

Article

The Long-Term Impact of Disaster Loans: The Case of Small Businesses after Hurricane Katrina

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Received: 31 May 2018; Accepted: 5 July 2018; Published: 7 July 2018



Abstract: The US government provided \$2.6 billion of small business administration (SBA) disaster loans to individuals and businesses in Mississippi after Hurricane Katrina in 2005. However, existing literature has not fully explored the firm-level effects of post-disaster loan aid, specifically, the effect on small businesses. The objective of this article is to examine whether SBA disaster loans played a significant role in the performance of small businesses after Hurricane Katrina. Data from a sample of 287 small businesses in Mississippi that were operating before Hurricane Katrina and still operating in 2013 were used in the analysis. Two hypotheses were tested: (1) small business owners that received SBA disaster loans have higher revenue change compared to before Katrina than those who did not receive the loan; (2) small business owners that received SBA disaster loans perceived their businesses to have higher revenue than before Katrina. Receiving a SBA disaster loan played a positive and statistically significant role in determining the actual revenue change and owners' perception of revenue.

Keywords: disaster; small business; revenue; loans; recovery

1. Introduction

Hurricane Katrina hit the Mississippi Gulf Coast of the United States in August 2005. The storm surged around the coastal states with heavy rain and strong winds of more than 150 miles per hour. The storm's landfall caused great destruction of towns [1]. More than 234,000 homes were damaged or destroyed within 24 h [2], and the fatalities rose to 238 people within the state of Mississippi [3].

After the disaster, the US government provided \$2.6 billion of small business administration (SBA) disaster loans to individuals and businesses in Mississippi [2]. SBA disaster loans are low interest rate, long-term loans used for damages, which were not fully insured. These loans are provided directly from the United States government, unlike other types of SBA loans where borrowers apply for commercial loans with a guarantee from SBA. Businesses of all sizes can apply for the disaster loan for the purpose of repairing or replacing damaged properties in a declared disaster area [2,4,5].

In this article, we investigate the effect of SBA disaster loans after Hurricane Katrina on small businesses in Mississippi. We test the following hypotheses: (1) small business owners that received SBA disaster loans have a higher percentage change in revenue compared to before Katrina than those who did not receive a loan; and (2) small business owners that received SBA disaster loans perceived their businesses to have a higher revenue change than before Katrina. In addition, we control for the demographics of owners and the characteristics of businesses that based on the literature are thought to contribute to the revenue performance of small businesses.

Hurricane Katrina was one of the costliest disasters in US history. Although more than 11 years have passed since the disaster, the recovery process is still continuing. It is important to understand

how and to what extent government assistance plays a role in small business recovery as well as providing helpful information for future disasters that may occur at any time.

2. Literature Review

2.1. The Small Business Disaster Recovery Framework

When focusing on business performance after a natural disaster, it is important to define the business recovery process. As Marshall and Schrank [6] point out, business recovery is a process that changes over time. In their small business disaster recovery framework (SBDRF), they categorize business recovery into demised, survived, recovered, or resilient based on information obtained from business owners.

In the SBDRF, a business is defined as demised when it is closed permanently. The survived category is explained as those businesses who barely survived the disaster but are still open even though their performance is worse compared to their pre-disaster level. Recovery applies when the measurement such as revenues stayed at the same level between pre-disaster and post-disaster. A business is resilient if post-disaster performance such as revenues are better off compared to pre-disaster levels [6].

2.2. How Do We Measure the Success of Business?

In Haynes et al. [7], the authors focused on the objective and subjective indicators of success for small, family-owned businesses. Typically, gross revenue, growth in sales, profits, survival, return on assets, and number of employees were used as objective indicators [7,8]. On the other hand, subjective indicators may include owners' expectations and perceptions. Deitch and Corey [9] analyzed the organizational performance of businesses after Hurricane Katrina with subjective and objective measurements. First, managers answered whether their business performance was better, the same, or worse compared to pre-disaster levels. Then, they indicated the percentage increase or decrease in revenue relative to the pre-Katrina level. Marshall and Schrank [6] pointed out the importance of considering owners' perceptions since "small business recovery is likely to be characterized by indicators that can only be reported by business owners" (p. 607). Therefore, the objective measure of success used in this study is percentage change in gross revenues in 2011 compared to 2004 pre-Katrina gross revenues. The subjective measure of success is the owners self-report of whether their gross revenues had decreased, stayed the same, or increased after Katrina.

2.3. Effect of Small Business Administration Disaster Loans

It is important to point out that the literature shows no consensus on the effects of SBA disaster loans and post-disaster aid on small businesses. Davlasheridze and Geylani [10] argued that SBA disaster loans significantly increased the growth and survival of all types of business establishments at the zip-code level in areas impacted by flood disasters between 1998 and 2010. The authors found that a one-dollar increase in SBA disaster loan to bank deposit ratio resulted in 12 additional small business establishments. Their results indicated that SBA disaster loans were particularly helpful to the smallest businesses: businesses with less than 50 employees. Furthermore, Deitch and Corey [9] claimed in their article that lack of federal assistance from the government was statistically significant and positively associated with decreased business performance, meaning that post-disaster assistance did play a positive role in business performance.

In contrast, Dahlhamer and Tierney [11] found that post-disaster assistance had a negative correlation with business recovery after the 1994 Northridge earthquake. They found that businesses that were heavily reliant on post-disaster aid were those that had the most severe damage, and therefore those who needed financial assistance were worse off to begin with. Loans were the most common method of aid for small businesses and they found that loans brought about increased indebtedness where even if income returned to the pre-disaster level, businesses were still worse off. They also

pointed out the possibility that the obtained assistance was not sufficient, or that external market forces were negatively influencing those businesses.

Similarly, Alesch et al. [12] claimed that SBA disaster loans were not an effective solution to disaster recovery. The unfortunate part of the process was that those who qualified for SBA disaster loans but who did not obtain those loans needed to use their homes and other personal assets as collateral. This meant that if small business owners found their post-disaster business was not viable and that they could not repay the loan, then the business owners faced the loss of all their assets up to the value of their disaster loans.

Haynes et al. [7] examined the impact of federal disaster assistance on the performance of small family-owned businesses with less than 500 employees from 1996 to 1999. They found that businesses in counties receiving more disaster assistance had a higher likelihood of not surviving, but compared to those located in counties with less disaster assistance, they were more likely to have positive revenue change. The location and the nature of the business played a significant role in determining business survival, but not the disaster assistance itself.

The effect of SBA disaster loans on business recovery and success is not fully understood. Although a few studies have tried to examine factors that determine the success of business recovery after disaster, their results have not been consistent regarding the effect of government assistance and in particular SBA disaster loans. The objective of this article is to examine whether SBA disaster loans played a significant role in the performance of small businesses after Hurricane Katrina.

In the case of Hurricane Katrina, Josephson and Marshall [4] examined the factors that affected the application and approval process, and the receipt of SBA disaster loans. They found that female owners had a higher likelihood of applying for the loans, but they actually received a lesser amount. Non-white business owners were at a disadvantage in the loan process, and they had lower likelihood of approval. Revenue was an important factor for repayment ability, and the amount they actually borrowed. Business owners with more insurance had a lower likelihood of applying and were less likely to borrow. This article enhances Josephson and Marshall's study by estimating the effect of SBA disaster loans on small business success [4]. Next, this article will focus on other variables used as controls in the models.

2.4. Owner Demographics

Owner's demographics such as gender, education and experience, and race are important factors when examining the objective and subjective measurements of business performance. Previous literature showed that owner's gender makes a difference to the success of their business [13,14]. Female owners were less successful compared to male owners when facing natural disasters [15,16]. In another article, Danes et al. [17] found that receiving assistance and resilience were statistically significant for both genders; it was positively associated with males and negatively associated with females. The result suggested that gender was an important factor when determining the relationship of federal assistance and resilience of owners. Enarson and Morrow [18] also pointed out the importance of focusing on women's vulnerability to disasters by using the post-Hurricane Andrew case in Miami.

In addition, owner's education and experience may influence their post-disaster business recovery. Khan and Sayem [19] conducted a study of 251 small-scale firm owners, which identified the factors affecting business recovery from flood disasters in Bangladesh. They found that when owners had more experience, they were less likely to experience delayed recovery. Similarly, those who had the benefit of institutional education were less likely to face delayed recovery from disaster. Their results indicated that educated owners were more likely to be able to predict their potential threats to their livelihood, and then adopted the means they considered effective to re-establish their firm after disaster.

The race and ethnicity of owners are other factors to consider. According to the US Census Bureau, the majority (almost 60%) of the entire population in Mississippi were White, whereas around 37% of the population were Black or Afro-American [20]. There were mixed, inconsistent results in the

literature about ethnic minority's preparedness towards disaster. According to Marshall et al. [16], race was a predictor of disaster recovery. In their article, non-white owners had higher odds of business closure after Hurricane Katrina.

There is little research about veteran-owned businesses and their performance after a natural disaster. Marshall et al. [15] found that veteran-owned businesses had higher odds of closing after Hurricane Katrina. Marital status also affects business performance. Men tended to experience a marriage premium while women experienced a motherhood penalty [21]. Other researchers found that copreneurial couples were less financially successful than non-copreneurs [22].

The business owner's personal resilience is also likely to be an important factor for coping with stress that may result from a natural disaster [15]. Researchers in the healthcare area have developed measures of personal resilience. Conner and Davidson [23] developed a resilience scale of 25 items called the CD-RISC (Connor–Davidson resilience scale). These scales measured whether the person is capable of adapting to change (item no.1) and think of themselves as strong person (item no. 17). Vaishnavi et al. [24] provided an abbreviated version of Conner and Davidson's scale, using a two-item version.

2.5. Pre-Disaster Business Characteristics

Legal ownership is another factor to consider. One disaster study done by Barman et al. [25] showed that business ownership types (whether it is owned or leased), had a statistical significance on the preparedness of disaster. Marshall et al. [15] pointed out this way; "legal ownership may represent a management labor resource and variation in demand on the business resources that comes from partners and shareholders as well as the support of multiple families of employees and owners" (p. 339).

Several industries are more resistant than others, particularly after natural disasters [9,11,19]. Some researchers said the construction and manufacturing industries could realize gains from post-disaster reconstruction [9]. Khan and Sayem [19] reported retailers were less likely to recover their businesses after flood disaster in Bangladesh.

Business age and number of employees are also important to recovery and success. Web et al. [26] found that older businesses had less likelihood of achieving recovery six years after a hurricane compared to other younger businesses. They explained that older businesses had more to lose; and therefore took longer to recover from the disaster. Number of employees represents firm size of the business. The literature found that the size of firm was an important proxy to figure out the available human assets [15]. Dahlhamer and Tierney [11] found that size mattered in coping with disaster: the bigger the better. However, several researchers, including Khan and Sayem [19] and Sydnor et al. [16], found that businesses with a larger number of employees were less likely to recover from disaster in the long run.

Business performance and success prior to natural disasters is also important to consider. Khan and Sayem [19] found that firm owners with higher monthly income had a greater likelihood of facing delayed recovery of business from disaster. Web et al. [26] found that the pre-disaster financial condition variable was statistically significant for long-term recovery. They suggested that businesses that reported they were in better financial condition before natural disasters were less likely to have achieved recovery in the long-term compared to businesses in worse financial situation right before the disaster. The possible reason behind is that better off firms simply have more to lose and it may take longer to recover, or they may also have higher expectations of their business performance.

Post-disaster difficulties such as business cash-flow problems after Katrina, power outage, and days of closure are other factors to consider. Both infrastructure and social structure broke down severely after Hurricane Katrina [27]. The loss of basic services such as power, natural gas, and clean water made it hard for local businesses to reopen after Katrina. The loss of electricity and downed telephone lines were severe disruptions to communications. In addition to that, business closure right after a disaster may have caused a change in longer-term consumer patterns, because customers might not come back when the firms reopened again [26]. We also controlled for the impacts of the British

Petroleum (BP) oil spill, which in April 2010, spilled over 200 million gallons of oil into the Gulf of Mexico. This had a tremendous environmental and economic impact on Mississippi and particularly on coastal businesses such as the seafood industry [28].

Business location is an important factor for business survival especially after natural disasters. When Hurricane Katrina hit Mississippi, those businesses in the coastal area were severely exposed to flooding and storm. Haynes et al. [7] claimed that the location of the business played a major role in determining business survival after Katrina. Some businesses, especially in the tourism sector, chose coastal location because they were operating on the beach, such as food stands and vacation rental equipment [15]. In addition to that, home-based businesses may have been different from other small businesses since their building properties have more functions and protections as residential areas. Headd [29] found that businesses that were home-based had increased survivability because they were able to keep costs low. In addition, the author pointed out that those home-based owners perhaps enjoyed the work-from-home lifestyle and kept their businesses open even if they were only “surviving”.

It is reasonable to expect that businesses that had an emergency plan before the disaster were better prepared and recovered well afterwards. However, others have pointed out that the having a disaster plan did not guarantee whether the recommended plan was successfully executed at the right timing when facing the disaster [12]. According to Deitch and Corey [9], a population-related predictor was important for organizational performance for two reasons. First, the local population was valuable as a labor source. Second, it was an important source for customers. For this reason, our study also uses percentage change in population for each county comparing before and after Katrina.

3. Materials and Methods

3.1. Data

We used the data from the 2013 Small Business Survival and Demise after Natural Disaster Project (SBSD). The study focused on small businesses operating in 2004 (before Katrina) in a 10-county area in southeastern Mississippi. These 10 counties were almost entirely in the right front quadrant of Hurricane Katrina. The counties included three coastal counties (Hancock, Harrison, and Jackson) that were a mix of rural and urban areas and took the brunt of the storm surge. Two counties (Lamar and Forest) are in the Hattiesburg, Mississippi. Pearl River, Stone, George, Greene, and Perry counties comprise a mix of small town, rural, and national forest areas. These 10 counties also represent a wide range of industries ranging from service businesses such as tourism and retailing to manufacturing to agriculture and forestry.

Mailing lists were obtained for all small businesses (200 employees or less) in the designated 10 county area, 17,060 businesses. From this population, a random sample of businesses open in December of 2004 was drawn for interview purposes. Although a random sample of 4000 was initially drawn, a second random sample of 1500 from the same pool was drawn because the address and phone records had changed for many of the business owners from the time we drew the initial sample to the time we could contact them for an interview. It is difficult to know whether the high number of address failures is the result of population dispersion, post-disaster “resettling” or a measure of the address verifications of the original list provider. In order to update as many addresses as possible, we purchased a 2013 mailing list to update our original list and found that even the most recent list was laden with address failures. All the business included in the sample were from the same original 2004 population and were randomly drawn in the same manner.

The University of Wisconsin Survey Research Center conducted telephone interviews with the subjects between January and October 2013. Both owner and business were screened to verify that the interviewee was the owner of the business and that it had been operating at the time of Hurricane Katrina. Interview topics included business and owner demographics, business hurricane preparations, financial information, post-disaster situation, owner resilience, and community attachment. The length

of the interview varied depending on whether the business had closed since Katrina or not. The average completed interview was about 37.4 min in length. The interviewees were given \$2 in a mailed request for participation, and paid an additional \$30 when the phone interview was completed.

Overall, the response rate was approximately 11.3%. Another way to evaluate the success of the survey is the cooperation rate. A total of 2610 businesses were eligible and had good contact information. Of the 2610 business owners reached in 2013, the cooperation rate was 19.12%, providing a sample size of 499 randomly drawn small businesses. Of the 499 businesses in the study, 25% (126 businesses) were no longer operating after Katrina and 373 were in operation eight years later when data was collected.

Table 1 shows the list of dependent and independent variables. The dependent variables are the change of business performance comparing before and after Hurricane Katrina, which are measured objectively and subjectively. We adopt the objective and subjective measurements similar to previous literature; the objective measurement used is the percentage change in gross revenues between pre-Katrina (2004) and post-Katrina (2011) and the subjective measurement used is the owner's perception of revenue change between pre- and post-Katrina. The subjective categories are classified into three revenue outcomes being gone down, stayed the same, or gone up.

Table 1. Dependent and Independent Variables.

Variable	Description
Dependent Variables	
Percentage Change in Revenue	Continuous Variable: Objective Measurement
Owner's Perception on Revenue Change	Categorical Variable: Subjective Measurement (0 = gone down, 1 = same, 2 = gone up)
Independent Variables	
SBA Disaster Loans	No = 0, Yes = 1
Gender	Male = 0, Female = 1
High School	No = 0, Yes = 1
Some College	No = 0, Yes = 1
Bachelor Degree	No = 0, Yes = 1
None-White	No = 0, Yes = 1
Veteran	No = 0, Yes = 1
Experience	Experience in years
Marital Status	No = 0, Yes = 1
Owner's Resilience	a: I am able to adapt to change. b: I tend to bounce back after illness or hardship. (Scale of 2–10)
Sole-Proprietor	No = 0, Yes = 1
Business Cash-Flow Problem After Katrina	No = 0, Yes = 1
Owner's Perception on Success Before Katrina	Not at All Successful = 1, Extremely Successful = 5
Services	No = 0, Yes = 1
Retail	No = 0, Yes = 1
Business Age	Business Age in Years
Number of Employees	Number of People
Coastal County	No = 0, Yes = 1
Home-Based	No = 0, Yes = 1
Emergency Plan Before Katrina	No = 0, Yes = 1
Days of Closure	Number of days
BP Oil Spill	No = 0, Yes = 1 (if the business had impact)
Power Outage	No = 0, Yes = 1 (if the business had impact)
Percent Change in County Population (2004–2010)	Continuous Variable

The hypothesis variable is whether the business received a SBA disaster loan. The owner's characteristics include gender, education, ethnicity, veteran, experience in business, marital status, owner's resilience, and owner's perception of pre-Katrina success. The owner's resilience is a scale of 2 to 10. It is measured by two items; whether the person is able to adapt to change and whether the person tends to bounce back after illness or hardship [24].

The business's characteristics are legal form of ownership, business cash-flow problems after Katrina, line of business (service industry and retail industry with agriculture, construction, manufacture, transportation, wholesale, retail, and other industry as the reference category), business age, firm size, location (coastal county, home base business), emergency plan, days of closure, and experience with the BP oil spill after Hurricane Katrina, a power outage after Hurricane Katrina. Lastly, we have a macro variable; the percent of population change in all 10 counties between 2004 and 2010 [20].

3.2. Methods

We use two types of econometric models. Model 1 predicts the objective measurement of business performance: actual percentage change in revenue between pre-Katrina and post-Katrina using a linear regression with an instrumental variable to account for an endogenous covariate ([30] for more information on extended regression modeling). In model 2, we use an ordered probit regression with an endogenous covariate because the dependent variable is a discrete choice of three categories (revenue went down = 0, stayed the same = 1 and went up = 2). In both models, the endogenous variable is SBA loan. We assume that the same factors that affect success will also affect getting an SBA loan. Therefore, we use an instrumental variables (IV) approach to account for endogeneity.

Model 1 for change in revenue (objective measurement) and takes the form

$$\begin{aligned} \text{Precent Revenue Change}(Y) \\ = \beta_0 + \beta_{c1} \text{SBAloan} + \beta_2 \text{Owner Demographics}_i + \beta_3 \text{Business Characteristics}_i \\ + \beta_4 \text{Macro Variable}_i + u_i \end{aligned}$$

$$\text{SBAloan} = \alpha_0 + \alpha_1 \text{Owner Demographics}_{ci} + \alpha_2 \text{Business Characteristics}_{ci} + u_{ci}$$

where u_i and u_{ci} are multivariate normal with mean 0 and covariance $\Sigma = \begin{bmatrix} \Sigma_c & \sigma_{1c} \\ \sigma'_{1c} & \sigma^2 \end{bmatrix}$.

Model 2 uses an ordered probit model for perception of change in revenue (subjective measurement). This article follows the Long and Freese [31] style by defining y^* as latent variable ranging from $-\infty$ to ∞ . Our structural model can be written as

$$\begin{aligned} \text{Perception on Revenue Change } (y^*) &= \beta' x_i + \varepsilon_i \\ &= \beta_0 + \beta_1 \text{SBAloan} + \beta_2 \text{Owner Demographics}_i + \beta_3 \text{Business Characteristics}_i \\ &+ \beta_4 \text{Macro_variable}_i + \varepsilon_i \end{aligned}$$

$$\text{SBAloan} = \alpha_0 + \alpha_1 \text{Owner Demographics}_{ci} + \alpha_2 \text{Business Characteristics}_{ci} + \varepsilon_{ci}$$

$$\Sigma = \begin{bmatrix} 1 & \sigma'_{1c} \\ \sigma_{1c} & \Sigma_c \end{bmatrix}.$$

where β' is the vector of regression coefficients, i is the observation and unobserved errors ε_i and ε_{ci} are multivariate normal with mean 0 and covariance where we observe

$$y = 0 \text{ if } \tau_0 = -\infty \leq y^* \leq \tau_1,$$

$$y = 1 \text{ if } \tau_1 \leq y^* \leq \tau_2$$

$$y = 2 \text{ if } \tau_2 \leq y^* \leq \tau_3 = \infty.$$

where cut points (threshold) τ_1 through τ_2 are estimated. This ordered probit model is a nonlinear probability model. The odds that an outcome is less than or equal to m versus greater than m given x

$$\Omega_{\leq m}(x) \equiv \frac{\Pr(y \leq mx)}{\Pr(y > mx)} \text{ for } m = 1, 2$$

Clusters are used in both models to allow flexibility in the variance-covariance matrix for addressing potential heteroscedasticity. As explained in the Marshall et al., “this allows for the presence of different variables across groups based on business location. The groups were clustered based on whether or not the business was located in one of the three coastal counties, which provided two clusters, coastal and non-coastal” [15] (pp. 342–343).

4. Results

4.1. Descriptive Statistics

Means, standard deviations, and maximum and minimum values of each variable are shown in Table 2. In the sample, 128 businesses applied to a SBA disaster loan and 64 businesses actually received assistance from SBA. However, five businesses received SBA disaster loan but were closed in 2013. These businesses were either closed by Katrina, closed by owner; sold, retired, gifted, or reopened after Katrina but not operating in 2013. These five businesses were dropped from the regression models. In addition to that, two businesses, which had more than 100 employees, were also eliminated. Finally, the total observations used after dropping observations that had missing variables was 287 for Model 1(actual revenue change) and Model 2 (perceived revenue change).

Table 2. Descriptive Statistics.

Variable	Total N	Mean	Std. Dev.	Min	Max
Dependent Variables					
Percentage Change in Revenue	287	1.05	4.62	−0.98	64.22
Owner’s Perception on Revenue Change	287	0.79	0.87	0	2
Independent Variables					
SBA disaster loans (Received = 1)		0.17	0.38	0	1
Gender (Female = 1)		0.29	0.45	0	1
High School		0.17	0.38	0	1
Some College		0.37	0.48	0	1
Bachelor Degree		0.21	0.41	0	1
Veteran		0.17	0.38	0	1
Experience in Years		29.61	11.02	6	63
Marital Status (Married = 1)		0.85	0.36	0	1
Owner’s Resilience		9.20	1.18	2	10
Sole-Proprietor		0.45	0.50	0	1
Business Cash-Flow Problem After Katrina		0.73	0.45	0	1
Owner’s Perception of Success Before Katrina		3.57	0.66	2	5
Services		0.39	0.49	0	1
Retail		0.20	0.40	0	1
Business Age		27.86	16.39	9	113
Number of Employees		6.32	10.50	0	74
Coastal County		0.67	0.47	0	1
Home-Based		0.31	0.46	0	1
Emergency Plan before Katrina		0.19	0.39	0	1
Days of Closure		51.16	125.76	1	1096
BP Oil Spill		0.56	0.50	0	1
Power Outage		0.30	0.46	0	1
Percent change in County Population (2004–2010)		0.03	0.10	−0.04	0.30

The objective measurement: the actual change in revenue variable showed that out of 287 respondents, approximately 52% of them had negative percentage change while about 48% of them had positive change in revenue. On the other hand, the subjective measurement: owner’s perception of revenue change showed that 50% perceived that their revenue went down, 21% perceived the revenue stayed the same level, and 29% of them said it went up. By comparing the results of objective and subjective dependent variables, the owners whose actual revenue increase was relatively small seem to have perceived that their revenue stayed the same level even though there was in fact a positive increase in the objective measurement model.

Out of 55 businesses that received SBA disaster loans and were operating at the time of survey in 2013, 53% of the owners perceived that their revenue went down. On the other hand, 18% of the SBA disaster loan borrowers answered that revenue stayed the same as the pre-disaster level, and 29% of the owners answered that revenue level went up. The result was similar for those who did not receive SBA disaster loans. Out of 260 businesses, 50% chose the worse off category, whereas 22% of them reported the same as well as 29% of them said they were better off.

Out of 287 businesses, 29% of the business owners were female. Within the male owners group, 47% of them reported their revenues are worse off while 20% of them said revenue stayed the same, and 32% of them chose the “revenue being better off” category. On the other hand, within the women’s group, 58% reported being worse off which was 10% higher than male group. Only 20% of women respondents reported their revenues being better off, which is 10% lower than male group who chose the better off category.

Veteran owners were 17% of the sample. On average, respondents had 30 years of industry experience and the businesses were about 28 years old. Forty-five percent of the businesses were sole-proprietorships, 31% were home-based businesses, and, on average, they had six employees. Interestingly, most had a high perception of business success before Hurricane Katrina but after the hurricane, 73% experienced cash-flow problems. Businesses belonged to various industries, but the two largest were services industry with 30% and 20% were in the retail industry.

Only 19% of had an emergency plan prior to Hurricane Katrina. The average number of days closed after the hurricane was 51 days. Among the respondents, 67% were located in a coastal county, 56% of them were impacted by the 2010 BP oil spill, and 30% were impacted by a power outage.

4.2. Model Results

4.2.1. Model 1—Extended Linear Regression Model for Change in Revenue

Model 1 predicts the actual percentage change in gross revenue comparing the pre-Katrina and the post-Katrina level in 2011 (Table 3). The model takes into account that receiving a SBA loan is endogenous and in fact the results show that the errors are statistically significantly correlated (-0.92 , $p < 0.01$). We hypothesized that SBA disaster loans played a significant role in determining revenue change post-Katrina. Receiving a SBA disaster loan had a positive and statistically significant ($p < 0.01$) effect on the revenue change of business. Receiving a SBA loan increased the percent change in revenue by 7.34%.

Table 3. Results Model 1—Linear Model for Change in Revenue (Objective Measurement).

Percent Change in Revenue	Coefficients	Standard Errors
SBA Disaster Loan (Received = 1)	7.34 ***	2.11
Gender (Female = 1)	−0.87 ***	0.28
High School	−0.87 **	0.43
Some College	−0.05	0.53
Bachelor Degree	−0.03	0.10
Experience in Years	−0.05 ***	0.01
Owner’s Resilience	−0.20	0.53
Sole-Proprietor	−0.81	0.94
Business Cash-Flow Problem After Katrina	−0.30	0.24
Services	0.74	1.19
Retail	−0.73 ***	0.20
Business Age	−0.01	0.01
Number of Employees	−0.03	0.02
Home-Based	−0.36 **	0.17
Days of Closure	−0.002	0.002
BP Oil Spill Experience	0.23	0.75
Power Outage	0.02	0.26
Percent Change in County Population (2004–2010)	4.86	5.51
Constant	4.28	4.65

Table 3. Cont.

Percent Change in Revenue	Coefficients	Standard Errors
SBA Disaster Loan (Endogenous Variable Model)		
Gender (Female =1)	0.07	0.50
High School	0.44 **	0.18
Some College	0.42 ***	0.12
Bachelor Degree	0.05	0.044
Nonwhite	0.49 ***	0.14
Veteran	−0.16 ***	0.06
Experience in Years	0.004 ***	0.001
Marital Status (Married =1)	0.23 ***	0.02
Sole-Proprietor	0.06	0.06
Owner's Perception of Success Before Katrina	0.10 ***	0.02
Services	−0.04	0.29
Retail	0.25	0.31
Business Age	0.002	0.004
Number of Employees	−0.001	0.005
Coastal County	0.07 *	0.04
Home-Based	−0.15 *	0.08
Emergency Plan before Katrina	0.38 **	0.20
Constant	−1.83 ***	0.14
Variance (e.percent Change in Revenue)	25.72	17.95
Correlation (e.sballoan, e.percent Change in Revenue)	−0.92 ***	0.07
N	287	
Log Likelihood = −219.86		
Wald chi2 (18) = 38.71***		

Reference categories: male; single; divorced, widowed; graduate degree; Caucasian; partner and corporation; service industry; non-coastal counties. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Various control variables were also statistically significant. If the owners were women, the revenue change decreased by 0.87%. Compared to having a graduate degree, having a high school education decreased revenue change by 0.87%. For every 10 years of experience, the change in revenue decreased 0.5%. If the business was in the retail industry, it had 0.73% less change in revenue than businesses in other industries. Home-based business is also experienced a 0.36% decrease in revenue compared to non-home based businesses.

4.2.2. Model 2—Ordered Probit Model for Perception of Change in Revenue

This model predicts the odds of owner's perception of change in revenues between pre-Katrina and post-Katrina, accounting for our endogenous variable SBA loan. The results show that the errors for perceived change in revenue and SBA loan are statistically significantly correlated ($-0.66, p < 0.01$). After running the model, the predicted probability for falling into revenue went down category was 50.7% whereas revenue stayed the same was 20.5%, and revenue went up was 28.8%. Table 4 shows the result of ordered probit model. In this model, SBA disaster loan was also positive and statistically significant. The probability that an owner would perceive that their revenue went up if they received a SBA disaster loan is 29.6%.

Several owner demographics were statistically significant. Being a woman and having a high school education decrease the probability being in the increased revenue category. Bachelor's degree and owner's resilience increased the probability of being in the increased revenue category.

Business demographics used as controls in the model were also statistically significant. If the business was a sole proprietorship, was an older business, or had cash flow problems after Hurricane Katrina, then the probability of being in the increased income category decreased. The probability of being in the revenue went up category also decreased if the number of days the business was closed after Hurricane Katrina increased. If a business was located in a county where population increased, then the probability would increase of being in the 'revenue went up' category.

Table 4. Results Model 2—Ordered Probit for Perception of Change in Revenue (Subjective).

Perceived Change in Revenue	Coefficients	Standard Errors
SBA Disaster Loan (Received = 1)	1.32 **	0.55
Gender (Female = 1)	−0.26 ***	0.07
High School	−0.63 **	0.29
Some College	−0.09	0.28
Bachelor Degree	0.09 ***	0.02
Experience in Years	−0.01	0.01
Owner's Resilience	0.27 ***	0.02
Sole-Proprietor	−0.34 ***	0.05
Business Cash-Flow Problem After Katrina	−0.26 ***	0.01
Services	−0.15	0.22
Retail	0.06	0.16
Business Age	−0.01 ***	0.003
Number of Employees	0.01	0.01
Home-Based	−0.0003	0.05
Days of Closure	−0.001 ***	0.0003
Oil Spill Experience	−0.32	0.22
Power Outage	0.08	0.10
Percent Change in Population (2004–2010)	0.83***	0.05
Constant 1	1.40	0.36
Constant 2	1.10	0.43
SBA Disaster Loan (Endogenous Variable Model)		
Gender (Female =1)	0.13	0.09
High School	0.60 *	0.34
Some College	0.70 ***	0.12
Bachelor Degree	0.13	0.08
Nonwhite	0.29 ***	0.04
Veteran	−0.10	0.26
Experience in Years	−0.005	0.003
Marital Status (Married =1)	0.20	0.18
Sole-Proprietor	0.13	0.08
Owner's Perception of Success Before Katrina	−0.20 ***	0.03
Services	0.30	0.21
Retail	0.54 ***	0.19
Business Age	−0.001	0.01
Number of Employees	−0.001	0.003
Coastal County	0.20 ***	0.01
Home-Based	−0.26 ***	0.07
Emergency Plan before Katrina	0.10	0.28
Constant	−1.05 ***	0.06
Corr (e.sballoan,e.perceived Change in Revenue)	−0.66 ***	0.03
N	287	
Log Likelihood = −375.01		
Wald chi2 (18) = 98.75 ***		

Note: Reference categories: male; single; divorced, widowed; graduate degree; Caucasian; other legal structures; other industries; non-coastal counties. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

5. Discussion

Receiving a SBA disaster loan played a positive and statistically significant role in determining the objective business performance measured by the percentage change in revenue and it also had a positive effect on the subjective business performance measured by owner's perception of change in revenue. For this reason, the two hypotheses about the effect of the SBA disaster loan were supported. These results follow those that have found disaster loans to positively impact recovery [7,9,10] and contradict those that have found that disaster loans negatively impact recovery [11,12].

As expected, if the owners were female, actual and perceived change in revenue decreased. This is consistent with other literature that argued that female owners tended to have lower business performance. For example, Marshall et al. [15] discussed that the women-owned businesses were more challenged by sustainability with failure that is more frequent and facing lower profitability

than men-owned businesses. Haynes et al. [7] also pointed out that women owners were less likely to survive after Hurricane Katrina.

Interestingly, education level made a statistically significant difference to the business performance in both objective and subjective measurement. Compared to the reference category (graduate degree holders), if the owners had some high school education, the actual and perceived percentage change in revenue decreased. On the other hand, in the subjective measurement of owner's perception, if the owners had a bachelor's degree, it had increased probability of being better off versus having a graduate degree. This showed that education level is important to some extent. However, it is not necessary to have the highest degree.

The owner's experience in years was negative in both models but only statistically significant in the objective model. This result showed opposite direction from what previous literature suggested [19]. They argued that the more experience owners have, the better business strategies they would have, which would lead to the better business performance.

In the subjective measurement model, owner's resilience was significant and it increased the probability of being success. The owner's resilience was not significant in predicting the actual percentage change in revenue. One would expect that the more resilient the owners are, the more positive revenue change they would face.

Business characteristics such as sole proprietorship and having cash flow problems after Katrina were negative in both models but only statistically significant in the subjective measurement of success. Sole proprietorships which are less formal forms of ownership have shown to be less successful than other more formal forms of legal structure after a disaster [16].

As previous research found, industry did affect organizational performance. In our results, the retail industry had decreased probability of being better off compared to the reference category. Location of the business also played a role in success [11]. Home-based businesses had a higher chance of success even though they were less likely to receive an SBA loan. According to Sydnor et al. [16], home-based businesses were more likely to survive in the short and long term. However, they may be less likely to be resilient according to the small business disaster recovery framework.

Macro-variables played statistically significant role in success outcomes. An increase in population, increased the probability of perceived change in revenue. However, it was only statistically significant in the subjective model. As Deitch and Corey [9] argued in their article, it is likely that those businesses had more customers and labor to support their business and therefore their revenues increased drastically.

6. Conclusions

The US government has paid billions of dollars in SBA disaster loans for people and businesses after Hurricane Katrina. In this article, we examined the effect of SBA disaster loans to business performance. The results indicate that receiving a SBA disaster loan played a statistically significant role in determining actual revenue change and owner's perception of revenue change for small businesses in Mississippi. The results concur with previous research that found that federal assistance has a positive role to play in the disaster recovery of small businesses [7,9,10]. It has a role not only at the financial level, but also in the minds of business owners. Business owners were more likely to have an increased probability of perceiving increased revenue if they had received a SBA loan.

Our study showed that many small businesses in Mississippi were still at the stage of trying to recover from the disaster even eight years after Hurricane Katrina. As Marshall and Schrank [6] discussed in SBDRE, since business recovery is a process, we can assume that those businesses that barely survived the disaster would have their goal to make their business recover; namely, set it back to the original performance level. After the business starts to reach the original revenue level, their next goal will be to become resilient—to be better off than the pre-disaster level.

It may be that businesses with SBA disaster loans are more likely to have financial difficulties in the first place [11]. In addition, increased indebtedness may make these businesses worse off even

when income returns to the pre-disaster level. Under these circumstances, these businesses may already be in ‘survival’ mode and are less likely to be better off after a disaster loan. More research focused on small business resilience is warranted to understand the differences between businesses that apply and receive a loan and those that do not.

The effect of another type of disaster loan called FEMA Community Disaster Loans should also be researched further. This loan is provided by congress to local governments based on the *Community Disaster Loan Act 2005* [32]. Any local government can apply if the local government suffers a loss due to the disaster event and the loans are used to help local governments maintain their functions or expand them to meet their needs. In 2014, nine years after Hurricane Katrina, the US government forgave \$391 million of the disaster loan borrowed by Louisiana State, which is 95.5% of the Katrina-related community disaster loan [33]. This fact shows that not only small businesses but also local governments are struggling to repay disaster loans.

Given these considerations, a recommended policy is to consider effective ways of financial assistance. Namely, not only limiting the distribution method to loans but also to include grants for those businesses that are worse off in the first place. This grant type of assistance will help business get back to the original level of success without adding financial liabilities. Then, for those businesses that are already in the recovered or resilient phase, a disaster loan may help them expand their businesses. The effect of disaster loans for successful businesses would be more explicit than those businesses that are worse off in the first place. In our study, those owners who experienced cash flow problems after Hurricane Katrina had negative revenue change in both the objective and subjective models.

Furthermore, a disaster loan opportunity could have positive impacts not only on the borrowing businesses, but also to the surrounding environment of neighboring businesses. Once the area is revitalized, it is possible to expect that the population of the region will increase again. Our study showed that a one percent increase in population would cause an almost seven percent increase in actual revenue change. By distributing both grants and loans, small businesses would be able to recover with less burden and more viability.

This article analyzed the effect of the SBA disaster loans using the dataset obtained in 2013. A limitation of the article is that only businesses that were open as of 2013 were used in the sample. This did not account for survival bias. One would assume that businesses that received a SBA disaster loan would be more likely to survive the disaster. Further work is needed to conduct analysis for the data collected at different times such as immediately after the disaster. In addition to that, it is necessary to develop this research by focusing on other dependent variables such as change in profits and customer base.

The main contribution of this article is that it estimated the effect of SBA disaster loans both objectively and subjectively for small businesses’ recovering in Mississippi after Hurricane Katrina. From the results, we recommend that current policy not only limit post-disaster financial aid to loans but also should include grants. Disaster recovery is a long process where the federal government is expected to play a larger, more effective role.

Author Contributions: Conceptualization, T.H.; Data curation, M.I.M.; Formal analysis, T.H.; Funding acquisition, M.I.M.; Methodology, T.H. and M.I.M.; Project administration, M.I.M.; Supervision, M.I.M.; Writing—original draft, T.H.; Writing—review & editing, T.H. and M.I.M.

Funding: This article is based upon material from the Purdue University Project “Small Business Survival and Demise after a Natural Disaster”, supported by NSF Grant #0856221-CMMI and “Small Business Disaster Recovery Process: An Analysis of Rural Communities in Mississippi” supported by USDA-NIFA Grant # 2011-67023-30609.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

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