

Business Recovery From Hurricane Harvey

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Abstract

This paper examines factors that affected the progress of post-disaster business recovery in South Texas of the United States with survey data collected after Hurricane Harvey struck the region. Among alternative types of disaster assistance, government aid seemed to be effective in business recovery from property damage. Local chamber members were also more likely to survive, and women business owners tended to reopen their businesses sooner than their counterparts. However, the loss of employees following the storm posted a challenge for affected businesses to recover.

Keywords: Disaster recovery; business return; property damage

* Declarations of interest: none.

1. Introduction

Hurricane Harvey made landfall near the Rockport-Fulton area of Aransas County in South Texas of the United States on August 25, 2017. According to local officials, this Category 4 storm damaged about 75% of residential and business properties across the county, and about one-quarter of homes were considered destroyed or uninhabitable. Physical structures in the impacted communities sustained storm damage from wind gusts over 130 miles per hour and water damage from tidal surge as high as 12 feet. Harvey is also regarded as one of the “costliest” natural disasters in U.S. history due in part to widespread flooding across southeast Texas, particularly areas around Houston.

In February of the following year, the first pass of debris removal in Aransas County was nearly complete (Acosta, 2018). Meanwhile, about 40% of its businesses were back in operation, and many homes were being repaired or rebuilt. As post-storm recovery began in those Gulf Coast communities, one interesting question concerns factors that might have affected local businesses’ reopening decisions and the progress of overall business recovery in the impacted communities. According to the Federal Emergency Management Agency (FEMA, 2015), historically about 40% to 60% of small businesses never reopened their doors after a major disaster.

Business survival following a disaster plays a vital role in long-term community recovery as the presence of reopened businesses influences residents’ return decisions, which in turn affect the likelihood for other businesses to recover (Xiao and Van Zandt, 2012). To this end, the objective of this paper is to explore factors that affected business recovery from Hurricane Harvey in light of survey data of businesses in the hardest-hit areas. We look at the progress of business recovery by focusing on the opening status of individual businesses in the survey sample six months and 12 months after the storm. Our findings also shed light on the effectiveness of government mitigation programs and other assistance aimed at accelerating

community recovery after a natural disaster like Hurricane Harvey.

The remainder of the paper is organized as follows. After a review of the related literature in Section 2, Section 3 describes the survey data, and Section 4 discusses results of estimating the survey data on storm impacts and business return decisions. Section 5 contains a summary and concluding remarks.

2. Related Literature

In this paper, we investigate Hurricane Harvey's impact on businesses and their subsequent recovery from the storm. There is a large body of empirical literature on economic recovery after a major natural disaster, such as an earthquake or a hurricane. Most studies focus on economic outcomes at the aggregate level, such as overall employment (e.g., Belasen and Polachek, 2008, 2009; Ewing et al., 2003; Vigdor, 2008; Xiao and Feser, 2013). However, as discussed below, some industries tend to recover more rapidly than others (Dahlhamer and Tierney, 1998), so a better understanding of disaster recovery would benefit from looking at individual businesses in different industries.

Business return decisions are key to broader community recovery after a natural disaster (Corey and Deitch, 2011; Lam et al., 2009; Webb et al., 2002; Xiao and Van Zandt, 2012). Local residents are more likely to return to the neighborhoods in which more businesses have reopened. This is especially critical for relatively smaller communities, which tend to have a smaller capacity to rebuild infrastructure due to relatively fewer local government resources (Asgary et al., 2012). For a variety of reasons, small, neighborhood businesses as opposed to large corporations are also particularly vulnerable to economic losses from natural disasters (Alesch et al., 1993; Webb et al., 2000).

Communities in Aransas County, where Harvey made its first landfall, represent a unique case study in the literature. Most previous studies look at disaster impacts and recovery

outcomes in relatively large areas, such as Los Angeles after the 1994 Northridge earthquake (Dahlhamer and Tierney, 1996, 1998; Tierney, 1997) and New Orleans after Hurricane Katrina in 2005 (Corey and Deitch, 2011; Lam et al., 2009; Xiao and Nilawar, 2013). In contrast to those large urbanized regions, Aransas County is the sixth smallest county in the state of Texas with a population of roughly 25,000 and mostly small businesses. Our findings would therefore shed light on business-level recovery outcomes in less urbanized communities.

Among studies that do look at recovery at the firm level, the focus is mostly on long-term outcomes years after the event. Corey and Deitch (2011) indicate that business survival immediately after a disaster is vital to long-term community-wide recovery. Lam et al. (2009) find that the rates of business reopening became indistinguishable across different industries two years following Hurricane Katrina. These findings imply that it would be fruitful to also look at business recovery shortly after a disaster.

The literature identifies a number of determinants of business recovery from disasters. Chang and Rose (2012) and Tierney (2007) provide reviews of recent studies. The majority of potential factors are related to a business' vulnerability to a disaster and its capability to recover from it. The broad categories of factors that affect business recovery outcomes are: (1) direct and indirect physical impacts, such as property damage and lifeline disruptions; (2) business and owner characteristics, such as the sector in which a business operates, firm size, age, financial conditions, and business owner demographics; and (3) the economic conditions of the impacted community.

2.1 Disaster Impacts

Above all, interruptions of lifeline infrastructure, such as power, water supply, roads and telecommunications, are detrimental to business and community recovery (Lam et al., 2009; Webb et al., 2000, 2002). On the heels of Hurricane Katrina, the entire city of New Orleans was

literally “closed” for at least one month due largely to flooding that slowed down restoration of community infrastructure and lifeline services (Corey and Deitch, 2011). In the case of Harvey, infrastructure was largely restored within a month among areas where it made its first landfall in South Texas, but it took much longer time for southeast Texas areas near Houston that sustained primarily flood instead of wind damage.

Some businesses are more susceptible to physical damage, which is damage to buildings, equipment, furnishings and inventory stocks (Zhang et al., 2009). As opposed to many service-based businesses, retail stores are inherently vulnerable to damage to inventory stocks. Likewise, structural damage tends to have a greater impact on the operation of hotels and other lodging facilities than other businesses. Disaster-related property losses also adversely affect businesses’ financial conditions.

In addition to physical damage, businesses in the affected areas may face operational disruptions due to displacement of their employees because of damage to their homes (Tierney, 1997; Xiao and Van Zandt, 2012). Likewise, some businesses, notably retailers and restaurants, rely on their suppliers, so disruptions in supply chains can also hamper their operations.

2.2 Business and Owner Characteristics

A large number of studies suggest that larger or more established businesses tend to be better equipped to withstand disaster-related economic losses. Kroll et al. (1990), Dahlhamer and Tierney (1998), and Webb et al. (2000, 2002) indicate that small businesses tend to have limited pre-disaster preparedness and have less access to insurance and other means of funds to finance property damage and income losses. Conversely, larger businesses with multiple locations tend to be less vulnerable to a disaster’s impact on population dispersion, which in turn affects their customer base as well as the availability of employees.

Another business characteristic related to size is age. However, Webb et al. (2002) find

no expected age effect on business recovery from the 1989 Loma Prieta earthquake, but an effect in the opposite direction as expected for businesses in Florida after Hurricane Andrew in 1992. They explain that younger businesses can adapt more easily to the changing environment.

The industry in which a business operates affects how well it weathers a natural disaster, especially during the short-term recovery period. Businesses that rely on local market demand, such as retail stores and restaurants, are less likely to resume operation as temporary population dislocation or permanent population losses reduce their market base (Tierney, 1997). Sales conditions also tend to deteriorate as surviving residents suffer economic losses (Chang and Falit-Baiamonte, 2002; Webb et al., 2002). On the contrary, community-wide rebuilding activities have been found to be a boon to the local construction and related industries, including engineering services (Kroll et al., 1990; Dahlhamer and Tierney, 1998; Balasen and Polachek, 2008, 2009; Chang, 2010; Corey and Deitch, 2011; Brown et al., 2015).

Some studies also relate business recovery to business owners' characteristics. In particular, Morrow and Enarson (1996) find that women faced more challenges than men in the areas hit by Hurricane Andrew. However, Webb et al. (2002) and Wasileski et al. (2011) find no evidence to support any gender effect in the long-term performance of businesses impacted by major natural disasters.

In addition to insurance payments, the capability for individual businesses and the broader community to recover from a natural disaster can be enhanced by external financial aid from such sources as FEMA, Small Business Administration (SBA), and the Red Cross. While Davlasheridze et al. (2017) find FEMA grants to be effective instruments for mitigating disaster-related property losses, Webb et al. (2002) report no evidence that government programs help improve long-term business recovery outcomes. Unlike assistance to affected individuals, the majority of government programs for businesses are in the form of loans that in fact generate additional indebtedness to business owners. Moreover, businesses that receive disaster relief

also tend to have suffered more economic losses and thus have been worse off in the first place than otherwise.

2.3 Community-Wide Environment

Other than business-level attributes, community-wide factors can affect businesses' return decisions. An economy more resilient to natural disasters may reinforce business recovery efforts with a more positive overall economic outlook. Disaster resilience typically refers to the capacity to resist external shocks or actions that facilitate timely recovery from downturns caused by natural disasters. Xiao and Drucker (2013) find that a diverse local economy, which is made up of a mix of different industries as opposed to high concentration of a few industries, tends to boost employment and income recovery after disaster events.

Some studies report that a major natural disaster can exacerbate the ongoing trend of an area's economy (Chang, 2010) or its businesses (Dahlhamer and Tierney, 1998). For instance, Dehlhamer and Tierney (1998) find that businesses that had experienced growth prior to the Northridge earthquake showed better recovery performance than other businesses. Webb et al. (2002) find similar evidence on affected businesses in the wake of the Loma Prieta earthquake and Hurricane Andrew. They also find strong association between business owners' assessment of their business recovery outcomes and the overall business climate of their communities.

Other community-level factors are related to social bonds or networks. For instance, Tierney (2007) find that the attitude of businesses in New Orleans following Hurricane Katrina depended on not only the extent that residents and employees return to the city, but also the opening of other local businesses. Similarly, Islam and Walkerden (2014) find spiritual support from neighbors and friends as key factors for community recovery from natural disasters.

3. Data

The Rockport-Fulton Chamber of Commerce conducted a survey of local businesses between mid-January and mid-February of 2018—about half a year after Hurricane Harvey struck the area. The city of Rockport and its neighboring town of Fulton together make up about 90% of all businesses in Aransas County. This survey concerned the immediate impact of the storm on individual businesses, how they had recovered, and any assistance they had received.

The survey instrument contains 27 questions. The appendix displays details of the questionnaire. To maximize the number of responses, the survey was announced through various town-hall meetings, local organizations, such as the Rotary Club, and emails and social media. Survey responses were collected online at Constant Contact. A total of 152 respondents completed the survey. This sample represented about 10% of the pre-Harvey business population. Slightly less than 90% of respondents received the survey through the Rockport-Fulton Chamber of Commerce's announcements, and the rest responded through social media.

As discussed below, a number of questions concerned individual businesses' demographics. Although the survey sample was not stratified by industry or economic sector, the demographic breakdown of respondents' businesses is representative of the area's business population. In particular, about one in four (25%) respondents belonged to the retail trade sector, and another 21% of them were owners or managers in the accommodation and food services sector. Slightly less than half (46%) of respondents indicated that their businesses had reopened. This closely matched the share of all reopened businesses (49%) in the area at the end of February, according to the regular field surveys on all local businesses by the Rockport-Fulton Chamber. From these perspectives, the survey findings seem to be robust to the potential survivorship or sample selection bias, which arises from a non-randomized sample that is likely to include mostly surviving businesses (Lam et al., 2009). Nevertheless, we have dealt with possible bias in the sample by replicating the results with the weighted endogenous sample

maximum likelihood estimator, as outlined in Greene (2018). The estimation results deviate little from those reported below and thus are not reported here to save space.

3.1 Storm Impacts

In response to the question about how long the business was closed immediately after Hurricane Harvey, 4% of respondents stated that their business was closed permanently. About 36% of them responded that their business was closed for more than one month. About 28% of businesses were closed for 15 days or less. The vast majority of these businesses did not sustain any property damage.

According to the survey, about 90% of businesses sustained property damage, either to building structure or contents, such as equipment, furnishings and inventory stocks. Slightly less than half of respondents (49%) registered with FEMA for assistance. About 31% of them indicated that they had not been able to receive materials, supplies, and services adequately since the storm.

2.2 Business Recovery

About 66% of respondents indicated that they had business insurance. Out of those respondents that had business insurance coverage, slightly less than half of them (45%) carried both flood and wind insurance, and 46% of them indicated that their insurance also covered income losses. When asked about how to finance the damages to business, however, about 47% of respondents listed personal savings as the primary source.

The next popular (43%) source to finance recovery was through windstorm insurance. Another 23% of them indicated retained earnings or business savings. Business owners also received financial aid from FEMA grants (7%) and SBA Disaster Assistance Loans (16%), and private donations (10%), such as the Rebuild Texas Fund, Red Cross and chambers of commerce

in the South Texas region.

One question concerned the share of business staff was negatively impacted by Harvey. About 42% of respondents indicated a percentage more than 90%. About 27% of them indicated no more than 10%. Another question dealt with the type of assistance that respondents had received. About 40% of them expressed no assistance at all, whereas 33% indicated financial assistance on working capital, structural repairs, or operating expenses. About 17% of them also listed physical help to repair their premises. About one in 10 respondents also acknowledged technical assistance with assessing options and determining financial needs.

The survey data allow us to address two broad questions: (1) How different is Hurricane Harvey's impact across different industries or businesses? (2) Particularly for those businesses that sustained property damage, what might help explain business owners' decision to reopen their business or close it permanently? We address these questions by applying two empirical models to the survey data. A discussion of the models' dependent and explanatory variables follows.

2.3 Descriptive Statistics

Table 1 lists the means of the variables included in the empirical models. The survey resulted in 152 observations. The means represent the shares of responses in the survey. The first (left) panel of the table lists the means of dependent variables, which equal 1 for an entry filled by the respondent and 0 otherwise. According to the survey, 77% of the local businesses sustained property damage, with relatively more damage to the structure of the establishments alone (62%) than damage to non-structural components or contents alone (40%).

Slightly less than half of respondents (46%) reported that their business had resumed operation by the time they took the survey. Each business' reported operating status was verified against the database of the Rockport-Fulton Chamber, which continuously monitored reopened

businesses in Aransas County beginning October 2017. The Chamber staff updated individual businesses' opening status with field surveys and phone calls. About half of those businesses that were open by mid-February did not sustain significant damage to either structural property or contents. Only 23% of the businesses with property damage were open at that time, and only 7% of them were open after sustaining damage to both structure and contents.

The Rockport-Fulton Chamber's regular update on local businesses also allowed us to look at business recovery one year after Harvey. In addition to the operating status in February 2018, we performed the same regression analysis on the operating status of the 152 survey respondents' businesses in August 2018. As shown in Table 1, the share of businesses that had reopened by that time rose from 46% in February to 89% another six months later. The corresponding shares of reopened businesses with property damage also more than doubled. This share of reopened businesses in the survey sample closely matched the share of reopened businesses in the entire local business population at 83%, according to the Chamber's database.

The second (right) panel of Table 1 lists the means of explanatory variables in our regression models. Except for age measured by years in business, size measured by the number of employees, and the share of lost employees, data entries for all variables are binary numbers (0 or 1) coded the same way as the dependent variables. Reflecting business locations across Aransas County, slightly more than 70% of respondents' businesses were located in Rockport, and 26% of the businesses were located in a downtown area of Rockport called the Heritage and Arts District. Another 45% of the businesses were located in other parts of Rockport. In preliminary model regressions, estimates for much smaller areas, such as Fulton, were not statistically significant, and so they are not considered here.

Another set of variables represents the different industries in which businesses operated. The distribution of those businesses by the NAICS two-digit sectors was representative of the local business population. One in four businesses (25%) were in the retail trade sector, followed

by accommodation and food services (21%), and real estate, finance and insurance (15%). The construction, education, and healthcare sectors each made up about 6% of the sample. About 10% of all businesses belonged to each of the two sectors of arts and recreation, and other services.

A number of survey questions concerned the characteristics of individual businesses. The time that respondents' businesses had been in operation, or age, ranged from less than one year to 95 years, with an average of slightly less than 16 years. The vast majority of businesses in Aransas County are small businesses with fewer than 50 employees. In this survey sample, the average size of employment per business before Harvey was 5.39, and the largest employer hired 45 workers. On average, respondents reported a loss of 14% of their staff after Harvey. The entries for two businesses are in fact negative as the respondents in fact reported the hiring of more employees following Harvey.

While 71% of businesses in the survey carried insurance coverage, 47% of respondents indicated that they were reimbursed by insurance companies for their losses. Similarly, more than half (56%) of businesses had registered with FEMA, but only 6% of businesses' losses were financed by FEMA. The most popular reason for not receiving FEMA assistance was that their applications were denied. FEMA offers disaster relief to individual residents, but not businesses. Following Harvey, however, FEMA partnered with the SBA to offer zero-interest disaster loans to impacted businesses. According to the survey, about one in five (20%) respondents received FEMA or SBA financial aid to finance their property and economic losses. Other funding sources, such as bank loans or personal savings, are not included in the models as they were not statistically meaningful in preliminary regressions perhaps due to too few entries.

About one in 10 businesses had also received donations from non-government organizations, notably the Rebuild Texas Fund. Other than financial support, nearly half of the respondents (49%) received material assistance from different sources. Among the respondents,

78% were members of the Rockport-Fulton Chamber of Commerce. Slightly less than one-third (31%) of businesses were owned by women. Only 3% of respondents were Hispanics. This latter demographic group is omitted here as its estimates were not statistically significant in preliminary regressions.

4. Estimation Results

We address the questions about Harvey's impact and business return by estimating two empirical models. The first model concerns damage to business establishments. The second model concerns an impacted business' operating status. All dependent variables take only the value of either zero or one (i.e., binary response). Following Greene (2018), we estimate the data with the probit maximum likelihood estimator.

Table 2 presents estimation results for the model about businesses that experienced property damage from Harvey. The dependent variables represent three alternative types of damage: (1) a business with property damage either to structure or contents; (2) a business with structural damage to its premises alone; and (3) a business with damage to contents alone. Holding all other variables constant, a higher coefficient estimate means a higher probability that the outcome of the dependent variable, e.g., damage to a business, will happen in association with the particular explanatory variable, e.g., downtown Rockport location. Due to the small number of firms with both structural and contents damage, we do not report their corresponding results here.

The explanatory variables capture different characteristics of the business sample. According to the likelihood ratio (LR) tests, the coefficient estimates are together statistically significant. Given the McFadden pseudo- R^2 statistics analogous to the R^2 statistics in a conventional regression, these variables together explain between 13% and 25% of Harvey's damage to different business properties. The constant terms give the predicted probability of

damage if all the explanatory variables are evaluated at zero. As expected, the predicted probability of damage is very low in each of the three cases.

The first two explanatory variables represent the primary location of a business in the Heritage and Arts District of downtown Rockport and the rest of the city of Rockport, respectively. According to the coefficient estimates, businesses in Rockport were more likely to experience property damage than businesses in other parts of Aransas County, and those within the downtown area of Rockport—closer to Harvey’s eyewalls—were more likely to experience structural damage.

The next 8 variables capture the different economic sectors that individual businesses belong to. The estimates indicate that hotels/motels and restaurants were more vulnerable to structural damage, whereas educational establishments were less likely to sustain property damage. For contents damage, only the estimate for the retail sector is statistically significant.

The bottom two explanatory variables in Table 2 are, respectively, the age and employment size of individual businesses. These variables also reflect the age of a structure and the size of the property, respectively. Natural logarithmic transformation was applied to the age data before estimation. For the number of employees, which contains zero entries, the inverse hyperbolic-sine function is applied to the data instead. This transformation is similar to natural logarithm but has the advantage of preserving observations with zero or negative values. The coefficient estimates confirm that an older structure was more likely to sustain overall property damage, and there seemed to be no statistically meaningful difference between businesses of different sizes.

4.1 Business Return

Next, we examine factors that might have affected local businesses' decision to resume operation about half a year after Harvey hit the area. Table 3 shows probit regression results for local businesses that were open in February 2018. The coefficient estimates indicate how the individual explanatory variables explain the probability of reopening a business. The pseudo-R² statistics suggest that the explanatory variables together explain 47% of variations in businesses' operating status, and slightly less for businesses with property damage.

The first regression applies to all businesses that were open about six months after Harvey, regardless of the extent of property and other economic losses. According to the estimation results, hotels/motels and restaurants, and businesses in arts and recreation were more likely to be back in operation, but healthcare facilities were more likely to remain closed. As the Rockport-Fulton area relied on tourism as its main economic driver, recreational businesses, especially tourist guides, were more likely to stay open than other local businesses. Tourism-related businesses might have also responded to the expected arrival of visitors during Spring Break in March, which historically marked the peak business season in that Gulf Coast community.

There is also evidence in support of the impact of a business' employees on its ability to resume operation. Among the alternative methods to finance economic losses, an affected business was more likely to be open if its losses were covered by insurance. Government assistance, such as FEMA/SBA grants and loans, did not seem to affect their operating status. However, registration with FEMA reduced the likelihood of business return. As discussed below, this is perhaps the outcome of business owners who registered with FEMA for assistance also tended to sustain more property damage and thus were less likely to reopen their business. On the contrary, members of the local chamber of commerce and women business owners were more likely to return after Harvey.

The regression results presented so far, however, do not control for the impacts of property damage. To deal with this drawback, the other regressions in Table 3 show results for reopened businesses that had sustained some form of property damage. In particular, the dependent variable under “structural damage” has data entries equal to one for open businesses with structural damage and zero otherwise. According to the estimation results, conditional on structural damage, those businesses located in downtown Rockport’s Heritage and Arts District were much more likely to open their doors than their counterparts in other neighborhoods. In addition, construction firms were more likely to be open. These estimation results highlight the role of business prospects on business recovery. Massive rebuilding activities in the disaster areas provided local construction firms and contractors incentives to recover rapidly, despite structural damage to their premises.

As for the construction sector, previous results for some other sectors no longer hold once structural or other property damage is controlled for. The estimation results indicate that property damage, either damage to structure or contents, adversely affected the operating status of retail shops, hotels/motels and restaurants. In addition, the previously positive estimate for the arts and recreation sector is no longer statistically meaningful, underscoring the fact that the majority of businesses in this sector, including tourist and fishing guides, did not experience any property damage and thus were more ready to resume operation after Harvey.

How a business financed its property damage and other losses also mattered for its recovery. Government grants and loans seemed to be effective in facilitating recovery of the business community. Given the estimation results, businesses with structural damage were 69% more likely to be open if it had received financial aid from FEMA or SBA. The impact of government assistance on the likelihood to reopen rose to 136% among businesses with contents damage. By contrast, there is no evidence to support that donations from non-government

agencies or material assistance helped to keep a business open, perhaps due to their relatively small amounts in comparison with financing options.

However, among businesses that had sustained contents damage, female business owners were nearly 200% more likely than their male counterparts to reopen their business. The estimates also support the positive effect of local chamber membership on the decision to reopen a business despite contents damage.

Did the major findings for businesses six months following Harvey still hold for the same businesses one year after the storm? To address this question, we repeated the above regressions with the opening status of the business sample in August instead of February. Table 4 shows estimation results corresponding to those in the earlier period (Table 3). Compared to Table 3, the only differences in regressions in Table 4 are the dependent variables, which depict the business opening status in August 2018 under alternative damage conditions. The estimation results in Table 4 are overall consistent with those in Table 3. The qualitative results, however, tend to be weaker. All pseudo- R^2 's in Table 4 are evidently smaller than their corresponding statistics in Table 3.

Nearly all coefficients that are statistically significant for the August data are also statistically significant for the February data. Business age is the only exception. In the regression for businesses that were open regardless of damage, the positive and statistically meaningful estimate suggests that in about one year after Harvey, older businesses were more likely to be open than their younger counterparts. However, this age effect disappeared once property damage is controlled for. Similarly, the gender effect that was observed earlier disappeared in this later period.

For businesses that sustained property damage, the method to finance losses still mattered for their recovery about a year after Harvey. As for results in February, the estimates for government aid are positive, meaning that government relief efforts continued to play a role in

business recovery one year after the storm. The positive effect of local chamber membership also remained prominent. However, the negative estimate for lost employees implies that businesses in the disaster areas continued to face a tight labor market.

4.2 Discussion

Despite a relatively small sample, our survey data on post-Harvey business recovery reaffirm several findings in the existing literature. First, as widely documented in the literature (Kroll et al., 1990; Dahlhamer and Tierney, 1998; Balasen and Polachek, 2008, 2009; Chang, 2010; Corey and Deitch, 2011), the local construction industry tended to recover from a hurricane like Harvey more rapidly than other industries due to rebuilding activities in the disaster area. On the contrary, hotels and motels were less likely to be open shortly after the storm because of their higher vulnerability to structural damage (Zhang et al., 2009). Likewise, damage to contents damage, particularly inventory stocks, affected retail stores' ability to resume operation.

Among the alternative ways to finance economic losses, we have found government aid to be particularly effective in promoting business recovery. Our finding in support of the government's mitigation programs is consistent with Davlasheridze et al. (2017) but at odd with Webb et al. (2002). The regressions generate the expected results due in part to the inclusion of FEMA registration, which controls for the extent of economic losses across businesses. Moreover, the statistically insignificant estimates for private insurance reflect Kousky et al.'s (2018) finding that federal disaster assistance crowds out insurance. Nonetheless, Davlasheridze et al. (2017) find that FEMA's ex-ante mitigation programs and planning projects lead to greater reductions in property losses than spending on ex-post recovery programs and clean-up. In addition to government aid, different types of financing sources proved to be crucial in the long-term performance of businesses sustaining property damage.

From the perspective of business characteristics, older businesses tended to be more likely to survive. However, the survey data yield no statistically meaningful results for the size effect as found in previous research (Kroll et al., 1990; Dahlhamer and Tierney, 1998; Webb et al., 2000, 2002). This might be the outcome of our sample that is made up of mostly very small businesses, including single owner-operators with no employees. For businesses with employees, however, Harvey's impact on their staff affected their ability to resume operation. This finding aligns with the previous studies (Tierney, 1997; Xiao and Van Zandt, 2012) that stress the role of operational disruptions on business survival.

Regarding business-owner attributes, we have found a strong gender effect. However, the estimates run in the opposite direction of what some studies (e.g., Morrow and Enarson, 1996) suggest. The positive estimates for women business owners indicate that women tend to be back in business after a disaster more rapidly than their male counterparts. Members of the local chamber of commerce are also more likely to survive than non-members. These findings are consistent with the emphasis on the role of social bonds or networks in business recovery (Tierney, 2007; Islam and Walkerden, 2014). Likewise, Norris et al. (2008) emphasize the importance of organizational linkages and social supports for promoting community resilience, which is the capability or ability of the area as a whole to bounce back from a major disruption.

A comparison of empirical results between six months and 12 months after Harvey corroborates Lam et al.'s (2009) assertion that it is more difficult to discern a disaster's impact on different industries or businesses when observations are taken later after the event. The collective explanatory power of different business attributes is weaker one year as opposed to six months after Harvey. Nonetheless, corroborating earlier findings of Davlasheridze et al. (2017) and Islam and Walkerden (2014), government relief efforts and social supports continued to play a role in business survival long after the storm.

The business reopening rate for the Rockport-Fulton area at nearly 90% about one year after Harvey was remarkably high. This was at odds with FEMA's (2015) historical observation that at least 40% of businesses did not survive a major natural disaster. In particular, Lam et al. (2009) find that 39% of businesses in New Orleans returned 10 months after Katrina—a hurricane comparable to Harvey—and the rate increased only to 66% two years after the storm.

Other than being much smaller in comparison with most disaster-hit areas in previous research, the seemingly more “resilient” business community in Rockport-Fulton than in New Orleans could be explained by differences in mitigation activities and other community services. Among a large number of disaster resilience measures, the Baseline Resilience Indicators for Communities (BRIC) rate U.S. counties' resilience based on indicators that reflect a community's vulnerability to natural disasters and its capacity to recover (Singh-Peterson et al., 2014). Aransas County, in particular, receives a relatively high score for the “institutional” category, although its scores for other aspects, such as economic, social, and infrastructure are lower than the U.S. average as well as the scores for New Orleans. Our particular finding regarding the effect of local chamber membership in business reopening decisions also highlights the role of social networks in community resilience to natural disasters.

5. Concluding Remarks

Results from a local business survey conducted after Hurricane Harvey have provided insight into the storm's impact on businesses and factors that affected the conditions for business survival. Other than the extent of direct physical and economic losses, economic prospects of businesses in different industries and business owners' characteristics affected the business return decision. Other than women business owners, local chamber members were more likely to reopen their business soon after a disaster.

Among various ways to finance economic losses, in addition to private insurance payments, government grants and loans seemed to be effective in facilitating business recovery. However, the survey results also underscore the challenge of rebuilding a business community in the face of a tight local labor market that often follows a major disaster.

The survey was conducted six months after the storm, so business return decisions at that time reflected recovery of individual businesses shortly after the event. To provide insight into post-disaster economic recovery over a longer term, we also analyzed the opening status of the same businesses in the survey sample another six months later (i.e., 12 months after Harvey). Empirical results are qualitatively weaker over the longer term, and some factors that explained business recovery in the earlier period were no longer statistically meaningful in the later period. Although recovery from Harvey is far from complete at this time, such comparative findings highlight the benefit of frequently monitoring business conditions on the road to full community recovery.

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Table 1: Means of Dependent and Explanatory Variables

<u>Dependent Variables:</u>		<u>Explanatory Variables:</u>	
Property Damage	0.77	Location-Heritage District	0.26
Structural Damage	0.62	Location-Other Rockport Areas	0.45
Contents Damage	0.40	Sector-Construction	0.07
		Sector-Retail	0.25
6 Months after Storm:		Sector-Real Estate, Finance & Insurance	0.15
Open	0.46	Sector-Education	0.07
Open with Structural Damage	0.18	Sector-Healthcare	0.07
Open with Contents Damage	0.13	Sector-Accommodation & Food Services	0.21
Open with Structural/Contents Damage	0.07	Sector-Arts & Recreation	0.10
		Sector-Other Services	0.10
12 Months after Storm:		Age (Years)	15.57
Open	0.89	Size (Employees)	5.39
Open with Structural Damage	0.59	Lost Employees	0.14
Open with Contents Damage	0.37	Finance-Insurance	0.47
Open with Structural/Contents Damage	0.23	Finance-Government	0.20
		Finance-Donations	0.10
		Material Assistance	0.49
		FEMA Registration	0.56
		Chamber Member	0.78
		Woman Owner	0.31

Table 2: Probit Regression of Business Damage

	<u>Property Damage</u>		<u>Structural Damage</u>		<u>Contents Damage</u>	
Constant	-0.99	(1.88) *	-0.87	(1.91) **	-0.86	(1.91) **
Location - Heritage District	0.78	(1.47)	0.90	(1.94) **	-0.39	(0.94)
Location - Other Rockport Areas	0.89	(2.27) **	0.57	(1.66) *	0.05	(0.16)
Sector - Construction	0.51	(0.71)	0.15	(0.23)	0.52	(0.83)
Sector - Retail	0.10	(0.21)	0.05	(0.14)	0.45	(1.91) **
Sector - Real Estate, Finance & Insurance	-0.05	(0.11)	0.04	(0.10)	-0.10	(0.02)
Sector - Education	-1.20	(1.67) *	-0.55	(1.80) *	-7.95	(0.33)
Sector - Healthcare	0.57	(0.65)	0.83	(1.08)	-0.68	(0.95)
Sector - Accommodation & Food Services	1.67	(2.60) ***	1.20	(2.90) ***	-0.04	(0.12)
Sector - Arts & Recreation	0.35	(0.67)	-0.22	(0.46)	0.47	(1.00)
Sector - Other Services	-0.24	(0.53)	0.28	(0.65)	0.27	(0.65)
Age	0.32	(2.34) *	0.12	(0.99)	0.17	(1.42)
Employment Size	0.08	(0.58)	0.15	(1.28)	0.04	(0.36)
LR Test for Coefficients		26.74 ***		24.28 **		18.82 *
Pseudo-R ²		0.25		0.22		0.13

Notes: Absolute t-statistics are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10%, respectively.

Table 3: Probit Regression of Reopened Businesses after 6 Months

	<u>All Businesses</u>	<u>Property Damage</u>	<u>Structural Damage</u>	<u>Contents Damage</u>
Constant	-0.11 (0.14)	-1.18 (1.45)	-1.51 (1.64) *	-5.08 (2.69) **
Location - Heritage District	-0.17 (0.24)	0.38 (0.59)	1.56 (1.97) **	-1.23 (0.19)
Location - Other Rockport Areas	-0.42 (0.84)	0.10 (0.21)	0.58 (1.08)	-0.44 (0.78)
Sector - Construction	-0.48 (0.54)	1.65 (2.04) **	1.00 (1.29)	2.83 (2.67) ***
Sector - Retail	0.90 (1.39)	-1.00 (1.75) *	-1.18 (1.96) **	-1.49 (1.68) *
Sector - Real Estate, Finance & Insurance	-0.27 (0.50)	0.31 (0.61)	0.32 (0.58)	-0.22 (0.34)
Sector - Education	0.29 (0.26)	-9.18 (0.33)	-8.62 (0.39)	-10.02 (0.49)
Sector - Healthcare	-2.00 (2.17) **	0.29 (0.31)	0.94 (0.97)	-7.14 (0.58)
Sector - Accommodation & Food Services	1.78 (2.46) ***	-1.22 (2.02) **	-1.21 (1.84) *	-2.44 (2.09) **
Sector - Arts & Recreation	1.99 (2.21) **	-0.56 (0.71)	-9.26 (0.66)	1.52 (1.33)
Sector - Other Services	0.38 (0.47)	-0.24 (0.33)	0.44 (0.60)	-0.97 (0.69)
Age	-0.05 (0.23)	0.24 (1.08)	0.01 (0.02)	1.08 (2.24) **
Employment Size	0.14 (0.70)	0.30 (1.57)	0.31 (1.58)	0.26 (0.94)
Lost Employees	-0.95 (1.81) *	-0.98 (1.70) *	0.27 (0.30)	1.06 (0.94)
Finance - Insurance	0.82 (1.78) *	0.55 (1.42)	0.43 (0.99)	0.36 (0.63)
Finance - Government	0.21 (0.38)	0.68 (1.73) *	0.69 (1.82) *	1.36 (1.86) *
Finance - Donations	0.29 (0.30)	-8.32 (0.55)	-9.74 (0.67)	-9.10 (0.93)
Material Assistance	-0.38 (0.79)	-1.60 (0.41)	-1.36 (0.67)	-2.67 (0.96)
FEMA Registration	-0.78 (1.66) *	-0.11 (0.26)	0.07 (0.15)	0.24 (0.40)
Chamber Member	2.16 (3.41) ***	0.30 (1.68) *	-0.05 (0.09)	0.70 (1.88) *
Woman Owner	1.12 (1.77) *	0.24 (0.50)	-0.52 (0.95)	1.96 (2.83) ***
LR Test for Coefficients	50.37 ***	48.84 ***	41.48 ***	45.55 ***
Pseudo-R ²	0.47	0.44	0.39	0.46

Notes: Absolute t-statistics are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10%, respectively.

Table 4: Probit Regression of Reopened Businesses after 12 Months

	<u>All Businesses</u>	<u>Property Damage</u>	<u>Structural Damage</u>	<u>Contents Damage</u>
Constant	-0.86 (0.93)	-0.91 (1.61) **	-0.98 (1.88) *	-1.26 (2.29) **
Location - Heritage District	-0.04 (0.04)	0.64 (1.22)	0.79 (1.67) *	-0.64 (0.19)
Location - Other Rockport Areas	-0.57 (0.78)	0.26 (0.68)	0.15 (0.41)	-0.30 (0.83)
Sector - Construction	7.01 (0.25)	0.34 (0.42)	-0.06 (0.08)	0.30 (1.99) *
Sector - Retail	1.14 (1.00)	-0.07 (0.15)	-0.18 (0.44)	0.24 (0.60)
Sector - Real Estate, Finance & Insurance	0.86 (0.93)	0.29 (0.60)	0.25 (0.58)	-0.08 (0.18)
Sector - Education	6.38 (0.20)	-1.33 (0.33)	-0.93 (0.39)	-8.37 (0.49)
Sector - Healthcare	6.46 (0.11)	0.70 (0.83)	0.78 (0.95)	-0.53 (0.58)
Sector - Accommodation & Food Services	-0.42 (0.67)	0.64 (1.38)	0.60 (1.48)	-0.44 (1.08)
Sector - Arts & Recreation	7.69 (0.12)	0.16 (0.27)	-0.57 (0.66)	0.50 (0.98)
Sector - Other Services	6.34 (0.31)	-0.04 (0.08)	0.61 (1.31)	0.36 (0.80)
Age	0.59 (1.90) **	0.24 (1.64)	0.02 (0.15)	0.12 (0.88)
Employment Size	-0.24 (0.81)	0.02 (0.16)	0.08 (0.60)	-0.06 (0.43)
Lost Employees	-2.03 (1.97) **	-0.18 (2.09) **	0.56 (0.91)	0.42 (0.70)
Finance - Insurance	0.04 (0.07)	0.69 (1.92) **	0.72 (2.25) **	0.37 (1.22)
Finance - Government	0.62 (0.72)	0.67 (1.87) *	0.31 (1.86) *	0.81 (2.17) **
Finance - Donations	7.68 (0.35)	0.52 (0.55)	1.15 (0.67)	0.16 (0.93)
Material Assistance	0.02 (0.03)	-0.68 (0.41)	-0.35 (0.67)	-0.36 (0.96)
FEMA Registration	0.31 (0.44)	0.29 (0.87)	0.43 (1.40)	0.30 (0.96)
Chamber Member	1.56 (2.16) **	0.48 (1.84) *	0.27 (0.72)	0.69 (1.85) *
Woman Owner	0.81 (0.92)	-0.13 (0.37)	-0.36 (1.11)	0.24 (0.88)
LR Test for Coefficients	23.78 ***	28.88 ***	30.55 ***	24.80 ***
Pseudo-R ²	0.25	0.26	0.27	0.22

Notes: Absolute t-statistics are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10%, respectively.

APPENDIX
Rockport-Fulton Chamber of Commerce
Business Assessment 2018 Survey

1. What is the name of your company and street address?
2. Where is your company located?
 - City of Rockport
 - Town of Fulton
 - Lamar/Holiday Beach
 - Aransas County
 - Other
3. Is your company located in the Rockport Cultural Arts, Heritage District/Downtown Rockport or Downtown Fulton?
 - Yes, Rockport Heritage District/Downtown Rockport/Cultural Arts
 - Yes, Downtown Fulton
 - No
 - Not sure
4. How long has your company been in operation in Aransas County?
5. What is your company's primary type of industry/affiliation? Select all that apply.
 - Accommodation
 - Food Service
 - Real Estate/Rental/Leasing
 - Finance and Insurance
 - Retail Trade
 - Health Care and Social Assistance
 - Educational Services
 - Construction
 - IT Services
 - Manufacturing
 - Transportation and Warehousing
 - Media/Printing
 - Management of Companies and Enterprises
 - Guide Services
 - Arts and Entertainment
 - Woman Owned
 - Minority Owned
 - Staffing/recruiting
 - Wholesale Trade
 - Waste Management and/or Remediation Services
 - Energy Services (Oil & Gas)
 - Childcare

- Services (car detail and maintenance)
 - Storage Facility
 - Other
7. Please provide the number of employees your company employs (currently) post Hurricane Harvey. If you are an Owner/Manager with no employees please indicate such.
8. Please provide the number of employees your company employed prior to Hurricane Harvey. If you are the Owner/Manager with no employees please indicate such:
9. What were your current hours of operation Pre-Hurricane Harvey?
10. What are your current hours of operation Post Hurricane Harvey?
11. How long was your business closed immediately after Hurricane Harvey? Select all that apply.
- It did not close
 - 1-15 days
 - 16-30 days
 - 31 or more days
 - It was permanently closed
 - Other
12. What happened to your business during Hurricane Harvey and immediately afterward?
- Stayed open; physical damage to structure
 - Stayed open; damage to contents or customer area
 - Closed; physical damage to structure
 - Closed; damage to contents or customer area
 - Nothing significant occurred
 - Other
13. Please estimate the total damage in dollars to your physical business location:
14. Please provide an estimated dollar amount of direct damages to your Inventory/Product and Equipment/Office/Assets:
15. Of the damages to your business, how are you financing recovery? Select all that apply.
- Line of Credit
 - Flood insurance
 - Windstorm insurance
 - Property or Business interruption insurance
 - FEMA Program
 - SBA Disaster Assistance Loan
 - Loan(s) from family or friends
 - Bank loan(s)

- Business savings (retained earnings)
- Personal savings
- Community Donations
- Self-insured
- I do not have damages
- Other

16. What percentage of your workforce has been negatively impacted by Hurricane Harvey?

- 0-10%
- 11-20%
- 21-30%
- 31-40%
- 41-50%
- 51-60%
- 61-70%
- 71-80%
- 81-90%
- 91-100%

17. After Hurricane Harvey, what assistance have you received? Select all that apply.

- Assessing my options
- Determining financial needs
- Operating expenses under \$10,000
- Operating expenses between \$10,000 and \$25,000
- Operating expenses over \$25,000
- Working capital or building repairs under \$10,000
- Working capital or building repairs between \$10,000 and \$25,000
- Working capital or building repairs over \$25,000
- Deciding how to rebuild my business
- Physical help to repair my business
- Finding a new location for my business
- Workforce Issues
- Expanding business
- Prospecting new home seller/buyers
- New Marketing Plan
- Reaching Client Base
- None
- Other

18. What additional assistance do you need help with? Select all that apply.

- Assessing my options
- Determining financial needs
- Operating expenses under \$10,000
- Operating expenses between \$10,000 and \$25,000

- Operating expenses over \$25,000
- Working capital or building repairs under \$10,000
- Working capital or building repairs between \$10,000 and \$25,000
- Working capital or building repairs over \$25,000
- Deciding how to rebuild my business
- Physical help to repair my business
- Finding a new location for my business
- Workforce Issues
- Expanding business
- Prospecting new home seller/buyers
- New Marketing Plan
- Reaching Client Base
- None
- Other

19. Do you have business insurance?

- Yes
- No

20. If you have insurance, does your business insurance cover flood or wind losses?

- Yes, flood losses
- Yes, wind losses
- Both flood and wind
- No
- Unknown
- Not applicable

21. If you have insurance, does your business insurance cover loss of income?

- Yes
- No
- Unknown
- Not applicable

22. Have you been able to receive materials, supplies, and services adequately since Hurricane Harvey?

- Yes
- No
- Not Applicable

23. Did you register with FEMA for assistance and receive a case number?

- Yes
- No
- Not applicable

24. Are you planning to seek or in the process of seeking a SBA disaster recovery loan or loan deferment?

- Yes
- No
- Not applicable

25. If your company is interested in providing services/products to help with Harvey recovery, what are your company's capabilities/qualifications/certifications? Select all that apply.

- Financial assistance
- Free respite services
- Long term/short term housing
- Healthcare services
- Business/Flood/Wind Insurance advising
- Volunteer (Manual Labor)
- Donation Services (Supplies, and other services)
- Business and/or Transactional Law Firm
- Communication services/IT Services
- Commercial and/or Residential Construction
- Meal services
- I am not interested
- Other

26. Name of the organization which you received this survey from:

- Rockport-Fulton Chamber of Commerce (Membership)
- City of Rockport (Community Planner)
- Town of Fulton (City Secretary)
- Aransas County (Judges Office)
- Social Media Platforms
- Rockport Yacht Club
- American Legion
- American GI Forum
- VFW (Candy Fletcher)
- Rotary Club
- Lions Club
- Rockport Area Board of Realtors
- Coastal Bend Guides Association
- Other
- Comment:

27. Please share any comments or concerns regarding Hurricane Harvey which you believe would be helpful: