97*	64.88*	64.34*
Hamilton Co, TN	74.37	**84.42**	80.49	81.47	83.26	83.00	78.70	80.38	80.35	79.37
McMinn Co, TN	66.01	**68.44**	64.67	63.48	63.25	66.26	64.76	65.85	65.58	66.80
Monroe Co, TN	54.25	**57.56**	56.31	57.56	58.08*	58.03*	55.37	56.54	57.11	57.67*

Note. *Statistically significant at two standard deviations from the baseline mean.

TABLE 4. 2011 RevPAR Seven Days after Severe Tornado Events

County	Mean 7 Days Before	Baseline (Mean + 2 Std. Dev.)	Day of	1 Day After	2 Days After	3 Days After	4 Days After	5 Days After	6 Days After	7 Days After
Calhoun Co, AL	28.97	**44.29**	49.88*	56.50*	58.45*	58.47*	49.14*	54.01*	51.03*	46.26*
Chamber Co, AL	21.23	**34.38**	32.70	27.06	22.42	24.02	12.57	25.49	28.91	22.16
DeKalb Co, AL	30.19	**46.80**	41.70	32.15	37.91	72.78*	66.91*	67.51*	70.81*	70.48*
Etowah Co, AL	21.61	**31.53**	42.52*	62.60*	61.60*	61.74*	52.85*	52.76*	47.92*	49.67*
Jefferson Co, AL	36.61	**59.86**	71.91*	76.58*	77.33*	79.87*	68.49*	82.34*	85.45*	87.50*
Morgan Co, AL	30.09	**46.59**	37.71	26.37	50.87*	57.24*	50.92*	57.22*	60.61*	58.05*
St. Clair Co, AL	27.31	**41.88**	60.85*	62.53*	66.93*	68.71*	72.12*	68.97*	71.80*	66.33*
Tuscaloosa Co, AL	29.29	**42.50**	35.56	50.48*	62.55*	63.52*	62.70*	67.73*	66.54*	67.95*
Catoosa Co, GA	28.35	**37.57**	52.42*	N/A	N/A	69.05*	66.71*	62.39*	63.85*	59.02*
Jasper Co, MO	36.87	**50.52**	26.51	48.95	58.29*	64.61*	64.88*	68.99*	69.58*	65.84*
St. Louis Co, MO	46.45	**65.96**	37.87	36.24	28.31	50.56	60.61	66.53*	60.64	62.06
Canadian Co, OK	51.41	**59.10**	55.41	55.83	57.16	55.43	59.95*	43.39	39.87	50.73
Blount Co, TN	29.56	**45.10**	42.35	48.33*	43.10	48.43*	29.72	43.34	47.15*	50.08*
Bradley Co, TN	27.60	**39.44**	39.72*	48.81*	48.86*	46.38*	36.40	40.26*	44.06*	43.86*
Hamilton Co, TN	39.11	**57.42**	65.50*	71.75*	75.12*	74.98*	61.55*	66.04*	66.49*	66.74*
McMinn Co, TN	36.97	**46.27**	43.11	46.05	49.04*	46.47*	32.33	37.55	40.16	43.12
Monroe Co, TN	30.80	**39.89**	38.49	41.10*	43.52*	40.64*	29.72	33.55	34.40	35.63

Note. *Statistically significant at two standard deviations from the baseline mean.

The financial benefits a hotel may experience following a severe tornado event are not without challenges. EF4 and EF5 tornadoes can cause devastating property losses as well as loss of life. In order to make any financial gains from a tornado, the property itself must first survive the storm. For example, the sizeable decline in Catoosa County's room inventory after the tornado suggests that property damage did occur to some of the hotels in the area, thus limiting the ability of the damaged properties to experience the financial benefits after the storm. Additionally, staffing after such an event can be quite difficult, particularly when employees and/or their loved ones may have perished in the storm, which was the case for hoteliers after the 2011 Joplin, Missouri tornado. Employees may also have to take time from work in order to address their own personal property losses, which adds to staffing challenges.

The findings of this study have implications for both the lodging industry and investors. A significant tornado event does not necessarily translate into financial devastation. In fact, just the opposite may be true. To recognize potential revenue gains, hoteliers should work to build relationships with government agencies and disaster relief organizations that provide assistance to communities impacted by tornadoes. These two sources of business alone can help sustain, if not improve, a hotel's revenue performance following a severe weather event.

The findings may also be useful to both investors and insurance underwriters as they consider the risks involved with hotel properties in tornado-prone areas. A severe tornado event may not have the negative risk implications one might think. The counties examined in this study experienced minimal hotel room inventory losses after extreme tornado events occurred. Although hotels in a few counties realized slight decreases in occupancy the day of or day after the tornado, the decline was relatively small. Overall, hotels in an area where a tornado has occurred may experience an immediate, brief, negative impact and a quick recovery following the event.

LIMITATIONS AND FUTURE RESEARCH

To put the discussion into context, it is important to note the limitations of this study. First, only the lodging ratios 7 days before and after a severe tornado event were considered in this particular study, giving just a snapshot of the impact of the disaster. This limits our ability to fully understand the disaster's long-term economic impact on the industry. Future research should examine changes in operating ratios for an extended period of time in order to gain a complete understanding of a severe tornado's impact and financial implications.

Second, the lodging industries in only 17 of the 45 counties impacted by either EF4 or EF5 tornadoes in 2011 were considered in this study. For STR to report summary lodging data for a county, at least four properties must submit performance information. Because 28 counties did not report sufficient lodging data, the generalizability of the study's results is somewhat limited. On the other hand, one might argue that if a county does not have at least four properties which report data to STR, the lodging industry may have little to no presence in that area.

Third, this study focuses on the room revenue and performance changes that occurred in the week following severe tornado events. In larger hotels, multiple revenue sources, such as food and beverage provisions, contribute to the total revenue structure of properties. Severe weather may result in canceled events and lost catering revenue. Therefore, future research should examine the impact severe tornado events might have on revenue generated from divisions outside of rooms.

Fourth, this study considers the lodging data of only the counties where tornadoes actually touched down. It does not take into account the influence the disaster might have on the lodging data of the surrounding counties. Future research is needed to better understand the economic effects a severe tornado event may have on hotels located in counties surrounding, because hotels fill up in the county where the tornado occurred, and the overflow of rooms needed may spill over into neighboring counties.

Finally, this study examined the lodging industry in counties where only either EF4 or EF5 tornadoes occurred. It does not take into account the impact that weaker tornadoes, such as EF1 or EF3 events, may have on the industry. Future research is needed to understand how these weaker tornado events impact hotel-room demand and room rates charged. The additional research may help determine if a tornado must cause a certain level of destruction in a county before the lodging industry realizes upticks in its performance data.

AUTHOR NOTE

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