

Household Finance after a Natural Disaster: The Case of Hurricane Katrina

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Abstract

Little is known about how affected residents are able to cope with the financial shock of a natural disaster. We investigate the impact that flooding from a major US hurricane had on household finance. Spikes in credit card borrowing and overall delinquency rates for the most flooded residents are modest in size and short-lived. Greater flooding results in larger *reductions* in total debt. Lower debt levels appear to be driven by homeowners using flood insurance to repay their mortgages rather than to rebuild. Debt reductions are larger in census tracts where mortgages were likely to be originated by non-local lenders.

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1 Introduction

Natural disasters caused at least \$113 billion of damage per year worldwide during the first decade of the 21st century (Rauch [2012]). Sixteen of the 24 most costly natural disasters from 1970-2009 occurred in the US, while the remaining eight were in other highly developed countries (Michel-Kerjan et al. [2012]). Many scientists believe that global climate change will increase the number of severe weather events such as hurricanes (IPC [2008]).

This paper does two things. First, we provide individual-level estimates of the causal effect of a costly natural disaster in the US on levels of household debt and indicators of financial distress. Despite the sizable aggregate cost and long history of natural disasters in developed countries, relatively little is known about how affected residents are able to cope with the financial shock of a disaster.¹ On one hand, the aggregate cost of these disasters are suggestive of large negative wealth shocks for residents living in the disaster areas. On the other hand, the US has insurance markets (e.g. flood insurance) and governmental institutions (e.g. federal disaster assistance) the aim of which is to assist in smoothing the negative wealth shock of a natural disaster and to mitigate potential losses.

Second, we provide evidence of the role that local and non-local lending institutions play in post-disaster recovery. In particular, we examine the role of local and non-local mortgage lenders and how affected residents' post-disaster outcomes differ based on their affiliation with these institutions. We compare post-disaster financial outcomes for residents whose mortgages are likely to be originated by local and non-local lending institutions.

The setting for this study is the city of New Orleans before and after the city was hit by Hurricane Katrina in 2005. Hurricane Katrina had a devastating impact on Gulf Coast residents killing at least 1,833 people and causing an estimated \$108 billion (2005\$) in property damage (Knabb et al. [2005]). We measure the financial impact using person-specific credit agency data on credit score, bill delinquency, and personal debt. The credit agency

¹Recent exceptions include working papers by Deryugina et al. [2014] and Gregory [2013].

data are a random 5% sample of US residents with a social security number and a credit history.² The data are quarterly and we are able to follow individuals who change residences. The financial data are matched at the census block-level to block-specific flood data. The flood data are from satellite images that show whether a block is flooded and the depth of the flood waters. Thus, even within the flooded group we can compare outcomes across the intensive margin of flooding severity.

The paper uses a difference-in-differences research design which exploits quasi-exogenous variation in who is flooded. We compare the financial outcomes for residents in flooded Census Blocks to residents in non-flooded Census Blocks. Our strategy is to compare financial outcomes of residents living in locations that are equally likely to flood. Thus, we focus on specifications which isolate variation in flooding that could not be predicted by Army Corps of Engineer flood risk maps and the elevation of the Census Block.³ The identifying assumption is that once we have controlled for these factors, differences in the depth of flooding are due to chance and could not have been predicted before Hurricane Katrina.

We find that flooding *reduces* total debt. More flooding leads to larger reductions in debt. Figure 1 previews this result by plotting quarterly total debt balances for individuals living in New Orleans at the time of Hurricane Katrina. Debt balances are in dollars and plotted separately for individuals living in the non-flooded, the least flooded, and the most flooded areas of New Orleans.⁴ The figure shows similar pre-Katrina trends in total debt among the three groups for the three years prior to the flood. At the time of Katrina, there is a sharp and immediate drop in total debt for the most flooded residents.

The reduction in total debt is driven almost exclusively by lower home loan debt.⁵ We show the the timing and magnitude of flood insurance claim payouts

²Approximately 90% of adults (18 years old or older) in the US have a credit history.

³To achieve this we add the flood risk and elevation variables and their interactions with the post-Katrina indicator to our simple difference-in-differences regression model.

⁴Throughout the paper, all dollar denominated values are in real terms and measured in year 2000 dollars unless otherwise noted.

⁵Home loan debt includes mortgages, home equity loans, and home equity lines of credit.

is consistent with homeowners having used the payouts to pay off mortgages rather than to rebuild. We show that alternative explanations for the reduction in mortgage debt after Katrina are either too small in magnitude or do not fit the time-pattern of the observed drop in home loan debt. The number of foreclosures and homes sales in the two quarters after Katrina are both far too small to explain the drop in mortgages. The federal government assistance provided by through the Louisiana Road Home program came after the large reduction in home loans that we measure in the two quarters immediately following Katrina.

Surprisingly, there is only modest evidence that residents used credit card debt to smooth consumption and pay for unexpected costs after the flood. On average, there is a temporary \$700 (23%) increase in credit card debt after Katrina for the most flooded group, relative to the non-flooded group. The result is similar when we condition on having a credit card at the time of Katrina. There is little to no effect on other types of debt such as auto and student loans.

As a means to gauge the degree to which individuals are able to cope with the financial shock of flood damage, we consider two broad measures of financial health: debt delinquency rates and credit scores. We find that the most flooded residents have 90 day delinquency rates that are approximately 10% higher, relative to non-flooded residents, for a year-long period following Katrina. Credit scores for the most flooded residents are lower, relative to non-flooded residents, for a two year period following Katrina. However, the drop in the credit score is not large and is equivalent to approximately 0.06 of a standard deviation.⁶

The second question we investigate is whether individual outcomes after the flood differ based on the likelihood that the mortgage was held by a non-local lender. The business incentives and financial stability of local and non-local lenders are likely to differ after a large disaster. These differences could lead to differing outcomes for residents based on their lender affiliation, and collec-

⁶The financial data are from Equifax Consumer Credit company. Equifax's proprietary consumer credit score is called the Equifax Risk Score (TM).

tively impact the post-disaster recovery of the region. For example, non-local lending institutions are likely to be more financially stable after a disaster due to a more geographically diversified lending portfolio. In New Orleans during our sample period non-local lenders are also more likely to take advantage of secondary markets for loan securitization. These national lending institutions may therefore be more willing to provide credit and capital to residents in the affected region after a disaster. At the same time, non-local lending institutions are (by definition) less invested in the region. Both the uncertain economic recovery of a region following a large natural disaster (e.g. Vigdor [2008]) and the higher short-term costs of conducting business in a disaster area (e.g. due to damaged infrastructure, population displacement, or a shortage of materials and personnel) could lead non-local lenders to reduce their activity in the impacted region.

We find that the reduction in home loan debt is much larger in census tracts with a higher share of mortgages originated by non-local lenders. A homeowner in the most flooded areas of New Orleans is twice as likely to have a home loan after Katrina if they live in a census tract with an above median share of loans made by local lenders, relative to a similarly flooded homeowner in a below median tract.⁷ We also find that there is a much larger drop in *new* loans to New Orleans residents by non-local lenders after Katrina as compared to local lenders. These results support the interpretation that non-local banks wanted to reduce their lending presence in New Orleans after Katrina. They are also consistent with media accounts that banks, and particularly banks without a local presence, pressured homeowners to use flood insurance checks to repay their mortgage loans rather than to rebuild their homes (e.g. Butler and Williams [2011]).

The institutional features of flood insurance payouts provide a possible

⁷The source of the mortgage lender information is Home Mortgage Disclosure Act (HMDA). This result does not change if we define a non-local lender share using the dollar amount of loans (rather than number of loans). There is a 97% correlation between the two measures. We also consider a 3rd definition of a local lender that is simply whether the lender has a branch in the New Orleans Combined Statistical Area (CSA). The branch definition provides substantively similar results.

way for lenders to pressure borrowers to repay rather than to rebuild. If a homeowner has a mortgage or line of credit where the home is used as collateral then flood insurance claim checks are written to both the homeowner and the lender. The flood insurance claims payout is typically held in escrow by the lender and disbursed in increments as repair work is completed.

Selection into mortgage contracts could contribute to the estimated differences in post-Katrina mortgage debt between homeowners with local and non-local lenders. However, we show that our results are robust to the addition of controls for observable borrower characteristics including credit score, race, and the rate of flood insurance take-up in the neighborhood. These controls are in addition to those from the first part which condition on a priori flood risk and individual fixed effects.

This paper contributes to the household finance literature by being among the very first to show the causal effect of a large natural disaster in the US on household finance using individual-level credit and debt information. Our empirical strategy allows us to compare how individuals living in the same disaster area and who are part of the same local economy are affected by heterogeneity in the disaster intensity.⁸

A better understanding of how natural disasters impact household finance is important for several reasons. First, the US has long-standing federal governmental programs in place to aid those residents impacted by a natural disaster. However, there is little direct empirical evidence as to their effectiveness. We provide detailed estimates for the net effect of a large natural disaster on household finance inclusive of federal assistance. Second, we highlight the critical role that privately held flood insurance policies had on household finance and disaster recovery of the region.⁹ Two-thirds of New Orleans residents were insured at the time of Katrina and there were approximately \$6.7 billion in flood insurance claims paid out to residents in the first four months after

⁸Basker and Miranda [2014] and Paxson and Rouse [2008] also exploit heterogeneity in disaster intensity to examine business survival and migration outcomes, respectively.

⁹Although flood insurance policies are privately purchased by homeowners, the federal government underwrites the National Flood Insurance Program (NFIP). Section 2.2 and Appendix Section A.5 have more details on the NFIP.

Katrina. Moreover, the speed of insurance payments was much faster than that of federal disaster assistance programs.¹⁰ Third, many scientists believe that the frequency and severity of natural disasters will increase in the future due to global climate change (IPC [2008]). Our estimates suggest that future natural disasters will have a manageable financial impact on individuals with a credit history given current levels of governmental assistance.

We also contribute to the literature on the role that the geographic location of lending institutions play in the economic recovery of a region after an environmental disaster (e.g. Morse [2011]; Hosono et al. [2012]). We are the first, we believe, to show how a US homeowner’s affiliation with a local mortgage lender (rather than a non-local lender) is highly correlated with post-disaster debt levels. We find that among the most-flooded homeowners, those who are likely to have their mortgage originated by a non-local lender are much more likely to use flood insurance claims payouts to pay down existing mortgage debt rather than rebuild. Flooded residents with a higher likelihood of having a mortgage from a non-local lender are also more likely to leave the New Orleans Consolidated Statistical Area (CSA). While not causally estimated, homeowners who are persuaded by mortgage lenders to use the insurance payout to pay down debt rather than rebuild may find themselves less able to access future credit to repair damaged homes and more likely to move.

Our paper is most similar to a recent working paper by Deryugina et al. [2014] that uses tax return information and a propensity score matching approach to measure the effect of Hurricane Katrina on New Orleans residents relative to residents of cities with similar populations. Deryugina et al. [2014] also find that Katrina had a relatively modest effect on personal finances for those individuals living in New Orleans at the time of the flooding. Our paper and Deryugina et al. [2014] use different data sources and identification strategies, and ask different questions, but nevertheless reach similar conclusions.

Our estimates, by construction, net out any common shock to New Orleans

¹⁰While the NFIP released the insurance money quickly, many homeowners with mortgages experienced delays in using the money for rebuilding due to the fact that banks also had to sign off on using the insurance money.

and isolate differences in personal finance attributable to Hurricane Katrina that are based on the severity of flooding in each resident’s block. Deryugina et al. [2014] ask what the total effect of Katrina (the sum of any common New Orleans shock and within New Orleans damage heterogeneity) is on individual outcomes for residents of New Orleans as compared to a control group outside the city. One interpretation of the fact that both papers find modest and temporary negative effects on household finances is that the impact of a common city-wide negative shock is small. A direct public policy implication of this interpretation is that governmental disaster assistance should be carefully targeted based on actual damages and not based simply on whether one resides in the disaster area at the time of the event.

The remainder of the paper is organized as follows. Section 2 provides background on Hurricane Katrina, private flood insurance, and public disaster assistance. Section 3 discusses the major data sources. Section 4 presents our difference-in-differences econometric model. Section 5 provides our estimation results. Section 6 discusses our results and Section 7 concludes.

2 Background

2.1 Hurricane Katrina

Hurricane Katrina hit New Orleans on the morning of August 29, 2005. Katrina was a Category 3 hurricane with maximum sustained winds of 129 mph when it made landfall in Louisiana. Hurricane force winds extended 120 miles from the center of the storm. In the days prior to making landfall in Louisiana, Katrina first crossed southern Florida as a Category 1 hurricane and then strengthened to a Category 5 hurricane over the Gulf of Mexico. Wind speeds slowed as Katrina moved from the warm gulf waters towards the Gulf Coast where the eye of the hurricane made landfall about 50 miles southeast of New Orleans (Knabb et al. [2005]).

Katrina caused a large coastal water storm surge that overwhelmed the levee protection system surrounding New Orleans and led to massive flooding

of the city.¹¹ The maximum storm surge in the vicinity of New Orleans was about 18 feet (ILI [2006]).¹² The initial levee breaches occurred along the outer levee walls on the eastern side of New Orleans that protects St. Bernard Parish and New Orleans East from Lake Borgne.¹³ Within three hours of the initial levee breaches, flood water covered most of New Orleans.

Hurricane Katrina had a devastating impact on Gulf Coast residents. Katrina initially displaced an estimated 450 thousand people (ILI [2006]). Five months after Katrina, the city of New Orleans had lost approximately 279 thousand residents as compared to the month before Katrina (Frey and Singer [2006]). At least 1,833 people were killed and total property damage was estimated at \$108 billion (2005\$) (Knabb et al. [2005]). Katrina is easily the most costly hurricane, in terms of property damage, in US history. Nevertheless, despite the massive economic damage, little is known about the financial impact on individual residents.¹⁴

2.2 Private Insurance

Homeowners insurance covers wind damage but does not typically cover flood damage. Approximately two-thirds of New Orleans homeowners had purchased a separate flood insurance policy at the time of Hurricane Katrina (Meitrodt and Mowbray [2006]). The Federal Government sets the rates for flood insurance through the National Flood Insurance Program (NFIP). Flood insurance policies are typically sold by private insurance companies at the rates specified by the NFIP. The NFIP collects all premiums, pays all claims, and

¹¹ILI [2006] provides a detailed account of the flooding of New Orleans.

¹²Overall, the maximum storm surge was 28 feet above mean sea level. A maximum wave height of 56 feet was measured. Both were the largest ever recorded in North America, but neither occurred in the New Orleans metro area (Sills et al. [2008]).

¹³Lake Borgne to the east of New Orleans and Lake Pontchartrain to the north are both bays connected to the Gulf of Mexico.

¹⁴Two recent working papers Deryugina et al. [2014] and Gregory [2013] also examine individual-level financial outcomes. Section 1 compares the findings of this paper with these studies. A related literature examines migration after Katrina: e.g. Frey and Singer [2006], Paxson and Rouse [2008], Groen and Polivka [2008], Sastry [2009], and Fussell et al. [2010].

bears all of the risk.¹⁵

In the event of a flood, flood insurance claims checks are written by the private insurance company (ultimately paid for by the NFIP) to the homeowner. However, if the flooded home has a mortgage, or another home loan where the home is used as collateral, then the insurance check is written to both the homeowner and the company that owns the mortgage. In such cases, both the company owning the mortgage and the homeowner must sign the insurance check before the insurance money can be distributed. Typically, the insurance money will be distributed to the mortgage company to hold in escrow. The mortgage company will usually release the insurance money in disbursements as repair work is completed. The expectation of the NFIP and of the U.S. Department of Housing and Urban Development (HUD) is that the insurance payout should be used to repair damages to the home (HUD [2012]).¹⁶

Rather than repairing the home, a homeowner could decide to use either all, or a portion of the flood insurance money to pay down a home loan. Legally, a mortgage company can not obligate homeowners to use any portion of their insurance settlement to pay down the mortgage. Nevertheless, media accounts and government documents following Hurricane Katrina indicate that some mortgage companies pressured homeowners to use the flood insurance money to pay down their mortgages, rather than for repairs.¹⁷

2.3 Public Disaster Assistance

Hurricane Katrina led to several sources of federal disaster assistance. First, Hurricane Katrina triggered a Presidential Disaster Declaration (PDD). The Disaster Relief Act of 1950 established the PDD system. The PDD system is a formalized process to request and receive federal assistance following large natural disasters. A Presidential Disaster Declaration opens the door to two major types of disaster assistance. The largest component of disaster assis-

¹⁵Policies can also be purchased at the same rates directly from the government. Private companies are compensated by the NFIP to transact the policies. Gallagher [2014] and FEM [2008] provide more details on the NFIP and the rate setting process.

¹⁶HUD oversees Federal Housing Administration (FHA) securitized mortgage loans.

¹⁷Refer to Section 5 for more details.

tance is Public Assistance. Public Assistance is available to local and state governments as well as non-profit organizations located in the impacted area. These groups can access grant money to remove debris, repair infrastructure, and to aid in reconstruction of public buildings. The damage must have been caused by the natural disaster. The second type of disaster assistance is Individual Assistance. Individual Assistance is available to residents. Homeowners can access low interest disaster loans to rebuild. Direct cash assistance is also available for temporary and emergency expenses such as interim housing.

Second, Hurricane Katrina also led to Congressionally approved federal disaster assistance that went beyond that authorized by the Presidential Disaster Declaration. \$67.9 billion (2009 \$) was approved by Congress as part of two supplemental appropriation bills (Michel-Kerjan et al. [2012]).¹⁸ For example, Congress approved the use of HUD Community Development Block Grants that could be given directly to homeowners to assist with rebuilding. In Louisiana, the HUD block grants funded the creation of the Louisiana Road Home program. The Road Home program provided grants up to \$150 thousand to homeowners for rebuilding costs not covered by insurance.

Third, the federal government used its role in the secondary mortgage market to pass a moratorium on home foreclosures for one year following Hurricane Katrina (Overby [2007]). All mortgages where the Federal Housing Administration (FHA), Department of Veterans Affairs (VA), Freddie Mac, or Fannie Mae provided mortgage securitization had a foreclosure moratorium through July 2006. Homeowners could not be foreclosed on if they fell behind in their mortgage payments or defaulted within the first year after Katrina.

¹⁸Total federal disaster assistance and reconstruction expenditures for the entire Gulf region (including PDD assistance) is estimated at \$125 billion (Michel-Kerjan and Kousky [2008]).

3 Data

3.1 Flood Depth Data

Approximately 85% of New Orleans was ultimately flooded (Sills et al. [2008]). Figure 2 shows census block mean flood water depths in the city of New Orleans on August 31, 2005.¹⁹ The light grey areas on the map are parts of New Orleans with no flooding. A large portion of the area in New Orleans without flooding is in the Algiers neighborhood located on the south side of the city, across the Mississippi River from the rest of the city. We divide the flooded area into four flooding quartiles based on Census blocks. The mean flood depth of Census blocks in the first flooded quartile ranges from just above 0 feet to 1.4 feet, while the mean flood depth for the fourth quartile is 5.4-11.1 feet. The non-flooded areas consist of about the same number of census blocks as each of the quartiles, breaking the city into roughly equal fifths.²⁰

The source of the flood depth data is the National Oceanic and Atmospheric Administration (NOAA). NOAA derived flood depths by combining a New Orleans area topography map and aerial flood photographs. The topography map was created using lidar mapping prior to Katrina.²¹ The August 31, 2005 flood photograph used to generate the flood depth data may slightly understate peak flood depths.²² The flood depth data have a depth resolution of one foot increments and a geographical resolution of 25 square meters.

¹⁹The flood depth data cover Census blocks including 99.6% of the population of the City of New Orleans. In addition to the City of New Orleans, the data also cover a few other townships including: Arabi, Chalmette, Jefferson, Meraux, Metairie, Poydras, and Violet. Throughout the paper we will refer to the coverage area as the City of New Orleans.

²⁰We limit most of the empirical analysis to the non-flooded, least flooded (1st quartile), and most flooded (4th quartile) groups. The middle flooded groups (quartiles 2 and 3) are dropped due to poor balance of observable covariates (see Table 1), although their inclusion does not change the main results (see Appendix Table 2).

²¹Lidar (light detection and ranging) mapping is a method to collect very accurate landscape elevation data using laser altimetry (Lid [2012]).

²²Flood water heights continued to rise in some areas of the city until September 1, 2005 (ILI [2006]). Unfortunately, flood depth data are not available from September 1, 2005. Flood depth data derived from a September 3, 2005 NOAA flood photograph confirms that flooding had receded in parts of the city.

3.2 Credit and Debt Information

We use individual-level credit and debt information from the Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP) (Lee and van der Klaauw [2010]). Equifax, one of several large consumer credit repository and credit scoring companies in the US, is the source of the credit and debt data in the CCP. The panel is built using a 5% sample of the US population that is selected based on the last two digits of the social security number. Thus, the sample population includes individuals with a credit history and whose credit file includes a social security number. The CCP has quarterly observations and runs from 1999Q1 to the present.

Consumer credit account information is divided into four main types: home loans, auto loans, credit card accounts, and student loans. Home loan information separately tracks first mortgages, home equity loans, and home equity lines of credit. Bank and retail card accounts (i.e. credit cards) cover all types of issuers: banks, bankcard companies, national credit card companies, credit unions, and savings & loan associations, as well as department store and other retail credit cards.

The CCP includes the number of accounts for each loan/debt type, the balance in each type of account, indicators for whether the individual is behind on payment for each type of account, and indicators for foreclosure and bankruptcy. The panel also includes the age, Census block of residence, and Equifax Risk Score (TM) for each individual.²³ Appendix Table 1 shows how the CCP data compare to information collected from the US Census. Using the CCP panel and US Census data we show that the implied ratio of adults in the US with a credit history is roughly consistent with that estimated by the Fair Isaac Corporation (FICO) (Jacob and Schneider [2006]).

²³The Equifax Risk Score is a trademarked measure of consumer credit risk and ranges from 280-850. A higher score indicates a higher measure of creditworthiness.

3.3 Engineering and Census Data

The estimation strategy of the paper uses the intensity of flooding as a measure of potential flood damage. The preferred models control for two measures of engineering data that are correlated with flood intensity. The first source of engineering data is the Army Corps of Engineers flood map for New Orleans. The flood map divides the area of New Orleans into flood risk zones. Flood zone A is the highest risk zone and corresponds to the 100-year flood plain.²⁴ Appendix Figure 1 is a map of New Orleans that shows Census blocks as being completely in the 100-year flood plain, partly in the flood plain, or completely out of the flood plain. While the majority of New Orleans is in the 100-year flood plain, there is still a substantial portion of the city that is zoned as being outside the 100-year flood plain.

The second source of engineering data is mean land elevation above sea level. Appendix Figure 2 shows mean census block elevation in New Orleans. The elevation data are from the US Geological Survey (USGS). The USGS calculates the elevation using lidar mapping technology. In the figure, the mean elevation is divided into quintiles. Half of the city has an elevation of 1.5 feet or less above sea level.

Table 1 compares how the engineering characteristics from Appendix Figures 1 and 2, demographic and socioeconomic characteristics from the 2000 Census, and CCP credit and debt characteristics vary by the level of flooding after Katrina. Flood depth is divided into the same five groupings as in Figure 2. The mean elevation for all five groups varies from about one foot (quartile 3 and 4) to just over two feet (the no flooding group and quartile 1). Not surprisingly, the table suggests a strong positive correlation between being in the flood plain and depth of flooding. 95% of the blocks in the worst flooded quartile are in the flood plain, compared to just 41% of the blocks in the least flooded quartile.

The middle panel of Table 1 shows the Census variables. The socioeco-

²⁴The 100-year flood plain is defined by FEMA as the area of land that will be “inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year.” (<http://www.fema.gov/floodplain-management/flood-zones>)

nomic Census variables—median household income, poverty rate, median home value, proportion owner occupied, and proportion with a college degree—paint a mixed picture across the five groups. We focus first on the four flooded groups. While not perfectly balanced, the differences between the least flooded (quartile 1) and the most flooded (quartile 4) residents are not always in the same direction. For example, median household income is very similar between the first and fourth quartile flood groups. The poverty rate is lower in the fourth quartile as compared to the first quartile, but so too is the proportion of the residents with college degrees. The proportion owner-occupied is higher in the fourth quartile, while the median home value is lower. There are also some differences in Census demographic characteristics. The first and fourth flooded quartiles have similar proportions of older and Hispanic residents, but the fourth quartile has a larger share of African Americans.

The Census characteristics for the 2nd and 3rd quartiles reveal that these residents are consistently the least economically advantaged: lowest household income, highest poverty rate, lowest home value, and lowest proportion of college educated. The middle quartiles are also consistently different from quartiles 1 and 4 among the demographic variables. The middle quartiles have the lowest proportion of residents 65 and older, the highest proportion of African Americans, and the lowest proportion of Hispanics.

The bottom panel of Table 1 shows average CCP characteristics for residents of New Orleans in 2005Q2 by each flood group. The CCP characteristics show a similar pattern to the Census variables. Comparing the 1st and 4th flooded quartiles we see that the Equifax Risk Scores (TM), total debt balance, and likelihood of a delinquency are similar between the two groups. Residents in the fourth quartile are more likely to have a home loan. This is consistent with the Census findings from the middle panel that these residents are more likely to be homeowners. The middle flooded quartiles are again the least economically advantaged with the lowest risk scores and highest delinquency rate (while holding the least total debt).

The empirical analysis for the rest of the paper focuses on New Orleans residents in the non-flooded, least flooded, and most flooded groups. Based on

the Census and CCP variables, residents in the 2nd and 3rd flooded quartiles are consistently the most economically disadvantaged and not well comparable to the non-flooded group. While not perfectly balanced, the 1st and 4th flooded quartiles are much more similar to the non-flooded group. For example, median income is roughly the same across these three groups. The poverty rate and median home value for the non-flooded group are both in between those of the least and most flooded groups. Finally, Figure 1 shows similar trends in total debt balance (our main dependent variable) between the three groups for the 12 quarters before Katrina.

Table 2 investigates correlates of flood depth using the engineering and Census variables. The five columns correspond to five different OLS regressions. The unit of observation is a Census block. The dependent variable for each regression is the Census block mean depth of flooding on August 31, 2005. The specification shown in column (1) includes only the mean, minimum, and maximum elevation above sea level found within the block and the proportion of the block that is in the 100-year flood plain. These four variables alone account for 32.7% of the variation in flood depth. Column (2) adds squared and cubed terms of each of these four variables as well as the interaction of mean block elevation and proportion of the block in the 100-year flood plain, increasing the variation in flood depth explained to 39.9%. Columns (3) and (4) demonstrate that a Census 2000 block group measure of median home values (the smallest geography available in public use tabulations) explains only 3.6% of the variation in flood depth by itself and does not change the R-squared value when added to the specification with the engineering variables. When the full set of 2000 Census block group-level socioeconomic and demographic variables are added to the regression (listed in Table 1) the amount of variation that can be explained increases modestly to 44.5%.

4 Empirical Specification

We begin our discussion of the empirical specification with a simple panel data difference-in-differences regression model which we specify as

$$y_{i,b,t} = \beta D_b * P_t + \gamma D_b + \delta P_t + \varepsilon_{i,b,t} \quad (1)$$

,where $y_{i,b,t}$ is a particular outcome for individual i in period t . The b subscript indicates the Census block in which they lived at the time of Hurricane Katrina (2005Q3). The outcomes we focus on in the paper are measures of debt, delinquency, and credit worthiness. D_b is a vector of indicator variables indicating whether the block that person i resided in at the time of Hurricane Katrina (2005Q3) was in one of the four depth quartiles. This vector can be regarded as a set of treatment dosage indicators. If all quartile indicators are zero, then the block was not flooded and the individual is part of the control group.²⁵ P_t is a post-Katrina indicator variable which equals 1 if the time period is 2005Q4 or after and 0 otherwise. β is the vector of coefficients of interest and measures the change in means (from pre- to post-Katrina) of the outcome variable for each of the treatment dosage groups relative to the change in means for the control group. Standard errors are robust to heteroskedasticity and are clustered at the block level.

The key assumption of Equation (1) is that the post-flood trend for the dependent variable for the non-flooded group is a valid counterfactual for each flooded group had there been no flood. Figure 1 provides strong visual support for this assumption.²⁶ The (unconditional) pre-flood time trend for total debt is very similar for the non-flooded, least flooded, and most flooded groups. The most flooded group exhibits a sharp and immediate decrease in total debt at the time of Hurricane Katrina. Approximately two quarters after Katrina,

²⁵The estimation sample only includes individuals in the non-flooded group and the 1st and 4th flood depth quartiles. Individuals living in the 2nd and 3rd quartiles at the time of Katrina are dropped from the sample (see Table 1 and the previous section for a discussion). Estimation results for a sample that includes all 4 quartiles are available on request. The point estimates for the 1st and 4th quartiles are consistent between the two samples. The point estimates for the 2nd and 3rd quartiles are almost always in between those of the 1st and 4th quartiles and in order of flood depth.

²⁶Throughout the paper we report home loan debt balances that have been imputed when data is missing due to non-reporting. The details of the imputation procedure are provided in the Appendix.

the time trends for total debt exhibit essentially the same upward trends as before the flood. There are, however, effects on the levels of debt between the three groups that persist until the end of the sample. The level of total debt for the non-flooded and least flooded groups continue to grow at rates that could have been predicted based on pre-flood trends had there been no Hurricane Katrina. This is not the case for the most flooded group. Total debt is much lower for the most flooded quartile relative to what would have been predicted solely from the pre-flood time trends.

Of course, similar pre- and post-flood trends between the three groups does not guarantee that, had each flooded group *not* been flooded, the financial variables would have exhibited a similar time series pattern as that of the non-flooded group. For example, we know that the engineering determinants of the flood depth (percent of the land in the 100-year flood plain and land elevation) differ between the groups. If residents sort based on these flood engineering characteristics so that more vulnerable residents are more likely to live in higher flood risk areas of New Orleans then this could lead to an overestimate of β .²⁷

Our preferred specifications control for differences in the engineering and Census variables. To achieve this we add the engineering and Census variables and their interactions with the post-Katrina indicator to our simple difference-in-differences regression model. In this model, the difference-in-differences estimator will only attribute variation in the outcome variables as due to flooding if it arises from variation in flood depth that is uncorrelated with the engineering and Census variables.²⁸ We also add a cubic in age and individual fixed effects to the baseline specification to control for life-cycle patterns in the out-

²⁷Table 1 shows that while observable socioeconomic variables do differ in some cases between the 1st and 4th flooding quartiles, these differences are not all in the same direction. On balance the socioeconomic status of the two groups are very similar before Hurricane Katrina. We are not aware of any evidence that shows residential sorting based on flood risk characteristics. If there were sorting on flood risk characteristics, we might expect that more vulnerable (i.e. “flood sensitive”) residents would sort *away* from the risk due to their greater willingness to pay for that housing attribute (Roback [1982]; Rosen [1974]).

²⁸Note that the control variables not interacted with the post-Katrina indicator, X_b , drop out of our model due to multicollinearity once block of residence at the time of Katrina or individual fixed effects are included.

come variables and any time-invariant, person-specific unobservable variables that may influence the outcomes. The resulting specification is

$$y_{i,b,t} = \beta D_b * P_t + \gamma D_b + \delta P_t + \eta X_b * P_t + \theta X_b + \kappa f(A_{i,b,t}) + \alpha_i + \varepsilon_{i,b,t} \quad (2)$$

,where X_b includes the engineering and Census block group socioeconomic and demographic variables, $f(A_{i,b,t})$ denotes a cubic function of age, and α_i an individual fixed effect.

5 Results

5.1 Effect of Flooding on Debt Balance and Account Delinquency

Table 3 presents estimates of difference-in-differences specifications using the dollar amount of total debt balances as the outcome variable. Column (1) estimates Equation (1), while Columns (2)-(7) estimate versions of Equation (2). Throughout this and the next sub-section we use a balanced panel of individuals that were living in the City of New Orleans at the time of Katrina (2005Q3) and were continuously in the CCP for the 12 quarters before and after Katrina.²⁹ The simple difference-in-differences estimates are $-\$5,407$ for individuals living in the least flooded quartile and $-\$13,896$ for individuals living in the most flooded quartile (relative to the change in debt levels in the non-flooded blocks). Model estimates in columns (3)-(7) show that the point estimates are relatively stable at approximately $-\$3,000$ for the least flooded quartile and approximately $-\$9,000$ for the most flooded quartile regardless of the exact covariate controls. Our preferred specification is Column (7) that

²⁹Recall that individuals enter the CCP sample when they first obtain a credit history and exit the CCP sample if they die. Extending the panel longer in either direction reduces the number of individuals in the sample. We selected a balanced panel with three years pre- and post- Katrina as a compromise between the length of the panel and the number of individuals in the sample.

includes individual fixed effects.

Table 3 shows that flooding is associated with large reductions in debt balances and that the debt balance reductions are larger in magnitude in blocks that experienced more flooding. We complement the analysis of Table 3 with an event study approach that examines the effect Katrina had on quarterly debt balances for our entire sample period. The event study approach allows us to analyze whether the reduction in debt persists to the end of our sample period. We also use the event study approach to separately consider the impact of flooding on different types of debt and measures of financial distress.

We implement the event study by replacing the post-Katrina flood depth quartile interaction variables of Equation (2) with a series of quarter by flood depth interaction variables. The 2005Q2 interactions are the omitted category. Figure 3 plots the coefficients and upper and lower confidence bounds for the least flooded (squares) and most flooded (circles) flood depth quartiles. Debt balances are not statistically different for either group for the three year period before Katrina. Figure 3 shows that the reductions in debt balance for individuals in the most flooded quartile begin immediately after Katrina and persist until the end of the sample. None of the quarterly coefficients for the least flooded quartile are statistically significant at the 5% level. The drop is largest in 2007 and early 2008, before rebounding a bit.³⁰

Figure 4 repeats the same specification, but changes the dependent variable from total debt balances to home loan balances (the sum of any first lien mortgages, home equity installment loans, and home equity lines of credit). The pattern is almost identical. The reduction in home loan balances accounts for nearly all of the change in total debt.

Figure 5 shows difference-in-differences estimates for homeowners with mortgage debt at the time of Katrina of an indicator variable of whether they have *any* mortgage debt. Six months after Katrina there is a 25 percentage point reduction in the likelihood that the most flooded homeowners have

³⁰This pattern is consistent with the unconditional time trends shown in Figure 1. Total debt balances continue to rise in the two years after Katrina for the non-flooded group, while total debt balances are still lower for the flooded groups until the end of the panel.

any mortgage debt (relative to the non-flooded homeowners). This reduction increases to approximately 30 percentage points a year and a half after Katrina before reversing trend. One striking feature of this finding is the speed with which mortgage debt disappears. The timing of when mortgage debt disappears is a key fact used to explain the reduction in mortgage debt in Section 5.2.

Our expectation was that residents would use credit cards as a means to smooth the income shock caused by the flood damage and forced evacuation of New Orleans. Surprisingly, there is only a modest change in credit card balances for either flood group after Katrina relative to the non-flooded group. Figure 6 plots the estimates and confidence intervals for the event study version of Equation (2) with total credit card balance as the dependent variable.

Credit card balances increase by \$700 in the 1st quarter after Katrina for the most flooded group. This represents a 22% increase over a pre-Katrina mean credit card balances (2005Q2) of about \$3,200. The debt increase is temporary. The point estimates for the change in credit card debt (relative to the quarter before Katrina) are small and statistically insignificant beginning in the 2nd quarter after Katrina. The results are similar when we condition on having a credit card at the time of Katrina.³¹

Access to credit card borrowing capacity is a possible explanation for the relatively modest change in credit card debt balances. 9% of all residents (16% of residents with credit cards) are at their credit card borrowing limit the quarter before Katrina. Nevertheless, the share of residents with credit card debt as large as their borrowing limit does not change in the 1st quarter after Katrina.

Auto loan debt is the only other debt category for which flooding led to a significant change. Auto debt increases by \$436 (significant at the 10% level) one year after Katrina (Appendix Figure 4).

Figures 7 and 8 show the impact of flooding on non-debt measures of individual financial health. Figure 7 shows the propensity to have at least one account that is 90 or more days delinquent. There is some evidence for

³¹There is a \$952 (21%) increase conditional on having a credit card.

increased delinquency beginning about a year after Katrina. One reason for a delayed effect in delinquency rates is that there was a one year grace period on making payments for most mortgages (see Section 2.3). Figure 8 shows the effect of flooding on the Equifax Risk Score (TM). There is a temporary drop of about 4 to 7 points (0.04 to 0.06 standard deviations) for both flooded quartiles for about a year and a half after Katrina. Together, Figures 7 and 8 suggest that Hurricane Katrina led to a modest and temporary decline in the financial health of the most flooded New Orleans' residents relative to non-flooded residents.

5.2 Flood Insurance and Reduced Mortgage Debt

If a flooded home covered by flood insurance has a mortgage, or another home loan where the home is used as collateral, then flood insurance checks are written by the NFIP to both the homeowner and the company that owns the mortgage. As discussed in Section 2.2, the expectation of both the NFIP and HUD is that the flood insurance payout should be used to repair damages to the home. However, rather than repairing the home, a homeowner could decide to use either all or a portion of the flood insurance money to pay down a home loan.

After Hurricane Katrina, media accounts and government memos indicate that some lenders, and particularly those without a local presence, pressured homeowners to use flood insurance checks to repay their mortgage loans rather than to rebuild their homes. For example, in 2012, a month after Hurricane Isaac hit Louisiana and Mississippi, the Department of Housing and Urban Development published a letter to “reinforce its existing policy requiring lenders to release insurance payouts to homeowners eager to rebuild their damaged homes following disaster.” The letter states that, “in the past, the U.S. Department of Housing and Development (HUD) noticed some lenders would instead use these insurance funds to pay off the outstanding mortgage balance, leaving many homeowners without the resources they need to rebuild

their homes” (HUD [2012]).³²

The NFIP does not track whether insurance claims money is spent on repairs or on paying down mortgage debt. Nevertheless, we can verify that flood insurance claims are highly correlated with flooding, that the timing of the insurance payout matches the observed drop in mortgage debt, and that the magnitude of the payout is large enough to account for the size of the estimated reduction in home loan debt.

Table 4 Panel A provides a flood insurance payout measure for New Orleans homeowners by depth of flooding. We compare the total flood insurance claims paid to residents in 2005 to the total mortgage debt owed by residents at the time of Katrina.³³ For the most flooded group, the ratio of insurance claims to mortgage debt is 0.92. This implies that the amount of flood insurance paid out would be large enough to pay off 92% of the total existing mortgage debt for these homeowners if all the claims dollars were applied towards paying down mortgage debt rather than rebuilding. The same statistic for the non-flooded group is 11%.³⁴

Foreclosure, home sales, and federal government assistance are all alternative explanations that could account for reductions in mortgage debt after Katrina. Table 4 Panel B displays the point estimates and robust standard errors (in parentheses) from six separate regressions of a foreclosure start indicator variable on a post Katrina indicator variable. The first row of Panel B covers our entire panel period, while the second row considers only the six months before and after Katrina. The point estimates from all six regressions

³²Examples in the popular press include Butler and Williams [2011]. Moreover, in December 2005 (4 months after Katrina) the Louisiana Attorney General opened an investigation into reports of mortgage companies withholding insurance money intended to be used for home repairs (of the Attorney General [2005]).

³³The CCP is the source of the mortgage debt. Since the CCP is a 5% sample we multiply the 2005Q2 CCP mortgage debt by 20. Flood insurance claims data are from NFIP administrative records and are for the 2005 calendar year. Please refer to Appendix Section A for more details on the calculation of this statistic.

³⁴We would expect annual flood insurance claims for 2005 to be non-zero for the “non-flooded” group if the rain from Hurricane Katrina caused flood damage to the house (e.g. roof leak) without leading to standing water for the entire census block. Also, our measure of flood insurance claims is for the entire calendar year.

are negative. The point estimates for the entire panel period regression for the most flooded group implies a 58% decrease in foreclosure starts for residents living in these blocks.

Recall that the vast majority of the reduction in home loan balances occurs within six months of Katrina (see Figures 4 and 5). The point estimate for the most flooded group that only considers the two quarters before (2005Q1 and 2005Q2) and after (2005Q4 and 2006Q1) Katrina implies a 100% drop in foreclosure starts. The foreclosure start rate for the most flooded group in the CCP in the two quarters after Katrina is zero and in the 3 years after Katrina is less than 0.2%. One reason for the zero foreclosure start rate during the first six months after Katrina is the federal government’s moratorium on foreclosures for mortgages where the Federal Housing Administration (FHA), Department of Veterans Affairs (VA), Freddie Mac, or Fannie Mae provided mortgage securitization.^{35 36}

Table 4 Panel C provides estimates for the fraction of the observed drop in home debt in the two quarters after Katrina that could be explained by home sales. The statistics in Panel C calculate the ratio of the total sales for the six months after Katrina to the total implied homeowner debt reported in the CCP for each flood group. The home sales data are from the records of the Orleans Parish Assessors Office. Revenue from property sales could pay off just 1% of the existing mortgage debt in the most flooded group if all of the revenue from the sales were applied directly towards existing mortgage debt.³⁷

Appendix Figure 3 reinforces the finding in Panel C. During the two year period *before* Katrina, the number of quarterly home sales in the most flooded New Orleans blocks follows a very similar trend to the least flooded blocks. Both groups of blocks hover around 200 home sales per quarter. In the first

³⁵The moratorium was scheduled for six months, but later extended to 11 (Overby [2007]).

³⁶The overall reduction in foreclosures is also consistent with using flood insurance to pay off mortgage debt, as (all else equal) there are fewer mortgages that could be foreclosed.

³⁷The sales records include information on 86% of the New Orleans parcels. This means that the number and total dollar value of property sales almost certainly understate actual sales. However, even if one were to double the estimate of property sales revenue in the most flooded group of blocks the property sales revenue could pay off only 2% of existing mortgage debt. See the Appendix for more details about the sales data.

quarter after Katrina, sales plummet to 33 for the most flooded group. Sales recover in the second quarter after Katrina to pre-Katrina levels.³⁸

The timing and magnitude of property foreclosure and sales do not match the observed reduction in mortgage debt. Likewise, The Louisiana Road Home Program, the federal assistance program that provided large sums of money to New Orleans residents to assist with rebuilding, did not begin disbursing money until more than one year after Katrina. We conclude that foreclosures, sales, and federal assistance can explain only a small part of the drop in mortgage debt immediately after Katrina.³⁹

5.3 Local versus Non-local Lending Institutions

A growing literature on the impact of natural disasters on subsequent economic growth highlights the role of investment in capital and how lenders facilitate that investment.⁴⁰ The location of a bank in relation to the location of the natural disaster has an impact on the bank's response. Hosono et al. [2012] find that banks located in areas affected by the 1995 Kobe earthquake in Japan had weakened lending capacity following the earthquake. In contrast, Chavaz [2014] finds that in the wake of hurricanes in the U.S., lenders that had been more concentrated in the area affected by the hurricane had higher mortgage lending growth than less concentrated lenders.

We aim to assess the degree to which variation in whether mortgages are held by non-local or local lending institutions could be associated with differences in the propensity to retire mortgage accounts. Ideally, we would know

³⁸Figure 5 implies that approximately 25% of residents with a home loan in the most flooded blocks had all of their home loan debt disappear from their credit records during the six months after Katrina. The 208 (33 in 2005Q4 and 175 in 2006Q1) sold properties in the two quarters after Katrina is less than 2% of the total estimated number of residents with a home loan.

³⁹Further evidence that the reduction in mortgage debt is due to accounts being paid off rather than being written down by the lender comes from descriptive codes attached to the mortgage data in the CCP. In 2006Q1 35% of the individuals living in the most flooded blocks that had a mortgage at the time of Katrina had a flag on their mortgage account indicating that the account was paid, closed, and had a zero balance. In contrast, only 0.2% had a flag indicating that the bank had charged off or written down the account.

⁴⁰See Hornbeck and Naidu [2014] and Morse [2011] for two recent examples.

which of the home loans that we observe in the CCP were held by a local lender. Unfortunately, this information is not part of the CCP. As a proxy for whether home loans are held by a local or non-local lender, we construct a census tract-level measure of the degree of local mortgage lending activity in the period leading up to Katrina.

We construct this local lending proxy measure using data on mortgages that were originated in the 212 census tracts in the area covered by our flood depth data. We use all new loans reported in the Home Mortgage Disclosure Act (HMDA) data between January 1997 and August 28, 2005 (the day before Katrina hit New Orleans).⁴¹ The HMDA loan information is merged with branch location data by year from the FDIC’s Summary of Deposits data. We construct three different measures of “local” lending institutions.

Our preferred measure of local lending is based on the proportion of loans each lender has in the New Orleans-Metairie-Hammond Combined Statistical Area (CSA) relative to their total lending activity.⁴² For each lender who issued at least one HMDA-measured home loan in New Orleans (between January 1997 and August 28, 2005) we calculate the proportion of loans for properties in the CSA relative to the lender’s total loans over the period. Each lender is then assigned this lender-specific New Orleans CSA loan ratio number. Next, we calculate the average local loan ratio for each census tract by averaging across the lender loan ratios associated with each mortgage originated in the census tract over the same time period. A census tract is an above median tract for *non-local* loans if the census tract average lender-specific loan ratio is 24% local or less. We create a non-local dummy variable that equals one for these census tracts. This implies that, on average, a loan in the tract is from a lender that makes at least 76% of its loans outside of the New Orleans CSA. We pick this cutoff since it is the median value in our estimation sample, splitting our sample into roughly equal numbers of people with mortgages

⁴¹January 1997 is the earliest available date for the HMDA lender data with a consistent reporting requirement. Please refer to the Appendix for details on the HMDA and FDIC Summary of Deposits data.

⁴²The CSA includes 10 parishes in Louisiana and one county in Mississippi. Throughout the rest of the paper we refer to this CSA as the New Orleans CSA.

living in local and non-local tracts at the time of Katrina.

Our second measure defines a local lender in exactly the same way as our preferred measure except that we use the share of the loan value (rather than the number of loans). There is a 97% correlation between the two measures. Our third measure of a local lender is simply whether the lending institution reported in the HMDA data has at least one branch in the New Orleans CSA.⁴³ We create a simple measure of local lending share by dividing the number of loans originated by a lender with a branch presence by the total number of loans originated in each tract from 1997 through August 28, 2005. Approximately half of the people in our CCP data lived in a tract with a local lending share of 37% or less.⁴⁴

Table 5 shows the results of four linear probability model regressions which investigate the degree to which greater reductions in the propensity to have a home loan occurred in census tracts that had a high share of non-local lending. Table 5 uses our preferred measure for a local lender, which is based on the share of loans made in the New Orleans CSA. The sample is limited to individuals in our panel that had a home loan at the time of Katrina. The dependent variable is an indicator variable for whether the person has a home loan. This is the same sample and outcome variable as shown in Figure 5. However, to limit the number of coefficients to report, we use the specification with a single post-Katrina indicator and its interaction with the variables of interest (Table 3 Column (7)).⁴⁵

Column (1) reinforces the quarterly event time result shown in Figure 5. Relative to the non-flooded group, the propensity to have a home loan drops after Katrina in places with deeper flooding. Column (2) adds the high non-local lending share indicator interacted with the flood depth indicators and

⁴³The FDIC Summary of Deposits data do not contain branch information regarding lenders that are regulated by HUD and the NCUA. These lenders include non-bank mortgage companies and credit unions respectively. We drop the credit union loans (only about 1%) and assume all of the HUD regulated lenders have no branch presence.

⁴⁴This is also true when we restrict to people who had a home loan at the time of Katrina.

⁴⁵Recall that the standard errors are clustered at the Census Block level. Clustering at the Census Tract level has very little effect on the size of the standard errors and does not change the statistical significance for any of the estimated coefficients (Appendix Table 4).

the post-Katrina indicator.⁴⁶ The estimates of the coefficients on the double interaction terms indicate that the propensity to have a home loan drops by a larger amount after Katrina in census tracts that have a high share of non-local lending. There is a 17 percentage point reduction in the propensity to have a home loan in a tract with a high share of non-local lending. This is in addition to the 16 percentage point reduction in the most flooded group. The point estimates for the least flooded group are negative, but not significant at the five percent level.

Column (3) adds the interaction of a post-Katrina indicator and a cubic function of the individual's mean pre-Katrina Equifax Risk Score (TM) to the specification to control for potential differences in credit risk characteristics of homeowners in the tracts with a high share of non-local lenders. Column (4) adds a control for Census blocks that have a high share of African American residents (over 95%) and interacts it with flood depth and the post-Katrina indicators in the same way that the high non-local lender share variable is interacted. The coefficients of interest are relatively stable across these alternative specifications.

Column (5) adds a control for the census block flood insurance coverage rate at the time of Katrina. We implement this control by adding the interaction of a post-Katrina indicator variable and the ratio of the flood insurance claims paid in 2005 to the total mortgage balances in 2005Q3. This is the same variable presented in Table 4. Its construction is discussed in Section 5.2 and in Section A of the Appendix. Adding the control for flood insurance coverage decreases the magnitude of all four coefficients presented in the table. However, the coefficients for the most flooded group remain economically large in magnitude, and highly statistically significant. Moreover, among the most flooded residents, those residents living in Census Tracts with an above median share of loans made by local lenders are twice as likely to have a home loan after Katrina (regardless of the exact specification in Table 5).

⁴⁶The two-way interaction of high non-local lending share and post-Katrina is also included. The two-way interaction of high non-local lending share and flood depth does not vary with time, and thus drops out of the specification since it is co-linear with the person fixed effects.

Robustness checks that use the CSA branch measure for a local lender, only consider HMDA mortgages in the pre-Katrina panel period (2002Q3-2005Q2), and cluster the standard errors at the Census Tract level all confirm the same pattern of findings as in Table 5.⁴⁷

The difference in lender correlated mortgage debt levels after Katrina could be explained by different post-Katrina incentives for local and non-local lenders. There are at least two reasons why incentives for local and non-local lenders differ after Katrina. First, the success of companies with a large lending presence in New Orleans is highly dependent on the economic well-being of the city. On the other hand, companies who have a relatively small share of their business in New Orleans may prefer to protect themselves from the uncertain economic environment of post-Katrina New Orleans by reducing their lending exposure in the city. The economic recovery of a region after a large disaster is far from certain and New Orleans was a city characterized by both a declining population and number of jobs before Katrina (Vigdor [2008]).⁴⁸

Non-local lenders interested in lowering their exposure to New Orleans can do so by reducing current mortgage debt or by issuing fewer new mortgage loans. Consistent with the previous finding, we observe a much larger drop in new loans to New Orleans by non-local lenders after Katrina as compared to local lenders. Figure 9 shows the quarterly number of new mortgages originated by local and non-local lenders for homeowners located in the area of New Orleans most flooded by Katrina. There is a sharp decline in the number of new mortgages immediately following Katrina. The immediate reduction is more than twice as large for the non-local lenders than for the local lenders whether measured in levels or percentage terms.⁴⁹ After Katrina, the number of new mortgages issued by local banks returns to near the pre-Katrina level

⁴⁷See Appendix Table 2.

⁴⁸We would expect that a lender who sells the original mortgage to be less responsive to the post-Katrina uncertainty and risk. Overall, in the three year sample period before Katrina 62% of new home loans were sold by the mortgage originator. While it is true that non-local lenders sold loans at a higher rate (75% versus 42%), these lenders still retained roughly a quarter of all new loans.

⁴⁹There is a 99% decrease in the number of loans originated from 2005Q2 to 2005Q4 for non-local lenders and a 91% decrease for local lenders

around mid-2007. The number of new mortgages issued by non-local lenders remains much lower throughout the post-Katrina period.⁵⁰

Second, mortgage companies are responsible for monitoring reconstruction of damaged homes throughout the rebuilding process to verify that insurance claim payouts are spent on fixing the property and not pocketed by homeowners or unscrupulous contractors. Local lenders are likely to have more personnel based in New Orleans and to have a higher degree of local knowledge about rebuilding conditions and local contractors.⁵¹ As a result, the costs to monitor the reconstruction process and to protect their investment are likely to be lower for local lenders than non-local lenders.

6 Discussion

6.1 Local Lending and Redevelopment

A property owner's decision of how to spend the flood insurance money, whether for rebuilding or to pay down existing mortgage debt, can affect the overall economic recovery of the neighborhood and the city. A property owner who spends the flood insurance money to pay down mortgage debt is less likely to rebuild. In a regression similar to those shown in Table 5, but using an expanded sample (see Appendix), we find that residents of the non-local lender tracts in the most flooded areas at the time of Katrina show an increased propensity to leave the New Orleans CSA for at least 3 years (through the end of our sample period) compared to residents of the local lender tracts in the most flooded areas. The increase in the propensity to leave is about 0.9 percentage points for the most flooded group and amounts to about 32% of the mean propensity to leave the New Orleans CSA in the most flooded group

⁵⁰The number of new mortgages after Katrina drops in all of New Orleans (not just the most flooded blocks). The average quarterly number of new loans after Katrina in census tracts with a high (low) share of non-local lending drops by 2,710 (968).

⁵¹A related literature has recognized the role that local banking institutions have in leveraging "soft" information on applicants to increase the provision of credit relative to larger national banks (e.g. Berger et al. [2005]; Agarwal and Hauswald [2010]; Chavaz [2014]).

in the post-Katrina sample period.⁵²

If local lenders are more likely to continue lending following a natural disaster, then their lending presence at the time of the disaster could have an impact on the level of rebuilding that occurs. If there are economies of agglomeration, the level of rebuilding could affect which, of the possibly many, future equilibria the city converges to. For example, Bleakley and Lin [2012] show evidence of path-dependence in economic activity that is consistent with the presence of agglomerative forces and multiple equilibria.⁵³ Thus, the decision not to rebuild could be costly in terms of foregone development, especially if New Orleans’ residents are more likely to return when their neighbors return (Paxson and Rouse [2008]).⁵⁴

6.2 Flood Insurance and Disaster Recovery

Flood damage from natural disasters in the US will almost certainly continue to increase in the future.⁵⁵ Federal disaster expenditures will also increase if disaster assistance continues to grow (more than) proportionally with overall costs (Jaffee and Russell [2013]). Flood insurance has the potential to protect homeowners against the financial risk of flooding, while also reducing direct federal disaster expenditures. In fact, two of the primary motivations for having individuals self-insure against the risk of a flood were to limit “unwise” development and to reduce the need for federal disaster aid after a flood (Sen [1966]).

The magnitude of insurance dollars and the speed with which the claims were processed by the NFIP provided (relatively) quick assistance for flooded

⁵²The mean quarterly propensity to leave is 2.75%. This is equivalent to an annual propensity of more than 10%.

⁵³See Bleakley and Lin [2012] for an excellent discussion of the related literature.

⁵⁴This could be the case if a resident’s neighbors include family and friends, or if population density in the neighborhood provides a positive amenity to residents. The positive amenity could be directly from the number people or indirectly due to the availability of greater public (e.g. street cleaning) or private (e.g. restaurants) amenities.

⁵⁵Population growth in coastal US counties most susceptible to oceanic flooding has increased at the same rate as the overall US population growth since 1980 (USC [2010]). At the same time, Global Climate Change makes it likely that flood risks will increase in the future due to higher sea levels and (potentially) more frequent storms (IPC [2008]).

homeowners. New Orleans residents received \$6.7 billion (2005\$) in flood insurance claim payouts during 2005.⁵⁶ It is likely that there would have been larger increases in credit card debt, higher rates of account delinquency, more foreclosures, and a more pronounced drop in credit scores if two-thirds of New Orleans' homeowners had not been covered by flood insurance.⁵⁷

Nevertheless, the federal government spent an unprecedented amount of money for direct rebuilding assistance to homeowners in the aftermath of Hurricane Katrina (Michel-Kerjan et al. [2012]; Michel-Kerjan and Kousky [2008]). In Louisiana alone, the federal government spent \$9 billion (2005\$) in direct cash transfers to flooded property owners through the Louisiana Road Home Program (LAC [2014]). Approximately 70 thousand New Orleans properties were without flood insurance at the time of Katrina. There would have been about \$3.4 billion (2005\$) of additional flood insurance available for reconstruction had the uninsured homeowners been insured and sustained flood damage at similar rates as those with insurance. This would have reduced direct federal government assistance under the Road Home program dollar for dollar.⁵⁸

7 Conclusion

We provide some of the first evidence for the effect that a large natural disaster in the United States has on levels of household debt and measures of financial distress using a new panel data set that combines account-level credit and debt information with a heterogeneous measure of disaster damage. We find

⁵⁶Author calculation using NFIP administrative claims data. Overall, about \$16 billion (2005\$) in claims were paid to Gulf Coast residents (Michel-Kerjan [2010]).

⁵⁷It is also possible that short term debt would not increase if, for example, homeowners made different post-Katrina spending decisions to partially offset the need for assistance, and were able to cover the remainder of the foregone flood insurance money with personal savings or increased governmental assistance.

⁵⁸Grant money from the Road Home program was available to both insured and uninsured homeowners. For those homeowners with insurance, the flood insurance claims dollars were first subtracted from the estimated reconstruction cost before calculating individual grant amounts. The dollar for dollar tradeoff assumes that the program itself would have been the same if all homeowners had flood insurance.

that Hurricane Katrina had a modest negative effect on personal finances as measured by increased short-term debt, account delinquency, and credit score. At the same time, there was a large and immediate reduction in debt for residents living in the most flooded blocks. The reduction in debt is due to lower home loan debt and is mostly a consequence of homeowners using flood insurance claims to pay down mortgages.

The propensity to pay off and close mortgage accounts was especially high in those neighborhoods of the deepest flooded areas of New Orleans where mortgages were most likely to have been originated by a non-local lender. We also find that new mortgage originations by non-local lenders fall sharply after Katrina relative to originations by local lenders. These differences in lending activity are likely to be driven by differences in the cost of information acquisition, business incentives, and the financial stability of local and non-local lenders after a large disaster. These differences could lead to differing outcomes for residents based on their lender affiliation, and collectively impact the post-disaster recovery of the region.

We interpret our findings as evidence that, even in the wake of a very large natural disaster, the combination of short-term disaster assistance and flood insurance payouts were enough to prevent even the most deeply flooded residents of New Orleans from serious financial problems. This result provides a measure of optimism that current institutions would perform reasonably well in buffering individuals against financial shocks caused by increasingly frequent natural disasters.

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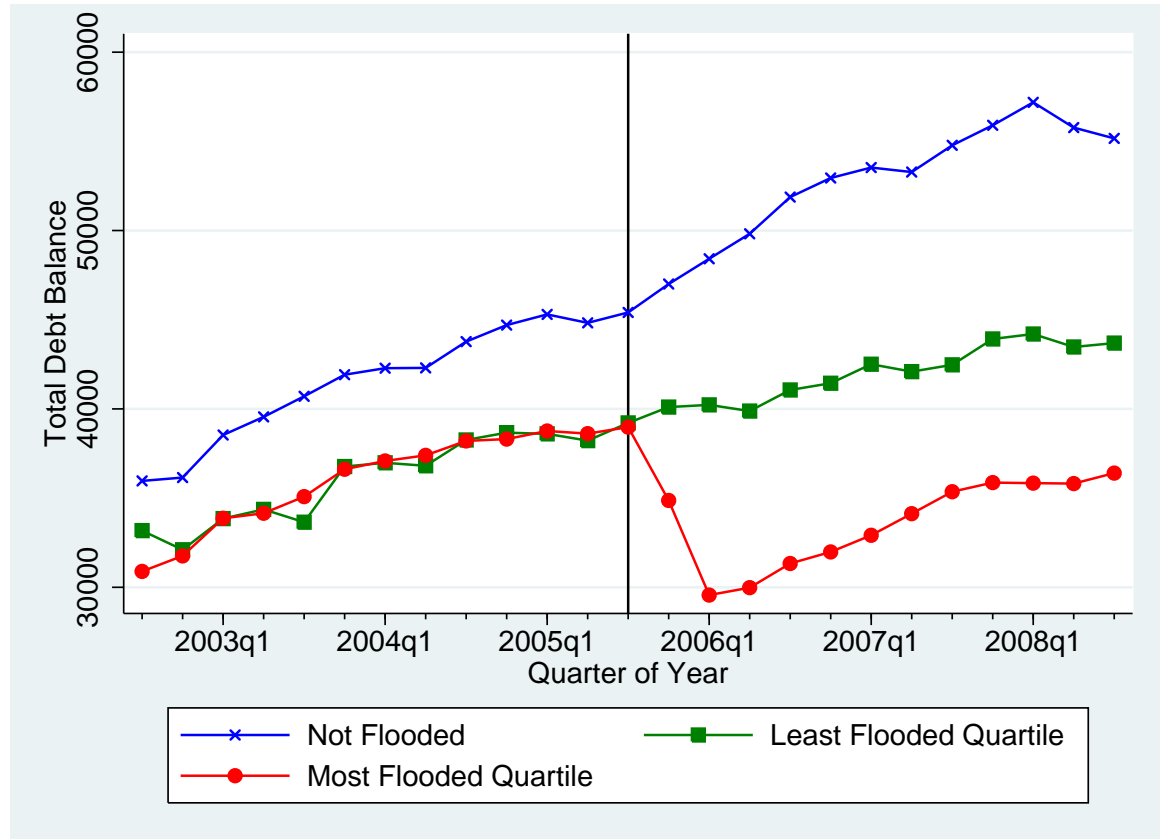
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9 Figures and Tables

Figure 1: Total Debt Balance for New Orleans Area Residents from 2002-2008 by Post Hurricane Katrina Flood Intensity



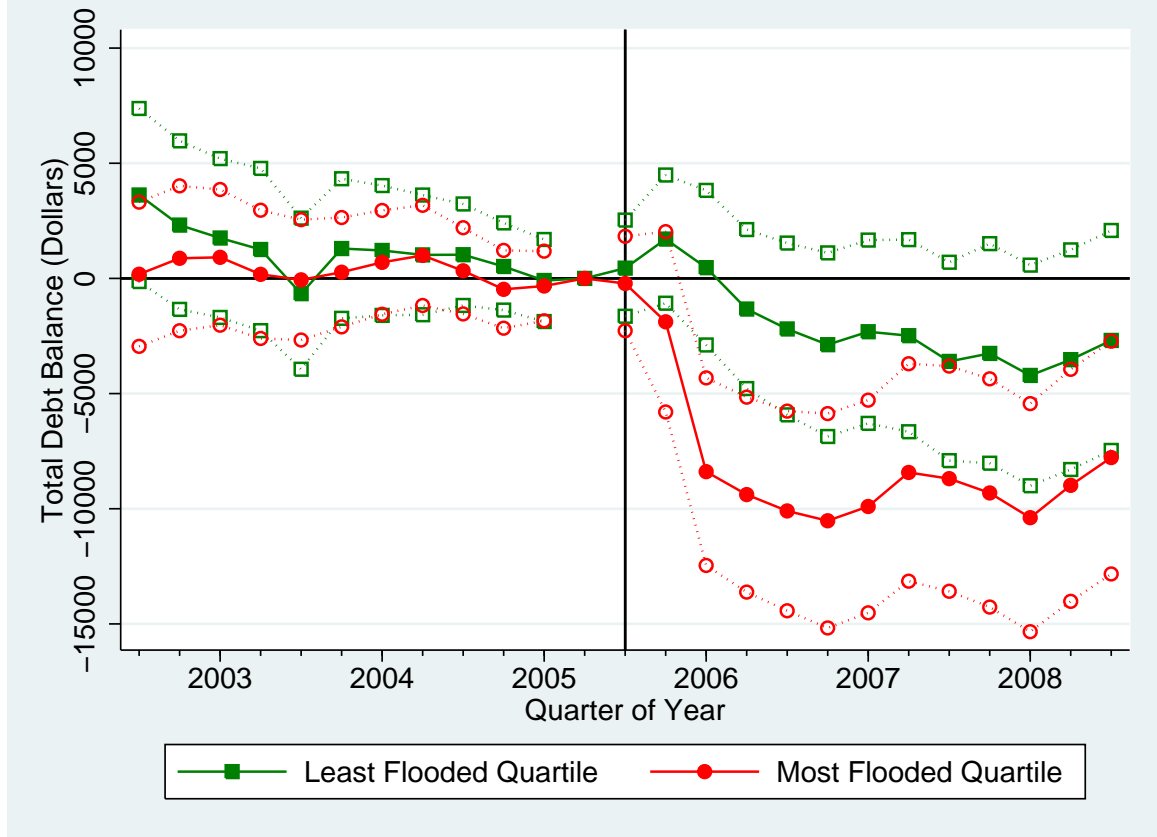
The figure plots quarterly individual debt balances (2000 \$) for residents living in New Orleans at the time of Hurricane Katrina (2005q3). Average debt balances are shown separately for residents living in non-flooded, the least flooded, and the most flooded census blocks. The least flooded blocks are defined as being those with average maximum flood depths of less than the 25th percentile (1.4 feet) among all flooded blocks. The most flooded blocks are those greater than the 75th percentile (5.4 feet). Debt information is from the Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP).

Figure 2: Mean Census Block Flooding Depth on August 31, 2005



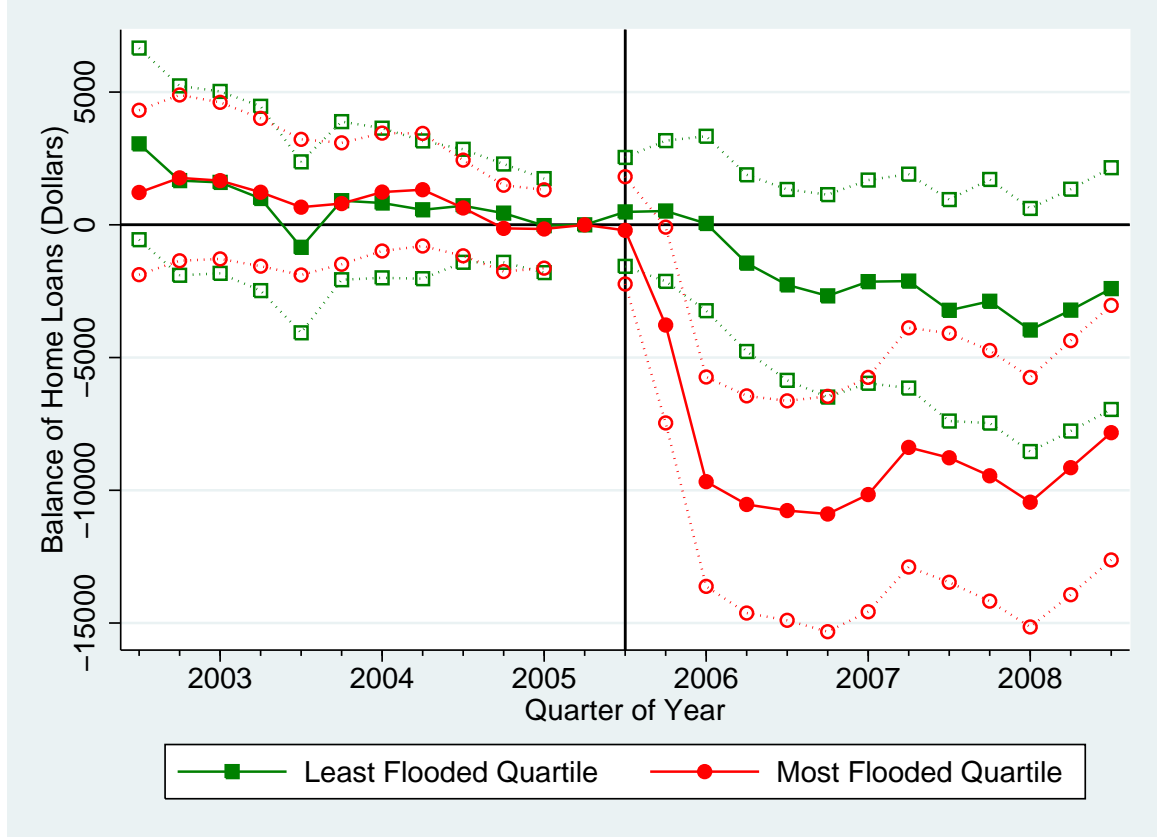
The figure shows mean census block flood depths on August 31, 2005 for New Orleans. Census blocks are divided into five groups: those with no flooding and four flooded quartiles (conditional on having a positive flood depth). The number of individuals in our sample in the non-flooded group is approximately one fifth of our sample. The source of the flood depth data is National Oceanic and Atmospheric Administration (NOAA). Please refer to the text for details.

Figure 3: Effect of Flooding on Total Debt Balance



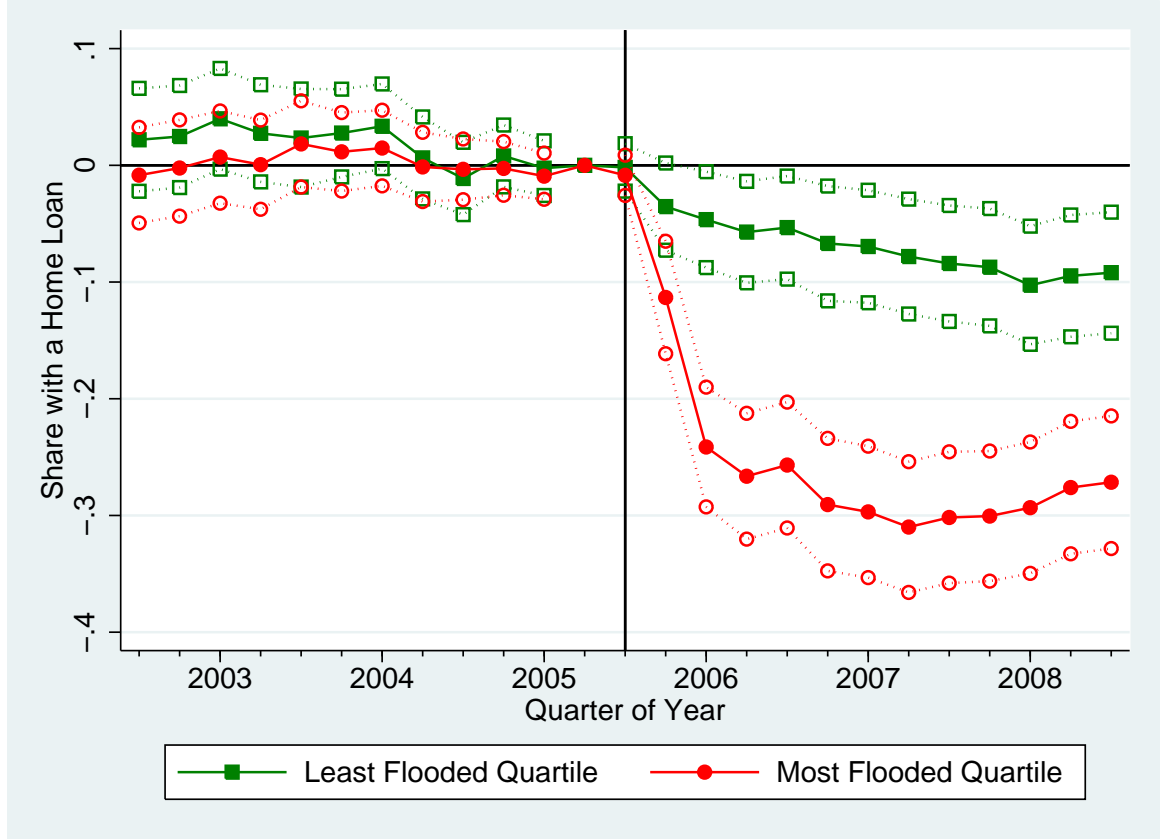
The figure plots difference-in-differences event time coefficients and 95% confidence intervals from the estimation of a version of Equation (2) that replaces the pre/post Katrina indicator with quarterly indicators. The dependent variable in the model is total debt balance in dollars. All coefficients can be interpreted as the change in debt balances for New Orleans residents living in a flooded block, as compared to residents in non-flooded blocks, relative to the quarter before Hurricane Katrina. The squares are point estimates for residents living in the least flooded blocks where the mean maximum block flood depth was less than 1.4 feet. The circles are point estimates for residents living in the most flooded blocks where the mean maximum block flood depth was greater than 5.4 feet. Standard errors use the Eicker-White formula to correct for heteroskedasticity and are clustered at the block level.

Figure 4: Effect of Flooding on Total Home Loan Balance



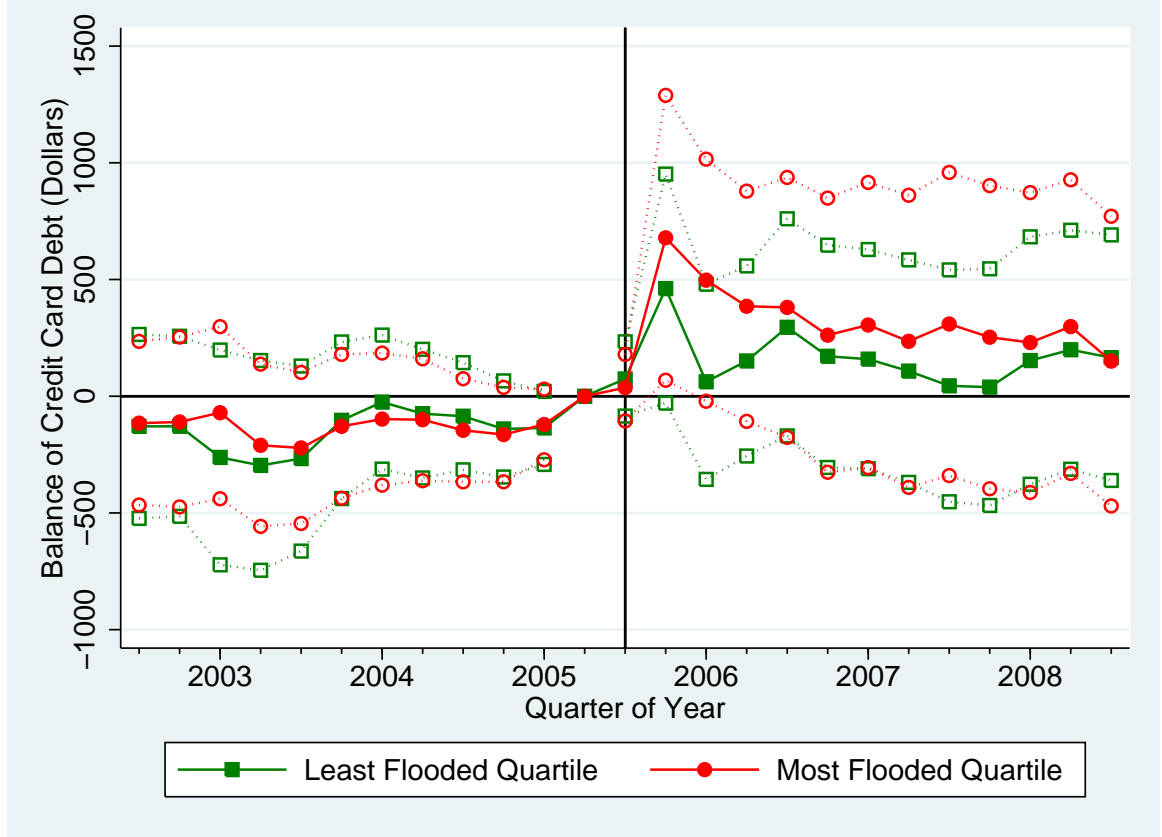
The figure plots difference-in-differences event time coefficients and 95% confidence intervals from the estimation of a version of Equation (2) that replaces the pre/post Katrina indicator with quarterly indicators. The dependent variable in the model is total home loan balance in dollars (2000 \$). All coefficients can be interpreted as the change in debt balances for New Orleans residents living in a flooded block, as compared to residents in non-flooded blocks, relative to the quarter before Hurricane Katrina. The squares are point estimates for residents living in the least flooded blocks where the mean maximum block flood depth was less than 1.4 feet. The circles are point estimates for residents living in the most flooded blocks where the mean maximum block flood depth was greater than 5.4 feet. Standard errors use the Eicker-White formula to correct for heteroskedasticity and are clustered at the block level.

Figure 5: Effect of Flooding on Having a Home Loan Conditional on Having a Home Loan in 2005Q3



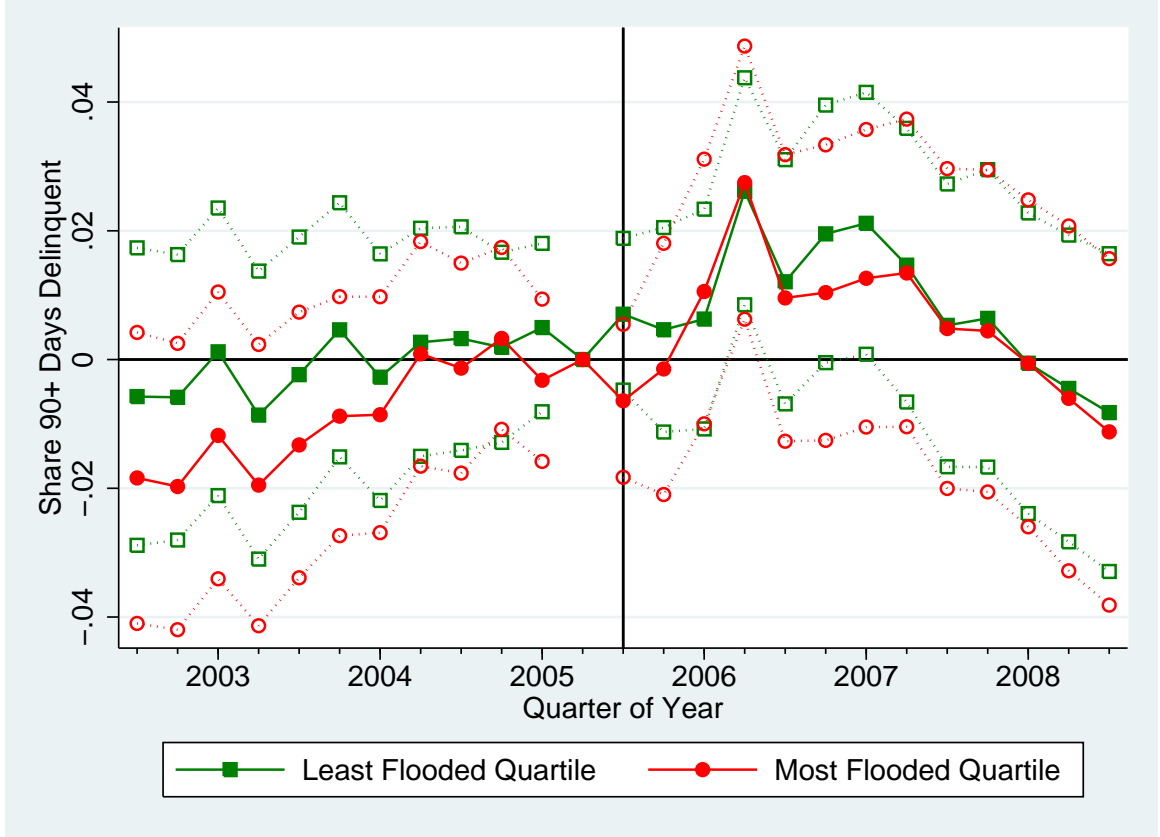
The figure plots difference-in-differences event time coefficients and 95% confidence intervals from the estimation of a version of Equation (2) that replaces the pre/post Katrina indicator with quarterly indicators. The dependent variable is an indicator variable equal to one if the individual has a home loan. The sample includes all residents of New Orleans in 2005Q3 who had a home loan. All coefficients can be interpreted as the change in the likelihood of having a home loan for New Orleans residents living in a flooded block, as compared to residents in non-flooded blocks, relative to the quarter before Hurricane Katrina. The squares are point estimates for residents living in the least flooded blocks where the mean maximum block flood depth was less than 1.4 feet. The circles are point estimates for residents living in the most flooded blocks where the mean maximum block flood depth was greater than 5.4 feet. Standard errors use the Eicker-White formula to correct for heteroskedasticity and are clustered at the block level.

Figure 6: Effect of Flooding on Credit Card Balances



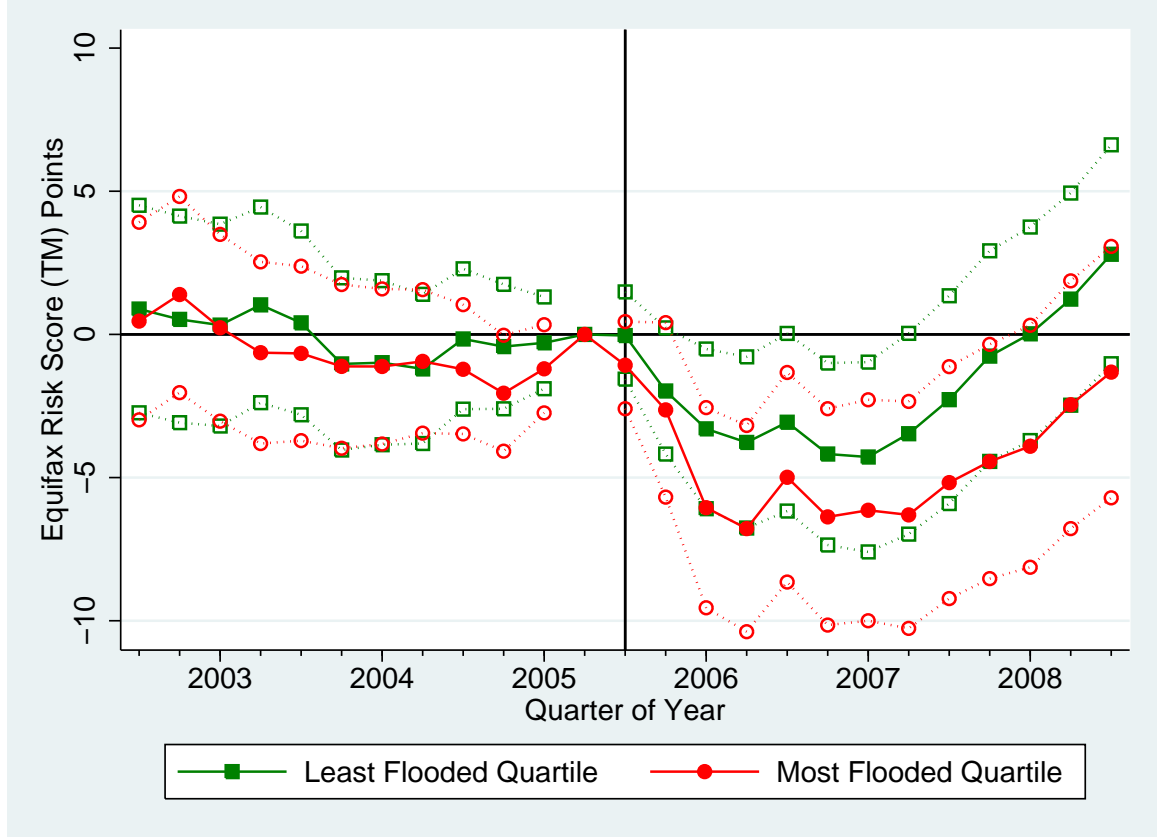
The figure plots difference-in-differences event time coefficients and 95% confidence intervals from the estimation of a version of Equation (2) that replaces the pre/post Katrina indicator with quarterly indicators. The dependent variable in the model is total credit card balance (2000 \$). All coefficients can be interpreted as the change in debt balances for New Orleans residents living in a flooded block, as compared to residents in non-flooded blocks, relative to the quarter before Hurricane Katrina. The squares are point estimates for residents living in the least flooded blocks where the mean maximum block flood depth was less than 1.4 feet. The circles are point estimates for residents living in the most flooded blocks where the mean maximum block flood depth was greater than 5.4 feet. Standard errors use the Eicker-White formula to correct for heteroskedasticity and are clustered at the block level.

Figure 7: Effect of Flooding on Having a 90+ Day Delinquency



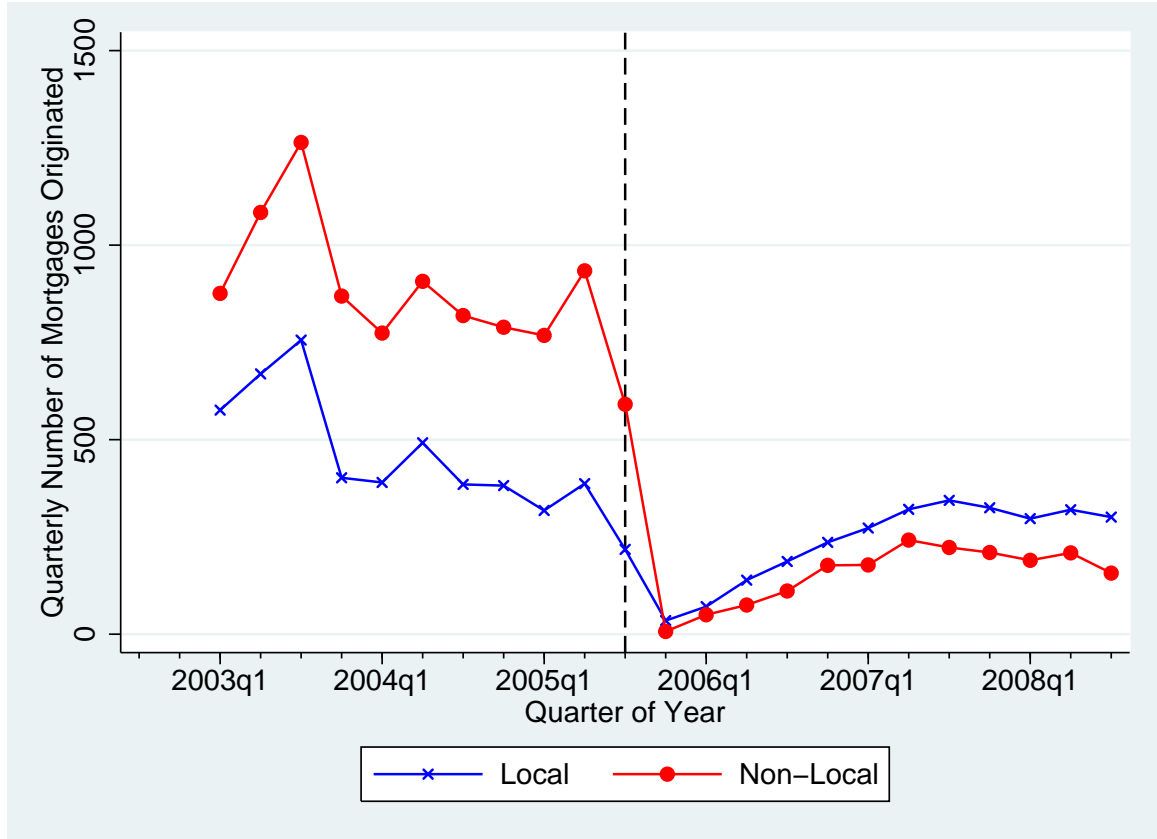
The figure plots difference-in-differences event time coefficients and 95% confidence intervals from the estimation of a version of Equation (2) that replaces the pre/post Katrina indicator with quarterly indicators. The dependent variable is an indicator for having at least one account 90 or more days past due. All coefficients can be interpreted as the change in delinquency rates for New Orleans residents living in a flooded block, as compared to residents in non-flooded blocks, relative to the quarter before Hurricane Katrina. The squares are point estimates for residents living in the least flooded blocks where the mean maximum block flood depth was less than 1.4 feet. The circles are point estimates for residents living in the most flooded blocks where the mean maximum block flood depth was greater than 5.4 feet. Standard errors use the Eicker-White formula to correct for heteroskedasticity and are clustered at the block level.

Figure 8: Effect of Flooding on Equifax Risk Score (TM)



The figure plots difference-in-differences event time coefficients and 95% confidence intervals from the estimation of a version of Equation (2) that replaces the pre/post Katrina indicator with quarterly indicators. The dependent variable is the Equifax Risk Score (TM). All coefficients can be interpreted as the change in risk scores for New Orleans residents living in a flooded block, as compared to residents in non-flooded blocks, relative to the quarter before Hurricane Katrina. The squares are point estimates for residents living in the least flooded blocks where the mean maximum block flood depth was less than 1.4 feet. The circles are point estimates for residents living in the most flooded blocks where the mean maximum block flood depth was greater than 5.4 feet. Standard errors use the Eicker-White formula to correct for heteroskedasticity and are clustered at the block level.

Figure 9: The Number of New Mortgages Originated by Local and Non-Local Lenders



The figure shows the total number of loans by quarter made in the most flooded quartile of census tracts split by whether the lender does a high share of their mortgage lending locally. Here, we define “local” as lenders that made 24% or more of their loans from 1997Q1 to 2005Q2 in the New Orleans CSA, while “non-local” is defined as lenders that made less than 24% of their loans from 1997Q1 to 2005Q2 in the New Orleans CSA. The series begin in 2003Q1 due to the fact that 2003 is the first year the HMDA data were reported using the 2000 Census tract boundaries. Conversion of HMDA data between 1990 and 2000 tract boundaries is discussed in section A of the Appendix.

Table 1: Characteristics of Blocks by Degree of Flooding

Flood Depth Quartile	No Flooding	1	2	3	4
Number of Blocks	2,541	2,215	2,214	2,214	2,214
Depth	0.00	0.57	2.40	4.49	6.87
Elevation	2.06	2.04	1.39	0.96	1.08
Proportion in Zone A	47.9%	40.6%	63.0%	86.3%	95.2%
Median Household Income	\$35,194	\$34,093	\$28,049	\$30,028	\$34,616
Poverty Rate	25.3%	26.7%	28.3%	27.8%	21.7%
Median Home Value	\$130,185	\$136,930	\$92,003	\$84,882	\$107,816
Proportion Owner Occupied	46.6%	48.7%	48.0%	50.8%	59.8%
Proportion with College Degree or Higher	31.5%	25.8%	17.7%	17.3%	22.6%
Proportion 65 or Older	11.8%	12.9%	11.7%	10.8%	13.2%
Proportion African American	46.7%	51.7%	64.4%	68.2%	61.3%
Proportion Hispanic	4.3%	3.2%	2.8%	3.1%	3.3%
Equifax Risk Score (TM)	652	645	635	628	647
Total Debt Balance	43,820	37,447	30,293	31,246	37,483
Have a Home Loan	29.6%	26.1%	27.9%	32.0%	32.7%
Have a 90+ Day Delinquency	23.4%	24.6%	27.2%	28.2%	25.9%

The top panel of the table compares the engineering data for five groupings of census blocks: those with no flooding and quartiles of blocks broken up by mean level of flooding for the block on August 31, 2005. The middle panel of the table compares block group level characteristics from the 2000 Census among the five flooded groups. The bottom panel compares sample means computed from Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP) data using the quarter before Katrina (2005Q2).

Table 2: Correlates of Flooding Depth

	(1)	(2)	(3)	(4)	(5)
Elevation and Flood Risk	X	X		X	X
Cubic and Interaction of Elevation and Flood Risk		X		X	X
Log Median Home Value of Block Group			X	X	X
Other Demographics of Block Group					X
<i>N</i>	11,283	11,283	11,283	11,283	11,283
<i>R</i> ²	0.327	0.399	0.036	0.399	0.445

This table presents statistics from OLS regressions of mean flood depth on August 31, 2005 by census block on covariates that could be correlated with flooding depth. Elevation and flood risk variables include the mean, minimum, and maximum elevation within the census block and the proportion of the census block that lies within the the 100-year flood plain (Zone A) as of 1999. Cubic and interaction of elevation and flood risk include a squared and cubed term of each of the previously mentioned variables as well as an interaction of the mean elevation and the proportion of the census block in the 100-year flood plain. Log median home value is from the 2000 Census and measured at the block group level. Other demographics of the block group are also from the 2000 Census and include: median household income, poverty rate, proportion of housing units that are owner-occupied, proportion of residents that have a college degree or higher, proportion of residents that are 65 or older, proportion of residents that are African American, and proportion of residents that are Hispanic.

Table 3: Impact of Flooding on Total Debt Balance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1st Quartile * Post Flood	-5,407*** (1,649)	-4,634*** (1,716)	-3,076* (1,854)	-3,198* (1,830)	-3,197* (1,831)	-3,197* (1,844)	-3,249* (1,864)
4th Quartile * Post Flood	-13,896*** (1,559)	-11,466*** (1,966)	-9,396*** (2,076)	-8,969*** (2,030)	-8,969*** (2,032)	-9,003*** (2,045)	-8,904*** (2,063)
1st Quartile	-5,107* (2,645)	-2,890 (2,626)	1,872 (2,482)	1,839 (2,394)	2,130 (7,239)		
4th Quartile	-5,576** (2,348)	1,024 (3,143)	-614 (2,740)	-1,227 (2,620)	1,879 (9,193)		
Post	11,449*** (1,131)	8,519*** (4,468)	-79,021 (51,566)	-87,570* (51,715)	-87,620* (51,747)	-86,526* (52,059)	-93,508* (52,705)
Elevation and Flood Risk		X	X	X	X	X	X
Cubic and Interaction of Elevation and Flood Risk		X	X	X	X	X	X
Log Median Home Value of Block Group			X	X	X	X	X
Other Demographics of Block Group			X	X	X	X	X
Cubic of Age				X	X	X	X
Census Tract FE					X		
Census Block FE						X	
Individual FE							X
<i>N</i>	245,375	245,375	245,375	245,375	245,375	245,375	245,375
<i>R</i> ²	0.004	0.024	0.080	0.116	0.134	0.392	0.745

This table presents a number of different specifications of OLS regressions of total debt balance (from the Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP)) on depth of flooding quartiles. Observations are at the individual level and contain all CCP primary individuals that were living in our flood depth coverage area in 2005Q3 and are continuously in the sample from 2002Q3 through 2008Q3 (9,947 individuals). Census block group variables correspond to the block group of residence in 2005Q3 and are described in the previous table note. Census tract and block fixed effects use the tract or block of residence in 2005Q3. Elevation, flood risk, cubic and interaction of elevation and flood risk, and all census block group characteristics are entered both alone and interacted with a post Katrina indicator. Robust standard errors clustered by census block of residence in 2005Q3 are shown in parentheses.

Table 4: Flood Insurance Claims, Foreclosure Rates, and Property Sales

	<u>Not Flooded</u>	<u>Least Flooded</u>	<u>Most Flooded</u>
Panel A: Flood Insurance Claims			
Ratio of 2005 Flood Insurance Claims to Outstanding Mortgage 2005Q2	0.11	0.89	0.92
Panel B: Foreclosures			
Difference in Foreclosure Start Rate 3 Years Before/After Katrina	-0.0008 (0.0006)	-0.0003 (0.0007)	-0.0018*** (0.0006)
Difference in Foreclosure Start Rate 6 Months Before/After Katrina	-0.0030** (0.0012)	-0.0018 (0.0020)	-0.0037*** (0.0011)
Panel C: Property Sales			
Ratio of Property Sales for 6 Months After Katrina to Outstanding Mortgage 2005Q2	0.06	0.02	0.01

Panel A reports statistics indicating how much of the collective mortgage debt could have been paid off if all flood insurance claims paid out were applied towards home loan (“mortgage”) balances. The statistics reported in Panel A show the ratio of 2005 flood insurance claims paid out to 2005Q2 mortgage balances for New Orleans residents living in each flood group. Panel B reports coefficients from univariate regression of a foreclosure start indicator on a post Katrina indicator variable. We run 2 different regressions for each of the 3 flood groups. Row 1 reports the post-Katrina point estimate and (robust) standard error using the 25 quarters of our panel. Row 2 considers just two quarters before (2005Q1 and 2005Q2) Katrina and two quarters after Katrina (2005Q4 and 2006Q1). Panel C reports a similar statistic as in Panel A, except that the numerator of the ratio is the total dollar value of home sales for the six months (2005Q4 and 2006Q1) after Katrina. The flood insurance claims data are from administrative records provided by the National Flood Insurance Program. The foreclosure rates and mortgage balances are from the CCP. Mortgage balances are multiplied by 20 to account for the 5% random sample. Property sales data are from the records of the Orleans Parish Assessors Office. Please refer to the Appendix Section A for a detailed data description.

Table 5: Non-local Lender Share and Reductions in Mortgages

	(1)	(2)	(3)	(4)	(5)
1st Quartile * Post Flood	-0.081*** (0.022)	-0.051* (0.027)	-0.052* (0.027)	-0.045 (0.027)	-0.018 (0.028)
4th Quartile * Post Flood	-0.263*** (0.026)	-0.161*** (0.038)	-0.167*** (0.038)	-0.173*** (0.038)	-0.141*** (0.040)
1st Quartile * Post Flood * Non-Local		-0.062 (0.046)	-0.059 (0.046)	-0.047 (0.046)	-0.000 (0.048)
4th Quartile * Post Flood * Non-Local		-0.174*** (0.045)	-0.168*** (0.045)	-0.173*** (0.047)	-0.155*** (0.047)
Control for Pre-Katrina Equifax Risk Score (TM)			X	X	X
Control for High Share African American Blocks				X	X
Control for Flood Insurance Coverage					X
<i>N</i>	66,509	66,509	66,509	66,509	66,509
<i>R</i> ²	0.378	0.378	0.381	0.382	0.382

This table presents four different specifications of OLS regressions of an indicator of whether an individual has any mortgage accounts (first lien, HELOAN, or HELOC from Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP)) on depth of flooding quartiles and interactions of those quartiles with an indicator of whether the tract had a high share of non-local mortgage lending. High share of non-local lenders is defined as a tract where the typical loan is originated by a lender that has at least 76% of their lending outside of the New Orleans CSA. The calculation is made using HMDA loan origination data from 1997 through August 28, 2005. The 76% cutoff is the median for our estimation sample. Observations are at the individual level and contain all CCP primary individuals that had any type of mortgage, were living in our flood depth coverage area in 2005Q3, and are continuously in the sample from 2002Q3 through 2008Q3 (2,795 individuals). Standard errors clustered by census block of residence in 2005Q3 are shown in parentheses. The specifications in columns (3), (4), and (5) include the interaction of a post-Katrina indicator and a cubic function of the mean of the individual's Equifax Risk Score (TM) during the pre-Katrina period (2002Q3-2005Q2). The specifications in column (4) and (5) include an interaction of an indicator for whether the block (in which the individual resided in 2005Q3) is over 95% African American and flood depth and post Katrina and all two-way interactions of those variables. Column (5) adds a control for the flood insurance coverage rate of the block. We implement this control by interacting the ratio of 2005 flood insurance claims to outstanding mortgage balances in 2005Q2. The means of this variable by flood depth area are shown in Panel A of Table 4 and its construction is discussed in the table notes. An indicator for post Katrina (2005Q3 and after), a cubic function of age, and individual fixed effects are included in all specifications.