

The Demand for Post-Katrina Disaster Aid: SBA Disaster Loans and Small Businesses in Mississippi*

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Abstract

Following Hurricane Katrina, the United States government provided billions of dollars in loans in order to repair the damage caused by the hurricane. However, the specifics surrounding demand for these loans and the process of application and approval for Small Business Administration (SBA) loans has yet to be fully examined. We analyze the demand of small businesses for such loans and delve into the factors which are associated with success in obtaining loan funds following disaster. Results indicate several factors are important in all of the stages of the loan process: the income of the business, whether the business had insurance or received money in an insurance claim, and the gender of the business owner.

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1 Introduction

When Hurricane Katrina hit the south-eastern United States in August of 2005, it became the costliest hurricane in the history of the country, with more than \$108 billion in damages and over 1,800 lives lost (FEMA, 2013). The recovery effort was similarly unprecedented: over 13 million Americans donated money as individuals, the Red Cross provided \$2 billion in emergency aid, and, in addition to \$75 billion in immediate relief, the United States government promised \$45 billion in loans and rebuilding funds (FEMA, 2013). However, despite the tremendous damage experienced in many areas, it is not clear what demand existed for reconstruction assistance. In particular, the process of application and acceptance for Small Business Administration (SBA) loans by small businesses has yet to be fully examined.

We investigate the application for and acceptance of SBA disaster loans following Hurricane Katrina for small businesses in Mississippi. With this research, we seek to determine: 1) the characteristics of businesses and owners associated with SBA loan application; 2) the characteristics of businesses and owners associated with SBA loan receipt; and 3) the characteristics of businesses and owners associated with SBA loan size. A truncation model framework is used to understand the SBA disaster loan process using data from approximately 500 small businesses.

The SBA has a stated mission to “aid, counsel, assist and protect the interests of small business concerns, to preserve competitive enterprise and to maintain and strengthen the overall economy of our nation (SBA, 2013).” Additionally, the SBA has a mission to support underrepresented groups, in particular female business owners (SBA, nd). It is important to examine whether the SBA met its goals following Hurricane Katrina. In this article, we attempt to investigate one aspect of these goals, with respect to the application and receipt of small businesses in Mississippi for disaster loans. In doing so, we contribute to the literature as the first study to examine the process of application for and acceptance of SBA loans, as well as by evaluating the success of the SBA in achieving its stated missions.

2 Small Business Administration Loans

The SBA provides disaster loans to businesses and individuals for disaster-related losses which are not covered by insurance. These disaster loans are structured differently than commercial loans, which are typically only guaranteed by the SBA. Conversely, disaster loans are provided directly by the government. A business may apply for a disaster loan in order to repair or replace entities damaged or destroyed in a declared disaster. These may include: real estate, personal property, machinery or other equipment, inventory, or business assets.

Following a disaster, regions are designated as “declared disaster areas”. Businesses and individuals located within these regions are eligible for financial assistance from the SBA. Businesses of any size, most private nonprofit organizations, and homeowners may apply to the SBA for a

loan. Loans are intended to cover losses not fully protected by insurance. Three primary loan types exist, including: 1) home and personal property loans; 2) business physical disaster loans; and 3) economic injury disaster loans.

Although SBA loans were available following Hurricane Katrina, evidence suggests that the process was mismanaged and that many eligible applicants were rejected. The Associated Press released a report based on SBA data, finding that 55 percent of homeowners and businesses that applied for help did not receive assistance. Of 318,953 applications processed, 175,463 were rejected and 143,490 were approved. Further, of the approved loans, only 60 percent ultimately reached recipients. SBA officials claimed that many applicants never accepted the loans as they found other ways to rebuild. But, many applicants indicated that applications were abandoned as the process took too long and was overly complicated (Weiss, 2010).

3 Related Studies

Many previous studies have focused on the ability of individuals and communities to recover from disasters. The process of recovery for small businesses is more limited and we seek to contribute to this literature. In particular, the disaster loan literature is narrow and was described by Nigg and Tierney (1990) as “uneven”. However, this previous literature does suggest that the loan application processes following disasters are problematic. Nigg and Tierney (1990) examined granted loans after the Whittier-Narrows earthquake of 1987, finding mixed results on characteristics which led to loan receipt. Tierney (1990) further found that, even when available, as after the 1993 Midwest Floods and the 1994 Northridge Earthquake, very few eligible parties applied for loans. The United States Government Accountability Office reviewed the particulars of the SBA loan procedures, leading to extensive testimony on the attempts to modify and improve the loan process, due to shortcomings following Hurricane Katrina (USGAO, 2010).

Several socio-demographic characteristics have emerged from this literature, however; these inform the use of some of our independent variables, which are described in greater detail later, in the model specification section of this article. There is some evidence that income plays a large role in loan application: lower income families are somewhat less likely to seek aid (Cochrane, 1975) as are more affluent families (Rossi et al., 1978; Bolin and Bolton, 1986). Vulnerability to cash flow problems and other income fluctuations has also been shown to cause problems in the loan process (Runyan, 2006). Further, gender and race play a role: women are less likely to receive funds (Nigg and Tierney, 1990), while white families recover much more quickly and at higher rates than non-white families (Bolin and Bolton, 1986). However, much of the previous work suggests that recovery, and the associated need for loans, may be linked to a range of factors, including the nature of the business, its location, its profitability, its age, as well as a variety of characteristics of the business owner, including the owner’s level of education or marital status.

While the literature on disaster loans may be limited, the investigation of loans is not novel

of itself. Considering the hurdle model employed in this article, similar frameworks have been undertaken considering loan defaults (Danis and Pennington-Cross, 2005; Moffatt, 2005) as well as commercial bank operating loans (Ahrendsen et al., 2011). Moffatt (2005) assumed that the process which results in non-default is not the same as that which results in default: the event that a borrower is a potential defaulter and the extent of the default by that borrower are treated separately. We adopt this framework, presuming that the process of application for a loan is separate from the process of the receipt and actual amount of the loan received.

This study contributes to the disaster literature by determining which business and owner characteristics are associated with applying for a SBA loan and, ultimately, the receipt and amount of that disaster loan. We also contribute by examining whether the SBA meets their stated goals with respect to disaster recovery and the objective to “maintain and strengthen” small businesses in the United States.

4 Method

This article addresses three decisions made in the SBA loan process. The first is made by the business owner, and the second and third are made by the SBA. We investigate factors influencing these decisions, focusing on the characteristics of the business and owner:

1. What businesses and owner characteristics were associated with loan application?
2. What businesses and owner characteristics were associated with loan receipt?
3. Given that a loan is granted, what businesses and owner characteristics were associated with loan size?

In this section we discuss the method employed in estimating the equations associated with each question.

Though these three questions signify multiple elements which contribute to a single process (receiving a loan from the SBA), not all decisions are made by the same decision-maker.¹ Therefore, we estimate our model in two stages: first, modeling question (1), where the decision is made by the business owner, then modeling questions (2) and (3), where the decisions are made by the SBA. We first use a probit model to estimate loan application, following question (1). We then use a double-hurdle model to estimate loan receipt and the loan associated amount, following questions (2) and (3). The double-hurdle model is an extension on the standard Tobit model, and assumes separation between the first and second stages. This is more flexible than the standard Tobit, which

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assumes that the receipt of a loan is identical to the effect on the amount of the loan received.² The model is given by equation 4.

$$f(y_3\bar{x}) = \begin{cases} \Pr[d_2 = 0 | x] & \text{if } y_3 = 0 \\ \Pr[d_2 = 1 | x] f(y_3 | d_2 = 1, x) & \text{if } y_3 > 0 \end{cases} \quad (1)$$

Equation 4 signifies the hurdle from the first to the second stage, wherein an individual “hurdles” to the second stage, if he or she received a SBA loan (given in d_2). If the left-hand side is equal to zero in the first stage, the individual does not make it to the second stage. Following notation used later in this section, y_3 is the amount, in dollars, of the loan received, x is a matrix of business owner and business characteristics, and d_2 is = 1 if the business receives a loan, = 0 if otherwise.

It is necessary to address some potential issues which may bias our results, including problems of sample selection and heteroscedasticity. First, there is some concern of non-random sample selection: the businesses that apply for loans may not be a random sample of the entire population of businesses. We therefore use an inverse-Mills ratio (IMR) from the first stage (application) and include it in the second (receipt) and third stages (amount) in order to adjust for non-random selection. The IMR both tests and adjusts for any selection bias which may be present.³ Second, we also address issues of potential heteroscedasticity, which may exist in both the probit and double-hurdle models. In order to do so, we relax the Gauss-Markov homoscedasticity assumption, allowing for the existence of different covariances across groups. We cluster on two levels, based on if a business is coastal or not.⁴

5 Model Specification

In this section, the model specification is discussed, including the equations used in calculating each regression and the variables included in each regression equation. The first regression is specified as a standard probit model. The second model is specified as a double-hurdle model, based on standard hurdle model specification. In this specification the initial decision stage modeled as a probit and the final participation stages as log-normal regression. For these equations, we follow Duan et al. (1983) and Cameron and Trivedi (2009).

In the first regression, we use a probit regression model to determine whether or not a business

²We test a standard Tobit model as one of the robustness checks included in the Appendix. The standard Tobit is used in Model R2 in A. Table 1.

³The IMR is often used in regression analysis to account for sample selection bias, in a method first proposed by Heckman (1979). It works as follows: first, a regression for observing a positive outcome of the dependent variable is modeled with a probit model. Then, the estimated parameters (x_b) are used to calculate the IMR using the calculation: $\frac{\text{PDF}(x_b)}{\text{CDF}(x_b)}$. Finally, the calculated IMR is then included as an additional explanatory variable in subsequent estimations. Results are given in the appendix for the method used in the paper, without the IMR correction.

⁴Approximately 67 percent of businesses in the sample are coastal.

owner applied for a SBA loan. Therefore,

$$\Pr (d_1 = 1 \mid \mathbf{x}_1) = \Phi(x_1'\beta_1) \quad (2)$$

Equation 2 is a normally distributed probability function regression, where d_1 is whether or not the business applied for a loan ($d_1 = 1$ if the business applies for a loan, $= 0$ if otherwise) and \mathbf{x}_1 includes business owner and business traits, discussed below.

Next we consider the double-hurdle model. In the first stage, we use a probit model to determine whether or not the business owner was approved for the loan. The businesses considered in this stage are those which applied for a loan, a subsample of 148 businesses. Therefore,

$$\Pr (d_2 = 1 \mid \mathbf{x}_2) = \Phi(x_2'\beta_2) \quad (3)$$

Equation 3 is a normally distributed probability function regression, where d_2 is whether or not the business received a loan ($d_2 = 1$ if the business receives a loan, $= 0$ if otherwise) and \mathbf{x}_2 includes business owner and business characteristics, discussed below.

The third equation is different as we use a continuous value in dollars for the amount of the loan received. We use a log-normal least squares regression for loan funds received, given that the business was approved for a loan, passing the second stage. Therefore, for the third stage:

$$(\ln y_3 \mid d_2 = 1, \mathbf{x}_3) = N[x_3'\beta_3, \sigma_3^2] \quad (4)$$

Equation 4 is a log-normal least squares regression, where y_3 is the amount, in dollars, of the loan received and \mathbf{x}_3 includes business owner and business characteristics, discussed below.

We use equations 2, 3, and 4 in order to estimate the relationship between loan application, loan approval, and received loan amount with a variety of business and individual characteristics. The variables included in each equation need to reflect and considerations which impact the respective decision in each regression, as well as the relevant factors identified in the literature.

In the first regression, the decision to apply is made by the business owner, therefore, the terms are characteristics of that owner or internal to the business (\mathbf{x}_1). These include: 1) whether the business is home-based, 2) stress related to the business, 3) perceived success level of the business, 4) experience with a past disaster (one which closed the business 24-hours or more), 5) the qualitative perceived damage following Hurricane Katrina (ranging from no to very little damage to catastrophic damage), and 6) the percent of income the family receives from the business.

In the second and third stages, the decision for approval and the decision for the amount received, the factors considered will relate to the business owner and the business itself, as these decisions are made by the SBA (\mathbf{x}_2 and \mathbf{x}_3). These variables are information that would be available to the SBA. These includes 1) if the business experienced cash flow problems quarterly or more frequently; this may relate to previous loans granted and ability to repay future loans, as well as 2)

the number of employees. Further, 3) whether an insurance claim was paid for the business or 4) home is also included, as this would be essential knowledge for the SBA, which only grants disaster loans for losses not covered by insurance.

In all stages, however, we include some traits that will be influential for all three questions considered. We include a series of business owner characteristics, including: 1) gender, 2) education, 3) race, 4) veteran status, 5) marital status, and 6) experience in the industry. We also include several characteristics of the business, including: 1) copreneurial status, 2) age of the business, 3) whether it is located on the coast, 4) the dollar amount of damage from Hurricane Katrina, 5) whether it is a sole proprietorship (according to Beesley (2013) 70 percent of businesses in the US are sole proprietors), 6) whether the business has insurance, 7) the revenue of the business (less than \$50,000, \$50,000 to \$500,000, \$500,000 to \$1 mil, greater than \$1 mil), and 8) several industry dummies. For a full list of variables used in each regression, see Table 1 and Table 2.

Table 1: Independent Variables: \mathbf{x}_1

Variable	Description
	\mathbf{x}_1 : Did the business apply for a loan?
gender	= 1 if female, = 0 if male
education	= 1 if college graduate, = 0 if not
race	= 1 if non-white, = 0 if white
veteran	= 1 if veteran, = 0 if not
married	= 1 if married, = 0 if not
copreneur	= 1 if spouse works in business, = 0 if not
experience	number of years worked in industry
age	age of business in years
home	= 1 if business operating from personal residence, = 0 if not
insurance	= 1 if business had insurance, = 0 if not
coast	= 1 if located on the coast, = 0 if not
stress	= 1 if report stress before Katrina, = 0 if not
percent income	percent of income which comes from the business
high success	= 1 if report high success before Katrina, = 0 if not
past	= 1 if previously suffered disaster which closed business for 24 hours or more, = 0 if not
sole proprietor	= 1 if company is sole proprietorship, = 0 if not
qualitative damage	owner's qualitative perception of incurred damage from hurricane, values range from 0 to 3, where: 0 = no to very little damage, 1 = some minor repairs needed, 2 = major repairs required before reopening, and 3 = catastrophic damage
quantitative damage	log of owner reported actual damage to business from hurricane, in dollars, where values range between \$0 and \$130,000,000
under 50K	= 1 if make less than 50 K, = 0 if otherwise
50 K to 500 K	= 1 if make more than 50 K and less than 500 K, = 0 if otherwise
500 K to 1 Mil.	= 1 if make more than 500 K and less than 1 million, = 0 if otherwise
over 1 Mil.	= 1 if make more than 1 million, = 0 if otherwise
industry	series of industry dummies, including: agriculture, construction, manufacturing, transportation, wholesale, retail, finance, and services

Table 2: Independent Variables: \mathbf{x}_2 and \mathbf{x}_3

Variable	Description
	$\mathbf{x}_2, \mathbf{x}_3$: Was the business approved for a loan? How much did the business receive?
gender	= 1 if female, = 0 if male
education	= 1 if college graduate, = 0 if not
race	= 1 if non-white, = 0 if white
veteran	= 1 if veteran, = 0 if not
married	= 1 if married, = 0 if not
copreneur	= 1 if spouse works in business, = 0 if not
experience	number of years worked in industry
age	age of business in years
insurance	= 1 if business had insurance, = 0 if not
coast	= 1 if located on the coast, = 0 if not
sole proprietor	= 1 if company is sole proprietorship, = 0 if not
cash flow problems	= 1 if report having cash flow problems at least one per quarter, = 0 if not
quantitative damage	log of owner reported actual damage to business from hurricane, in dollars, where values range between \$0 and \$130,000,000
claim paid: business	= 1 if insurance claim was paid for the business, = 0 if not
claim paid: residence	= 1 if insurance claim was paid for the residence, = 0 if note
under 50K	= 1 if make less than 50 K, = 0 if otherwise
50 K to 500 K	= 1 if make more than 50 K and less than 500 K, = 0 if otherwise
500 K to 1 Mil.	= 1 if make more than 500 K and less than 1 million, = 0 if otherwise
over 1 Mil.	= 1 if make more than 1 million, = 0 if otherwise
industry	series of industry dummies, including: agriculture, construction, manufacturing, transportation, wholesale, retail, finance, and services

6 Data

The data used are from the 2013 Small Business Survival and Demise after a Natural Disaster Project (SBSD). In order to identify small business owners after Hurricane Katrina whose businesses were operating before Hurricane Katrina, a mailing list was obtained from the Dun and Bradstreet database for December 2004. It included small businesses from ten contiguous counties in southeastern Mississippi: a total of 17,060 businesses. For the purpose of this research, small businesses were defined as those that had fewer than 200 employees and were headquartered in the state of Mississippi. The designation of “headquartered in Mississippi” ensured local control and management of the surveyed businesses.

The population from which the sample was drawn was deliberately limited geographically to south Mississippi. The land mass of the ten chosen counties was almost entirely to the right of the storm track, in the right front quadrant of Hurricane Katrina. Doing so ensured several important elements for studying small businesses. First, it ensured that the majority of businesses were exposed to the hurricane event. Second, it limited the study area to a single state, which addressed the potential for differing political decisions and legal issues which may affect outcomes for small businesses, if multiple states were included.

The methods used to draw the sample are described in detail in Marshall et al. (2015). Methods used to verify contact information and eligibility included phone contacts and field visits and are described in Schrank et al. (2013). A total of 2,610 businesses were eligible and had good contact information. Telephone interviews were conducted by the University of Wisconsin Survey Research Center between January and October of 2013. Eligibility was verified to determine that the business had been in operation prior to Hurricane Katrina and that the owner was the person being interviewed. Ultimately, the response rate was 19.12 percent, providing a sample size of 499 operating and closed small businesses. Of these 499 businesses, 77 had no employees and only two had more than 100 employees. The majority of businesses (420) employed between 1 and 74 employees. The sample included 373 operating businesses and 126 businesses that were not operating at the time of the survey. For the purposes of this article, 485 small businesses were included. Businesses sold by the owner after Katrina ($N = 12$) and businesses with more than 100 employees ($N = 2$) were excluded from analysis.

Descriptive statistics for the variables of interest can be found in Table 3. With respect to the dependent variables, just over 30 percent of the businesses (148 businesses) applied for a SBA loan. Of these 148, only 62 would receive a loan; of the subsample that applied this is about 42 percent, and of the entire sample it is about 13 percent. For those who received a loan, the mean amount was \$112,976, and the median was less than half at \$45,000. This suggests a fairly large variation in the amount of money received. However, these descriptive statistics are quite close to the findings about SBA loans following Hurricane Katrina which indicates that 55 percent of those who applied for a loan were denied. This suggests the potential for broader external validity and applicability

of the study’s conclusions.

Table 3: Descriptive Statistics of Regressors

Variable	Mean	Standard Deviation
gender	0.321	0.467
education	0.431	0.496
race	0.075	0.263
veteran	0.187	0.390
married	0.763	0.425
copreneur	0.211	0.409
experience	29.151	12.455
age	28.489	16.597
home	0.318	0.466
insurance	0.568	0.496
coast	0.675	0.469
stress	0.344	0.475
percent income	66.794	35.107
high success	0.549	0.498
past	0.333	0.472
employees	5.400	9.116
sole proprietorship	0.462	0.499
cash flow	0.159	0.366
qualitative damage	1.516	1.002
log of quantitative damage	3.612	5.363
claim: business paid	0.799	0.402
claim: residence paid	0.882	0.323
less than 50 K	0.176	0.381
50 K to 500 K	0.327	0.470
500 K to 1 Mil	0.083	0.276
greater than 1 Mil	0.091	0.288

7 Results and Discussion

In this section, we present the results of the three questions to be answered about the process of loan application and receipt. With the first question, we examine characteristics associated with loan application. The results for this can be found in Table 4. With the second question, we consider traits associated with loan approval. Finally, with the third question, we observe which of the traits associated with the loan amount received. The results for the final two questions can be found in Table 5.

7.1 Did the business apply for a loan?

The first regression considers whether business owners applied for a loan, using a probit model. The results show that female owners, those on the coast, those with a greater percent of their income coming from the business, those with more perceived and actual damage, those with higher stress, and those making less than \$50,000 per year were more likely to apply, while those operating from home, those with insurance, and those with high success before Katrina were less likely to apply.

Largely these results are intuitive. Businesses on the coast may have received more damage and thus will be more likely to apply. Further, if a business owner perceived a high amount of damage, both with regard to the qualitative and quantitative measures, he or she would be more likely to apply for supplemental assistance from the SBA. Also, those making less money or with a large percent of their income solely from the businesses are more likely to require assistance as they may not be able to cover losses using business income alone.

Conversely, if a business owner had insurance, he or she would be less likely to require additional support from the SBA. Circumstances may be similar for businesses with high success before Katrina; these business owners may have had a safety net which allowed them to better mitigate the damage from the hurricane. Those operating from home may not have realized that they were eligible for SBA loans, as a home-based business. This is likely because the SBA application process following Katrina was marred by confusion on the part of business owners regarding eligibility (Weiss, 2010).

It is not necessarily clear why women were more likely to apply as well as those with higher stress. Based on previous studies of SBA loan acceptance, women are less likely to receive SBA loans (Nigg and Tierney, 1990); however, this study suggests that women are more likely to receive a loan than men, so this positive relationship may capture changes in attitude or access which occurred between the Whittier Narrows earthquake in 1987 and Hurricane Katrina in 2005. Why those with higher stress are more likely to apply may simply be a matter of need. In a similar way to the result that those with greater damage may need the funds from the SBA more, those with higher stress may also have higher need for loan assistance.

7.2 Was the business approved for a loan?

The second regression, the first stage of the double-hurdle model, considers if the business was approved for a loan. The results indicate that female business owners, those on the coast, those with more employees, those with a paid insurance claim, and several of the revenue tiers are more likely to be approved, while non-white owners, those who went to college, older businesses, and those with cash flow problems are less likely to be approved.

Again, many of these results are intuitive. First, having filed and received a claim may be a signal of the high amount of damage incurred, and hence requiring additional funding from the SBA. Similarly, those located on the coast may incur a large amount of damage and thus require

Table 4: Results of Probit Model: Did the business apply for a loan?

	Apply?
gender	0.387** (0.202)
education	-0.031 (0.047)
race	-0.085 (0.109)
veteran	0.010 (0.072)
married	-0.117 (0.225)
copreneur	-0.031 (0.291)
experience	-0.003 (0.001)
age	-0.004 (0.006)
home	-0.492*** (0.080)
insurance	-0.366** (0.153)
coast	0.367*** (0.071)
stress	0.127*** (0.048)
percent income	0.001*** (9.4E - 05)
high success	-0.217*** (0.006)
past	-0.031 (0.445)
sole proprietor	-0.097 (0.220)
qualitative damage	0.270*** (0.055)
quantitative damage	0.010** (0.006)
under 50K	0.471*** (0.022)
50 K to 500 K	0.284 (0.293)
500 K to 1 Mil.	0.153 (0.277)
over 1 Mil.	0.153 (0.542)
constant	-1.045 (0.174)

Note: Sample size equal to 485. Standard errors in parentheses. Fully robust standard errors clustered at the household are in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$). Industry dummies not included in table for parsimony, available from authors upon request.

greater assistance. Second, the significance of the revenue tiers indicates that revenue makes a difference in loan approval from the SBA; however, this seems to be based on need, as well as ability to repay: those making \$500,000 to \$1 million have the largest coefficient, followed by those making less than \$50,000. This may also explain why those with cash flow problems may be less likely to be approved, as they may have difficulty with repayment. Finally, that non-white business owners are less likely to be approved for loans follows previous literature (Bolin and Bolton, 1986) suggesting that non-white businesses may be disadvantaged in the disaster recovery process.

The result that female owners and businesses with more employees are more likely to be approved while those who went to college and older businesses are less likely to be approved for loans are somewhat puzzling. The first result, regarding female owners, is contrary to previous research (Nigg and Tierney, 1990), though may indicate cultural shifts between the study periods. Second, the larger number of employees may indicate a greater level of economic loss, and thus greater need of assistance. The final results about education and age may suggest a relationship with need. It may be that owners with a college education and older businesses are less likely to be approved for loans due to a lack of need or the ability to receive loans from other sources. The SBA provides loans based on the ability to find credit elsewhere, so if a business is able to find loans from another bank, then, it is possible that they may not be approved for a loan from the SBA.

Finally, the IMR is also significant in this regression. As discussed above, this indicates that businesses which apply for loans are not a random sample. However, the inclusion of the IMR simultaneously corrects for the selection bias. We include the estimates of the double-hurdle model, without the IMR in Table 4 for comparison. Without the IMR, fewer coefficients are statistically significant. These include age of the business, whether the business is coastal, number of employees, whether the business had cash flow problems, and one revenue tier. Similarly, one revenue tier (the greater than \$1 million tier) is now statistically significant. There is one change in sign: with the IMR, whether a business had a claim paid is statistically significant and positive, while without the IMR it is statistically significant and negative. Taken together, these differences in results demonstrate the importance of the IMR adjustment in our regression in order to correct for selection bias.

7.3 How much did the business receive as a loan?

The third regression, the second stage of the double-hurdle model, considers the loan amount received by the business. The results of this stage indicate that married business owners, those with more experience, those with previous cash flow problems, and those with a paid insurance claim on their residence were more likely to receive a larger loan, while female owners, copreneurial owners, businesses on the coast, those with a paid insurance claim on their business, and several revenue tiers were less likely to receive a large loan.

These results are again largely intuitive. First, though those with cash flow problems receiving

larger amounts may be contrary to expectation, it may be due to the need these business owners have for larger loans, due to these problems, that brings this result. Additionally, cash flow problems may be associated with previous loan repayments that show an ability to repay loans, despite cash flow issues. Similarly, business owners with more experience may have demonstrated an ability to repay loans previously. Second, those on the coast may have alternative sources of income and thus only require smaller loans. Third, the results of the revenue terms are intuitive. Those making less in the lower revenue tiers may not have the ability to readily repay the loan, and therefore will receive smaller loans, while those making more in higher revenue tiers may be unable to demonstrate the same need for a loan.

It is an interesting result that those with a paid insurance claim on the home are more likely to receive higher amounts while those with paid insurance claim on the business are more likely to receive lower amounts. This may be because those with a paid claim for their home additionally have a business property and separate damage on the business, thus requiring supplemental assistance from the SBA. Conversely, those with a paid business insurance claim may have less damage still not covered by insurance, and therefore receive lower loans.

The result that women and copreneurial couples receive lower loans, while married business owners receive larger loans, is somewhat contrary to expectation. However, that women receive lower loan amounts may be associated with the previous result by Nigg and Tierney (1990) that women are less likely to receive a loan. We do not observe women getting fewer loans, but we instead observe lower loan amounts for those which do receive a loan. The copreneurial result is puzzling, particularly as marriage is a positive and significant factor in loan amount received. However, it may be the case that those with a spouse working in the business may have better ability to access credit or mitigate the effects of damage, and therefore require less loan support from the SBA.

Finally, the IMR is again significant in this regression. This indicates that businesses which apply for loans are not a random sample, though the IMR corrects for this bias. We include the estimates of the double-hurdle model, without the IMR in Table 4. Without including the IMR, experience of the business owner, if a claim was paid (both business and residential), and the top three revenue tiers are no longer statistically significant, while the age of the business and the amount of quantitative damage are now statistically significant. There is also one change in sign: with the IMR the coefficient on whether the business was coastal was statistically significant and negative, while without the IMR it is statistically significant and positive. As in the previous stage, these differences in results demonstrate the importance of the IMR adjustment, in order to correct for selection bias.

Together, these results suggest that the characteristics which encourage a business owner to apply for a loan are different from those which ultimately result in receipt of a loan. A few important factors through all stages emerge, including: the income of business, whether the business had insurance and whether an insurance claim was paid, and the gender of the business owner.

Table 5: Results of Double-Hurdle Model: Did the business receive a loan? What was the amount of the loan?

	with IMR		without IMR	
	Receive?	Amount	Receive	Amount
gender	0.620*** (0.150)	-4.953*** (0.343)	0.549*** (0.117)	-1.544*** (0.092)
education	-0.198*** (0.041)	0.390 (0.691)	-0.232*** (0.078)	-1.694 (1.190)
race	-0.096*** (0.025)	-2.206 (1.930)	-0.544*** (0.075)	2.985 (4.896)
veteran	0.350 (0.933)	-0.272 (3.355)	0.241 (0.517)	-1.600 (4.122)
married	-0.293 (0.213)	5.676*** (0.033)	-0.354 (0.287)	1.447* (0.740)
copreneur	0.290 (0.482)	-8.123*** (1.674)	0.029 (0.500)	-6.588*** (0.831)
experience	0.001 (0.008)	0.213*** (0.026)	-0.0001 (0.003)	-0.005 (0.038)
age	-0.016*** (0.004)	0.005 (0.036)	0.001 (0.010)	-0.071* (0.036)
insurance	-0.224 (0.152)	1.069 (0.926)	0.386 (0.439)	-3.010 (2.057)
coast	0.358*** (0.107)	-6.724*** (1.167)	0.028 (0.039)	1.057** (0.451)
employees	0.026*** (0.008)	-0.148 (0.108)	-0.004 (0.015)	0.088 (0.073)
sole proprietorship	0.923 (0.677)	-1.222 (1.032)	0.090 (0.177)	-1.316 (3.173)
cash flow	-1.009*** (0.084)	1.953*** (0.240)	-0.182 (0.285)	0.789*** (0.009)
log of quantitative damage	0.024 (0.022)	-0.081 (0.080)	0.014 (0.025)	0.386*** (0.068)
claim: business paid	0.494*** (0.136)	-7.238*** (1.841)	-0.195* (0.111)	-2.036 (4.022)
claim: residence paid	0.454*** (0.033)	3.732*** (0.141)	0.225*** (0.011)	-0.195 (2.179)
less than 50 K	1.452*** (0.262)	-9.410*** (1.974)	1.063*** (0.216)	-4.481*** (2.701)
50 K to 500 K	1.089*** (0.031)	-6.654*** (2.217)	0.461** (0.228)	-2.095 (3.092)
500 K to 1 Mil	2.117*** (0.788)	-7.761*** (0.857)	0.407 (0.228)	-0.158 (1.441)
greater than 1 Mil	1.681 (1.139)	-5.380*** (1.131)	0.879*** (0.329)	-0.989 (0.543)
Inverse Mills Ratio	-1.499*** (0.949)	26.277*** (2.774)		
constant	-1.924 (0.385)	16.932 (3.180)	-1.924 (0.385)	16.932 (3.180)
sample size	148	62	148	62

Note: Standard errors in parentheses. Fully robust standard errors clustered at the household are in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$). Industry dummies not included in table for parsimony, available from authors upon request.

Many of these results follow expectation and highlight the success of the SBA in assisting businesses with the greatest need, balanced with the realities of loan repayment.

A particularly interesting result is that pertaining to female business owners. Our results are somewhat contrary to previous research and indicate that women are more likely to receive loans, though they are also more likely to receive smaller amounts. This is worthy of investigation in the future, in particular due to the mission of the SBA to assist female business owners (SBA, nd).

8 Summary and Conclusions

Despite tremendous damage incurred in many regions following Hurricane Katrina, it is not clear what demand existed for reconstruction assistance. Though many billions of dollars were pledged by the United States government for rebuilding, how the funding was allocated to small businesses has not been evident. Disaster relief assistance from the SBA is one of the methods of that provision. In this study we investigated the factors that influence the application for, approval of, and receipt of SBA disaster loans after Hurricane Katrina.

We are able to draw several important policy conclusions from the results. First, female business owners are more likely to apply for and receive loans from the SBA. However, the loans that they receive are more likely to be small. This result is different from that of previous literature, which suggests that women are less likely to receive loans. This may signal a turn in attitude or advantage for female business owners, who are underrepresented in small business ownership. However, non-white business owners remain disadvantaged in the loan process, and are less likely to be approved for loans; only 36 percent of non-white business owners who applied for loans were approved by the SBA in our sample. This finding supports previous literature, and suggests that not all underrepresented groups of small business owners are being effectively targeted for loans. This indicates that there is room for improvement by the SBA for targeting these generally underrepresented groups. Improving targeting of these groups may improve the success of the SBA in meeting its mission of strengthening underrepresented groups with business development.

Additionally, we are able to conclude the importance of revenue and insurance in the SBA loan process. Revenue is an important factor in application and approval for a loan, and need and ability to repay influences the ultimately amount received. Similarly, results indicate that those with insurance are less likely to apply and those with paid claims are less likely to receive loans. This is logical and further suggests success on the part of the SBA in targeting those with the greatest need which is uncovered by other sources.

Taken together, the results indicate achievement by the SBA in finding both those with need and ability to repay, essential components of their mission, while still finding that there is room for improvement in targeting unrepresented groups. These outcomes may be at odds with one another, however, but is worthy of investigation in the future. Particularly the interaction between female business owners and the ability to repay: this potential interaction may show whether women

receive smaller amounts because they have less ability to pay back, they ask for less, or due to some bias in the SBA granting process.

Further, more work in the future should address the different types of SBA loans available, as well as the impact of these different loans. While some previous work has determined that loans do not increase the success of the business or probability of survival (Alesch et al., 2001; Haynes et al., 2011), the specific impact of SBA loans has not been investigated. The disaggregation of demand for types of loans could help to determine which loans were the most needed, following Hurricane Katrina, as well as the relevant impact of each on the survival and success of the business in the future.

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Appendix

For completeness, we estimate three robustness checks. First, designated R1 and found in columns (1) and (2) in Table 6 below, we estimate stage 1 (application) and stage 2 (approval) as probits and stage 3 (amount) using ordinary least squares (OLS). Second, designated R2 and found in columns (3) and (4), we estimate stage 1 as a probit, stage 2 as a Tobit, and stage 3 as a truncated regression. Finally, designated R3 and found in columns (5) and (6), we combine stages 1 and 2 (= 1 if business applies for a loan and is accepted, = 0 otherwise) and estimate as a probit and then estimate the next stage (amount) with OLS.

In R1 and R2, we do not include the first stage estimates, as they do not change from the results reported in Table 4.

Table 6: Results of Double-Hurdle Model: Robustness Checks

	R1		R2		R3	
	(1)	(2)	(3)	(4)	(5)	(6)
gender	0.256*** (0.077)	-0.205 (0.158)	0.365*** (0.119)	-4.133*** (0.147)	0.506*** (0.192)	-0.074 (0.078)
education	-0.177 (0.130)	-0.190 (0.604)	-0.263 (0.209)	-0.269 (0.450)	-0.193* (0.103)	-0.172 (0.321)
race	-0.414*** (0.107)	0.644* (0.092)	-0.639*** (0.176)	-2.941 (2.556)	-0.527*** (0.121)	0.639 (0.352)
veteran	0.244 (0.522)	-0.048 (0.958)	0.355 (0.772)	0.113 (3.145)	0.230 (0.440)	-0.022 (1.116)
married	-0.265 (0.309)	0.596 (1.209)	-0.398 (0.388)	5.284*** (0.197)	-0.346 (0.334)	0.550 (0.787)
copreneur	0.029 (0.477)	-0.378 (0.713)	0.044 (0.721)	-7.662*** (1.475)	0.079 (0.526)	-0.335 (0.599)
experience	0.02 (0.003)	0.005 (0.012)	0.003 (0.004)	0.228*** (0.010)	0.002*** (0.001)	0.004 (0.009)
age	0.003 (0.009)	0.002 (0.028)	0.005 (0.013)	0.017 (0.020)	-0.001 (0.009)	0.000 (0.024)
home					3.939*** (0.358)	
insurance	0.544 (0.461)	-0.788 (0.754)	0.800 (0.640)	2.124*** (0.537)	4.519*** (0.348)	-0.918 (0.440)
coast	-0.263*** (0.045)	-0.401 (0.198)	-0.401*** (0.022)	-7.351*** (0.277)	-0.012*** (0.036)	-0.250 (0.276)
stress					0.214* (0.130)	
percent income					0.000 (0.002)	
high success					0.012 (0.343)	
employees	-0.005 (0.016)	0.004 (0.046)	-0.007 (0.022)	-0.175** (0.080)	-0.005 (0.012)	0.006 (0.044)
past					0.030 (0.132)	
sole proprietorship	0.183 (0.186)	-0.105 (0.621)	0.257 (0.260)	1.224 (1.082)	0.093 (0.194)	-0.161 (0.449)
cash flow	-0.179 (0.272)	0.149 (0.630)	-0.248 (0.340)	1.541*** (0.331)	-0.145 (0.276)	0.171 (0.434)
past					0.229*** (0.059)	
log of quantitative damage	-0.016 (0.020)	0.033 (0.033)	-0.023 (0.028)	-0.123*** (0.019)	-0.009*** (0.033)	0.052 (0.030)
claim: business paid	-0.225*** (0.076)	0.022 (0.071)	0.318*** (0.116)	-7.688*** (2.639)	-0.215 (0.212)	0.048 (0.294)
claim: residence paid	0.272*** (0.461)	-0.255** (0.754)	0.377** (0.640)	4.088*** (0.537)	0.269*** (0.348)	-0.335 (0.440)
less than 50 K	0.751*** (0.192)	-0.1045 (0.987)	1.079*** (0.205)	-8.153*** (0.867)	1.107*** (0.239)	-0.969 (0.167)
50 K to 500 K	0.267 (0.183)	0.130 (0.090)	0.390 (0.276)	-6.214*** (1.892)	0.472*** (0.154)	0.166 (0.247)
500 K to 1 Mil	0.316 (0.916)	0.449 (1.589)	0.451 (1.344)	-7.391*** (0.855)	0.412 (0.911)	0.388 (1.742)
greater than 1 Mil	0.658* (0.391)	0.151 (2.462)	0.922 (0.473)	-4.771*** (0.707)	0.899*** (0.354)	0.117 (1.986)
Inverse Mills Ratio	1.456*** (0.407)	0.895 (0.375)	2.051*** (0.695)	28.997*** (1.042)		8.920*** (0.013)
constant	-2.370*** (0.233)	-0.588 (0.104)	-3.348 (0.122)	5.673* (1.042)	6.362*** (0.514)	-0.279 (0.631)
sample size	148	62	148	62		

Note: Standard errors in parentheses. Fully robust standard errors clustered at the household are in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$). Industry dummies not included in table for parsimony, available from authors upon request.