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The effect of Small Business Administration (SBA) Disaster Loans on Revenues of Small
Businesses in Mississippi after Hurricane Katrina

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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 (FEMA 2015). 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 paper 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 373 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 did not play statistically significant role in determining the actual revenue change. However, SBA disaster loans had a negative and statistically significant association with owners' perception on change of revenue compared to pre-Katrina levels.

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. Anything east of where the storm landed in Mississippi was literally wiped out (Brown 2015). More than 234,000 homes were damaged or destroyed within 24 hours (FEMA 2015), and the fatalities rose to 238 people within the state of Mississippi (CNN 2016).

After the disaster, the US government provided \$2.6 billion of Small Business Administration (SBA) disaster loans to individuals and businesses in Mississippi (FEMA 2015). The SBA disaster loans are low interest rate, long-term loans that intend to cover losses not fully protected by insurance. These are provided directly from the United States government; unlike other types of SBA loans which borrowers apply commercial loans with a guarantee from SBA (Josephson & Marshall 2016, FEMA 2015). A business can apply for a SBA disaster loan for the purpose of repairing or replacing entities damaged or destroyed in a declared disaster.

In this paper, we investigate the effect of SBA disaster loans following 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 after a disaster.

Hurricane Katrina was one of the costliest disaster in the US history. Although more than 11 years have passed after 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.

Literature Review

The small business disaster recovery framework (SBDRF)

When focusing on the business performance after a natural disaster, it is important to define the business recovery process. As Marshall and Schrank (2014) pointed out, business recovery is a process that changes over time. In their Small Business Disaster Recovery Framework (SBDRF), they categorize the business recovery into demised, survived, recovered or resilient based on information obtained from the business owners.

In the SBDRF, a business is defined as demised when it is closed permanently. Survived category is explained as those businesses who barely survived the disaster but are still open even though their performance is worse compared to the pre-disaster level. Recovery category applies when the measurement such as revenues stayed the same level between pre-disaster and post-disaster. A business is resilient if the post-disaster performance such as revenues are better off compared to the pre-disaster levels (Marshall and Schrank 2014).

How do we measure the success of business?

In Haynes et al. (2011), the authors focus on the objective and subjective indicators of success for small, family-owned businesses. The typical objective indicators of business success are such as gross revenue, survival, return on assets, growth in sales, profits and number of employees (Haynes et al. 2011, Miner 1998). On the other hand, subjective indicators are such as owner expectations and perceptions. Marshall and Schrank (2014) pointed out the importance of taking owners' perceptions into account since "Small business recovery is likely to be

characterized by indicators that can only be reported by business owners” (p.607). Dietch and Corey (2011) also analyzed the organizational performance of businesses after Hurricane Katrina with subjective and objective measurements. Firstly, managers indicated whether their business performance was better/same/worse compared to pre-disaster level. Next, managers indicated the percentage increase or decrease in revenue relative to the pre-Katrina level.

In our paper, we adopt the objective and subjective measurements similar to previous literature; the objective measurement used is the percentage change in revenues between pre-Katrina and post-Katrina and the subjective measurement used is the owner’s perception on revenue change between pre- and post-Katrina. The subjective categories are classified into revenue level being worse off/stayed the same/better off.

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 (2015) 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 to 2010. The authors argue that a one-dollar increase in SBA disaster loan to bank deposit ratio results in 12 additional small business establishments. Especially, the result indicated the effect of SBA disaster loans on the smallest business size: employees less than 50, was larger in magnitude compared to those establishments of 50-99 and those more than 100 employees. Furthermore, Dietch and Corey (2011) claimed in their paper that lack of federal assistance from the Government was statistically significant to the performance difficulties of businesses, meaning that post disaster assistance does play a positive role to their business performance.

In contrast, Dahlhamer and Tierney (1998) claimed that post-disaster aid was negatively correlated with business recovery after the 1994 Northridge earthquake. They found that the heavy users of post-disaster aid were those that had the most severe damage, and therefore those who needed financial assistance were worse off to begin with. Due to the limited types of assistance for small businesses of which loans are the most common method of aid, they found that loans brought about increased indebtedness where even if income returned to the pre-disaster level, businesses were worse off. They also pointed out the possibility that the assistance received was insufficient, or that external market forces are working against those businesses.

Similarly, Alesch et al. (2001) claimed that SBA disaster loans were not an effective solution to disaster recovery. The hard part is that those who qualify for SBA disaster loans but who do not obtain SBA loans need to use their homes and other personal assets as collateral. This means that if small business owners find their post-disaster business not viable and cannot repay the loan, then the business owners face the loss of all their assets up to the value of their disaster loans.

Haynes et al. (2011) examined the impact of federal disaster assistance on the survival and success of small family-owned businesses with employees less than 500 people from 1996 to 1999. They claim that businesses in counties receiving more disaster assistance are not more likely to survive, but these firms are more likely to realize positive changes in revenue than firms located in counties receiving less disaster assistance. The location of the business and the nature of the business played a significant role in determining business survival, but not the disaster assistance itself.

The problem is that the effect of SBA disaster loans on business recovery and success is not fully understood. Although a few studies have attempted to examine factors that determine

the success of recovery for individual businesses post disaster, the results have been not consistent regarding the effect of government assistance and in particular SBA disaster loans. The objective of this paper 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 (2016) examined the factors that influence the application for, approval of, and the receipt of SBA disaster loans. They found that female owners are more likely to apply for the loans, and receive a less amount. Non-white business owners remain disadvantaged in the loan process, and are less likely to be approved. Revenue is important factor for the ability to repay and the amount received. Business owners with more insurance are less likely to apply and receive loans. This paper enhances the study by Josephson and Marshall (2016) estimating the effect of SBA disaster loans on small business success.

Data and Methods

We used the “MS Small Business Recovery Survey” (2013) dataset. The study focused on small businesses operating in 2004 (before Katrina) in a ten county area in southeastern Mississippi. These ten 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, MS. Pearl River, Stone, George, Greene and Perry counties comprise a mix of small town, rural and national forest areas. These ten 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, a total of 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 4,000 was initially drawn, a second random sample of 1,500 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, and 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 minutes in length. The interviewees were given \$2 in a mailed request for participation, and paid an additional \$30 when the phone interview was completed.

Over all, the response rate was approximately 11.3%. Another way to evaluate the success of the survey is the cooperation rate. A total of 2,610 businesses were eligible and had

good contact information. Of the 2,610 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 performances comparing before and after Hurricane Katrina, which are measured objectively and subjectively: 1. a percent change in revenue comparing the pre-Katrina revenue and post-Katrina revenue in 2011, and 2. owner's perception on the change of revenue comparing before and after Katrina.

TABLE 1 ABOUT HERE

The hypothesis variable is whether the business received a SBA disaster loan. The owner's demographics are gender, education, ethnicity, veteran, experience in business, marital status, household size and owner's resilience. The business's characteristics are legal form of ownership, business cash-flow problems before Katrina, line of business, business age, firm size, location (coastal county/home base business), emergency plan, days of closure, an experience of oil spill after Hurricane Katrina, a power outage after Hurricane Katrina, owner's perception on pre-Katrina success and post-Katrina success, the actual pre-Katrina revenue (included only in the subjective measurement: Model 2) and a macro variable; the percent of population change in all 10 counties between 2004 and 2010.

Among those samples, 128 businesses applied to a SBA disaster loan and 64 businesses actually received assistance from SBA. However, there were 5 businesses that received SBA disaster loan but were not opened at the time of survey. These businesses were either closed by Katrina, closed by owner; sold, retired, gifted, or reopened after Katrina but currently not

operating. These 5 businesses were dropped from the regression models. Furthermore, two businesses which had more than 100 employees were also eliminated.

Hypotheses

- 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.

Models

In order to test these hypotheses, two types of econometric models were created.

Model 1. Ordinary Squares Model for Change in Revenue (Objective measurement)

Revenue Change(Y)

$$= \beta_0 + \beta_1 \text{SBAloan} + \beta_2 \text{Owner_demographics}_i + \beta_3 \text{Business Characteristics}_i + \beta_4 \text{Macro_variable}_i + u_i$$

where u_i are independent, normally distributed random errors with mean 0 and variance σ^2 .

Model 1 predicts the objective measurement of business performance: actual percentage change in revenue between pre-Katrina and post-Katrina using the ordinary least squares method.

Model 2. Ordered Probit Model for Perception of Change in Revenue (Subjective measurement)

Perception on Revenue Change (y^*) = $\beta'x + \varepsilon$

$$= \beta_0 + \beta_1 \text{SBAloan} + \beta_2 \text{Owner_demographics}_i + \beta_3 \text{Business Characteristics}_i + \beta_4 \text{Macro_variable}_i + \varepsilon$$

What we observe is

$$y = 0 \text{ if } y^* \leq 0,$$

$$y = 1 \text{ if } 0 \leq y^* \leq \mu_1,$$

$$y = 2 \text{ if } \mu_1 \leq y^* \leq \mu_2$$

With the normal distribution, we have the following probabilities:

$$Prob(y = 0) = \Phi(-\beta'x),$$

$$Prob(y = 1) = \Phi(\mu_1 - \beta'x) - \Phi(-\beta'x),$$

$$Prob(y = 2) = \Phi(\mu_2 - \beta'x) - \Phi(\mu_1 - \beta'x)$$

where $0 < \mu_1 < \mu_2$.

Model 2 provides the predicted probability of owner's perception on revenue change falling into each worse off/same/better off category for the independent variables while keeping other variables at means. Clusters are used to allow flexibility in the variance-covariance matrix in order to address potential heteroscedasticity. As explained in the Marshal et al. (2015), “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” (p.342-343).

Results

Descriptive Statistics

Means, standard deviations, maximum and minimum values of each variable are shown in Table 2. The objective measurement: the actual change in revenue variable showed that out of 327 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 on revenue change variable showed that out of 370 respondents, 50.27% perceived

their revenue to went down, 21.35% perceived the revenue stayed the same level and 28.38% of them said it went up. By comparing the results of objective and subjective dependent variables, owners whose actual revenue increase was relatively small seem to have reported their perception to be “revenue stayed the same” category even though there was actually a positive increase in the objective measurement model.

TABLE 2 ABOUT HERE

Out of 59 businesses that received SBA disaster loans and were operating at the time of survey in 2013, 52.54% of the owners perceived that their revenue went down. On the other hand, 18.64% of the SBA disaster loan borrowers answered that revenue stayed the same as the pre-disaster level, and 28.81% of the owners answered that revenue level went up. The result was similar for those who did not receive SBA disaster loans. Out of 310 businesses, 50.00% chose the worse off category, whereas 21.94% of them reported the same as well as 28.06% of them said they are better off.

Out of 370 businesses, 71.08% of the owners were male and 28.92% of them were female. Within the male owners group, 47.53% of them reported their revenues are worse off while 20.91% of them said revenue stayed the same, and 31.56% of them chose the “revenue being better off” category. On the other hand, within the women’s group, 57.01% chose that they are worse off which is 10% higher than male group whereas 22.43% of women chose the revenue stayed the same group, and only 20.56 % of them chose that they are better off, which is 10% lower than male percentage of choosing the better off category.

Among 369 respondents, veteran owners were 18.97% and non-veterans were 81.03%. Within the veterans group, 44.29% of them reported their revenue levels are worse off while 31.43% of veterans answered they are better off. On the other hand, within the non-veterans

group, 51.84% of them reported they are worse off while 27.76% of them answered they are better off.

Out of 369 respondents, 80.49% of the businesses did not have emergency plans prior to Hurricane Katrina while 19.51% of the businesses had them. Even though less than 20% of the businesses had a pre-disaster emergency plan, this group had a higher percentage of business performance to be better off. In fact, 37.50% of people within the group that had emergency plan reported they are better off while only 26.26% of the businesses that did not have emergency plans said they are better off.

Model Results

Model 1. Ordinary Squares Model for Change in Revenue (Objective measurement)

TABLE 3 ABOUT HERE

This model estimates the characteristics of businesses that are better off in terms of actual revenues changes. The dependent variable is a percent change in revenue comparing the pre-Katrina revenue and the post-Katrina revenue in 2011.

In Model 1, we hypothesized that SBA disaster loans played a significant role in determining revenue change post-Katrina. Receiving a SBA disaster loan did not have a statistically significant effect on the revenue change of business. However, various control variables were statistically significant. If the owners are women, the revenue change will decrease by 1.29% at 5% significance level. If the scale of the owner's resilience increases by one unit, the percentage change in revenue will decrease by 0.59% at 5% significance level. If the owner's perception on their business success today increases by 1 unit, the percentage change in revenue will increase for 0.77% at 5% significance level. If the business was in service

industry, the revenue change increased for 1.17% at 5% significance level. If the number of employees are one unit higher, the change in revenue is 0.07 percent smaller at 5% significance level. If the business had an emergency plan before Katrina, it increases the revenue change by 2.27% at 1% significance level. Furthermore, it shows that 1% increase in population in a county will raise 6.94% in revenue change at 5% significance level.

Model 2. Ordered Probit Model for Perception of Change in Revenue (Subjective measurement)

This model predicts the owner's perception on change in revenues between pre-Katrina and post-Katrina. Table 4 shows the result of Ordered Probit Model and the marginal effects of the independent variables. In the Model 2, SBA disaster loan was statistically significant at 10% level and the coefficient was negative (hypothesis 2). If the business received a SBA disaster loan, there is 0.150% higher chance of falling into the category of revenue being "worse off" while there are decreased probabilities to fall into "revenue stayed the same" or "revenue went up" category by 0.057% and 0.093%, respectively.

TABLE 4 ABOUT HERE

Veteran was statistically significant at 1% level and negative. Veteran is 0.083 % more likely to fall into the category of revenue being "worse off" which is consistent with the previous literature. On the other hand, there are decreased probabilities of falling into "revenue stayed the same" or "revenue went up" categories by 0.032% and 0.052%, respectively.

The owner's household size was statistically significant at 5% level and positive. One-unit increase in the household size decreases the probability to fall into the category of revenue being "worse off" by 0.061 %. On the other hand, there are increased probabilities of falling into "revenue stayed the same" or "revenue went up" categories by 0.023% and 0.038%, respectively.

The owner's perception on pre-Katrina success was significant at 1% level and negative. One-unit increase in owner's perception on pre-Katrina success increases the probability of falling into the category of revenue being "worse off" by 37.001%. On the other hand, there are decreased probabilities of falling into "revenue stayed the same" or "revenue went up" categories by 14.053% and 22.948 %, respectively.

Owner's perception on how successful the business today was significant at 1% level and positive. One-unit increase in the owner's perception on their success today decreases the probability of falling into the category of revenue being "worse off" by 44.125%. On the other hand, there are increased probabilities of falling into "revenue stayed the same" or "revenue went up" categories by 16.758% and 27.367 %, respectively.

The log of pre-Katrina revenue was significant at 5% level and positive. One-unit increase in the log of pre-Katrina revenue decreases the probability of falling into the category of revenue being "worse off" by 6.114%. On the other hand, there are increased probabilities of falling into "revenue stayed the same" or "revenue went up" categories by 2.322% and 3.792 %, respectively.

Discussion

Receiving a SBA disaster loan does not play a significant role in determining the objective business performance measured by the percentage change in revenue. However, it does play a role (a negative one) in predicting the subjective business performance measured by owner's perception change in revenue. The difference may be due to the psychological burden the SBA disaster loan may have on owners so that they underestimate their revenue change.

The result for the subjective measurement model is consistent with the findings by Dahlhamer and Tierney (1998) that post-disaster aid was negative and significantly associated

with business recovery after 1994 Northridge earthquake. However, it is also important to point out that the marginal effects of the SBA disaster loans to the subjective performance were very small (0.15% higher chance of falling into worse off category) which is almost negligible.

As expected, if the owners were female, actual percentage change in revenue decreased by 1.29%. This is consistent with other literature that argues that female owners tend to be worse off. For example, Marshall et al. (2015) discussed that the women-owned businesses are more challenged by sustainability with higher rates of failure and facing lower profitability than men-owned businesses. Haynes et al. (2011) also pointed out that women owners were less likely to survive after Hurricane Katrina. On the other hand, gender did not play statistically significant role in predicting the subjective performance in our study.

Veteran was 0.083 % more likely to fall into revenue being “worse off” category in the subjective measurement of performance. This is also consistent with the findings from Marshall et al. (2015) that veteran owners had higher odds of business closure after Hurricane Katrina. On the other hand, in the objective measurement of actual change in revenues, veteran was not statistically significant.

In the subjective measurement of revenue change, a unit increase in size of the owner’s household made it 0.061% less likely the owner would fall into revenue being “worse off” category. The percentage may be negligible but still shows the statistical difference. This might be suggesting that the more household members they have, the more chance of having human capital assets that owners can rely on. Therefore, it is contributing to the owner’s perception on business performance to be better off. On the other hand, in the objective measurement of the business performance, this variable was not statistically significant.

The owner's resilience was negatively significant when predicting the actual percentage change in revenue, as the results showed a unit increase in resilience will decrease revenue change by 0.59%. This seemed counterintuitive. One would expect that the more resilient the owners are, the more positive revenue change they would face. In the subjective measurement model, owner's resilience did not make a statistical difference.

Owner's perception of success before Hurricane Katrina was statistically significant and negative in the subjective measurement model. This may suggest that those owners who think they were successful prior to Hurricane Katrina do have higher expectation of their business performance. The chance of their perception falling into "worse off" category after Hurricane Katrina increased by 37.0%. On the other hand, the owner's perception on success prior to Katrina did not make a statistical difference to the objective performance of the businesses.

Owner's *current* perception of success after Hurricane Katrina was statistically significant and positive in both objective and subjective measurements. This is intuitive as one would expect that the more successful they are, the more positive revenue change they would see.

As Dahlhamer and Tierney (1998) claimed, industry does affect organizational performance. In our results, the service industry had 1.17% higher change in actual revenue. Marshall et al. (2015) also found that being in the service industry decreased the odds of business being closed by Hurricane Katrina or reopen and then close versus operating. In contrast, the service industry was not statistically significant in the owner's perception of revenue change.

Number of employees were statistically significant in the objective measure of success and negative. This was not as expected that the larger the number of employees the more revenue

change that will occur. The literature finds that the size of firm is an important proxy to figure out the available human assets (Marshall et al. 2015). Dahlhamer and Tierney (1998) found that size matters in coping with disaster: the bigger the better. Our results show the opposite. It could perhaps be explained this way; larger companies would already have larger scale of revenues. Therefore, it is harder for them to have the positive increase in revenue after facing a disaster. On the other hand, in the subjective measurement model, the number of employees did not make a statistical difference to the owner's perception of revenue change.

If the business had an emergency plan, it showed that the actual revenue change was 2.27% more. It shows the preparedness for the disaster does played an important role in increasing performance in the business after facing a disaster. However, it did not make any statistical difference to the subjective measurement of business performance.

The log of pre-Katrina revenue was statistically significant and positive in the subjective measurement of business performance. A unit increase in log of pre-Katrina revenue decreased the probability to falling into the category of revenue being "worse off" by 6.114%. This indicates that if they were actually doing well with actual revenue before Hurricane Katrina, they may have higher chance of perceiving themselves as better off even after the disaster. We did not have this variable as an independent variable for the objective measurement because we have it as a part of the dependent variable ($\text{Change in revenue} = \text{Post-Katrina revenue} - \text{Pre-Katrina revenue}$).

One percentage increase in population had a large positive significance on predicting the actual change in revenue in that it increases by 6.94%. It would seem that when there is a population increase in the county, it is more likely that those businesses have more customers

and therefore their revenues will be increased. On the other hand, this variable did not make a statistical difference to the subjective measurement of business performance.

Conclusion

In this paper, we examined the effect of SBA disaster loans to the objective and subjective measurements of business performances after Hurricane Katrina. As a result, it turned out that receiving a SBA disaster loan does not play a statistically significant role in determining actual revenue change between pre-Katrina and post-Katrina. However, it did play a statistically significant role in determining owner's perception on revenue change between the pre-disaster and post-disaster level showing that it is more likely to be worse off. The difference may be due the psychological burden the SBA disaster loan may have on borrowers' perception so that they underestimate their revenue change. It is also important to note that the marginal effect of the SBA disaster loans on the owner's perception of their business performance were very small and almost negligible.

The US government has paid billions of dollars as SBA disaster loans for people and businesses after Hurricane Katrina. However, our study showed that the effect of the disaster loan was negatively significant in the owner's perception on change of revenues as well as not statistically significant in actual percentage change of revenues. In the case of small business recovery in Mississippi after Hurricane Katrina, it is possible to conclude that borrowing SBA disaster loan did not effectively help those businesses to be better off.

However, this results may only capture a part of the effect of SBA disaster loans as it is only focusing on the business performances associated with change in revenues. Further work is needed to address the effect of the SBA disaster loans on other measurements such as change in customer base between pre- and post-Katrina.

It is also important to note that in the subjective measurement model, the result indicated that all 6 significant independent variables including the SBA disaster loan showed the highest probability to fall into “revenue went down” category compared to the probabilities of falling into “revenue stayed the same” or “revenue became better off” categories. It indicates that disaster recovery is continuing and being *Recovered* or *Resilient* from the disaster as defined in the Small Business Disaster Recovery Framework (Marshall and Schrank 2014) is hard to achieve even 8 years after Hurricane Katrina.

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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 |
| Size of Household | Number of people |
| Owner's Resilience | Strongly disagree = 1, Somewhat disagree =2, Neither agree nor disagree =3, Somewhat agree = 4, Strongly agree = 5 |
| Sole-Proprietor | No = 0, Yes = 1 |
| Partner | 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, Just slightly successful =2, Moderately successful =3, Very successful =4, Extremely successful=5 |
| Owner's Perception on Success After Katrina | Not at all successful =1, Just slightly successful =2, Moderately successful =3, Very successful =4, Extremely successful=5 |
| Services | 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 |
| Oil Spill | No = 0, Yes = 1 |
| Power Outage | No = 0, Yes = 1 |
| Log of Pre-Katrina Revenue | Continuous Variable (Only for Model 2) |
| Percent Change in Population (2004 - 2010) | Continuous Variable |

Table 2. Descriptive Statistics

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|--|-----|-------|-----------|-------|---------|
| Dependent variables | | | | | |
| Percentage Change in Revenue | 327 | 1.04 | 4.75 | -0.98 | 64.22 |
| Owner's Perception on Revenue Change | 370 | 0.78 | 0.86 | 0.00 | 2.00 |
| Independent Variables | | | | | |
| SBA disaster loans | 372 | 0.16 | 0.37 | 0.00 | 1.00 |
| Gender (Female =1) | 373 | 0.29 | 0.45 | 0.00 | 1.00 |
| High School | 373 | 0.17 | 0.38 | 0.00 | 1.00 |
| Some College | 373 | 0.36 | 0.48 | 0.00 | 1.00 |
| Bachelor Degree | 373 | 0.21 | 0.41 | 0.00 | 1.00 |
| None-White | 372 | 0.07 | 0.26 | 0.00 | 1.00 |
| Veteran | 372 | 0.19 | 0.39 | 0.00 | 1.00 |
| Experience | 373 | 30.18 | 11.73 | 6.00 | 74.00 |
| Marital Status | 373 | 0.84 | 0.37 | 0.00 | 1.00 |
| Size of Household | 372 | 2.77 | 1.37 | 1.00 | 14.00 |
| Owner's Resilience | 367 | 9.21 | 1.25 | 2.00 | 10.00 |
| Sole-Proprietor | 370 | 0.44 | 0.50 | 0.00 | 1.00 |
| Partner | 370 | 0.04 | 0.18 | 0.00 | 1.00 |
| Business Cash-Flow Problem After Katrina | 368 | 3.65 | 1.24 | 1.00 | 5.00 |
| Owner's Perception on Success Before Katrina | 373 | 3.61 | 0.67 | 2.00 | 5.00 |
| Owner's Perception on Success After Katrina | 372 | 3.02 | 1.04 | 1.00 | 5.00 |
| Services | 373 | 0.38 | 0.49 | 0.00 | 1.00 |
| Business Age | 372 | 28.63 | 17.70 | 9.00 | 113.00 |
| Number of Employees | 371 | 5.98 | 10.02 | 0.00 | 74.00 |
| Coastal County | 373 | 0.66 | 0.47 | 0.00 | 1.00 |
| Home-based | 371 | 0.31 | 0.46 | 0.00 | 1.00 |
| Emergency plan before Katrina | 372 | 0.20 | 0.40 | 0.00 | 1.00 |
| Days of closure | 346 | 56.77 | 147.43 | 1.00 | 1461.00 |
| Oil Spill | 369 | 0.57 | 0.50 | 0.00 | 1.00 |
| Power Outage | 372 | 0.30 | 0.46 | 0.00 | 1.00 |
| Log of Pre-Katrina Revenue | 373 | 11.98 | 1.61 | 0.00 | 17.08 |
| Percent Change in Population (2004 - 2010) | 370 | 0.03 | 0.10 | -0.04 | 0.30 |

Table 3. Result of Model 1: OLS Model for Change in Revenue (Objective Measurement)

| Independent Variables | Coefficients | Standard errors |
|--|--------------|-----------------|
| SBA disaster loans | 0.11 | 0.72 |
| Gender (Female =1) | -1.29** | 0.64 |
| High School | 0.59 | 0.87 |
| Some College | 1.10 | 0.71 |
| Bachelor Degree | 0.07 | 0.80 |
| None-White | 1.62 | 1.23 |
| Veteran | -0.68 | 0.76 |
| Experience in Years | -0.04 | 0.03 |
| Marital Status (Married =1) | 0.31 | 0.82 |
| Size of Household | -0.18 | 0.22 |
| Owner's Resilience | -0.59** | 0.23 |
| Sole-Proprietor | -0.74 | 0.60 |
| Partner | -1.86 | 1.57 |
| Business Cash-Flow Problem After Katrina | -0.14 | 0.25 |
| Owner's Perception on Success Before Katrina | -0.09 | 0.42 |
| Owner's Perception on Success After Katrina | 0.77** | 0.32 |
| Services | 1.17** | 0.56 |
| Business Age | -0.01 | 0.02 |
| Number of Employees | -0.07** | 0.03 |
| Coastal County | -0.84 | 0.74 |
| Home-based | -0.34 | 0.63 |
| Emergency plan before Katrina | 2.27*** | 0.71 |
| Days of closure | 0.00 | 0.00 |
| Oil Spill | 0.99 | 0.60 |
| Power Outage | -0.53 | 0.59 |
| Percent change in Population (2004 - 2010) | 6.94** | 3.48 |
| Constant | 6.49** | 3.08 |
| N | 290.00 | |
| R-sq | 0.18 | |
| adj. R-sq | 0.10 | |

* p<0.10, ** p<0.05, *** p<0.01

Table 4. Result of Model 2: Ordered Probit Model for Perception of Change in Revenue
(Subjective Measurement)

| Independent Variables | Ordered Probit Coefficients | Standard errors | Prob[Y=0] | Prob[Y=1] | Prob[Y=2] |
|--|-----------------------------|-----------------|--------------|--------------|--------------|
| SBA disaster loans | -0.0377* | 0.00219 | 0.00150* | -0.00057* | -0.00093* |
| Gender (Female =1) | -0.22054 | 0.15789 | 0.08687 | -0.03507 | -0.05180 |
| High School | -0.02674 | 0.24371 | 0.01060 | -0.00408 | -0.00653 |
| Some College | 0.20487 | 0.19555 | -0.08138 | 0.02959 | 0.05179 |
| Bachelor Degree | 0.27850 | 0.20773 | -0.11073 | 0.03675 | 0.07398 |
| None-White | 0.28364 | 0.29549 | -0.11275 | 0.03460 | 0.07814 |
| Veteran | -0.00210*** | 0.00037 | 0.00083*** | -0.00032*** | -0.00052*** |
| Experience in Years | -0.1012 | 0.00740 | 0.00402 | -0.00153 | -0.00249 |
| Marital Status (Married =1) | -0.12822 | 0.20789 | 0.05104 | -0.01810 | -0.03294 |
| Size of Household | 0.00155** | 0.00070 | -0.00061** | 0.00023** | 0.00038** |
| Owner's Resilience | -0.00035 | 0.00039 | 0.00014 | -0.52955D-04 | -0.86477D-04 |
| Sole-Proprietor | -0.07371 | 0.17328 | 0.02924 | -0.01117 | -0.01807 |
| Partner | 0.07890 | 0.51360 | -0.03141 | 0.01128 | 0.02013 |
| Business Cash-Flow Problem After Katrina | -0.00016 | 0.00046 | 0.61762D-04 | -0.23457D-04 | -0.38305D-04 |
| Owner's Perception on Success Before Katrina | -0.93207*** | 0.15857 | 0.37001*** | -0.14053*** | -0.22948*** |
| Owner's Perception on Success After Katrina | 1.11152*** | 0.11934 | -0.44125*** | 0.16758*** | 0.27367*** |
| Services | -0.03365 | 0.17712 | 0.01335 | -0.00510 | -0.00825 |
| Business Age | 0.00017 | 0.00051 | -0.68909D-04 | 0.26171D-04 | 0.42738D-04 |
| Number of Employees | 0.00082 | 0.00109 | -0.00032 | 0.00012 | 0.00020 |
| Coastal County | 0.10222 | 0.14833 | -0.04048 | 0.01575 | 0.02473 |
| Home-based | 0.12299 | 0.16726 | -0.04890 | 0.01789 | 0.03101 |
| Emergency plan before Katrina | 0.14346 | 0.19608 | -0.05710 | 0.02021 | 0.03689 |
| Days of closure | 0.83395D-04 | 0.00020 | -0.33106D-4 | 0.12573D-04 | 0.20533D-04 |
| Oil Spill | -0.00121 | 0.00098 | 0.00048 | -0.00018 | -0.00030 |
| Power Outage | 0.00395 | 0.01716 | -0.00157 | 0.00059 | 0.00097 |
| Log of Pre-Katrina Revenue | 0.15402** | 0.06441 | -0.06114** | 0.02322** | 0.03792** |
| Percent change in Population (2004 - 2010) | -0.00040 | 0.00078 | 0.00016 | -0.60594D-04 | -0.98952D-04 |
| Constant | -1.71803* | 0.89116 | | | |
| N = 370 | | | | | |
| Pseudo- R^2 = 0.30 | | | | | |
| Log likelihood = - 267.77 | | | | | |
| Mu (01) | 0.88311*** | 0.09829 | | | |

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