Underwater? Household Finance and Migration Decisions after a Flood: The Case of Hurricane Katrina

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March 4, 2014

Abstract

Hurricane Katrina was the most costly hurricane, in terms of property damage, ever to hit the United States and flooded most of the City of New Orleans. We investigate the impact that flooding due to Katrina had on individuals' debt levels and on their propensity to leave New Orleans. We use individual-level credit and debt data provided by a large credit scoring company.

We find that higher levels of flooding resulted in larger *reductions* in total debt balances. The reduction in total debt is driven almost exclusively by lower home loan debt (e.g. mortgages). Surprisingly, there is only modest evidence that residents used credit card debt to smooth consumption and pay for unexpected costs after the flood. Flooded residents have 90 day delinquency rates that are approximately 10% higher, relative to non-flooded residents, for a year-long period following Katrina. The reduction in home loan debt is 66% larger in census tracts with a higher share of mortgages originated by non-local lenders. This result is consistent with media accounts that banks, and particularly banks without a local presence, pressured home-owners to use flood insurance checks to repay their mortgage loans rather than to rebuild their homes.

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The authors would like to thank Jesse Gregory, Mark Kutzbach, Sam Schulhofer-Wohl, and Tara Watson for helpful comments and suggestions. The authors would like to thank seminar participants at the Association of Environmental and Resource Economists 2013 Summer Conference, Urban Economics Association 2013 Annual Meetings, and the Federal Reserve System Committee on Regional Analysis 2013 Meeting for their helpful comments on this project. We also thank Commander Timothy Gallagher and Christopher Locke for their assistance in accessing and interpreting the New Orleans area flood depth data. Kyle Fee and Anthony Gatti provided outstanding research assistance. The opinions expressed are those of the authors and do not necessarily represent the views of the Federal Reserve Bank of Cleveland or of the Board of Governors of the Federal Reserve System.

1 Introduction

The aim of this paper is to provide causal, individual-level estimates of the impact that unexpected natural disasters have on household finances and migration decisions. In particular, we investigate the role that borrowing from local versus non-local lending institutions has on individual-level outcomes. The economic literature has focused primarily on the aggregate effect of natural disasters (**?**). Much less is known about individual-level outcomes (Basker and Miranda [2013]; Gregory [2013]).

The paper measures the impact on personal finance and migration decisions for individuals who are known to have resided in a flooded Census Block within the city of New Orleans at the time of Hurricane Katrina in 2005. The paper uses a difference-in-differences research design which exploits quasi-exogenous variation in who is flooded. We compare the financial and migration outcomes for residents in flooded Census Blocks to residents in non-flooded Census Blocks.[1] Our strategy is to compare financial and migration 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, the elevation of the Census Block, or socioeconomic characteristics of the Census Block Group. 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.

The financial impact is measured using person-specific credit agency data on credit score, bill delinquency, and personal debt. Importantly, we are able to follow individuals who change residences after Hurricane Katrina. The financial data are matched at the block-level to block-specific flood data. The flooding data are from satellite images that show whether a block is flooded and the elevation of flood waters. The data contain snapshots of the flood depth on a number of days over the two weeks following the breaching of the levees in the wake of Hurricane Katrina. Thus, even within the flooded group we can compare outcomes across the intensive margins of severity and duration of flooding.[2]

The first question this paper asks is what is the impact of flooding on household

[1]Preliminary findings show similar results when residents of cities with similar socioeconomic characteristics to New Orleans (such as Memphis and St. Louis) are used as controls.

[2]Our current analysis focusses on the peak depth of flooding, but we plan to explore whether we can learn more by incorporating variation in flood duration that is not correlated with peak depth.

finances as measured by debt levels, delinquency, and credit score? We focus on the debt side of the household balance sheet. We consider these measures as revealing of how well prepared households are to cope with the unexpected financial impact of a flood.

We find that higher levels of flooding resulted in larger reductions in total debt balances. 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.[3] 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.[4] Surprisingly, there is only modest evidence that residents used credit card debt to smooth consumption and pay for unexpected costs after the flood. There is little to no effect on other types of debt such as auto and student loans. We do find that flooded residents have 90 day delinquency rates that are approximately 10% higher, relative to non-flooded residents, for a year-long period following Katrina.

The second question we investigate is whether individual outcomes after the flood differ based on the likelihood that the mortgage was held by a local lender. 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 66% less likely to have a home loan after Katrina if they live in a census tract with a high share of loans made by non-local lenders.[5] This result is 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.

Flood insurance payout data support this interpretation. Flood insurance payouts are highly correlated with flooding, are not correlated with whether the home loan

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

[4]Home loan debt includes mortgages, home equity loan, and home equity lines of credit.

[5]This result does not change if we define a non-local lender using the share of the number of loans (rather than loan value). There is a 99% 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 CSA. The branch definition provides substantively similar results.

was originated by a local bank, and are of a magnitude large enough to explain the reduction in mortgage debt. Foreclosure rates do not change markedly after Katrina and would need to be more than an order of magnitude larger to explain the size of the reduction in mortgage debt.

One economic explanation is that the success of companies with a large lending presence in New Orleans is highly dependent on the economic well-being of the city. A large proportion of their customer base is in New Orleans. 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 negative welfare consequence for residents who used insurance payouts to reduce debt, rather than repair their homes, can be large if residents are unable to obtain a new home building loan at the same rate as their mortgage, or if paying off the mortgage disqualifies homeowners for public assistance. Preliminary evidence suggests that there was a tightening of credit after Katrina. Further, New Orleans residents who paid off their home loan did not qualify for the largest available source of public assistance, the Louisiana Road Home program, which awarded grants of up to $150 thousand to homeowners for rebuilding costs.

Finally, we examine the impact of flooding on migration rates. We find that the likelihood of leaving the City of New Orleans increases sharply after Katrina. This increase is greater for areas with deeper flooding.

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.

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. The maximum storm surge in the vicinity of New Orleans was about 18 feet (ILI [2006]).[6] 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.[7] 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, 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. Total property damage is estimated to be twice as large as Hurricane Sandy, the next most costly storm, which made landfall in New Jersey in 2012. Nevertheless, despite the massive economic damage, little is known about the financial impact on individual residents.

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.[8] The Federal Government sets the rates for flood insurance through the National Flood Insurance Program (NFIP). Flood insurance polices are sold by private insurance companies at the rates specified by the NFIP. There is a $250 thousand limit on the amount of insurance available for the structure and a $100 thousand limit on insurance for personal items (FEM [2002]).

In the event of a flood, flood insurance claims checks are written by the private

[6] Overall, 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]).

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

[8] As reported in the article "After Katrina, pundits criticized New Orleans, claiming too many residents had no flood insurance. In fact, few communities were better covered", *The Times-Picayune* (March 19, 2006).

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 flood insurance payout should be used to repair damages to the home (HUD [2012]).[9]

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 following Hurricane Katrina report that some mortgage companies pressured homeowners to use the flood insurance money to pay down their mortgages, rather than for repairs (Callimachi [2006]; Butler and Williams [2011]).

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 assistance 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

[9] HUD oversees Federal Housing Administration (FHA) securitized mortgage loans.

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. 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. Approximately nine billion dollars was dispersed during the first four years of the program (Gregory [2013]).

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), Vetrans Affairs (VA), Freddie Mac, or Fannie Mae provided mortgage securitization had a foreclosure moritorium 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.

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.[10] 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.[11] We divide the flooded area into four flooding quartiles based

[10]With the addition of Algiers (see next footnote), the 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 flood depth data also cover a few other townships including: Arabi, Chalmette, Jefferson, Meraux, Metairie, Poydras, and Violet. Throughout the paper we will refer to the flood depth coverage area as the City of New Orleans.

[11]The National Oceanic and Atmospheric Administration (NOAA) did not generate flood depth data for the Algiers neighborhood. According to Wikipedia, there was no flooding in Algiers during Hurricane Katrina. We are looking for other sources to verify this claim. The fact that Algiers was an official evacuation location for residents in other parts of the city is consistent with a lack of flooding.

on Census blocks. Flood depth for the first flooded quartile is 0-1.4 feet, while 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.[12]

The National Oceanic and Atmospheric Administration (NOAA) provided us with the flood information shown in Figure 2. NOAA derived the flood depth data by combining a New Orleans area topography map and aerial flood photographs. The topography map was created using lidar mapping prior to Hurricane Katrina.[13] The August 31, 2005 flood photograph used to generate the flood depth data may slightly understate peak flood depths.[14] The flood depth data have a depth resolution of one foot increments and a geographical resolution of 25 square meter squares.

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 the 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 and 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 include 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 mortgages, auto loans, credit card accounts, and student loans. Home mortgage information separately tracks 1st mortgages, as well as, 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,

[12]We 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 from most of the empirical analysis due to poor balance of observable covariates (see Table 1).

[13]Lidar (light detection and ranging) mapping is a method to collect very accurate landscape elevation data using laser altimetry. Light impulses are typically shot from above by a passing aircraft (Lid [2012]).

[14]Flood 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 some parts of the city.

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.[15] Appendix Table 6 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]).

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.[16] Appendix Figure 13 is a census block map of New Orleans that shows blocks as being completely in the 100-year flood plain, completely outside of the flood plain, or containing a portion of the block in 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 flood plain.

The second source of engineering data is mean land elevation above sea level. Appendix Figure 14 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 13 and 14, demographic and socioeconomic characteristics from the 2000 Census, and

[15] The Equifax Risk Score is a trade marked measure of consumer credit risk and ranges from 280-850. A higher score indicates a higher measure of creditworthiness.

[16] The 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)

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 socioeconomic 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 Q2 2005 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 depth of flooding on August 31, 2005. The specification shown in column (1) includes only the mean, minimum, and maximum elevation above 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 (the smallest geography available in public use tabulations) measure of median home values explains only 3.6% of the variation in flood depth by itself and does not change the R-square 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 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

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

,where $y_{i,t}$ is a particular outcome for individual i in period t. 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.[17] 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 measure 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 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.[18] 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 decreases in total debt at the time of Hurricane Katrina. Approximately two quarters after Katrina, 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.

[17]The sample estimated 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 last 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.

[18]Throughout 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.

Of course, similar pre- and post-flood trends between the three groups does not guarantee that had each flooded group *not* been flooded that 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.[19]

We consider some specifications that specifically 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. We also add cubic in age and individual fixed effects to the baseline specification to control for life-cycle patterns in the outcome variables and any time-invariant, person-specific unobservable variables that may influence the outcomes. The resulting specification is,

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

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

[19]Table 1 shows that while observable socioeconomic variables do differ in some cases between the 1st and 4th flooding quartiles that 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]).

5 Results

5.1 Effect of Flooding on Debt Balance

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.[20] The simple difference-in-difference 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 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 yearly debt balances for our entire sample period. The event study approach allows us to analyze whether the reduction in debt balances persist 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 2005 quarter 2 interactions are the omitted category. Figure 3 plots the coefficients and upper and lower confidence bounds for the 1st (squares) and 4th (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

[20] Recall 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 balance sample with three years pre- and post- Katrina as a compromise between the length of the panel and the number of individuals in the sample.

in debt balance for individuals in the 4th quartile begin immediately after Katrina and persist until the end of the sample. None of the quarterly coefficients for flooded quartile 1 are statistically significant at the 5% level. The drop is largest in 2007 and early 2008, before rebounding a bit.[21]

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, suggesting that a reduction in home loan balances is driving the reduction in total debt. Figure 5 keeps home loan debt as the outcome, but limits the sample to only include people that had a home loan at the time of Katrina. Roughly one third of the people in our sample had a home loan at the time of Katrina. Again the pattern is similar, but the reductions are much larger in magnitude. Part of this larger reduction might be explained by the downward trend in the pre-period. At the beginning of our sample period, residents in the 4th quartile group had an average home loan balance that was about $10,000 higher than residents in the non-flooded group. However, this difference disappears about one year before Katrina.

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 point estimates and confidence intervals for the event study version of Equation (2) with total credit card balance as the dependent variable. The only statistically significant effect is a $700 increase in the 1st quarter after Katrina for the most flooded group. This represents a 23% increase over a pre-Katrina mean credit card balance of about $3,100. The results do not change when we condition on having a credit card at the time of Katrina.[22]

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 increased delinquency beginning about a year after Katrina. One reason for a delayed effect in delinquency rates

[21]This 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.

[22]The only other debt category (other than home debt and credit cards) to increase in debt balance after Katrina is auto loans (significant at the 10% level). See Appendix Figure 15.

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 (relative to a pre-Katrina mean of about 650) 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 Why are Home Loan Balances Dropping?

The previous sub-section shows a striking drop in home loan balances in flooded areas relative to non-flooded areas. This reduction is largely caused by drops in loan balances for individuals with mortgages at the time of Katrina, rather than a drop in the number of individuals obtaining mortgages after Katrina. This is shown in Figure 9. There are larger relative drops in the fraction of people that have a home loan in areas with deeper flooding.[23]

5.2.1 Local versus Non-local 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 whether the home loans that we observe in the CCP data 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 non-local lender, we construct a tract-level measure of the degree of non-local mortgage lending activity in the period leading up to Katrina.

We construct this 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 loans reported as originated in the Home Mortgage Disclosure Act (HMDA) data between January 1997 and the end June of 2005.[24] We merge these loans with branch location data by year from the FDIC's Summary of Deposits data. We construct three different measures of "local" lending institutions.

[23]The estimates shown in the figure are from the sample of people that had a home loan at the time of Katrina.

[24]January 1997 is the earliest available date for the HMDA lender data.

Our preferred measure of local lending is based on the proportion of loans each lender has in the New Orleans CSA relative to their total lending activity. For each lender who issued at least one HMDA-measured home loan in New Orleans (between January 1997 and June 2005) we calculate the proportion of loans to home owners in the CSA relative to their total loans. 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 home loan in the census tract issued over the same time period. A census tract is in the upper quartile for *non-local* loans if the census tract average lender-specific loan ratio is 20% or less.[25] We create a non-local dummy variable that equals one for these census tracts.

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 99% 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-Metarie-Hammond Combined Statistical Area (CSA) which includes 10 parishes in Louisiana and one county in Mississippi.[26] 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 to the end of June 2005.[27] One quarter of the people in our CCP data lived in a tract with a local lending share of 32% or less.[28].

Table 4 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 4 uses our preferred measure for a local lender, which is based on the share of loans made in

[25]This implies that, on average, a loan in the tract is from a lender that makes at least 80% of its loans outside of the New Orleans CSA.

[26]The 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 plan to do more robustness checks, but as a first cut, we drop the credit union loans (only about 1%) and assume all of the HUD regulated lenders have no branch presence.

[27]The HMDA data switch from using 1990 Census tract boundaries to 2000 Census tract boundaries in the 2003 data. Fortunately, only a small number of the tracts in our coverage area change boundaries from 1990 to 2000. We plan to use the 1990 to 2000 population-based tract relationship file to allocate pre-2003 loans to the appropriate 2000 Census tract.

[28]This is also true when we restrict to just those people that had a home loan at the time of Katrina

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 9. However, to limit the number of coefficients to report, we use the specification shown in Table 3 Column (7) that uses a single post-Katrina indicator and its interaction with the variables of interest rather than quarter indicators and their interactions.[29]

Column (1) reinforces the quarterly event time result shown in Figure 9. Relative to the non-flooded group, the propensity to have a home loan drops after Katrina in places where flooding was deeper. Column (2) adds the high non-local lending share indicator interacted with the flood depth indicators and the post-Katrina indicator.[30] 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 16 percentage point (66%) reduction in the propensity to have a home loan in a tract with a high share of non-local lending. The point estimates for the least flooded group are negative, but not significant.

Column (3) adds a cubic function of the 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 stable across these alternative specifications. Robustness checks that use the MSA branch measure for a local lender, only consider HMDA mortgages in the pre-Katrina panel period (2002Q3-2005Q2), and change the non-local threshold cutoff from the 75th percentile to the 50th percentile all confirm the same pattern of findings as in Table 4.[31]

[29]Recall 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 (relative to clustering at the Census Block) and does not change the statistical significance for any of the estimated coefficients.

[30]The 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.

[31]See Appendix Table 7.

5.2.2 Flood Insurance as a Mechanism

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 (HUD [2012]). 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.

Table 5 provides evidence on flood insurance claims, foreclosure rates, and mortgage origination. Flood insurance payouts are highly correlated with flooding and the magnitude of the insurance payout is large enough to account for the size of the estimated reductions in home loan debt. The first row of Panel A calculates a measure of flood insurance payout for New Orleans homeowners by depth of flooding. We compare the total 2005 flood insurance claims paid to homeowners to the total mortgage debt owed by residents in the quarter before Katrina.[32] For the most flooded group, the ratio of insurance claims to mortgage debt is 0.91. This implies that, collectively, the amount of flood insurance paid out would be large enough to pay off 91% of the total existing mortgage debt for these homeowners. The same statistic for the non-flooded group is 11%.[33] Finally, flood insurance claims are not correlated with whether the home loan was originated by a local bank (not shown in the table).

An alternative explanation for the striking reduction in mortgage debt after Katrina would be an increase in the foreclosure rate. There is no difference in the foreclosure rate for homeowners in any of the three flood groups (Panel A, row 2). The pre-Katrina average quarterly foreclosure rate is 2.6 foreclosures for every thousand homeowners. The post-Katrina foreclosure rate would need to be at least an order of magnitude larger to account for the observed reduction in mortgage debt.[34]

[32]The flood insurance payout data is for 2005 and is only available aggregated by zip code and flood zone. We formed the ratio by aggregating total home loan balances as of 2005Q3 and dividing the claim payouts by this aggregate. Next we merged this ratio in to the CCP by zip code*flood zone.

[33]We 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 calender year.

[34]Rows 2 and 3 of Panel A show regression statistics from a time-series regression of the mean

Table 5 Panel B shows the difference in the number and total value (in millions of dollars) of mortgages originated by local and non-local lenders before and after Hurricane Katrina for properties in New Orleans. There is a much larger reduction in both the number of new loans and the value of new loans originated by non-local lenders.[35] This is consistent with the reduction in the value of existing mortgage loans for homeowners living in high non-local lender blocks. Non-local lenders interested in lowering their exposure to New Orleans can do so by reducing current mortgage debt by pressuring homeowners to pay down their mortgages with flood insurance money and by issuing fewer new mortgage loans.

Figure 10 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. After Katrina, the number of new mortgages issued by local banks returns to the pre-Katrina level beginning around 2007. The number of new mortgages issued by non-local lenders remains much lower throughout the post-Katrina period.

5.2.3 Welfare Consequences

The negative welfare consequence for residents who used insurance payouts to reduce debt, rather than repair their homes, can be large if residents are unable to obtain a new home building loan at the same rate as their mortgage, or if paying off the mortgage disqualifies homeowners for public assistance. Preliminary evidence suggests that there was a tightening of credit after Katrina. Further, New Orleans residents who paid off their home loan did not qualify for the largest available source of public assistance, the Louisiana Road Home program, which awarded grants up to $150 thousand to homeowners for rebuilding costs.

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quarterly foreclosure start rate on post Katrina indicator variables. Each column is a separate regression containing 25 quarterly observations corresponding to our sample period (2002Q32008Q3). Row 2 shows the coefficient on the post Katrina indicator (with robust standard error in parentheses). Row 3 shows the constant from the regression.

[35]In Panel B the dependent variable is either the total number of mortgages originated per quarter (Row 1) or the total dollar amount (in Millions) of mortgages originated per quarter (Row 2). The data are from HMDA. The regression in the "Local" column uses only loans made by lenders that made 20% or more of their loans from 19972005Q2 in the New Orleans CSA, while the regression in the "Non-Local" column uses only loans made by lenders that made less than 20% of their loans from 19972005Q2 in the New Orleans CSA.

5.3 Effect of Flooding on Migration

In addition to the impact of Katrina on household debt, the hurricane also had a large effect on migration rates. To assess the impact of flooding on migration, we construct indicator variables for whether a person was living in the City of New Orleans in the previous quarter but left New Orleans in the current quarter. We create two migration variables using two different duration definitions: left New Orleans for (at least) one year, and left New Orleans for (at least) three years. These variables equal one in the first quarter the resident leaves New Orleans and zero otherwise. We also create analogous variables for whether a resident of New Orleans leaves the New Orleans CSA.

We estimate the migration rates using the same event study model as before (Equation 2 with quarterly interactions) except that we use the migration indicator as the dependent variable. The sample is also different. We include all individuals in the CCP that lived in New Orleans at any time in the three years prior to Katrina. That is, we do not restrict the sample to residents living in New Orleans when Katrina hits (2005Q3). The change in sample is necessary to estimate a pre-period migration rate.

Figure 11 plots the coefficients of the interactions between the flood depth quartiles and the year and quarter indicators. The omitted quarter is 2005Q2. The dependent variable is the indicator for moving away from the City of New Orleans for at least one year. The figure shows that in the quarter after Katrina (2005Q4) the relative increase in moving out of the city for at least a year was about 10 percentage points in the quartile of blocks with the deepest flooding. There was also a significant relative increase in leaving the city for the least flooded quartile of 3 percentage points. These heightened relative exit rates taper off over the next 2 to 3 years.

Figure 12 shows the same type of plot as Figure 11 except that the dependent variable is an indicator of whether the person has moved away from the City of New Orleans for at least 3 years. The figure looks quite similar to the previous figure except that the size of the increase in the propensity to leave the city after Katrina is smaller. The relative increases in the propensity to leave the city are 7 and 2 percentage points in the quarter after Katrina in flood depth quartiles 4 and 1, respectively. The difference between these increases and those shown in the previous figure indicate that there was a significant amount of return migration; people that left for more than a year but less than 3 years.

The plots using the variables indicating leaving the New Orleans CSA for a year or more and 3 years or more as the dependent variable look similar in shape to the previous two figures, but the response is smaller in magnitude. In the quarter after Katrina the increase in propensity to leave the CSA using the 1 year or more measure ranges from 4 to 2 percentage points of relative increase. The same range for the 3 year measure is from about 3 to 1 percentage points. Comparing these estimates to those for the City of New Orleans suggests that many of the people that left the city did not leave the CSA.

5.4 Conclusion

We find that flooding after Hurricane Katrina in the city of New Orleans leads to a reduction in overall household debt levels. This reduction in debt levels is driven by a reduction in home loan balances after Katrina. The reduction in home loan balances is greatest for residents living in more flooded areas. There is modest evidence that flooding led to temporarily higher levels of credit card debt and little to no evidence that flooding led to higher levels of auto, or student loan debt. We do find that flooded residents have 90 day delinquency rates that are approximately 10% higher, relative to non-flooded residents, for a year-long period following Katrina.

Consistent with many other studies, we find that the likelihood of leaving the City of New Orleans increases sharply after Katrina. We contribute to this body of research by showing that migration rates are higher in areas with deeper flooding.

A homeowner in the most flooded areas of New Orleans is 66% less likely to have a home loan after Katrina if they live in a census tract with a high share of loans initiated by non-local lenders. This result is consistent with media accounts that banks, and particularly banks without a local presence, pressured home-owners to use flood insurance checks to repay their mortgage loans rather than to rebuild their homes.

Finally, we want to emphasize that this research is still in progress. There are several ways in which we plan to enrich our analysis. First, we plan to consider alternative control groups outside of New Orleans. We are interested in using other cities with socioeconomic and demographic characteristics that are similar to New Orleans as controls (for example, residents of St. Louis and Memphis). The advantage of a control group outside of New Orleans is that it allows us to estimate the impact of flood levels on household finances inclusive of city-wide effects that may have impacted those residents in non-flooded New Orleans Census Blocks. For example, Katrina changed city-wide services available and effected the entire metropolitan labor market. Our current approach that uses the non-flooded New Orleans residents as the control group in the difference-in-differences estimation approach nets out any common, city-wide Katrina impact on household finances.

Second, we hope to improve on the welfare analysis which compares homeowners living in high local lender versus high non-local lender census blocks. Our current conjecture is that homeowners in high non-local lender census blocks likely suffer a welfare loss relative to homeowners in high local lender census blocks. Nevertheless, we have not yet formalized this analysis.

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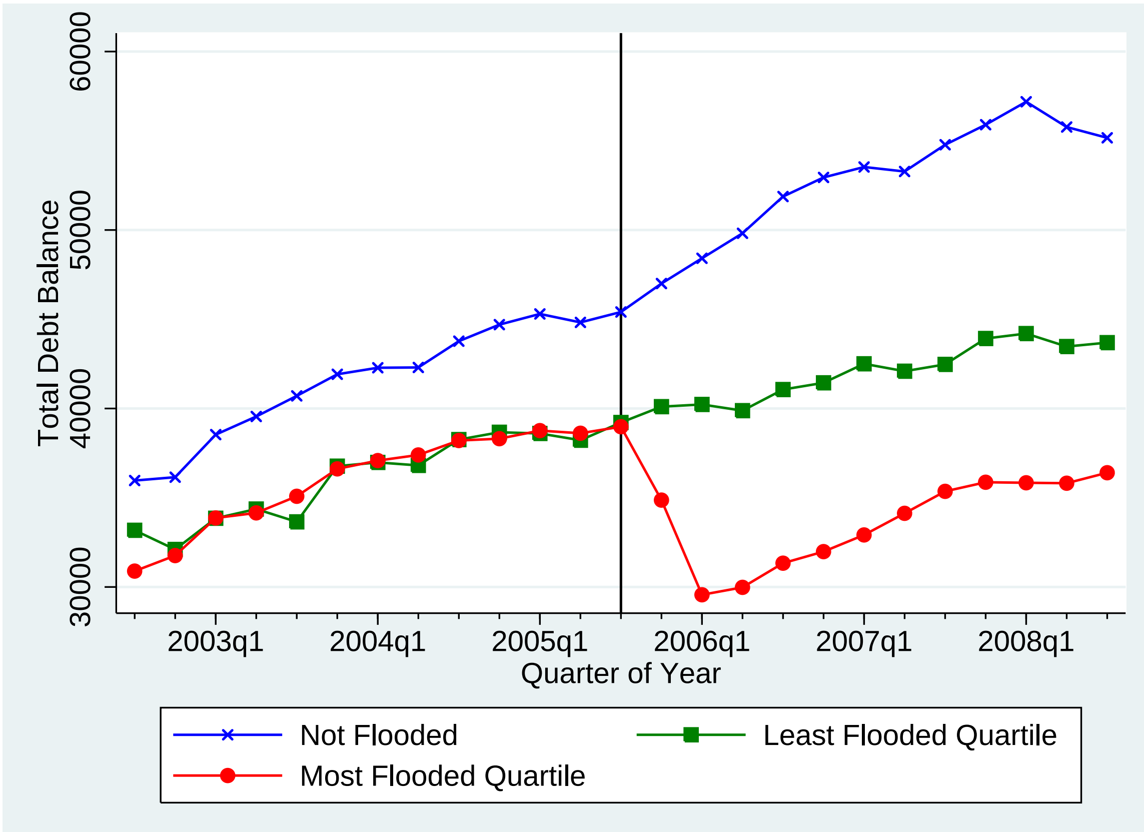
7 Figures and Tables

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

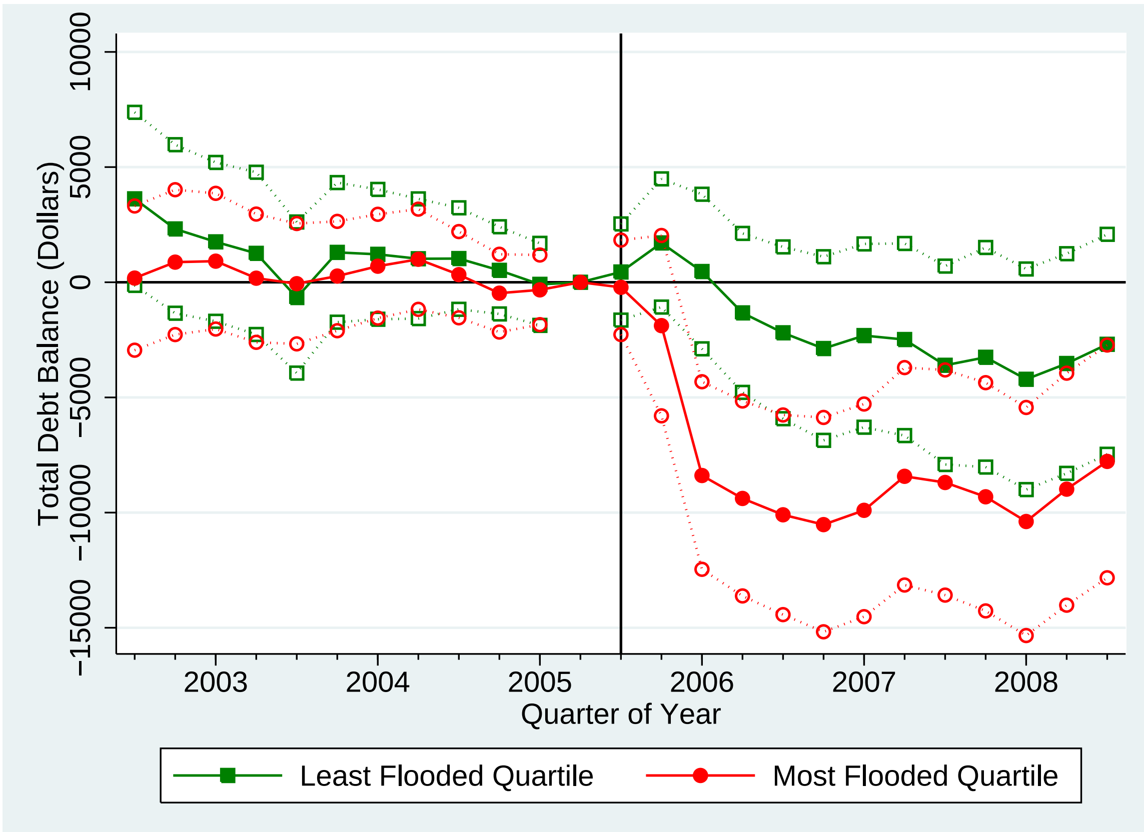


The figure plots quarterly individual debt balances (2000 $) for residents living in New Orleans at the time of Hurricane Katrina (2005q3). Average debt balances are shown separately for residents living in non-flooded, the least flooded, and the most flooded census blocks. The least flooded blocks are 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

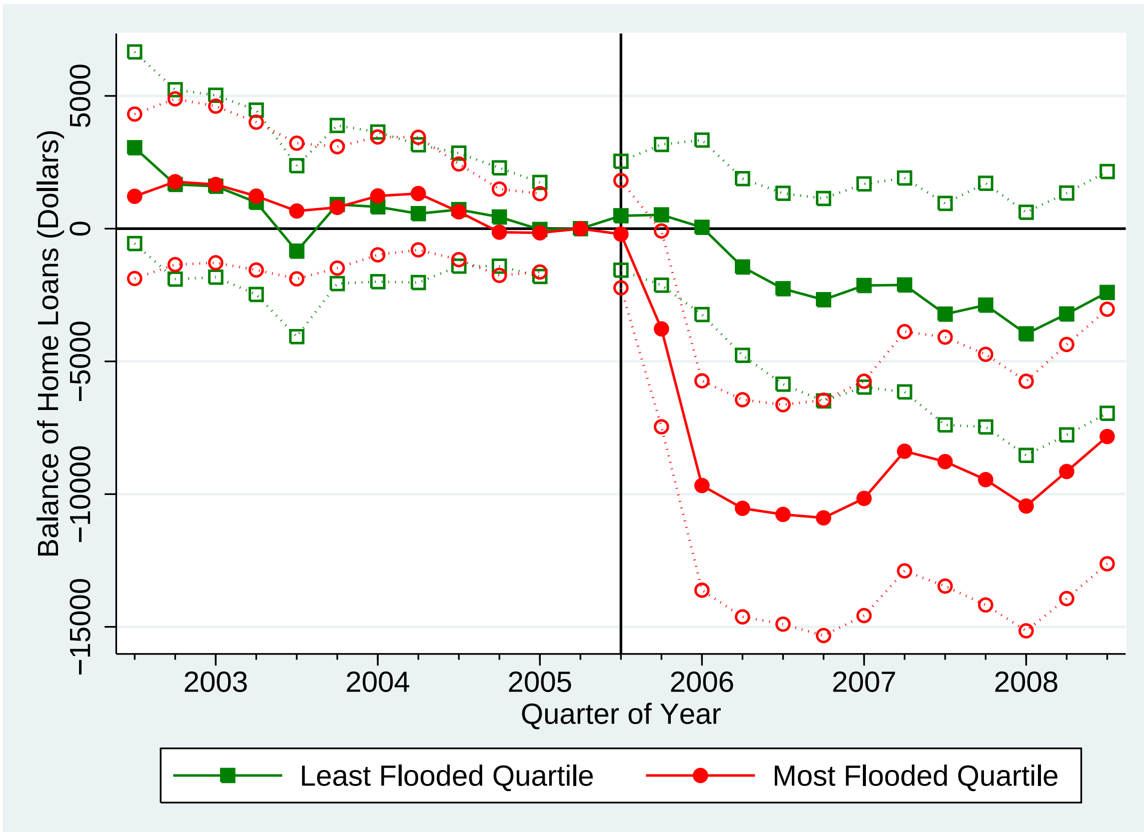
The figure shows mean census block flood depths on August 31, 2005 for the city of New Orleans. Census blocks are divided into five groups: those with no flooding and four flooded quartiles (conditional on having a positive flood depth). The number of individuals in our sample in the non-flooded group 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



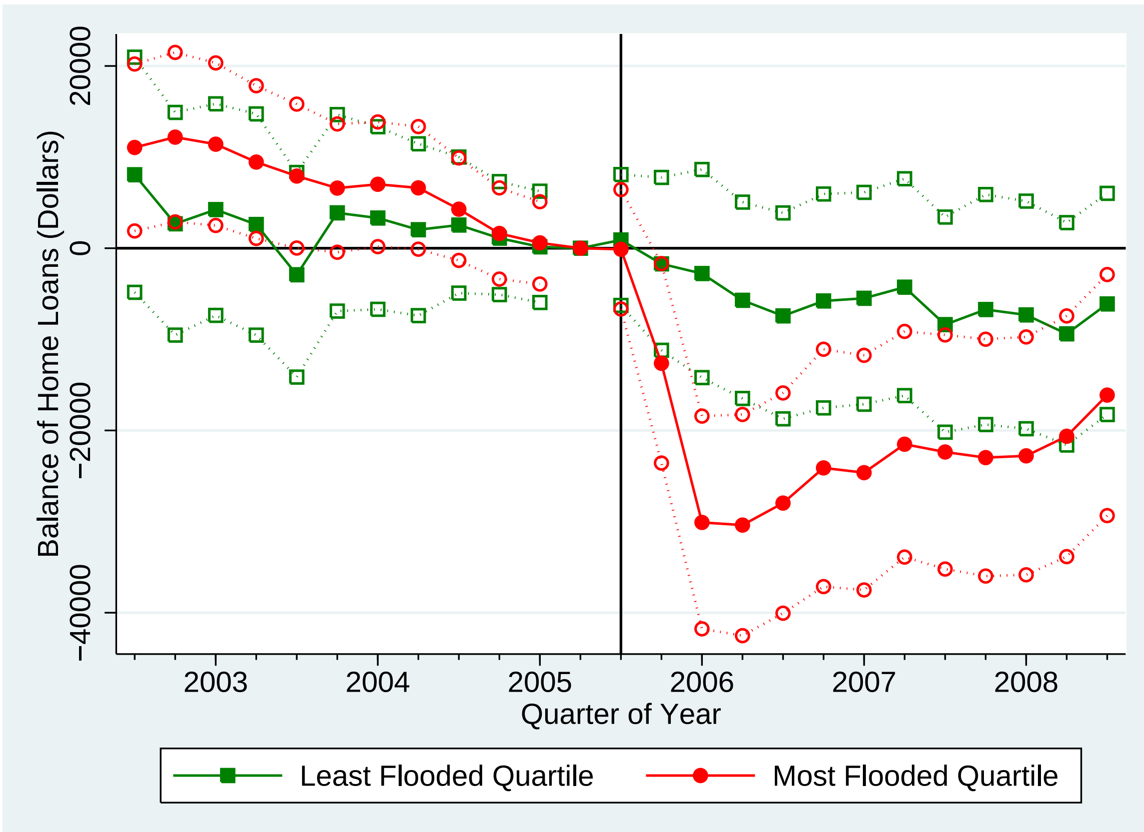
The figure plots difference-in-differences event time coefficients and 95% confidence intervals from the estimation of a version of Equation (2) that replaces the pre/post Katrina indicator with quarterly indicators. The dependent variable in the model is total debt balance in dollars. All coefficients 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 hereroskedasticity and are clustered at the block level.

Figure 4: Effect of Flooding on Total Home Loan Balance



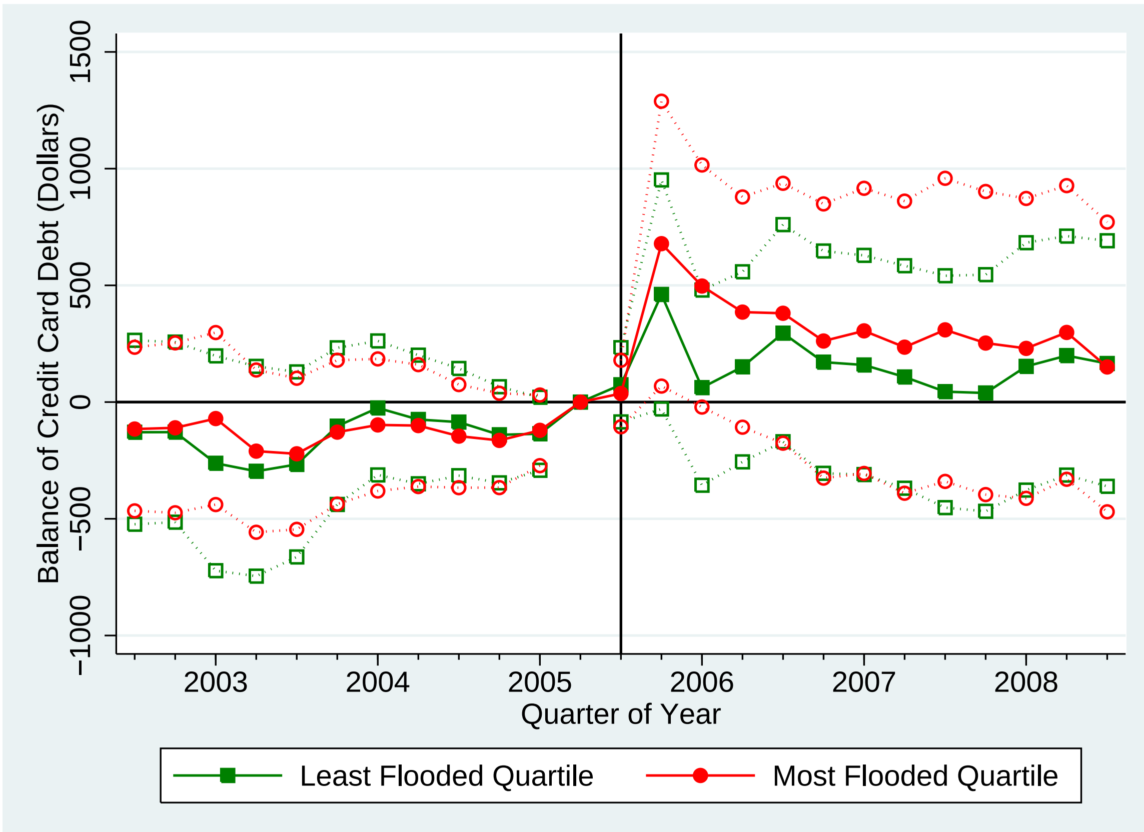
The figure plots difference-in-differences event time coefficients and 95% confidence intervals from the estimation of a version of Equation (2) that replaces the pre/post Katrina indicator with quarterly indicators. The dependent variable in the model is total home loan balance in dollars (2000 $). 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 hereroskedasticity and are clustered at the block level.

Figure 5: Effect of Flooding on Total Home Loan Balance for Homeowners with a Home Loan at the Time of Hurricane Katrina



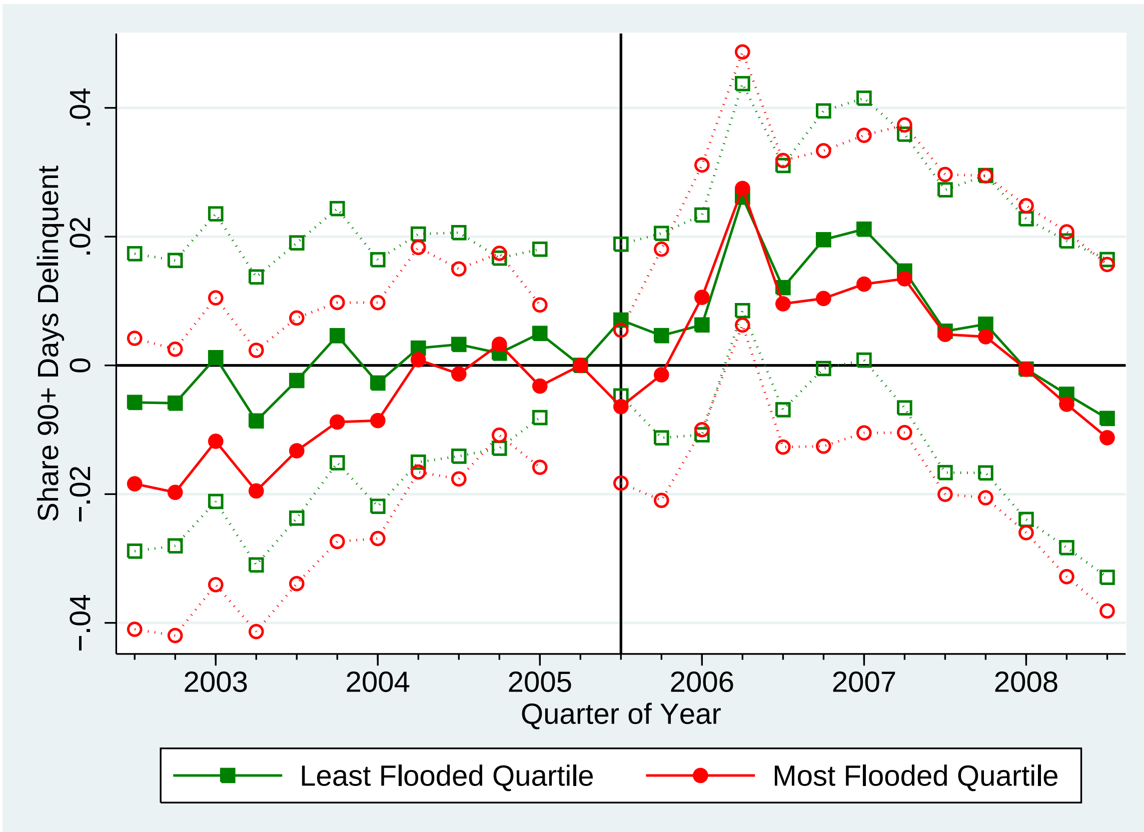
The figure plots difference-in-differences event time coefficients and 95% confidence intervals from the estimation of a version of Equation (2) that replaces the pre/post Katrina indicator with quarterly indicators. The dependent variable in the model is the total home loan balance (2000 $) for homeowners with a home loan. 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 hereroskedasticity and are clustered at the block level.

Figure 6: Effect of Flooding on Credit Card Balances



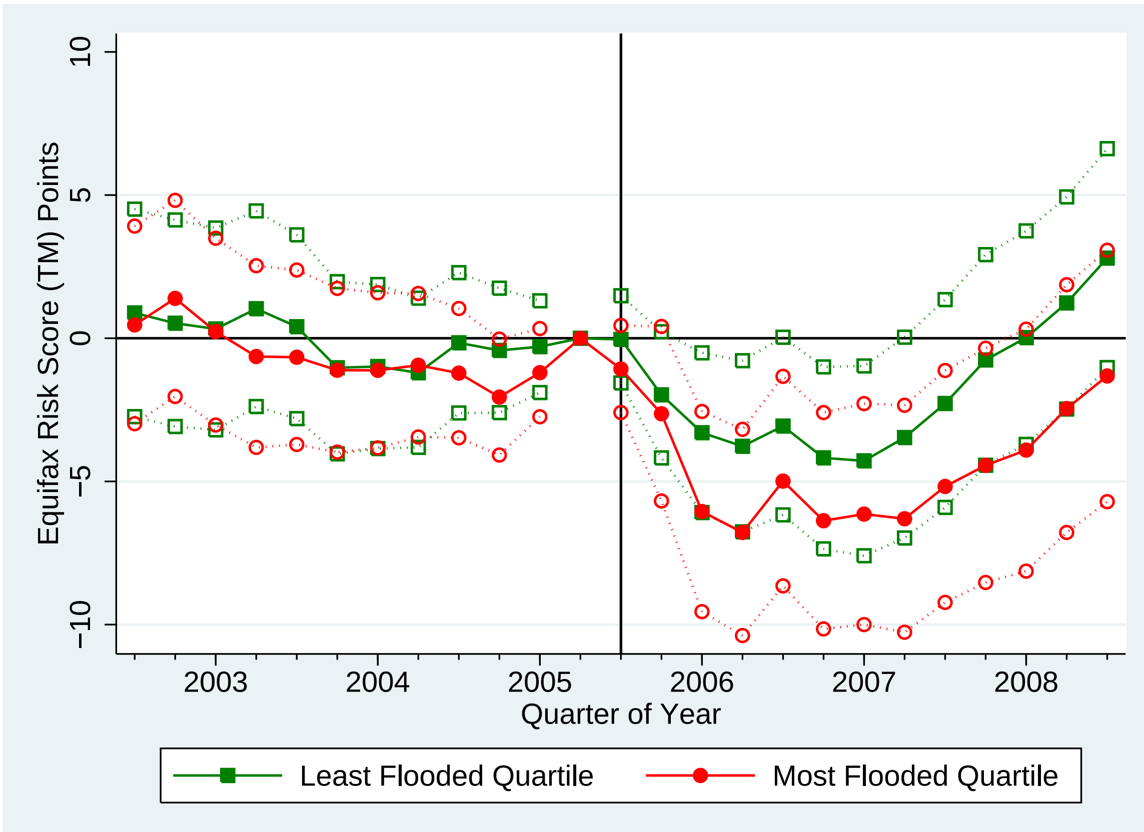
The figure plots difference-in-differences event time coefficients and 95% confidence intervals from the estimation of a version of Equation (2) that replaces the pre/post Katrina indicator with quarterly indicators. The dependent variable in the model is total credit card balance (2000 $). All coefficients 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 hereroskedasticity and are clustered at the block level.

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



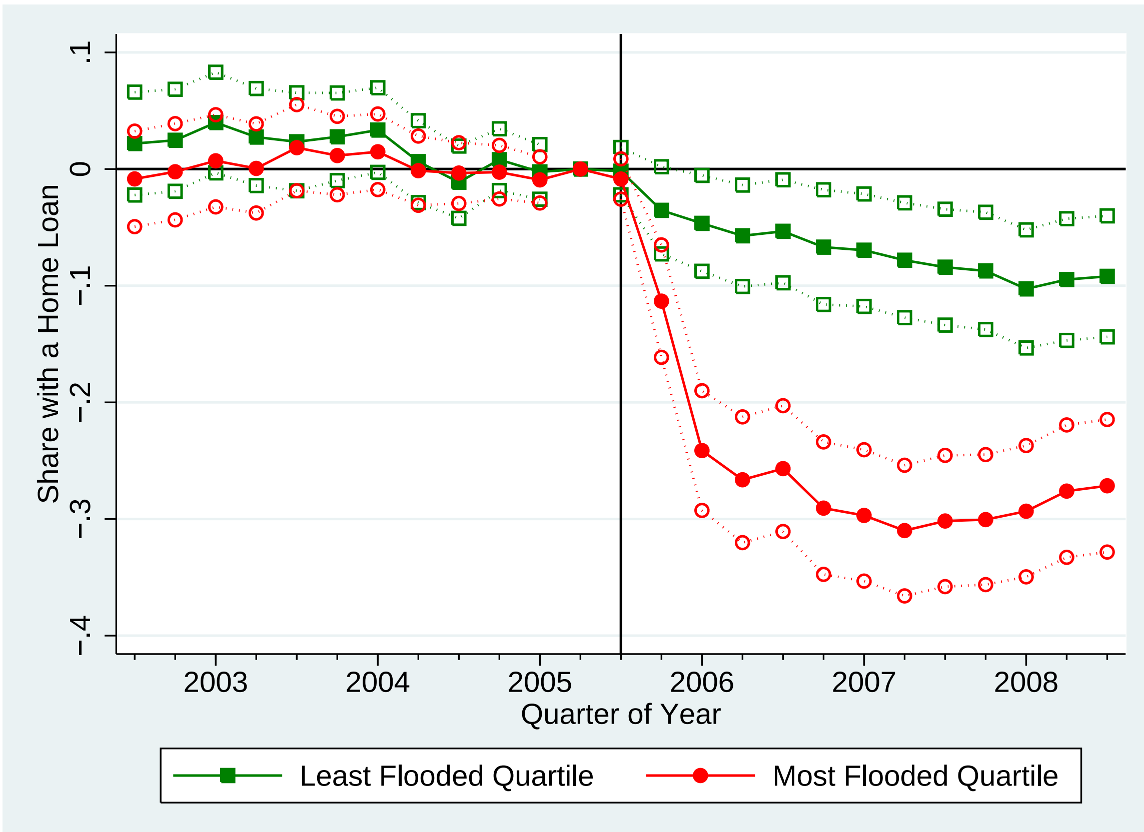
The figure plots difference-in-differences event time coefficients and 95% confidence intervals from the estimation of a version of Equation (2) that replaces the pre/post Katrina indicator with quarterly indicators. The dependent variable is an indicator for having at least one account 90 or more days 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 hereroskedasticity and are clustered at the block level.

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



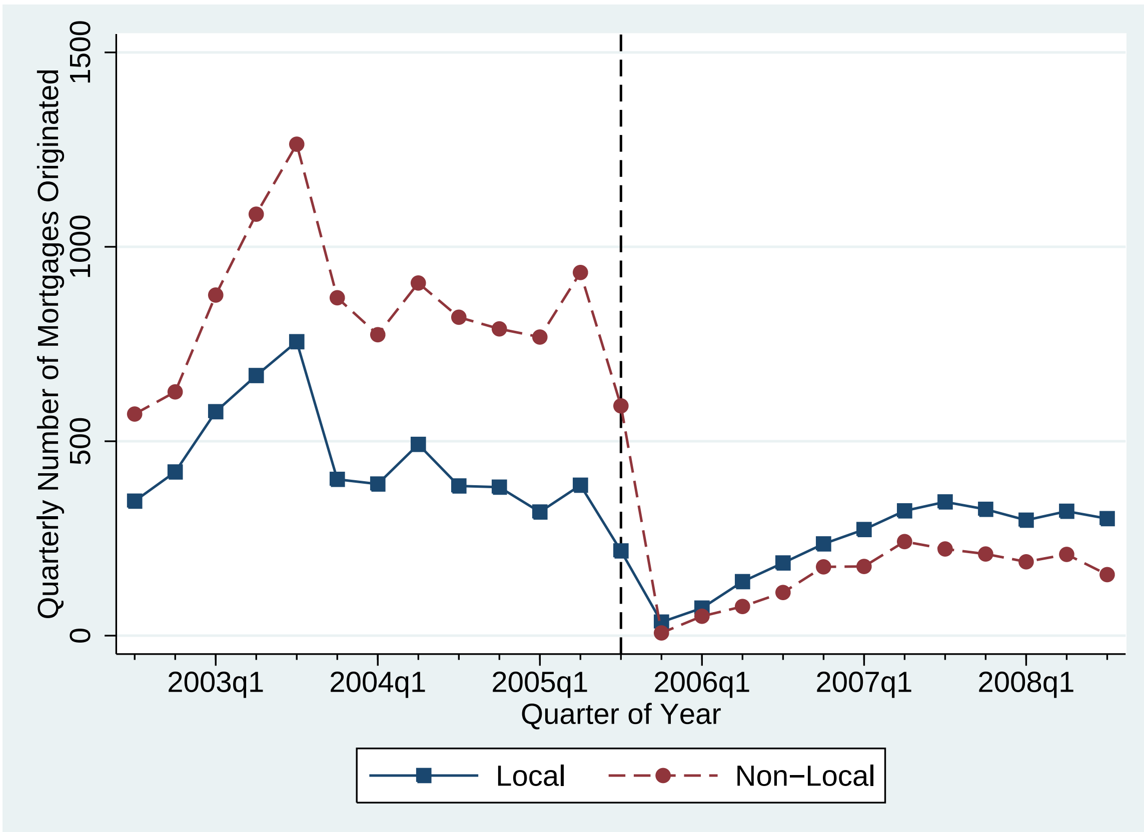
The figure plots difference-in-differences event time coefficients and 95% confidence intervals from the estimation of a version of Equation (2) that replaces the pre/post Katrina indicator with quarterly indicators. The dependent variable is the Equifax Risk Score (TM). All coefficients can be interpreted 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 hereroskedasticity and are clustered at the block level.

Figure 9: Effect of Flooding on having a Home Loan Conditional on Having a Home Loan in 2005Q3



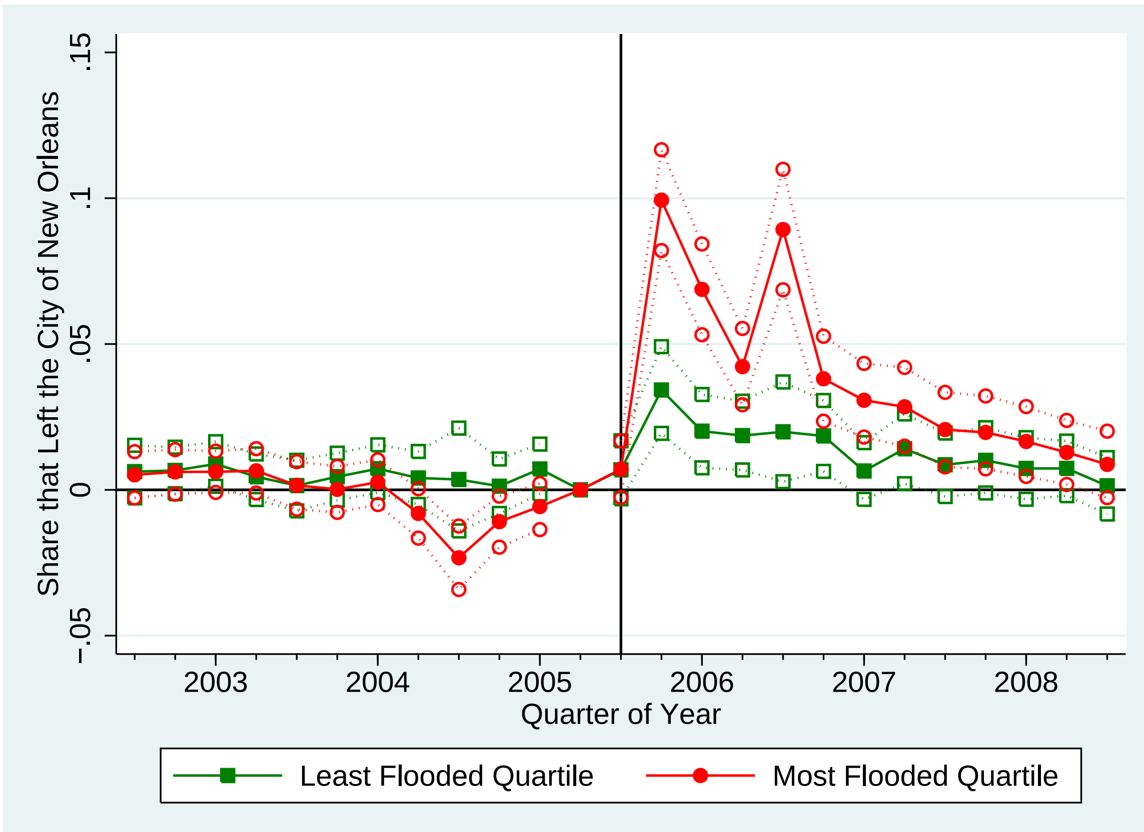
The figure plots difference-in-differences event time coefficients and 95% confidence intervals from the estimation of a version of Equation (2) that replaces the pre/post Katrina indicator with quarterly indicators. The dependent variable is an indicator variable equal to one if the individual has a 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 hereroskedasticity and are clustered at the block level.

Figure 10: The Number of New Mortgages Originated by Local and Non-Local Lenders



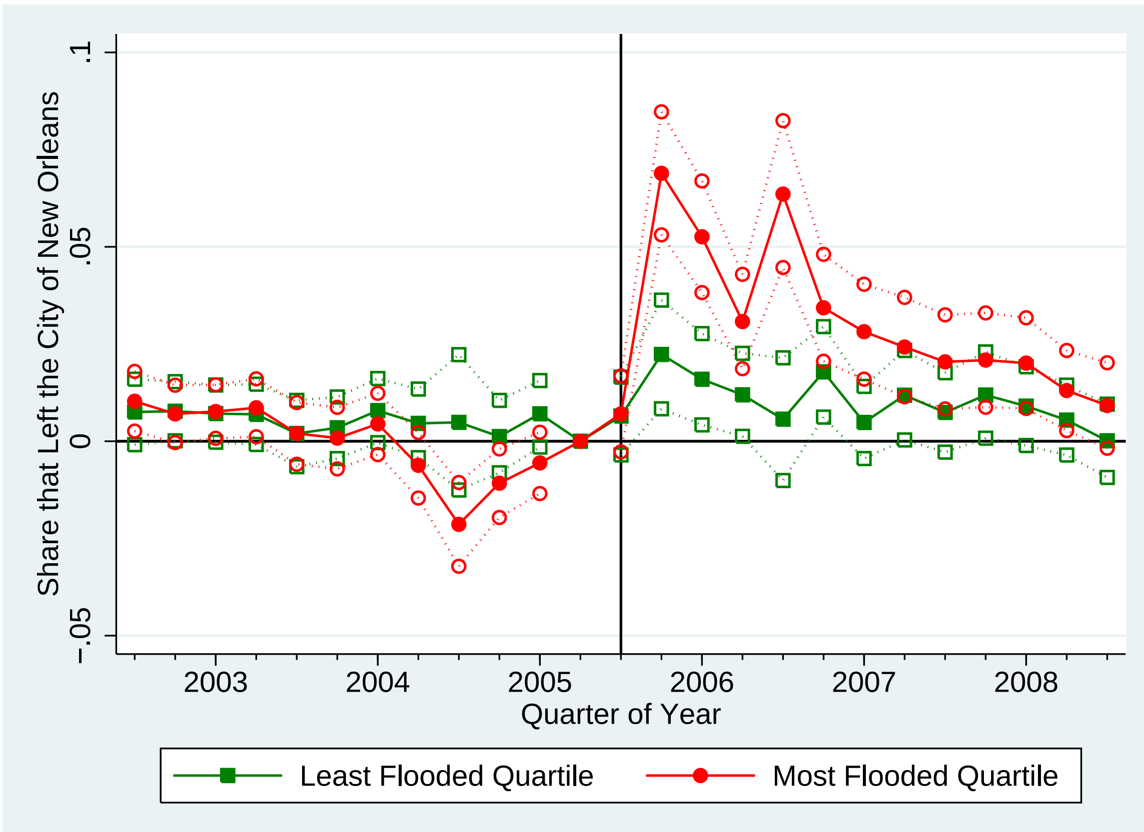
The figure shows the total number of loans by quarter made in the most flooded quartile of census blocks (Q4) split by whether the homeowner is in a census block with a high share of "non-local" lending. Here, we define "local" as lenders that made 20% or more of their loans from 1997 2005Q2 in the New Orleans CSA, while "non-local" is defined as lenders that made less than 20% of their loans from 1997 2005Q2 in the New Orleans CSA.

Figure 11: Effect of Flooding on Propensity to Move Away from the City of New Orleans for at Least One Year



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 moved out of New Orleans in the current quarter and remained away for at least one year. The sample includes residents of New Orleans who moved in the three years before Hurricane Katrina. All coefficients can be interpreted as the change in the migration rate 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 hereroskedasticity and are clustered at the block level.

Figure 12: Effect of Flooding on Propensity to Move Away from the City of New Orleans for at Least Three Years



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 moved out of New Orleans in the current quarter and remained away for at least three years. The sample includes residents of New Orleans who moved in the three years before Hurricane Katrina. All coefficients can be interpreted as the change in the migration rate 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 hereroskedasticity and are clustered at the block level.

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 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
N	11,283	11,283	11,283	11,283	11,283
R^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)
Q1 * Post	-5,407***	-4,634***	-3,076*	-3,198*	-3,197*	-3,197*	-3,249*
	(1,649)	(1,716)	(1,854)	(1,830)	(1,831)	(1,844)	(1,864)
Q4 * Post	-13,896***	-11,466***	-9,396***	-8,969***	-8,969***	-9,003***	-8,904***
	(1,559)	(1,966)	(2,076)	(2,030)	(2,032)	(2,045)	(2,063)
Q1	-5,107*	-2,890	1,872	1,839	2,130		
	(2,645)	(2,626)	(2,482)	(2,394)	(7,239)		
Q4	-5,576**	1,024	-614	-1,227	1,879		
	(2,348)	(3,143)	(2,740)	(2,620)	(9,193)		
Post	11,449***	8,519***	-79,021	-87,570*	-87,620*	-86,526*	-93,508*
	(1,131)	(4,468)	(51,566)	(51,715)	(51,747)	(52,059)	(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
N	245,375	245,375	245,375	245,375	245,375	245,375	245,375
R^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: Non-local Lender Share and Reductions in Mortgages

	(1)	(2)	(3)	(4)
Q1 * Post	-0.081***	-0.069***	-0.066***	-0.059**
	(0.022)	(0.023)	(0.023)	(0.023)
Q4 * Post	-0.263***	-0.236***	-0.228***	-0.233***
	(0.026)	(0.028)	(0.028)	(0.028)
Q1 * Post * Non-Local		-0.089	-0.089	-0.071
		(0.066)	(0.066)	(0.068)
Q4 * Post * Non-Local		-0.155***	-0.159***	-0.157***
		(0.050)	(0.050)	(0.053)
Cubic in Equifax Risk Score (TM)			X	X
Control for High Share African American Blocks				X
N	66,509	66,509	66,509	66,509
R^2	0.378	0.379	0.383	0.383

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 80% of their lending outside of the New Orleans CSA. The calculation is made using HMDA loans from 1997-2005Q2. Tracts with 80% or greater are in the upper quartile of this measure. 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). Robust standard errors clustered by census block of residence in 2005Q3 are shown in parentheses. The specification in column (4) includes 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. An indicator for post Katrina (2005Q3 and after), a cubic function of age and individual fixed effects are included in all specifications.

Table 5: Flood Insurance Claims, Foreclosure Rates, and Mortgage Origination

Panel A: Flood Insurance and Foreclosure			
	Not Flooded	Least Flooded	Most Flooded
Ratio of Flood Insurance Claims to Outstanding Mortgage	0.11	0.83	0.91
Difference in Foreclosure Start Rate Before/After Katrina	-0.0008	-0.0000	-0.0007
	(0.0006)	(0.0007)	(0.0010)
Pre-Katrina Average Quarterly Foreclosure Start Rate	0.0027	0.0023	0.0026
Panel B: Mortgage Origination			
	Local	Non-Local	
Difference in Number of Mortgages Originated Before/After Katrina	-924***	-2,357***	
	(171)	(229)	
Difference in $M Value of Mortgages Originated Before/After Katrina	-94***	-254***	
	(22)	(29)	

The first row of Panel A shows the average of the ratio of flood insurance claim payouts to total outstanding home loan balances across people living in the flood depth areas. The flood insurance payout data is for 2005 and is only available aggregated by zip code and flood zone. We formed the ratio by aggregating total home loan balances as of 2005Q3 and dividing the claim payouts by this aggregate. Next we merged this ratio in to the CCP by zip code*flood zone. Rows 2 and 3 of Panel A show regression statistics from a time-series regression of the mean quarterly foreclosure start rate on a post Katrina indicator variables. Each column is a separate regression containing 25 quarterly observations corresponding to our sample period (2002Q3 2008Q3). Row 2 shows the coefficient on the post Katrina indicator (with robust standard error in parentheses). Row 3 shows the constant from the regression. Panel B shows coefficients on a post-Katrina indicator from similar time-series regressions containing 25 observations each. In Panel B the dependent variable is either the total number of mortgages originated per quarter (Row 1) or the total dollar amount (in Millions) of mortgages originated per quarter (Row 2). The data are from HMDA. The regression in the "Local" column uses only loans made by lenders that made 20% or more of their loans from 1997 2005Q2 in the New Orleans CSA, while the regression in the "Non-Local" column uses only loans made by lenders that made less than 20% of their loans from 1997 2005Q2 in the New Orleans CSA.

8 Appendix

8.1 Data Description

Appendix Table 6 shows how the CCP data compare to information collected from the US Census. The five columns in the table correspond to the five flood depth groups. The first row in the table is the 2000 Census population estimate for each group. The second row is the CCP sample population. The CCP population is derived by multiplying the number of individuals in the sample by 20. The third row of the table is the coverage ratio. For example, the ratio of the CCP sample population to the census population is 72% for the first flooding quartile. The coverage ratio is 86% when the Census population is restricted to individuals 18+ years old.

There is some evidence that there is an over representation of the 75+ year old population (not shown) in the CCP panel. The coverage ratio is 84% after restricting the analysis to 18-74 year olds and 95% for the 18+ population that includes individuals in the CCP with missing age. These ratios bound the Fair Isaac Corporation (FICO) estimate for the ratio of adults in the US who have a credit history (Jacob and Schneider [2006]).[36]

Appendix Figure 13 is a census block map of New Orleans that shows blocks as being completely in the 100-year flood plain (red), completely outside of the flood plain (blue), or containing a portion of the block in the flood plain (green or yellow). The majority of New Orleans is in the 100-year flood plain. Nevertheless, there is still a substantial portion of the city that is zoned as being outside the flood plain.

The second source of engineering data is mean land elevation above sea level. Appendix Figure 14 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 deciles. Half of the city has an elevation of 1.5 feet or less above sea level.

8.2 Robustness Checks

Figure 6 in the text shows a modest increase in credit card balances the quarter following Katrina. The only other debt category (other than home debt and credit cards) to increase in debt balance after Katrina is auto loans. Appendix Figure 15 shows a relatively small temporary increase in auto loan balances for quartile 4 after Katrina, although none of the point estimates are statistically significant at the 5% level. We might expect an increase in

[36]Fair Isaac estimates that 22 million do not have a credit score in 2006 (Jacob and Schneider [2006], p2). There are approximately 225 million US adults in 2006 (US Census data, author calculation).

auto loans due to the financing of replacement vehicles for those that were totaled in the flooding.

Appendix Table 7 considers robustness specifications for the non-local lender model run in Table 4. Column (1) of Appendix Table 7 repeats the preferred specification (column 4) from Table 4. Recall that this specification uses the loan share measure of a non-local lender, the 75th percentile as the cut-off threshold for a non-local lender tract, and all available HMDA pre-Katrina data in calculating the threshold. Column (2) considers how the estimates change if we only use HMDA data from our pre-Katrina panel period (2002Q3-2005Q2). Column (3) considers how the estimates change if we use the median as the cut-off threshold for a non-local lending tract. Column (4) considers how the estimates change if we use the CSA branch definition as the measure of a non-local lender. Overall, the estimated coefficients from Columns (2)-(4) are very similar to those in Column (1). Please refer to Section 5.2 in the text and the footnote to Table 4 for more details regarding the data, the model specification, and the non-local lender definitions.

8.3 Imputing Excluded Account Information

The Federal Reserve Bank of New York Consumer Credit Panel Equifax (CCP) panel has an inclusion rule for whether account information in Equifax is included as part of an individual's reported credit content in the CCP. Only accounts that are updated by the creditor within the last three months at the time when the data are pulled are included in the panel (Lee and van der Klaauw [2010]). The goal is to avoid the inclusion of non-current accounts that have been closed, sold, etc.

The inclusion rule is responsible for a temporary missing data anomaly at the time of Hurricane Katrina. At the time of Hurricane Katrina, there is a large spike in non-reporting for home loan and auto loan accounts for residents of New Orleans. This spike in non-reporting occurs for all areas of New Orleans regardless of the level of flooding. Figure 16 shows a time series plot of the share of individuals with a non-reporting home loan from 2001Q1 to 2009Q4. The figure separately plots non-reporting for the five New Orleans flood groups (conditional on living in New Orleans in 2005Q3) as well as individuals in the CCP living in Baton Rouge, Memphis, and St. Louis at the time of the flood. The baseline non-reporting rate ranges from about two percent to five percent for the entire time period for all groups except for the year-long window immediately following Katrina. During the year after Katrina there is a large immediate spike in non-reporting for all individuals in the CCP living in the two Louisiana cities (Baton Rouge and New Orleans). There is no spike in non-reporting for individuals living in St. Louis and Memphis.

We are uncertain of the exact cause of the non-reporting. We suspect that it is a combination of two factors. First, the devastation in Louisiana after Katrina disrupted business as usual and this may also have been true for the creditor companies with accounts in Louisiana. Second, as described in Section 2.3 most mortgages had a moratorium on foreclosure for the 11 months following Katrina. This temporary moratorium may have affected how information on mortgages were reported and processed.

Fortunately, we are able to correct for temporary non-reporting of home loans using information contained in the CCP. Each home loan account has a unique id number. We use the id number to distinguish between accounts that temporarily disappear and those that permanently disappear. We define temporarily disappearing accounts as those that are included in the CCP at the time of Katrina, disappear for at least one quarter following Katrina, and then reappear later. We use the knowledge that certain mortgages subsequently reappear to impute balances and indicators for having a mortgage for people in the CCP that have temporarily non-reporting mortgages.

Figure 17 shows the share of residents with a home loan by quarter from 2001Q1 to 2009Q4 for the same groups as in the previous figure. In the uncorrected CCP, the share of residents with a home loan falls sharply at the time of Katrina for the five New Orleans groups and for residents in Baton Rouge. There is no drop for residents of Memphis and St. Louis. Figure 18 classifies homeowners who have a home loan that temporarily disappears due to non-reporting as continuously having a home loan. The share with a home loan in Memphis and St. Louis is shifted up by about a percentage point (relative to Figure 17) and the trends remain the same. There is no longer evidence of a sharp drop for Baton Rouge or for New Orleans residents in non-flooded locations. There is a modest decline for New Orleans residents in the least flooded locations of about two percentage points (as compared to 10 percentage points before the correction). The three most flooded locations still have large and immediate reductions in the share of residents with a home loan (although these reductions are somewhat smaller than before the correction).

Figure 19 shows (uncorrected) home loan balances for the five flood groups in New Orleans. In light of Figure 17, it is not surprising that there is an immediate drop in balances at the time of Katrina for all five flood groups.

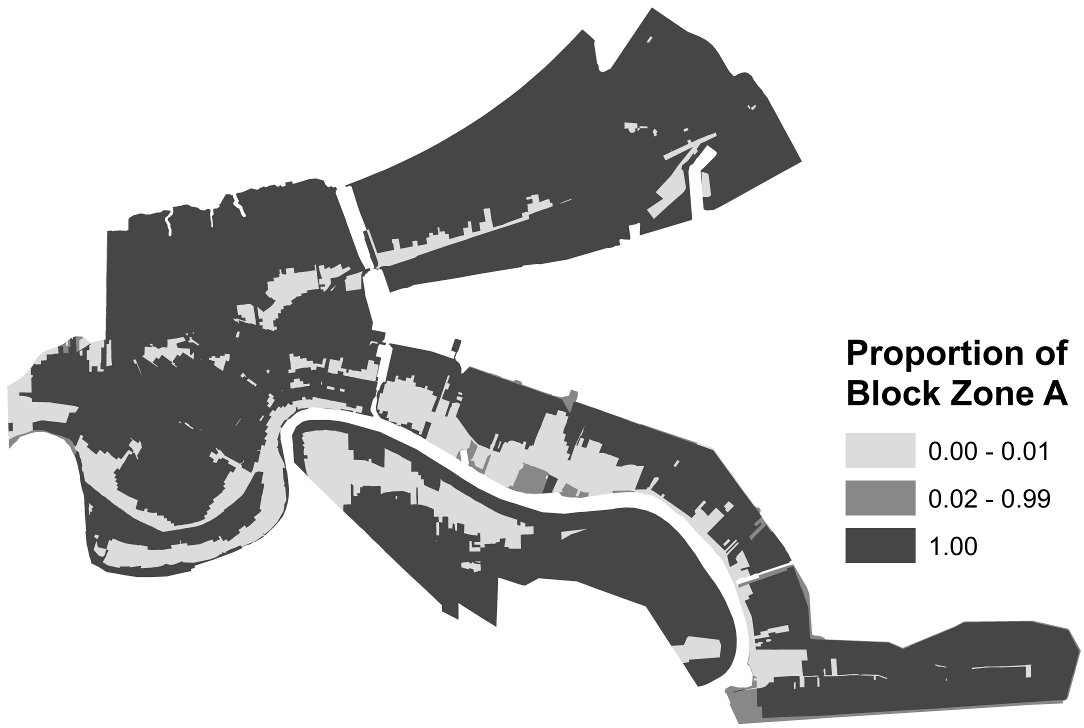
The estimates in the paper use a measure of home loan balances that corrects for the spike in non-reporting following Katrina. We use the mortgage id number to identify mortgages with temporarily missing balances. Next we impute missing mortgage balances. We consider three approaches to impute the missing balances. First, we impute missing balances with the last reported balance level *before* the home loan temporarily disappears. Second, we impute missing balances with the first reported balance level *after* the home loan returns. Third, we linearly extrapolate between the last reported value before the home loan disappears and the first reported value once the home loan returns.

Figures 20, 21, and 22 show debt balances using the last, next, and linear corrections. Overall, the three imputation approaches provide similar results. Imputed levels are largest when using the last reported balance and smallest when using the first reported balance after the home loan returns. Our preferred approach is to use linear extrapolation. The empirical estimates reported in the text of the paper are from a sample corrected for missing values using the linear extrapolation approach.

Figures 22 and 23 consider whether there is evidence of non-reporting at the time of Katrina for auto loans and credit cards. Figure 22 shows a roughly 2.5 percentage point drop in the share of people with auto loan accounts in the quarter after Katrina. The fact that this dip occurs immediately after Katrina, occurs for both Louisiana cities but not Memphis and St. Louis, and only lasts for one quarter suggests that it could be due to non-reporting of auto loans due to Katrina. Unfortunately, we are not able to correct for non-reporting auto loans because the CCP sample does not contain a unique identifier for auto loans. Figure 23 does not show any evidence of Katrina-related non-reporting of credit cards. However, there is a striking decline over time in the share of residents in all four cities with credit cards.

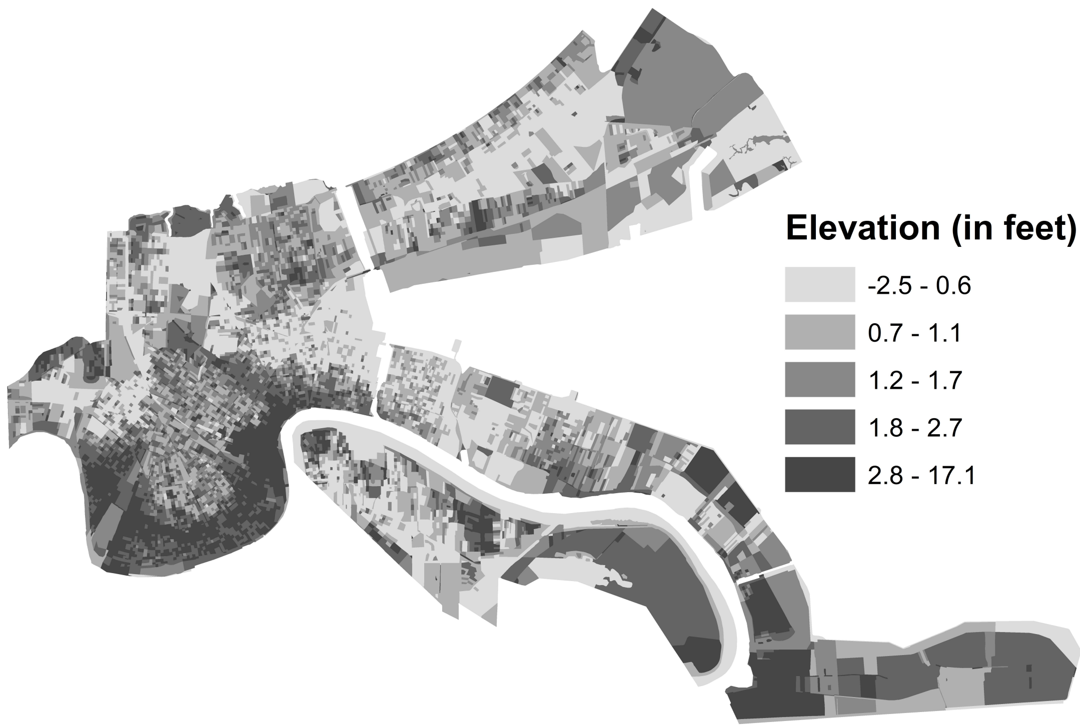
9 Appendix Tables and Figures

Figure 13: Proportion of Census Block in the 100-Year Flood Plain (Risk Zone A)



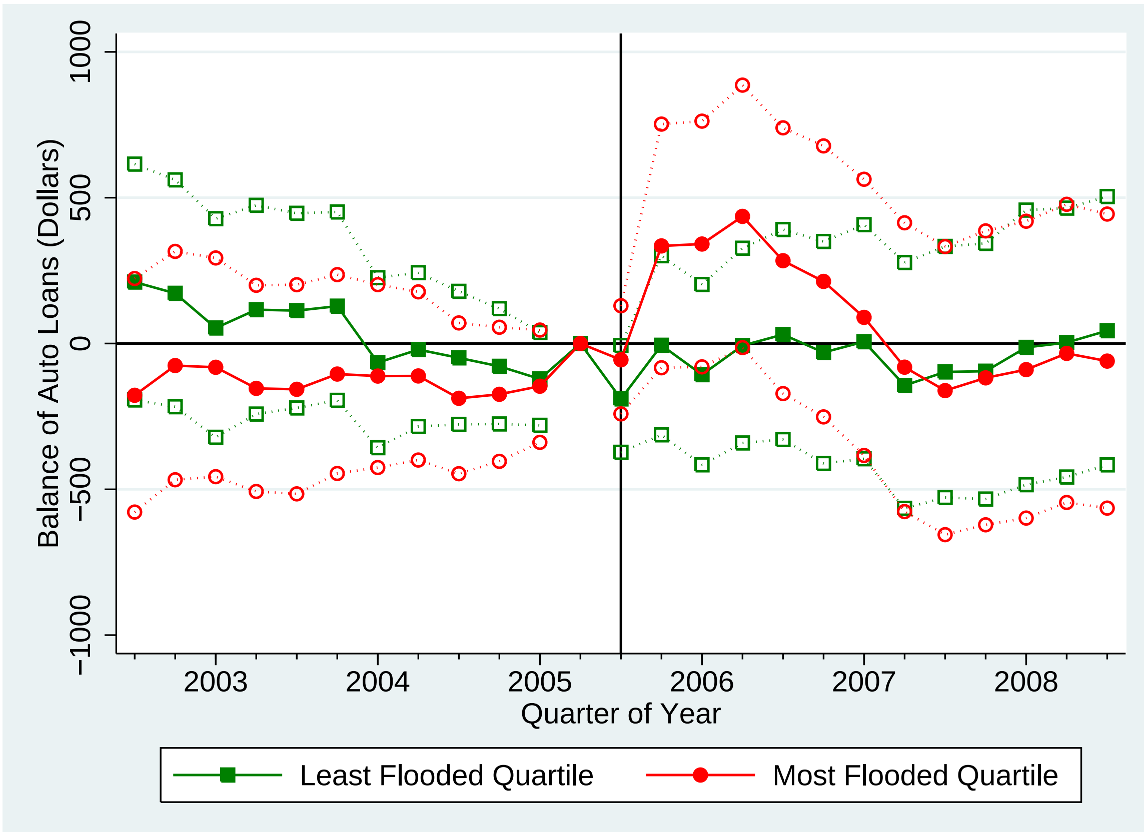
The figure classifies each census block in New Orleans as being either completely inside the 100-year flood plain, outside the flood plain (less than 1% of the land in the flood plain), and having a portion of the block in the flood plain. The figure was created in GIS using the spatial match between census blocks and the FEMA (pre-Katrina) flood map for New Orleans. Please refer to the text for details.

Figure 14: Mean Census Block Elevation



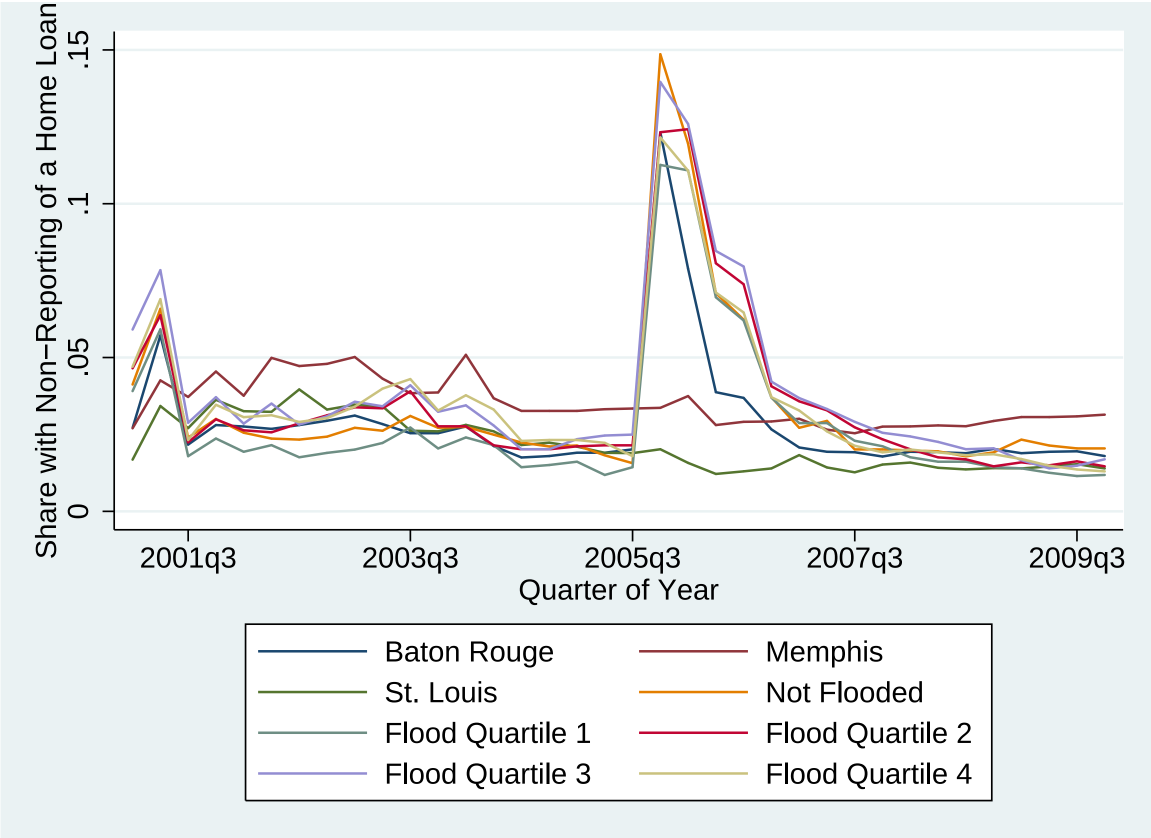
The figure shows the mean elevation above sea level for census blocks in New Orleans. Elevation data are from the US Geological Survey (USGS). Please refer to the text for details.

Figure 15: Effect of Flooding on Auto Loan Balance



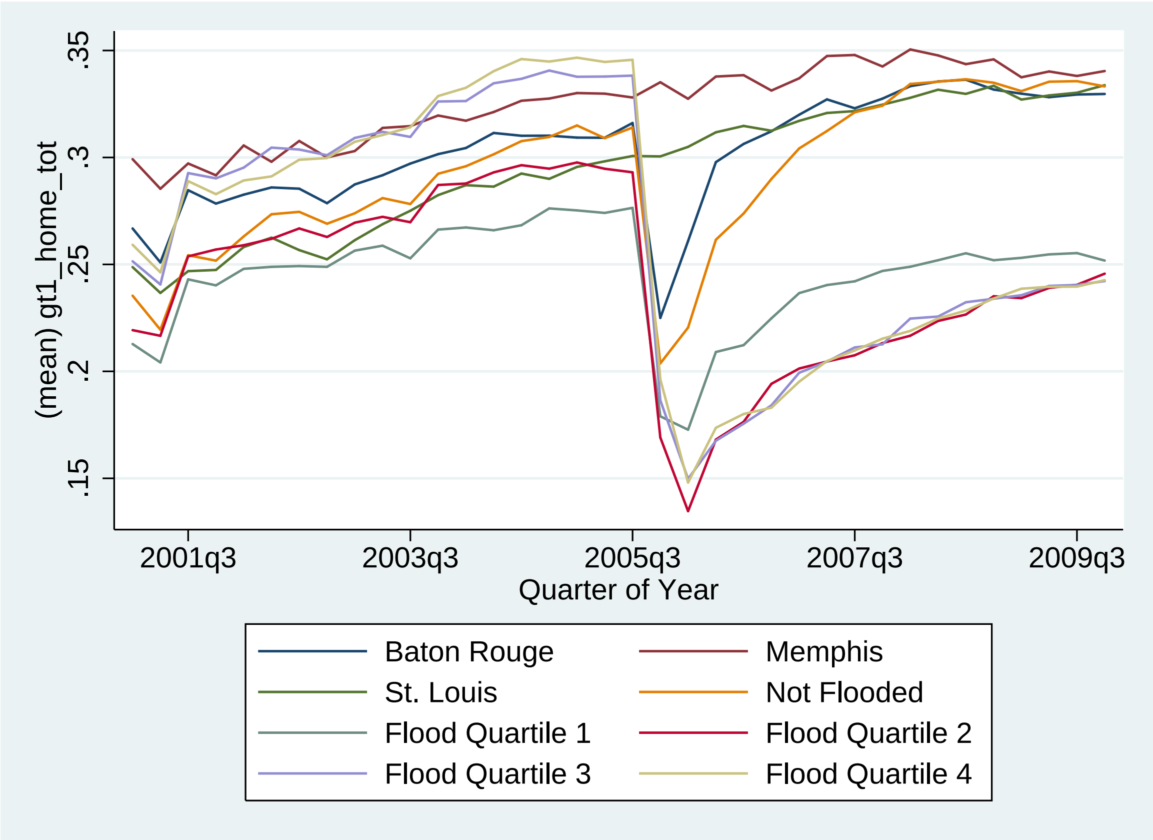
The figure plots difference-in-differences event time coefficients and 95% confidence intervals from the estimation of a version of Equation 2 that replaces the pre/post Katrina indicator with quarterly indicators. The dependent variable in the model is total auto balance. All coefficients can be interpreted as the relative 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 1.3 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 hereroskedasticity and are clustered at the block level.

Figure 16: Share of Residents with a Non-Reported Home Loan



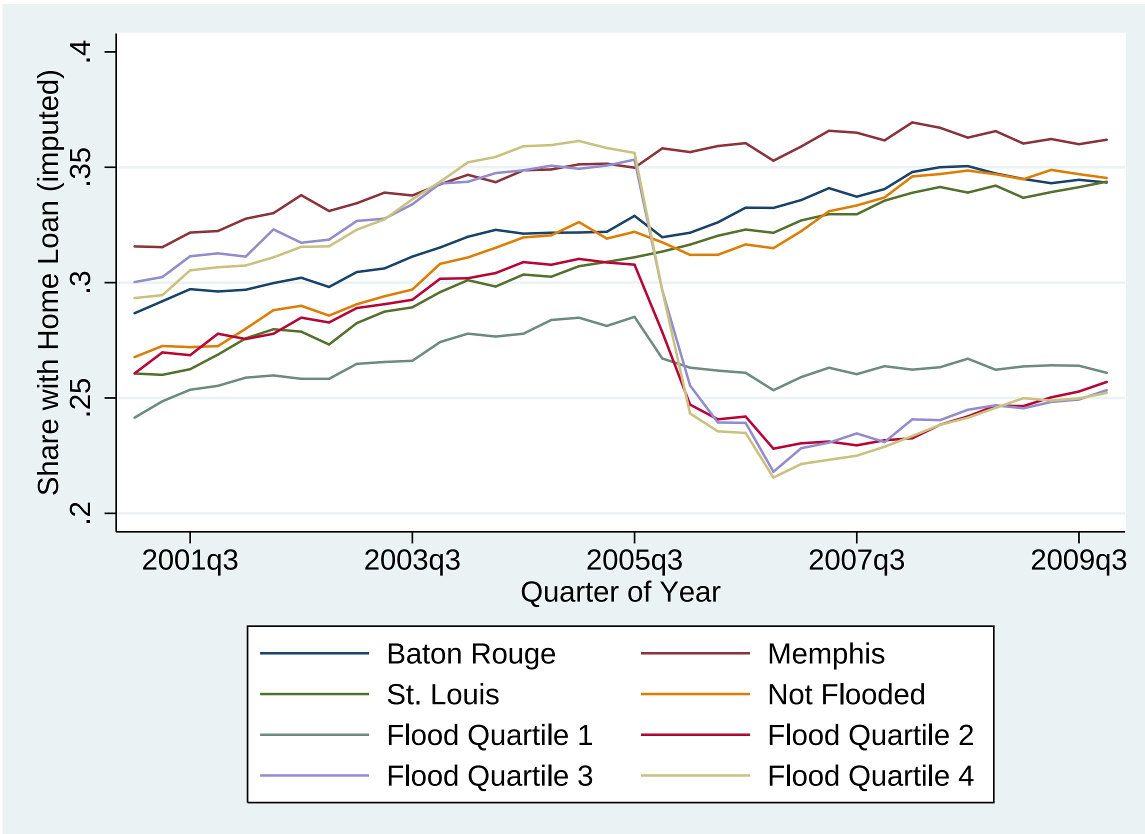
The figure plots the share of residents with a non-reported home loan for the five New Orleans flood groups as well as residents of Baton Rouge, Memphis, and St. Louis. Each quarter in the figure can be interpreted as the share of non-reporting home loans that quarter among all home loans for the particular flood group. We identify non-reporting home loans by tracking the unique home loan identification number in the CCP. A non-reporting loan is defined as one that disappears for a quarter, but reappears for any quarter later in our sample. Please refer to the Appendix for more details.

Figure 17: Share of Residents with a Home Loan (Not Corrected)



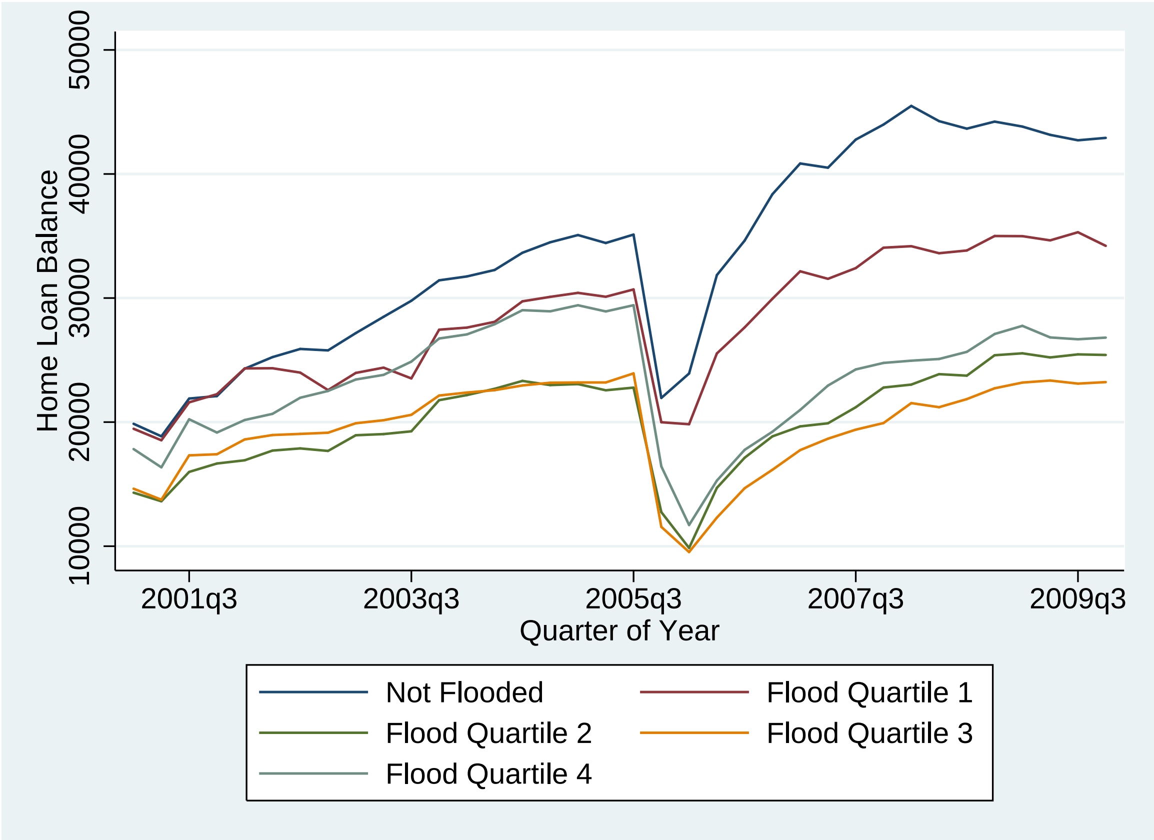
The figure plots the (uncorrected) share of residents with a home loan for the five New Orleans flood groups as well as residents of Baton Rouge, Memphis, and St. Louis. Please refer to the Appendix for more details.

Figure 18: Share of Residents with a Home Loan (Imputed)



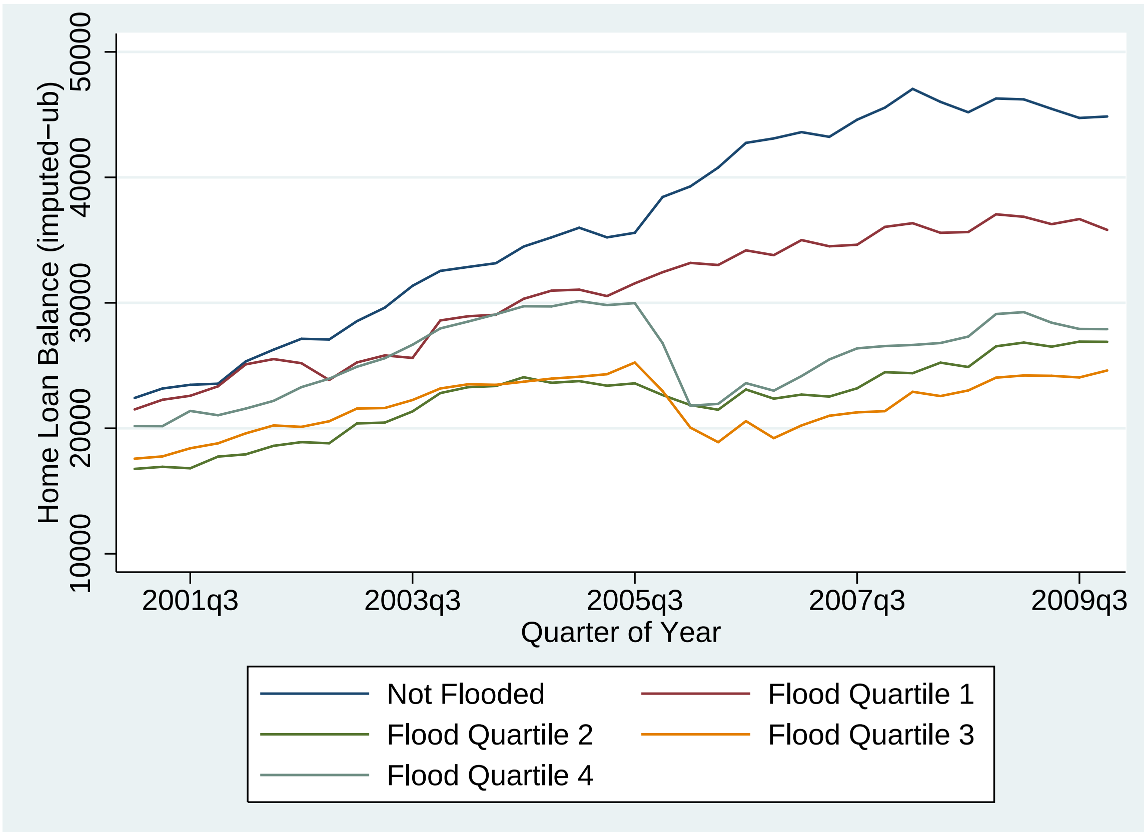
The figure plots the share of residents with a non-reported home loan for the five New Orleans flood groups as well as residents of Baton Rouge, Memphis, and St. Louis. The home loan share is corrected for non-reporting home loans. A non-reporting loan is defined as one that disappears for a quarter, but reappears for any quarter later in our sample. Please refer to the Appendix for more details.

Figure 19: Home Loan Balances (Not Corrected)



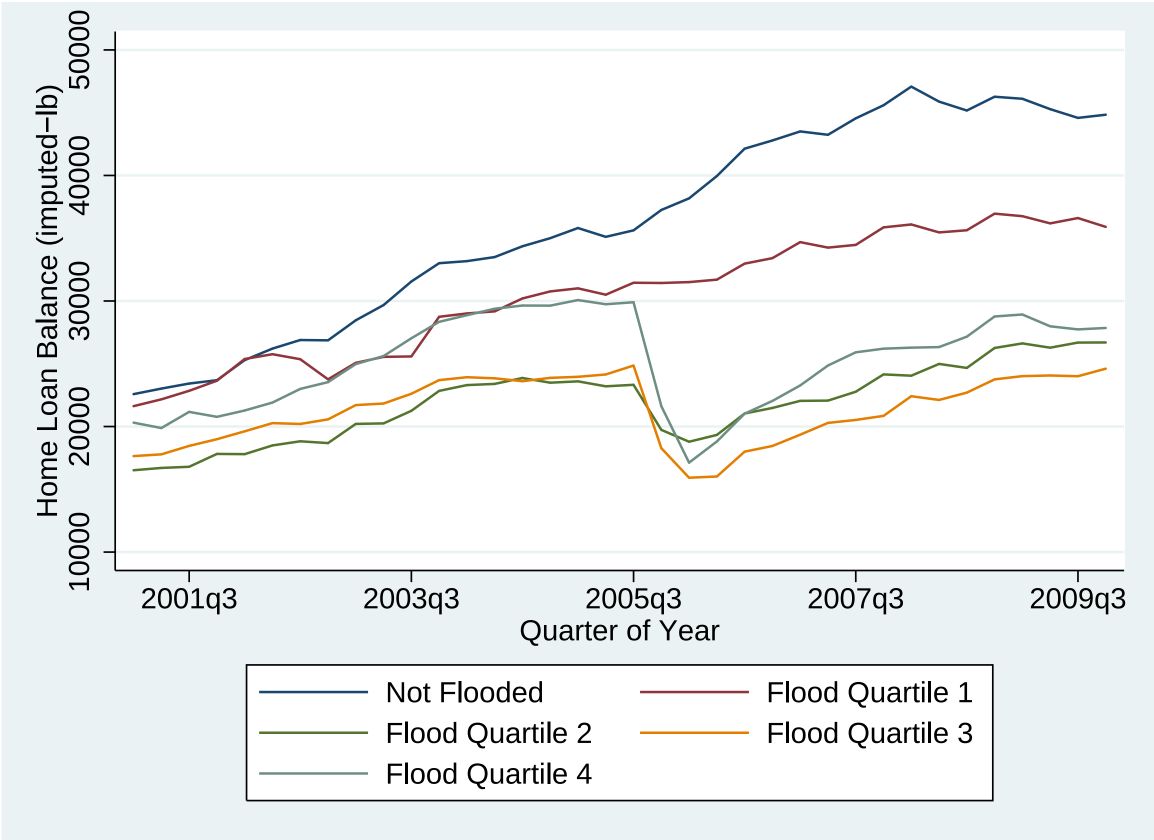
The figure plots home loan balances in dollars for the five New Orleans flood groups. Please refer to the Appendix for more details.

Figure 20: Home Loan Balances, Corrected Using Last Reported Balance



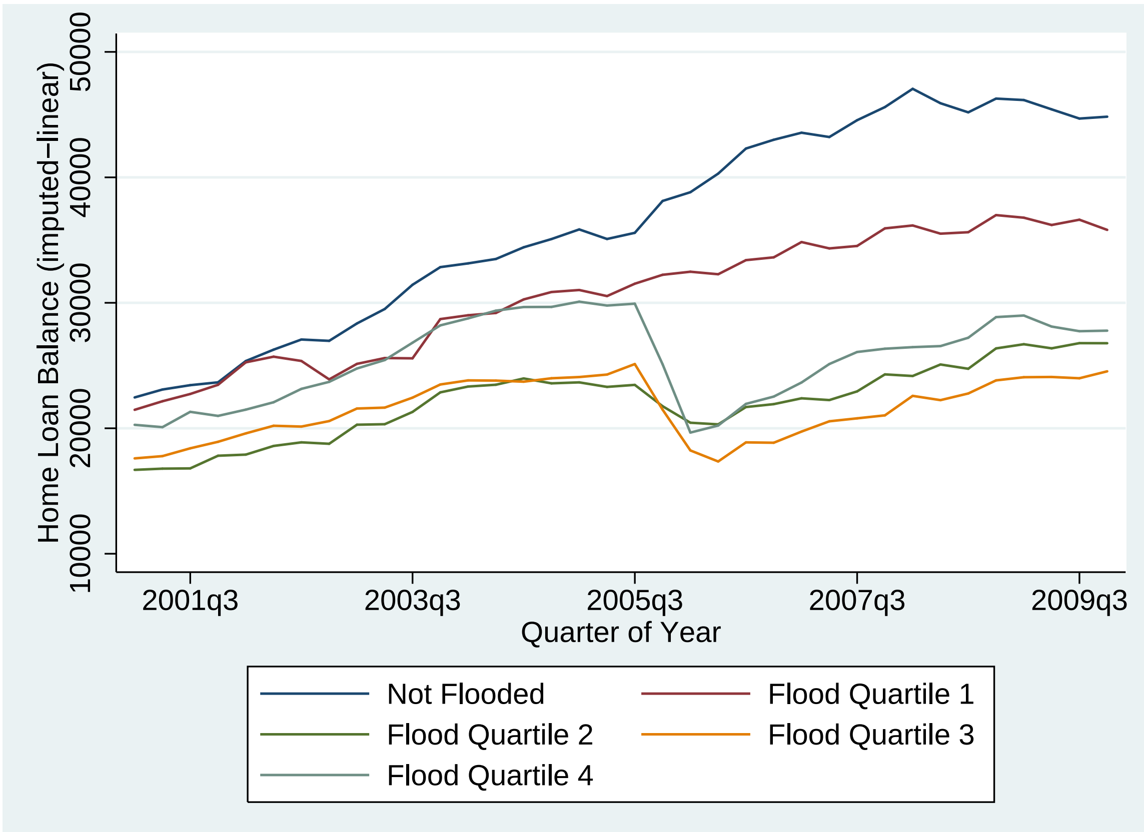
The figure plots corrected home loan balances in dollars for the five New Orleans flood groups. We correct loan balances by imputing the last reported loan balance for non-reporting home loans for the quarters that the home loan is non-reported. A non-reporting loan is defined as one that disappears for a quarter, but reappears for any quarter later in our sample. Please refer to the Appendix for more details.

Figure 21: Home Loan Balances, Corrected Using Next Reported Balance



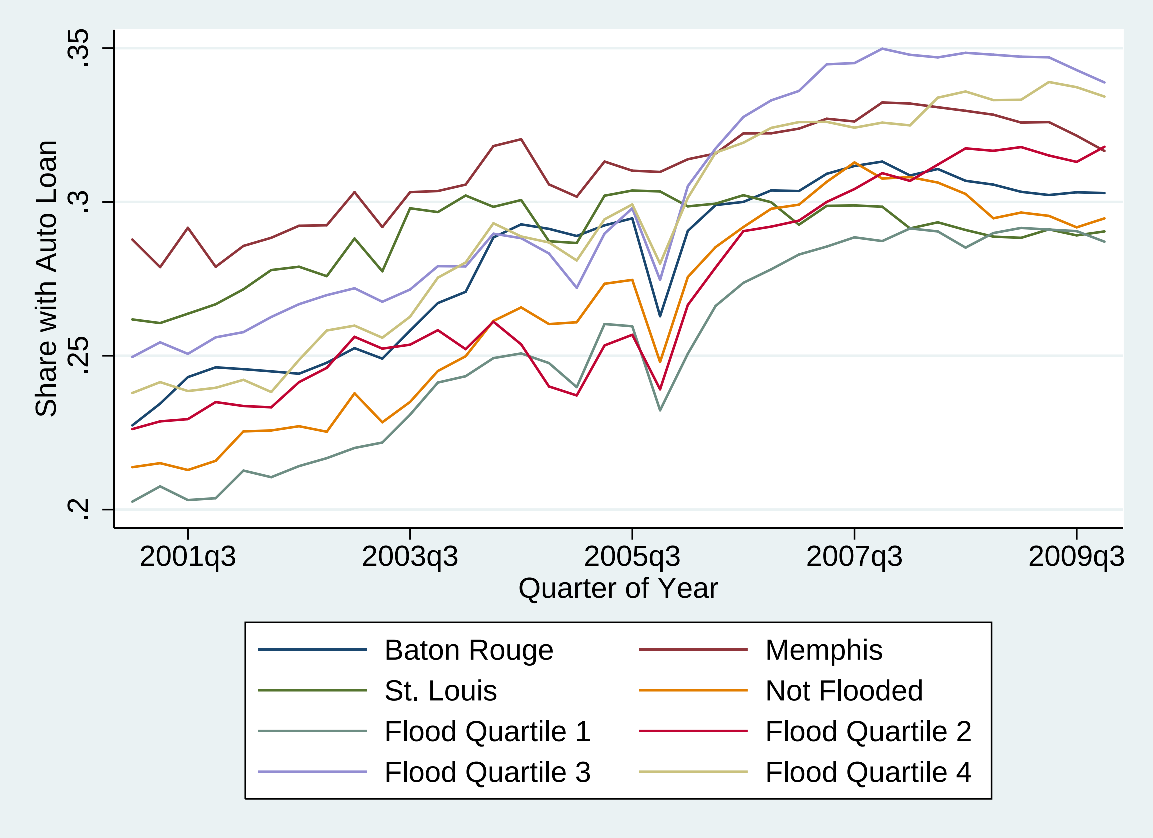
The figure plots corrected home loan balances in dollars for the five New Orleans flood groups. We correct loan balances by imputing the first reported loan balance once a home loan reappears for non-reporting home loans for the quarters that the home loan is non-reported. A non-reporting loan is defined as one that disappears for a quarter, but reappears for any quarter later in our sample. Please refer to the Appendix for more details.

Figure 22: Home Loan Balances, Corrected Using a Linear Extrapolation



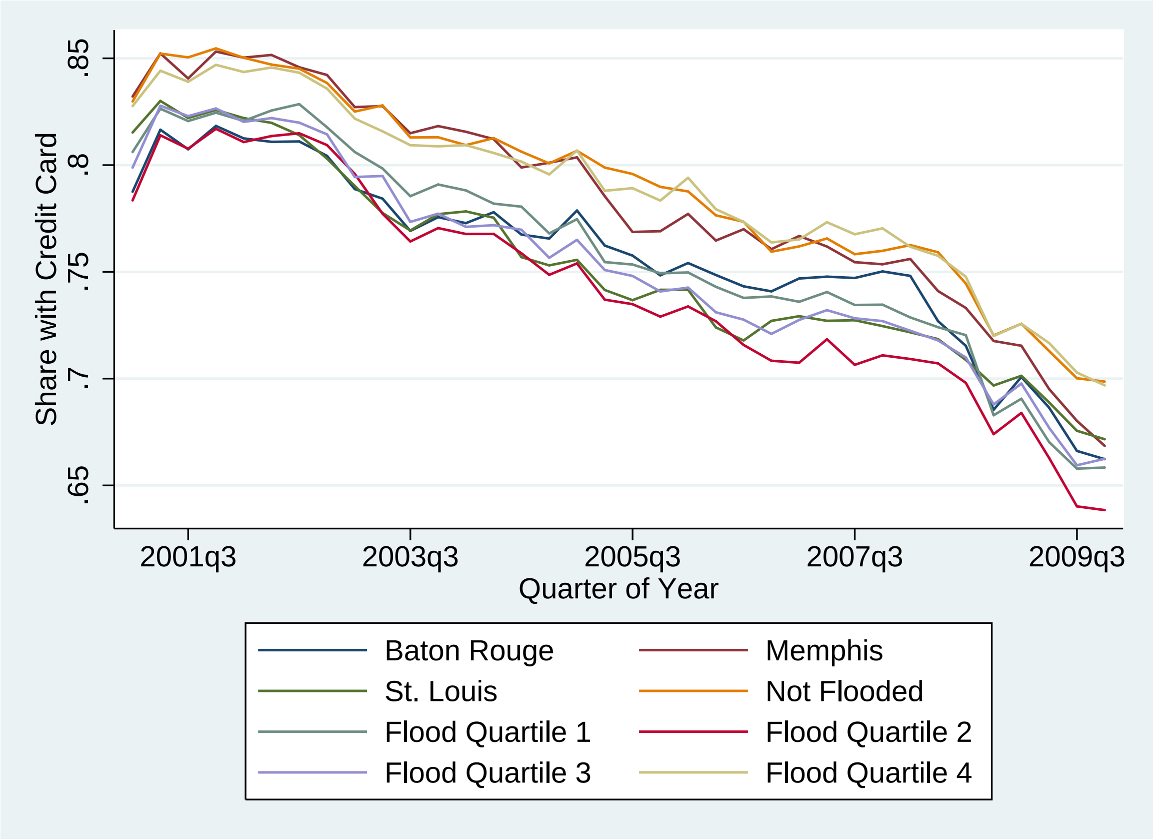
The figure plots corrected home loan balances in dollars for the five New Orleans flood groups. We correct loan balances by linearly extrapolating between the last reported loan balance before a non-reporting home loan disappears and the first reported loan balance once the non-reporting home loan reappears. A non-reporting loan is defined as one that disappears for a quarter, but reappears for any quarter later in our sample. Please refer to the Appendix for more details.

Figure 23: Share with a Auto Loan (Not Corrected)



The figure plots auto loan balances in dollars for the five New Orleans flood groups as well as residents of Baton Rouge, Memphis, and St. Louis. Please refer to the Appendix for more details.

Figure 24: Share with a Credit Card



The figure plots the share of residents with a credit card for the five New Orleans flood groups as well as residents of Baton Rouge, Memphis, and St. Louis. Please refer to the Appendix for more details.

Table 6: Comparison of CCP Population Coverage to US Census by Degree of Flooding

Flood Depth Quartile	No Flooding	1	2	3	4
Census Population	110,875	100,780	116,049	119,001	118,188
CCP Population	85,280	71,740	81,100	84,980	79,080
Coverage Ratio	77%	72%	70%	71%	67%
Missing Age in CCP	9%	10%	9%	9%	7%
18 + Coverage Ratio	92%	86%	89%	91%	83%
18 - 74 Coverage Ratio	92%	84%	88%	90%	79%
18 + Coverage Ratio with missing age	101%	95%	98%	100%	89%

This table compares block level 2000 Census and 2000Q2 Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP) age distributions for five groupings of census blocks: those with no flooding and quartiles of blocks broken up by mean level of flooding by block on August 31, 2005. All Proportions are frequency weighted by census block population.

Table 7: Robustness Checks: Local Versus Nonlocal Lenders

Model Specification:	Column (4) from Table 4	Only Panel Period HMDA Data	Above Median Threshold	Local Definition: MSA Branch
	(1)	(2)	(3)	(4)
Q1 * Post	-0.059**	-0.057**	-0.036	-0.056**
	(0.023)	(0.024)	(0.026)	(0.023)
Q4 * Post	-0.233***	-0.232***	-0.177***	-0.221***
	(0.028)	(0.029)	(0.038)	(0.029)
Q1 * Post * Non-Local	-0.071	-0.068	-0.082	-0.025
	(0.068)	(0.068)	(0.046)	(0.062)
Q4 * Post * Non-Local	-0.157***	-0.128**	-0.148***	-0.112**
	(0.053)	(0.057)	(0.047)	(0.050)
Cubic in Equifax Risk Score (TM)	X	X	X	X
Control African American Blocks	X	X	X	X
N	66,509	66,509	66,509	66,509
R^2	0.383	0.383	0.384	0.383

This table runs robustness specifications for the Table 4 non-local lender results. Column (1) of this table repeats the preferred specification (column 4) from Table 4. Recall that this specification uses the loan share measure of a non-local lender, the 75th percentile as the cut-off threshold for a non-local lender tract, and all available HMDA pre-Katrina data in calculating the threshold. Column (2) considers how the estimates change if we only use HMDA data from our pre-Katrina panel period (2002Q3-2005Q2). Column (3) considers how the estimates change if we use the median as the cut-off threshold for a non-local lending tract. Column (4) considers how the estimates change if we use the CSA branch definition as the measure of a non-local lender. Please refer to Section 5.2 in the text and the footnote to Table 4 for more details.