Online Appendix for "Household Finance after a Natural Disaster: The Case of Hurricane Katrina"

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Contents

A Data Description

A.1 Flood Depth, Flood Risk, and Land Elevation Data

Flood Depth

The source of the flood depth data is the National Oceanic and Atmospheric Administration (NOAA). NOAA derived flood depths by combining a New Orleans area topography map and aerial flood photographs. The topography map was created using lidar mapping prior to Katrina. Lidar (light detection and ranging) mapping is a method to collect very accurate landscape elevation data using laser altimetry (Lid [2012]). The flood depth data have a depth resolution of one foot increments and a geographical resolution of 25 square meters. We thank Commander Timothy Gallagher at NOAA and Christopher Locke, a GIS analyst at Research Planning, Inc., for their assistance in providing and interpreting the flood depth data. We use GIS software to calculate the mean, minimum, and maximum flood depth for each census block. Figure 2 in the text shows mean census block depths on August 31, 2005 for New Orleans. Please refer to the notes to Figure 2 and Section 2 in the text for more details.

Flood Plain

We extract block-level flood risk information from the Army Corps of Engineers (1999 FIRM) flood map. We use these data to control for one of the "engineering" determinants of a flood in our preferred empirical model. We accessed a digital copy of the flood map from *Atlas: The Louisiana Statewide GIS* website (http://atlas.lsu.edu/). The website is run by the Louisiana State University CADGIS Research Laboratory (Baton Rouge, LA). Appendix Figure 1 is a census block map of New Orleans that shows blocks as being completely in the 100-year flood plain (black), completely outside of the flood plain (light gray), or containing a portion of the block in the flood plain (dark gray). 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.

Land Elevation

The second source of engineering data is mean land elevation above sea level. The elevation data are from the US Geological Survey (USGS) and accessed via the website http://earthexplorer.usgs.gov/. The USGS calculates the elevation using lidar mapping technology. We use GIS software to calculate the mean elevation for each census block. Appendix Figure 2 shows mean census block elevations in New Orleans. 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.

A.2 Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP)

The Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP) is the main source of credit and debt information used in the paper. Equifax, a large consumer credit repository and credit scoring company in the US, is the underlying source of the data. Researchers at the Federal Reserve Bank of New York first created the panel in conjunction with Equifax. The panel is built using a 5% sample of the US population that is selected based on the last two digits of the social security number. Thus, the sample population includes individuals with a credit history and whose credit file includes a social security number. The CCP has quarterly observations and runs from 1999Q1 to the present. Lee and van der Klaauw [2010] provide a good overview of the panel construction and variables. Section 2.4 in the text summarizes the variables we use. There is a CCP data reporting anomaly at the time of Katrina in New Orleans. We discuss how we assess and account for this anomaly in Appendix Section B.

CCP and Decennial Census Coverage Comparison

Appendix Table 1 shows how the CCP data compare to information collected from the US Decennial 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 quartile of flood depth. 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% for the first quartile of flood depth after restricting the analysis to 18-74 year olds and 95% for the 18+ population that includes individuals in the CCP with a missing value for the age variable. 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]). 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).

CCP Panel Construction Details

Our main estimation panel only includes CCP panel individuals who were living in New Orleans at the time of Katrina (2005Q3). Further, we restrict the panel to individuals who have a complete credit history for the 12 quarters before and after 2005Q3. There is one technical consideration regarding how we determine whether debt balances are zero or missing. We take a conservative approach and only count balances as zero if the variables indicating the number of accounts are non-missing. This leads to a total of 16,573 individuals in our main sample with both number of accounts and balances variables that are populated. There are a total of 16,766 individuals in the panel if we assume that individuals with missing values for the number of accounts and missing values for account balances actually have a zero balance. As a robustness check we estimate our preferred difference-in-differences model on total debt using this alternative sample and find qualitatively similar results (see Appendix Table 2).

A.3 Home Mortgage Disclosure Act (HMDA)

We use HMDA data for two purposes. The first is to create a measure of the degree to which mortgages that existed at the time Hurricane Katrina hit were likely to have been held or serviced by a "local" or "non-local" lender. We use HMDA data from January 1, 1997 through August 28, 2005 to construct our measure. While HMDA data exist before 1997, the minimum reporting requirements began to be indexed to adjust for inflation in 1997. Thus, starting in 1997 there are consistent criteria for reporting (Pettit and Droesch [1998]). HMDA data will not capture the lending activity of the smallest lenders. At the time of Hurricane Katrina, depository institutions with less than $34 million in assets and non-depository institutions with less than $10 million were not required to file HMDA data (`https://www.ffiec.gov/hmda/history2.htm`). We drop any observations from 2005 with an action date (i.e. the date the loan was originated) after August 28 (the day before Katrina made landfall in New Orleans).

The second use of the HMDA data is to measure the quarterly number of mortgages originated by local and non-local lenders *by flood intensity*. We break the flooded tracts (rather than blocks) into quartiles of flood depth. Census tracts are the finest geography available in the HMDA data. We calculate the total number of mortgages originated by lenders above and below the median lender local share in each quarter for our entire sample period (2002Q3 - 2008Q3).

The HMDA data from 1997 through 2002 are reported using 1990 Census tract boundaries, while the later HMDA data use the 2000 Census tract boundaries. Most tract boundaries in New Orleans do not change from the 1990 Census to the 2000 Census. However, to be consistent, we construct our tract-level local lending measures by first converting tract-level measures based on the 1990 boundaries to 2000 boundaries using the Census' 1990 to 2000 tract relationship file.

Our primary tract-level measure of local versus non-local lending is created by calculating the share of loans that each lending institution made in the New Orleans-Metarie-Hammond Combined Statistical Area (CSA) from 1997 through August 28, 2005. We calculate the proportion of loans a lender makes for properties in the New Orleans CSA relative to the lender's total loans for each lender who issued at least one HMDA-measured home loan in the CSA. Each lender is assigned this lender-specific New Orleans CSA loan ratio number. Next, we calculate the average local loan ratio for each census tract for each calendar year by averaging across the lender local loan ratios associated with each mortgage originated in the census tract during the year. Each individual in our CCP sample is assigned an average local loan ratio based on the census tract of the property and the year of origination of their largest home loan. Individuals with loans opened before 1997 are assigned the average census tract local loan ratio for the 1997 - August 28, 2005 period. Finally, in Figure 5 of the text we split lenders that made loans in the New Orleans CSA into local and non-local groups. We do this based on whether their lender-specific New Orleans CSA loan ratio number is above or below the median local loan ratio in the CCP sample (21%).

We also construct variations of our primary measure in which we calculate local lending shares using dollar amounts of loans rather than counts, using only those individuals with mortgages originated from 1997 - August 28, 2005, and calculating an alternative measure based on branch locations using FDIC Summary of Deposits data (see next subsection). The local lending share constructed using loan value is completely analogous to the measure based on the number of loans. These alternative local lending measures are used as robustness checks in Appendix Table 7.

A.4 FDIC Summary of Deposits

We construct an alternative measure of a local lender using the Federal Deposit Insurance Corporation (FDIC) Summary of Deposits data. We define a lending institution as local to New Orleans if it has at least one branch in the New Orleans CSA. As with the loan-based measures, we then calculate the share of loans coming from local and non-local lending institutions for each census tract for each year (1997 - August 28, 2005). Finally, we assign each homeowner a local lender share based on the census tract of the property and the year of the loan origination. The FDIC Summary of Deposits data do not cover HUD-regulated mortgage companies and National Credit Union Administration-regulated credit unions. When we construct our tract-level lending measure we count all loans originated by a HUD regulated lender as non-local and drop loans originated by credit unions. Approximately 1% of the loans in our HMDA sample are originated by credit unions. Appendix Table 7 Column (3) shows the coefficients from a regression model that uses the New Orleans branch measure of a local lender.

A.5 Property Sales Data from Orleans Parish

We use property sales data as a means to evaluate whether home sales after Katrina could explain reduced mortgage debt. The source of the residential property sales data is the Orleans Parish Assessor's Office website (http://nolaassessor.com/). The sales data cover the time period from the mid 1980s to the present. We use a two step process to collect the data. First, we start with a list of all parcel numbers in Orleans Parish. We obtained this list from a parcel-level GIS shapefile from the City of New Orleans data website (https://data.nola.gov/). The shapefile was dated February 21, 2014. Second, we download records of all sales recorded in the system for each parcel. Our script successfully returned data on the parcel for 86% of the 150,050 parcels in the full list. The key to constructing the URL of the page containing the sales data consists of the street number, street name, and street suffix. We believe that cases in which no data was returned for a parcel may have been due to discrepancies in the street name spelling and suffix between our parcel list and the Orleans Parish Assessor's website.

It is important to highlight that the home sales data only include sales from Orleans Parish. Recall that Orleans Parish is coterminous with the City of New Orleans. Our main analysis in the text is determined by the coverage area of our flood depth data. The flood depth data cover (99.6% of the population of) Orleans Parish, as well as, a portion of St. Bernard and Jefferson Parishes. However, our analysis of home sales is limited to Orleans Parish.

Cleaning the Property Data

We take two steps to clean the sales data. First, we drop commercial parcels. Second, we drop transactions with a dollar value of zero. Zero dollar transactions are typically transfers from one family member to another, or into or out of a trust. About 30% of the transactions have a value of zero during our sample period. The share of transactions with a value of zero is fairly consistent throughout the panel, including around the time of Katrina. For example, the mean share of transactions with a zero value in the 4 quarters prior to Katrina was 29% while that share was 26% in the 4 quarters after Katrina.

A.6 Assessed Value Data

The Orleans Parish and St. Bernard Parish Assessor's Offices are the sources of the parcel-level assessed value data. The data we use are provided by the private company CoreLogic. We limit our analysis to parcels (N = 66,935) that have a pre-Katrina assessed value between 2003-2005 and a post-Katrina assessed value between 2007-2013. For 52.4% of these parcels (N = 35,092) there is a reduction in the assessed value (measured in real terms in 2005 dollars) between the last pre-Katrina assessment and the first post-Katrina assessment. Appendix Figure 3 shows the distribution of price reductions for these parcels.

We follow (Gregory [2013]) and use the change in assessed value to define a proxy variable for properties that were severely damaged by Katrina. We define a property as *severely damaged* if there is at least a 50% drop in the assessed value. We define a severely damaged property as *rebuilt* if a severely damaged property's 2nd post-Katrina assessed value is at least 100% larger than the 1st post-Katrina value (i.e. the parcel recovers its value).

We also experiment with a 2nd set of severely damaged and rebuilt definitions that are defined analogously, but use a drop threshold of 30% and a rebuilt threshold of 43%. The results of the regressions described in Section 5.1 of the text and Appendix Section C are similar if we use the 2nd set of damage and rebuilt proxy variables.

A.7 Flood Insurance Data

The flood insurance policy data were obtained from the National Flood Insurance Program (NFIP) as part of a Freedom of Information Act Request. The administrative data used in this paper were first compiled as part of a panel used by Gallagher [2014]. The data include information on all flood insurance policies for 2004 and 2005 for residents living in our New Orleans flood map region. Specifically, the data include information on the number of policies, the number of claims, and total claims paid out aggregated by zip code and flood zone. We also use data on the total amount of flood insurance aggregated at the Parish level.

Table 5 Panel A of the text provides a flood insurance payout measure for New Orleans homeowners by depth of flooding. We formed the 3 ratios in Panel A by first aggregating total home loan balances as of 2005Q3 and dividing the 2005 New Orleans claim payouts by this amount. We then merged this ratio into the CCP by zip code and flood zone. The total 2005 insurance payout statistic reported in Section 4.3.4 of the text is calculated by summing the claims paid to residents living in our New Orleans flood map region.

There are three main limitations of the flood insurance data. First, as noted above, the data are aggregated at a higher geographic unit than the CCP data. Second, the NFIP does not track whether claims money is spent on repairs or on paying down mortgages. Third, the flood insurance data are reported by year. Thus, 2005 flood insurance claims is an imprecise measure of claims attributable to Hurricane Katrina. Some of the claims dollars from 2005 may be due to smaller and more localized flood events. At the same time, some Katrina payouts may have been delayed until 2006. Nevertheless, two additional pieces of data help to verify that the vast majority of Katrina claims occur in 2005: (1) overall claims reported in 2006 are two orders of magnitude lower than those from 2005 for our New Orleans flood map region, and (2) the GAO reports that 95% of claims related to Katrina (in all locations) had been closed by May 2006 (GAO [2006]).

A.8 Federal Government Assistance

The Individual Assistance Program administrative data were obtained from FEMA as part of a Freedom of Information Act Request. The data record all federal assistance distributed as part of the Individual Assistance Program. The data report the total number of payments and the total amount of the payments by zip code. The total 2005 Individual Assistance statistic reported in Section 4.3.4 of the text is calculated by summing the payments to residents living in our New Orleans flood map region.

A.9 US Census Data

The paper uses data from the 2000 Decennial Census. The smallest geographic region publicly reported by Decennial Census is the block group. We use block group level socioeconomic and demographic information as control variables in our econometric models. The middle panel of Table 1 in the text reports the means by flood depth for a these variables.

B 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. Appendix Figure 4 shows a time series plot of the share of individuals with a non-reporting home loan from 2002Q3 to 2008Q3. 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 Memphis, and St. Louis at the time of the flood. The baseline non-reporting rate ranges from about two 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 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 normal business activity, which may also have been true for the creditor companies with accounts in Louisiana. Second, as described in Section 2 of the text, 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 impute balances and indicators for having a mortgage for people in the CCP that have temporarily non-reporting mortgages.

Appendix Figure 5 shows the share of residents with a home loan by quarter from 2002Q3 to 2008Q3 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. There is no drop for residents of Memphis and St. Louis. Appendix Figure 6 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 Appendix Figure 5) and the trends remain the same. There is no longer evidence of a sharp drop 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.

Appendix Figure 7 shows (uncorrected) home loan balances for the five flood groups in New Orleans. In light of Appendix Figure 5, 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. Again, we use the mortgage id number to identify mortgages with temporarily missing 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 interpolate between the last reported value before the home loan disappears and the first reported value once the home loan returns.

Appendix Figures 8, 9, and 10 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 interpolation. The empirical estimates reported in the text of the paper are from a sample corrected for missing values using the linear interpolation approach.

Appendix Figures 11 and 12 consider whether there is evidence of non-reporting at the time of Katrina for auto loans and credit cards. Figure 11 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 New Orleans 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. Appendix Figure 12 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 three cities with credit cards.

C Additional Figures and Tables Referenced in Text

Auto and Student Loan Debt

Appendix Figure 13 shows quarterly event study estimates for total auto debt. There is a relatively small temporary increase in auto loan balances for the most flooded residents after Katrina, although none of the point estimates are statistically significant at the 5% level. We might expect an increase in auto loans due to the financing of replacement vehicles for those that were totaled in the flooding. We interpret this estimate with some caution as there is evidence of non-reporting of auto debt after Katrina. Unfortunately, unlike home loan debt, we are unable to correct for the non-reporting of auto debt. [Referenced in Section 4.1.2 of the text.]

The student loan debt balances are not consistently recorded as a separate debt category in the CCP until 2004Q3. Prior to 2004Q3 student loan debt was sometimes classified as part of "other" debt (Brown et al. [2014]). Thus, there are only three pre-Katrina quarterly coefficients estimated in the quarterly event study panel. Appendix Figure 14 shows the quarterly event study estimates for student loan debt. The debt level spikes after Katrina for both the most and least flooded residents.

Credit Constraints and Credit Card Debt

Appendix Table 3 examines whether consumer credit constraints may be one reason why we do not observe a larger change in credit card debt following Katrina (e.g. Gross and Souleles [2002]; Sullivan [2008]; Jappelli and Pistaferri [2010]). We investigate the role of consumer credit constraints in two ways. First, we use consumer initiated credit inquiries as a proxy for credit demand (Bhutta and Keys [2014]), and the change in the number of new accounts to proxy supply (columns 1-3). We find evidence of a tightening credit market for the most flooded residents. Second, we split our sample based on the likelihood of being credit constrained. Specifically, we estimate our quarterly event study model separately for residents who were above and below the median Equifax Risk Score (TM) for the sample in the quarter prior to Katrina (columns 4 and 5), and residents who were and were not within $500 of their total available card credit limit in the quarter prior to Katrina (columns 6 and 7). We find that the most flooded residents who are likely to be less credit constrained increase their average quarterly debt by approximately $450, which is about an order of magnitude larger than those residents who are likely to be credit constrained. However, this estimate is neither statistically significant nor economically significant. Appendix Figure 15 plots the coefficients from our event study specification for credit card debt when estimated using the above median Equifax Risk Score (TM) sample as in Appendix Table 3 column 4. The figure shows a spike in credit card debt of about $850 in the quarter after Katrina for the most flooded group (probability value 0.107). [Referenced in Section 4.2 of the text.]

Migration

Appendix Figures 16, 17, and 18 use our event study model to estimate the effect of flooding on quarterly migration rates. Figure 16 defines migration as living in New Orleans the previous quarter and then leaving New Orleans and not returning to the New Orleans CSA for at least 3 years. This is the definition of migration estimated using our difference-in-differences model in the text (Table 4 column 7). The difference in migration rates peaks in the 1st quarter after Katrina at 2.6 percentage points. Figure 17 defines migration as living in New Orleans in the previous quarter and then leaving New Orleans and not returning to the city of New Orleans for at least 3 years. Figure 18 defines migration as living in New Orleans in the previous quarter and then leaving New Orleans and not returning to the New Orleans CSA for at least 1 year. All three measures of migration show quarterly migration peaking the quarter after Katrina. Migration rates after Katrina are higher for those in the most flooded group than those in the least flooded group for the first 1-2 years following Katrina. As expected, the estimated post-Katrina migration rate is higher than the 3 year New Orleans CSA measure if we use either the 3 year city of New Orleans or 1 year New Orleans CSA definitions. [Referenced in Section 4.1.4 of the text.]

Likelihood of Having a Home Loan

Appendix Figure 19 shows quarterly event study estimates for homeowners with mortgage debt at the time of Katrina. The dependent variable is an indicator variable of whether there is *any* mortgage debt. Six months after Katrina there is a 24 percentage point reduction in the likelihood that the most flooded homeowners have *any* mortgage debt (relative to the non-flooded homeowners). This reduction increases to 31 percentage points 7 quarters after Katrina before reversing trend. One striking feature of this finding is the speed with which mortgage debt disappears. The timing of mortgage debt disappearance is a key fact used to differentiate between the possible reasons for the reduction in mortgage debt in Section 4.3 of the text. [Referenced in Section 4.3 of the text.]

Quarterly Home Sales

Appendix Figure 20 shows the quarterly number of home sales in the non-flooded, least flooded and most flooded areas in Orleans Parish. During the two year period before Katrina, the number of quarterly home sales in the most flooded Orleans Parish blocks follows a very similar trend to the least flooded blocks. In the first quarter after Katrina, sales plummet, before returning to pre-Katrina levels in 2006Q1. Home sales in the most flooded blocks are higher than those in the least flooded blocks starting about a year after Katrina. [Referenced in Section 4.3.2 of the text.]

Housing Characteristics by Neighborhood

Appendix Table 4 is a companion table to Table 6 in the text. This table shows zip code level housing characteristics for eight geographic areas or "neighborhoods" of New Orleans. The eight columns in the table calculate summary statistics for each of the eight neighborhoods. The statistics are tabulated by zip code. Thus, the neighborhood labels are rough approximations based upon which neighborhood the largest share of the zip code is in. The neighborhood labels are meant only to give context to readers that may be familiar with the city's neighborhoods, but not its zip codes. The zip code level data are weighted by the CCP population when combining zip codes into neighborhoods. Panel A and Panel B display socioeconomic and demographic characteristics from the 2000 US Decennial Census and the CCP. These variables are used as control variables in the OLS regressions that test the homeowner rebuilding decision framework discussed in Section 5.1 of the text. The Census data used for the table are originally aggregated at the zip code level. The CCP data are originally at the census block level and aggregated up to the zip code. All dollar values are adjusted (when necessary) to 2005 dollars using the Consumer Price Index. Please refer to Section 5.1 of the text or Appendix Section C for more details.

The exact definitions and source of the variables in Appendix Table 4 and in Table 6 in the text are as follows:

- *Flood Policies per Housing Unit*: The number of 2004 flood insurance policies (NFIP) divided by the number of housing units reported in the 2000 Decennial Census
- *Median Home Value*: Median home value reported in the 2000 Census
- *Proportion with a Mortgage*: Proportion of CCP residents reporting a positive home loan value in 2005Q2
- *Average Mortgage Balance*: Average mortgage balance for CCP residents in 2005Q2
- *Average Mortgage Balance Conditional on Having a Mortgage*: Average mortgage balance for CCP residents conditional on reporting a positive loan value in 2005Q2
- *Average Flood Depth*: Average flood depth (NOAA)
- *Proportion Properties w/ Severe Damage*: Proportion of assessed properties with at least a 50% drop in assessed value from pre-Katrina to post-Katrina (CoreLogic)
- *Average Flood Insurance Claim Conditional on Having a Claim*: Total NFIP claims in 2005 divided by the number of claims in 2005

- *Ratio of Average Claim to Median Value*: Average Flood Insurance Claim Conditional on Having a Claim divided by Median Home Value
- *Same Census Block 3 Years After Katrina*: The proportion of CCP residents who are living in the same census block in 2008Q3 as they were in 2005Q3
- *Severely Damaged Properties Rebuilt*: Proportion of assessed properties with at least a 50% drop in assessed value from pre-Katrina to post-Katrina, and a subsequent 100% increase in assessed value (CoreLogic)
- *Proportion Hispanic*: Proportion Hispanic (Census)
- *Proportion African American*: Proportion African American (Census)
- *Proportion Age 65 or Older*: Proportion age 65 or older (Census)
- *Proportion with a College Degree*: Proportion with a college degree (Census)
- *Proportion owner-occupied housing*: Proportion of occupied housing units that are owner-occupied (Census)
- *Poverty Rate*: Poverty rate (Census)
- *Median Household Income*: Median household income (Census)
- *Equifax Risk Score*: Equifax Risk Score (TM) (CCP)
- *Proportion with an account that is 90+ days delinquent*: Proportion of CCP residents that have at least one account that is 90 days delinquent
- *Age*: Average age of CCP residents

Appendix Table 5 displays coefficients of interest from four OLS regressions. The dependent variable for each regression is the proportion of New Orleans residents living in the same census block three years after Hurricane Katrina (as they were at the time of the storm). Columns 1 and 2 estimate zip code-level specifications using the same data as that of the two neighborhood tables (Table 6 in the text and Appendix Table 4). Columns 3 and 4 estimate individual level specifications using our CCP sample. The list of control variables included in the specifications in columns 2 and 4 is the same list of variables in Appendix Table 4 (with the exception that age squared and age cubed are also included). Standard errors are robust to heteroskedasticity in each specification and clustered at the block level in columns 3 and 4.

Claim to Value measures the ratio of the average flood insurance claim (conditional on having a claim) divided by the median home value. The homeowner rebuilding framework in Section 5.1 of the text predicts that there will be a negative correlation between this ratio and the decision to stay and rebuild (as proxied by living on the same block 3 years after Katrina). Each model confirms this prediction. For example, in specification shown in column 4, a change in the claim to value ratio of 0.6 (equivalent to the average difference between residents in Uptown and the 9th Ward (see Table 6 in the text)) is associated with a 4.7 percentage point drop in the proportion of residents living in the same block 3 years after Katrina. Interestingly, Claim to Value is the only statistically significant variable among the 16 variables included in the specification shown in column 2.

Appendix Table 6 also evaluates the hypothesis that there will be a negative correlation between the flood insurance claim to home value ratio and the decision to stay and rebuild. The table estimates OLS regression models where the dependent variable is a proxy for rebuilding. The regressions only consider severely damaged parcels. We define a parcel as as severely damaged if the parcel had at least a 50% drop in assessed value from the last pre-Katrina assessment to the first post-Katrina assessment. We define a parcel as being rebuilt if there was a 100% increase in the assessed value between the 1st and 2nd post-Katrina assessments. Overall, the estimates in Appendix Table 6 are fairly noisy and are not as consistent as those in Appendix Table 5 which uses the CCP moving variable as the outcome. One possible reason is that there is likely to be more measurement error in the rebuilding proxy variable. Nevertheless, the estimate for the most geographically fine fully controlled specification, shown in column 4, is statistically significant with the expected sign.

D Robustness Checks

D.1 Alternative Flood Depth Models

Total Debt Balance

Appendix Table 2 presents three additional robustness specifications for the estimates of the impact of flood depth on total debt balance shown in Table 3 of the text. Column 1 of Appendix Table 2 repeats the specification shown in column 7 in Table 3 of the text. All controls listed for column 7 of Table 3 are included in each of the four specifications in Appendix Table 2. Column 2 runs our main model using the alternative sample inclusion rule discussed in Appendix Section A.2. The results are similar to our preferred sample.

In the main estimation sample we include residents in all flood depth quartiles. Most of the discussion in the text focuses on the least and most flooded residents. The reason for this is that these residents are most similar to the non-flooded residents in terms of their US Census and CCP characteristics (see Section 2.5 of the text), and also have similar trends for *all* of the dependent variables discussed in the text. Nevertheless, one might be worried that including individuals from flooded quartiles 2 and 3 in the sample could lead to misleading estimation results for the coefficients of interest for quartiles 1 and 4. This could occur because the inclusion of the calendar time (quarterly) fixed effects and the interacted control variables are estimated off of all quartiles. Column 3 only includes individuals from quartiles 1 and 4 (along with non-flooded residents) when estimating our main model. The coefficients on the most and least flooded groups do not change much by including the middle flood depth groups (moving from column 1 to column 3).

The specification shown in column 4 replaces the flood depth quartile indicators with an indicator for *any* flooding and a linear measure of flood depth. This specification shows a reduction of about \$4,685 in places that were slightly flooded and a further reduction of \$893 in debt for each foot of flooding relative to the non-flooded group. The debt reduction estimates reported in column 1 are very similar to those implied by the linear model in column 4 combined with the mean flood depths by quartile reported in Table 1 of the text. It appears that the impact of flooding on debt reduction jumps discontinuously going from no flooding to positive flooding, but then scales somewhat linearly with flood depth.

Mortgage Debt and Local Lending Institutions

Appendix Table 7 considers robustness specifications for the local lender results shown in Table 7 of the text. Column 1 of Appendix Table 7 repeats the preferred specification (column 5) from Table 7 of the text. Recall that this specification uses the local loan share measure and includes all individuals with a positive CCP home loan balance at the time of Katrina. The estimates imply that a one standard deviation (0.06) increase in the local share for a homeowner in the most-flooded group is associated with a 16% (calculated as $(0.06 * 0.686)/0.263$) decrease in the likelihood of paying off a home loan relative to the mean drop in the share with home loans in the most flooded group (the -0.263 coefficient reported in the second row of column 1 of Table 7 in the text). Column 2 considers how the estimates change if we use the dollar share of home loans to calculate the local lender share. The column 2 estimates imply that a one standard deviation (0.05) increase in the local share for a homeowner in the most-flooded group is associated with a 3.4 percentage point decrease (13% relative to the mean) in the likelihood of paying off a home loan. Column 3 considers how the estimates change if we use the CSA branch definition as the measure of a non-local lender. The column 3 estimates imply that a one standard deviation increase (0.10) in the local share for a homeowner in the most-flooded group is associated with a 4.6

percentage point decrease (18% relative to the mean) in the likelihood of paying off a home loan. Column 4 repeats the specification in column 1 except that the sample is limited by dropping individuals whose largest home loan was originated before 1997 (this drops 15% of the sample). Recall that we are not able to assign these homeowners a census tract by year local lender share because consistently reported in HMDA data begins in 1997. Column (5) repeats the specification in column 1, but clusters the standard errors at that census tract level. The point estimate for the post-Katrina interaction between the local lender share and the most flooded group just misses statistical significance at conventional levels. Please refer to the text and Appendix Section A for more details regarding the data, the model specification, and the local lender definitions.

D.2 Propensity Score Matching Estimates

Our main analysis uses a difference-in-differences specification and four "treated" groups. Figure 1 in the text and the quarterly event study figures in the text and the appendix show that all of the outcome variables of interest for the non-flooded, least flooded, and most flooded groups have similar pre-flood trends. The common pre-flood trends provide evidence to support a key identification assumption that in the absence of flooding the outcomes for the non-flooded, least flooded, and most flooded groups would have continued to evolve at similar rates.

Table 1 in the text shows that there are differences between the levels of covariates (and pre-flood outcome variables). These differences are greatest when comparing quartiles 2 and 3 to the non-flooded group. In principle, the differences in covariate levels should not effect the consistency of our difference-in-differences estimates for the least and most flooded groups. However, these differences are more concerning for the middle flood quartiles for which there are some differences in the pre-trends of the dependent variables. Using OLS regression with treated and control groups that have different covariate distributions can lead to extrapolation across areas of the control distribution with poor treatment group overlap. In such cases, the estimated treatment effects can be sensitive to the differences in the distributions of covariates between the treatment and control groups (Imbens [2004]). We may also be concerned that there is something specific to the treated population that effects their response to flooding.

We use inverse propensity score weighting in our difference-in-differences model to evaluate the robustness of our main analysis. First, we estimate a propensity score for the likelihood of being flooded. We do this separately for each of the four flood groups. For each group, we estimate a probit model using the sample of residents in non-flooded blocks

- the control group - and the sample of residents in blocks in one of the flooded quartiles - the treatment group. We include all of our engineering, economic, and demographic control variables from our main difference-in-differences specification as independent variables in the probit analysis. The full set of explanatory variables in the probit correspond to all of the variables listed in the notes of Table 2 in the text and a cubic of age in the quarter prior to Katrina.

Second, we drop observations from our sample due to poor overlap of the estimated propensity score. We follow Imbens and Wooldridge [2007] and drop observations with a propensity score outside of the interval [0.1, 0.9]. In our main sample the number of individuals in each flood group are as follows: 3,308 in the non-flooded group, 2,951 in quartile 1, 3,254 in quartile 2, 3,620 in quartile 3, and 3,440 in quartile 4. After the trimming, the number of individuals in each flood group sample are: 2,832 non-flooded and 2,951 quartile 1 in the "quartile 1 sample", 2,242 non-flooded and 3,254 quartile 2 in the "quartile 2 sample", 1,441 non-flooded and 3,620 quartile 3 in the "quartile 3 sample", 1,112 non-flooded and 3,440 quartile 4 in the "quartile 4 sample".

Appendix Table 8 shows our difference-in-differences propensity score robustness specifications for the estimate of flooding on total debt balance. There are four panels in the table. Each panel corresponds to a different flood group. For example, Panel A includes non-flooded residents and individuals in the 1st flood quartile. There are three columns. Column 1 includes model estimates using each propensity score trimmed sample. Column 2 uses the propensity score to re-weight the trimmed samples. We re-weight non-flooded individuals in each sample by the ratio of the propensity score over one minus the propensity score. Column 3 adds the full set of control variables from our preferred specification (Table 3 column 7) to the trimmed, re-weighted samples.

The difference-in-differences estimate for the least-flooded group in the trimmed sample (column 2), -$6,636, is very similar to that from the full sample without covariates (Table 3 column 1 in the text): -$6,781. The estimate for the most-flooded group in the trimmed sample (-$15,406) is about 10% lower than the same estimate from the full sample in the text. Re-weighting by the propensity score leads to lower estimates for the three least-flooded groups, but little change for the most-flooded group. Adding the full set of control variables from our preferred specification in the text lowers the point estimates for the three least-flooded groups by between $900 and $1,600 and for the most-flooded group by about $400. Overall, the estimate from column 3 for the least-flooded group is slightly smaller than the preferred estimate in the paper (Table 3 column 7), while the estimate for the most-flooded group is about one-third larger (but still smaller in magnitude than the estimate without any control variables shown in Table 3 column 1).

D.3 Quantile Regression

Appendix Table 9 displays quantile regression coefficients for the effect of flooding on total debt balances for the 25th, 50th, and 75th quantiles (Koenker and Hallock [2001]). We estimate the quantile regression coefficients for our complete sample (columns 2-4) and for the 30% of our sample population that had a home loan at the time of Katrina (columns 6-8). We also include the OLS difference-in-differences coefficient estimate for both samples (columns 1 and 5). The quantile and OLS specifications include the set of control variables from Table 3 column 4 in the text. Standard errors are robust to heteroskedasticity and clustered at the block level.

The 75th quantile difference-in-differences estimate is greater than the mean difference-in-differences estimate for all flood groups when we estimate our full sample. This is exactly what we would expect given that reductions in home loan debt are driving the overall debt results and only 30% of the sample has a home loan.

The quantile estimates for the sample of residents with a home loan show less dispersion and indicate that the effect of flooding for this population is more uniform relative to the entire population. This is particularly true for the least flooded quartiles. The quantile estimates for the most-flooded group show larger absolute differences, but again we can not reject a "locational shift" model (across these quantiles).

D.4 Persistence of Reduction in the Number of Mortgages

Appendix Figure 21 displays difference-in-differences event time coefficients and 95% confidence intervals from the estimation of a version of Equation 2 in the text that replaces the pre/post Katrina indicator with quarterly indicators. The main difference is that instead of the balanced panel of individuals from the CCP, here the unit of observation is the Census block - quarter. Our sample is a balanced panel of the Census blocks in our flood depth coverage area and runs from 2002Q3 through 2015Q3. The dependent variable is equal to 20 times the number of individual in the CCP living in the Census block that have at least one home loan. We multiply by 20 to account for the fact that the CCP is a 5% sample of the population. The specification includes Census block fixed effects and interactions of all engineering and Census socioeconomic variables (listed in the note to Table 2 of the text) with a post-Katrina indicator variable. In this way, the specification is similar to a block-level version of our preferred specification shown in column 7 of Table 3 of the text.

The figure shows that severe flooding is associated with a steep drop in the number of people with a mortgage per Census block which reaches almost 8 people by 2007Q1. This number can be compared to a pre-Katrina mean of 10.7 people with mortgages per block in the most flooded blocks in the quarter prior to Katrina. Some of this drop may be attributable to the missing data anomaly discussed in Appendix Section B. However, the shares of non-reporting mortgages was almost back to pre-Katrina levels by 2007Q1 as shown in Appendix Figure 4. While, the reduction in the number of people with a mortgage decreases in magnitude fairly steadily after 2007, it is remarkably persistent, remaining at about -4 (still almost a 40% reduction) a full 10 years after Katrina in 2015Q3.

This reduction is due to a reduction in the CCP population, as well as a decreased propensity for this population to have a mortgage. For example, a similar plot for CCP population shows a drop of 12 people per Census block in the most flooded blocks by 2015Q3 which reflect a 30% drop relative to the pre-Katrina mean of 40 people per Census block. While the data do not allow us to determine whether people own their homes without a mortgage, it is likely that there are fewer homes and a smaller share of those are owner-occupied.

Data from our individual-level balanced CCP panel reflect this persistence in drop in mortgages along another dimension. Of the people in the sample that had a mortgage at the time of Katrina, but did not have a mortgage by 2006Q1, only about 40% ever have a mortgage again through 2015Q3.

E References

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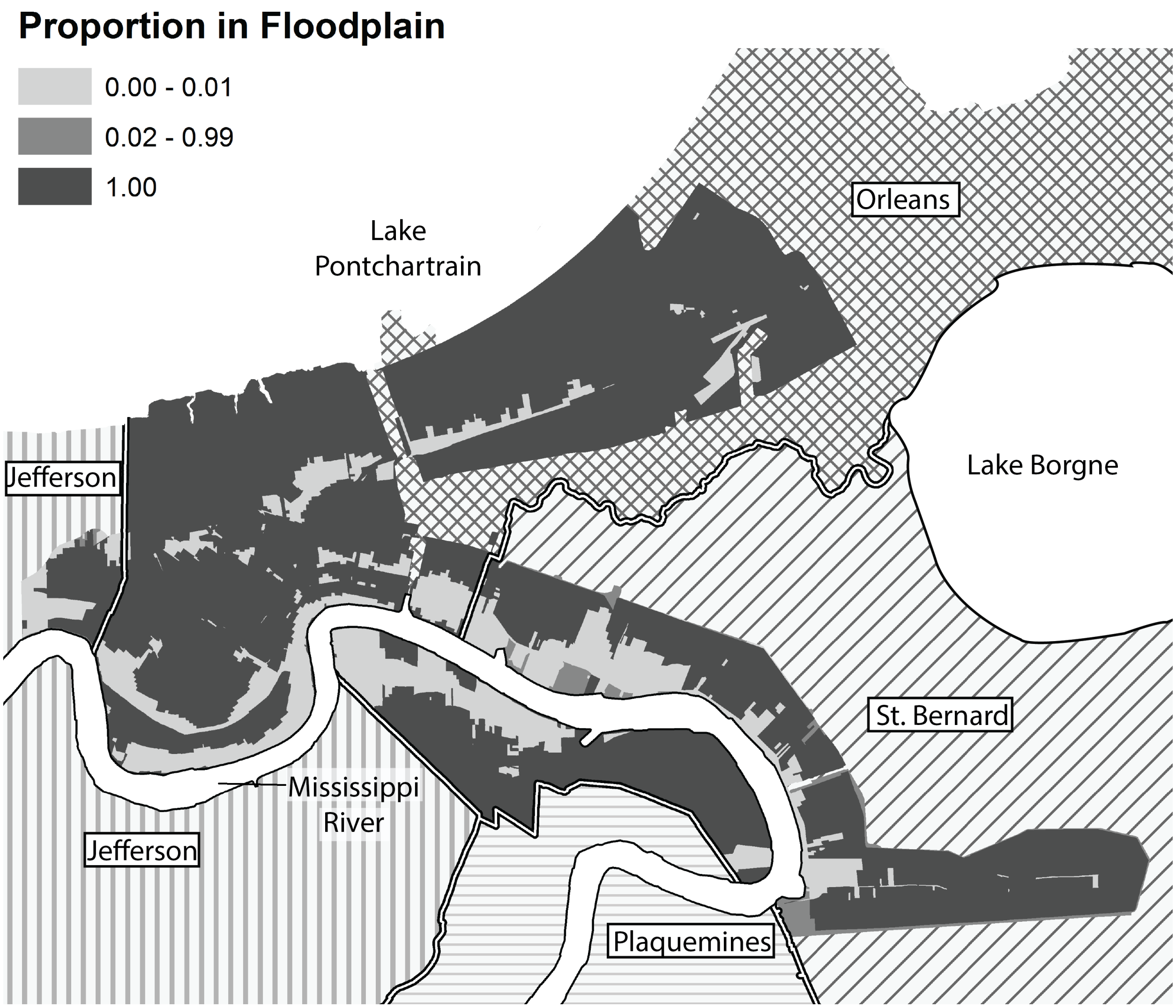
F Figures and Tables

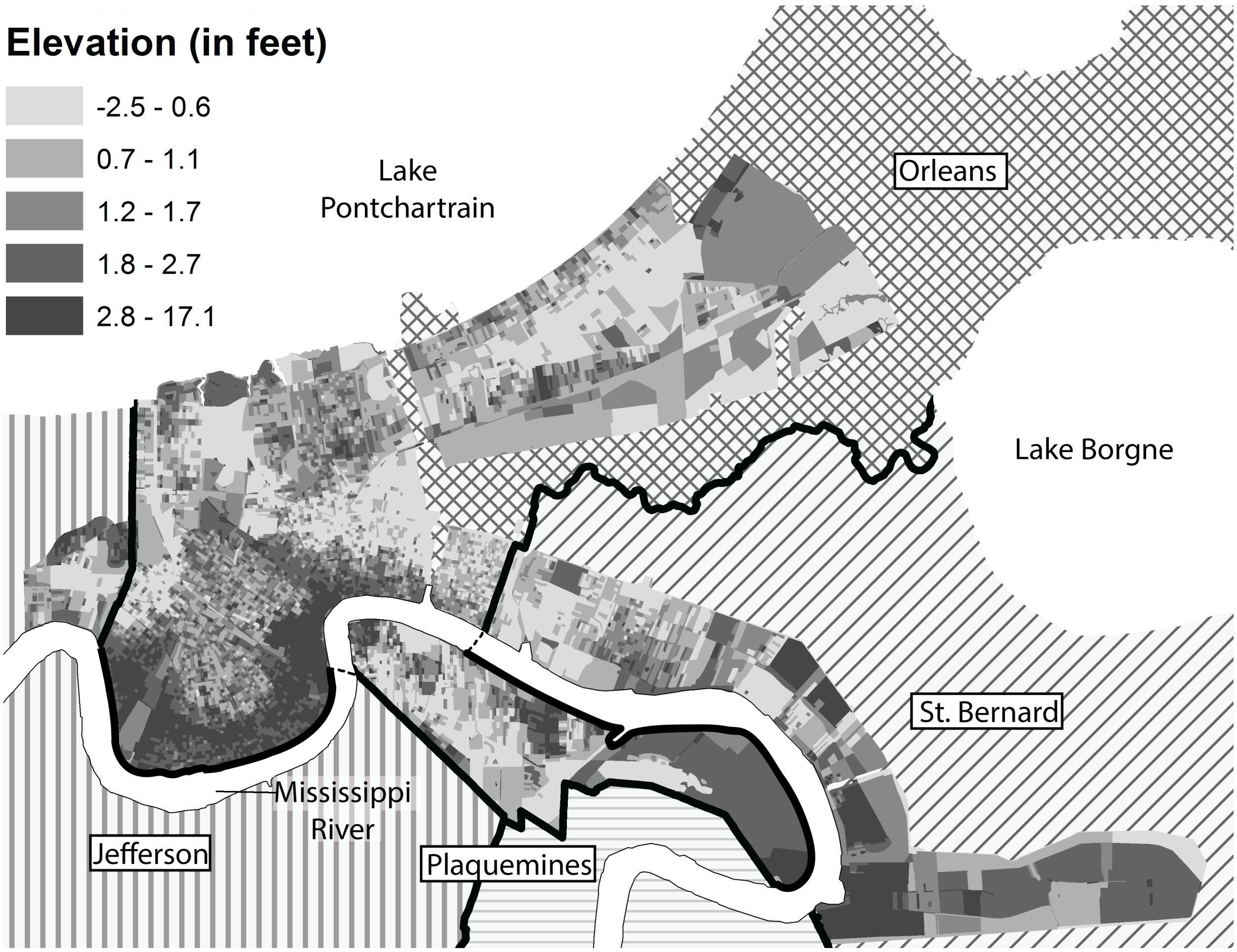
F.1 Figures

Figure 1: Proportion of Census Block in the 100-Year Flood Plain



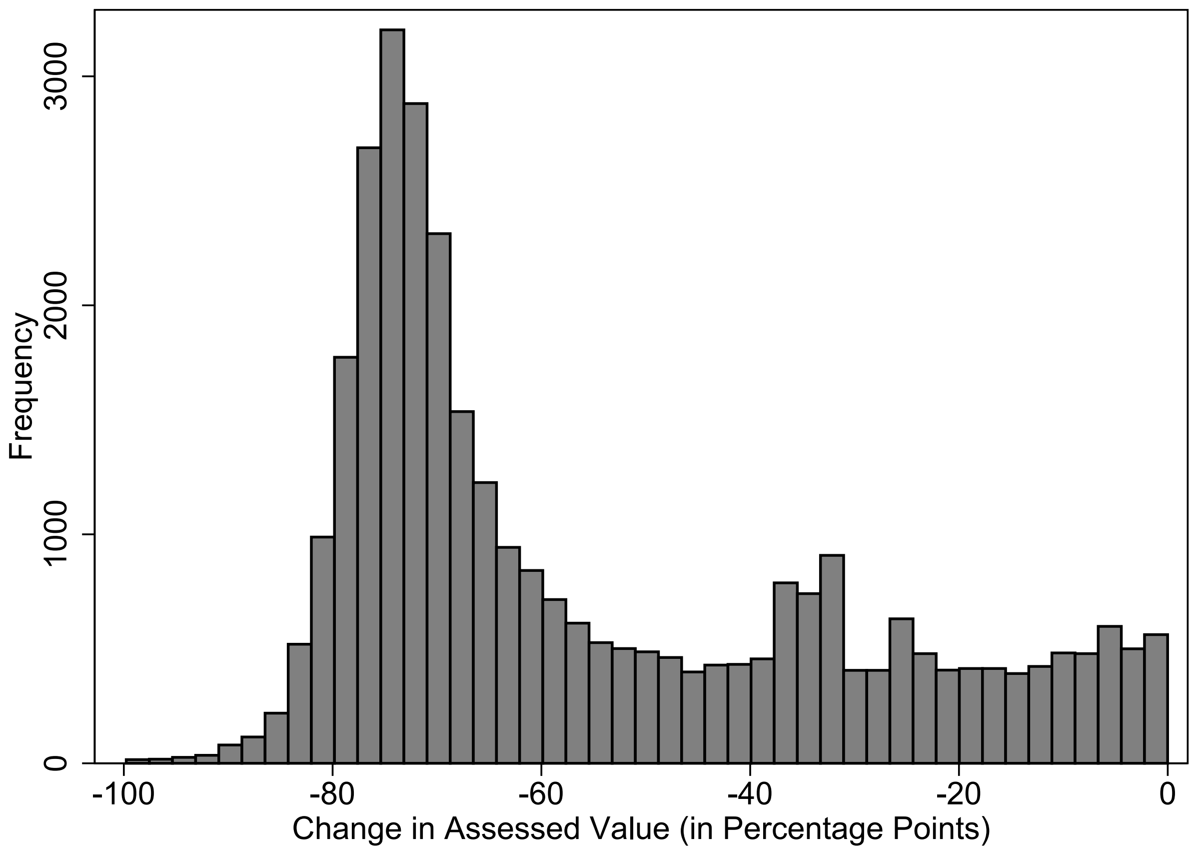
The figure classifies each census block in New Orleans as being either completely inside the 100-year flood plain, outside the flood plain (less than 1% of the land in the flood plain), or having a portion of the block in the flood plain. The figure is created with GIS using the spatial match between census blocks and the FEMA (pre-Katrina) flood map for New Orleans. The flood plain map covers portions of three Louisiana Parishes: Jefferson, St. Bernard, and Orleans. Please refer to Section 2 of the text and Appendix Section A for details.

Figure 2: Mean Census Block Elevation



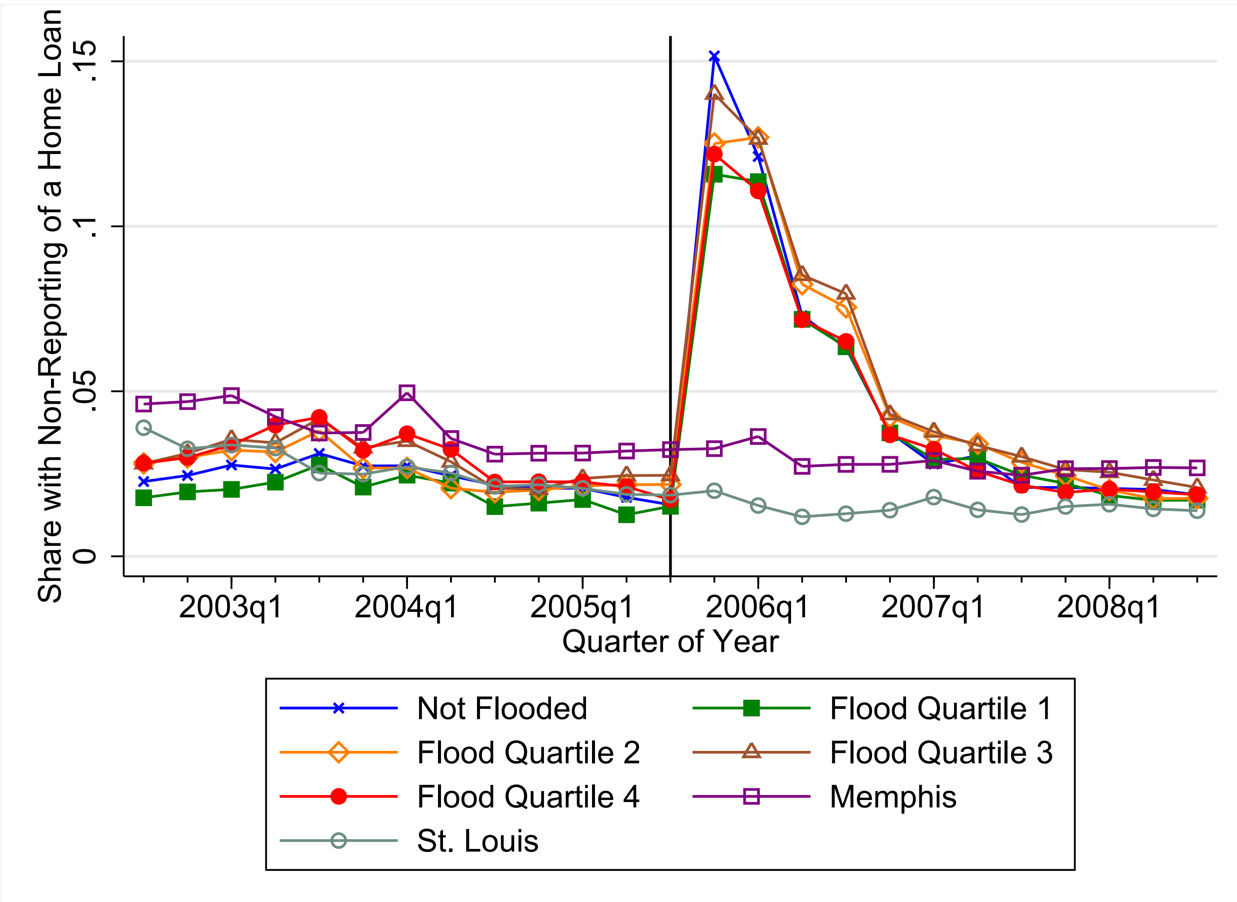
The figure shows the mean elevation above sea level for census blocks in New Orleans. Elevation data are from the US Geological Survey (USGS). The elevation map covers portions of three Louisiana Parishes: Jefferson, St. Bernard, and Orleans. Please refer to Section 2 of the text and Appendix Section A for details.

Figure 3: Distribution of the Change in Assessed Property Values for Properties that Drop in Value from the Last Pre-Katrina Assessment to the First Post-Katrina Assessment



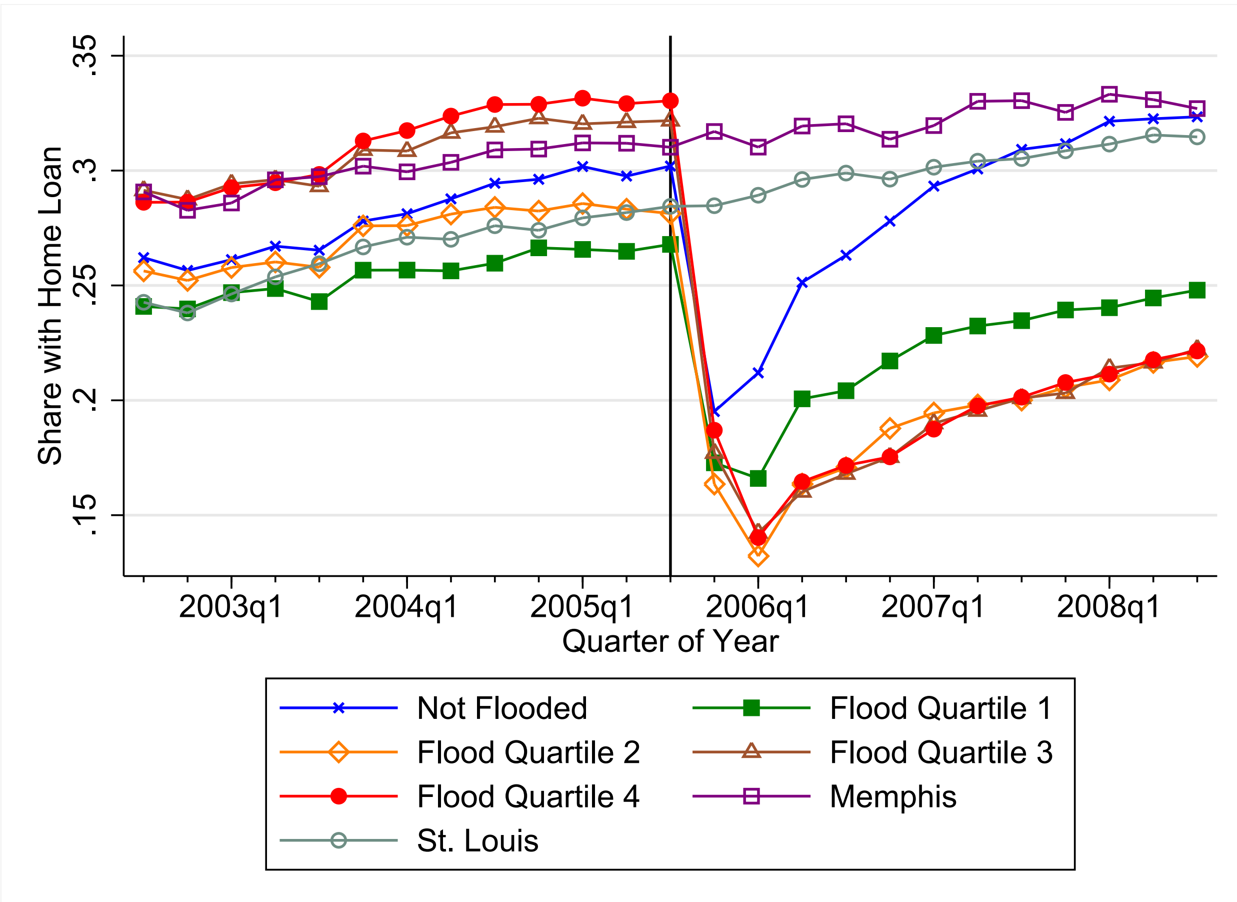
The figure shows the change in assessed value for Orleans Parish and St. Bernard Parish properties in our our flood depth coverage area which have both pre-Katrina and post-Katrina assessed values. We plot the change in assessed value for the 35,092 parcels (52.4% of the total number of parcels) that had a drop in assessed value. The source of the data are the Parish Assessors Offices and the data were provided by CoreLogic. Refer to Appendix Section A for additional details.

Figure 4: Share of Residents with a Non-Reported Home Loan



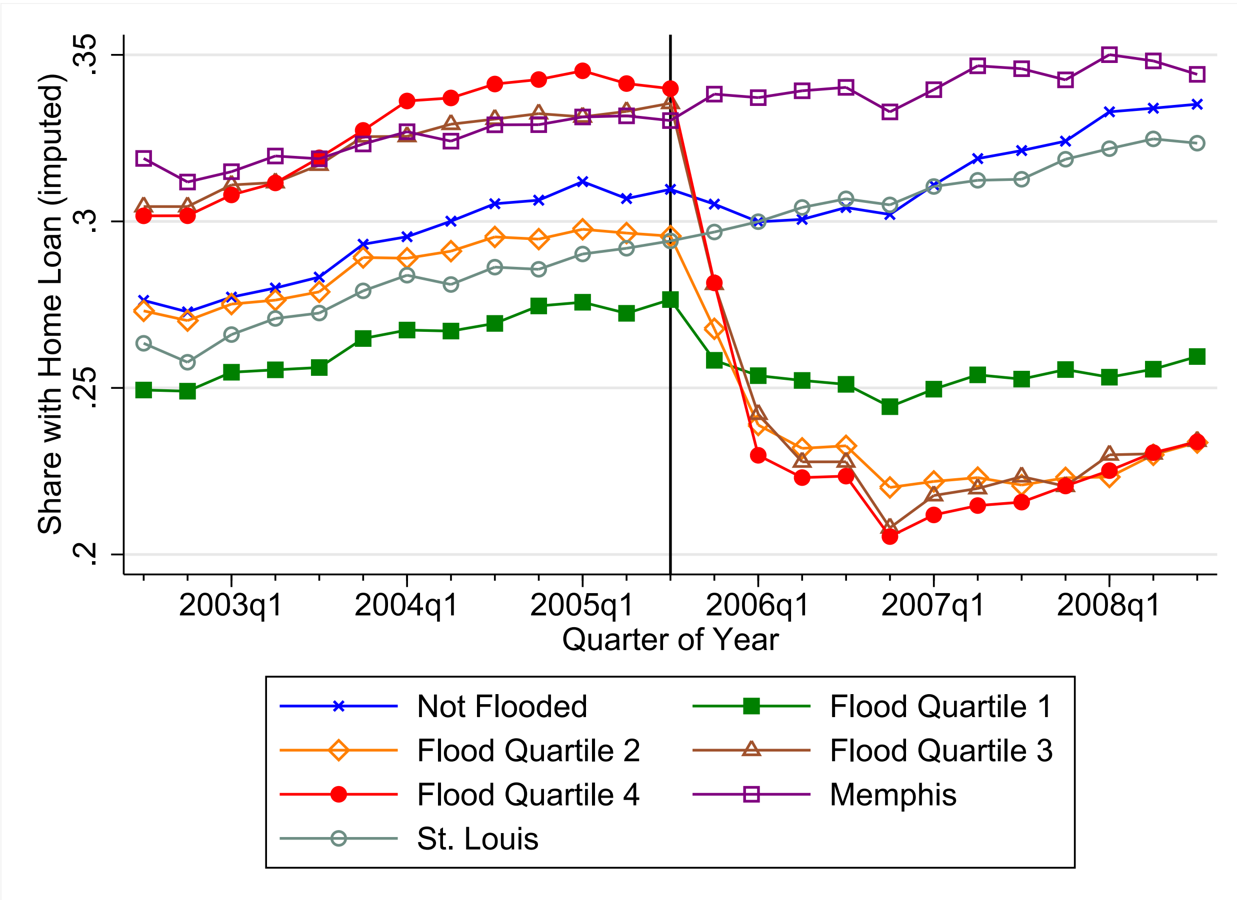
The figure plots the share of residents with a non-reported home loan for the five New Orleans flood depth groups as well as residents of Memphis, and St. Louis. Each point in the figure can be interpreted as the share of non-reporting home loans for that quarter among all home loans for each particular 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 at least a quarter, but reappears at some point later in our sample. Please refer to the Appendix Section B for more details.

Figure 5: Share of Residents with a Home Loan (Not Corrected)



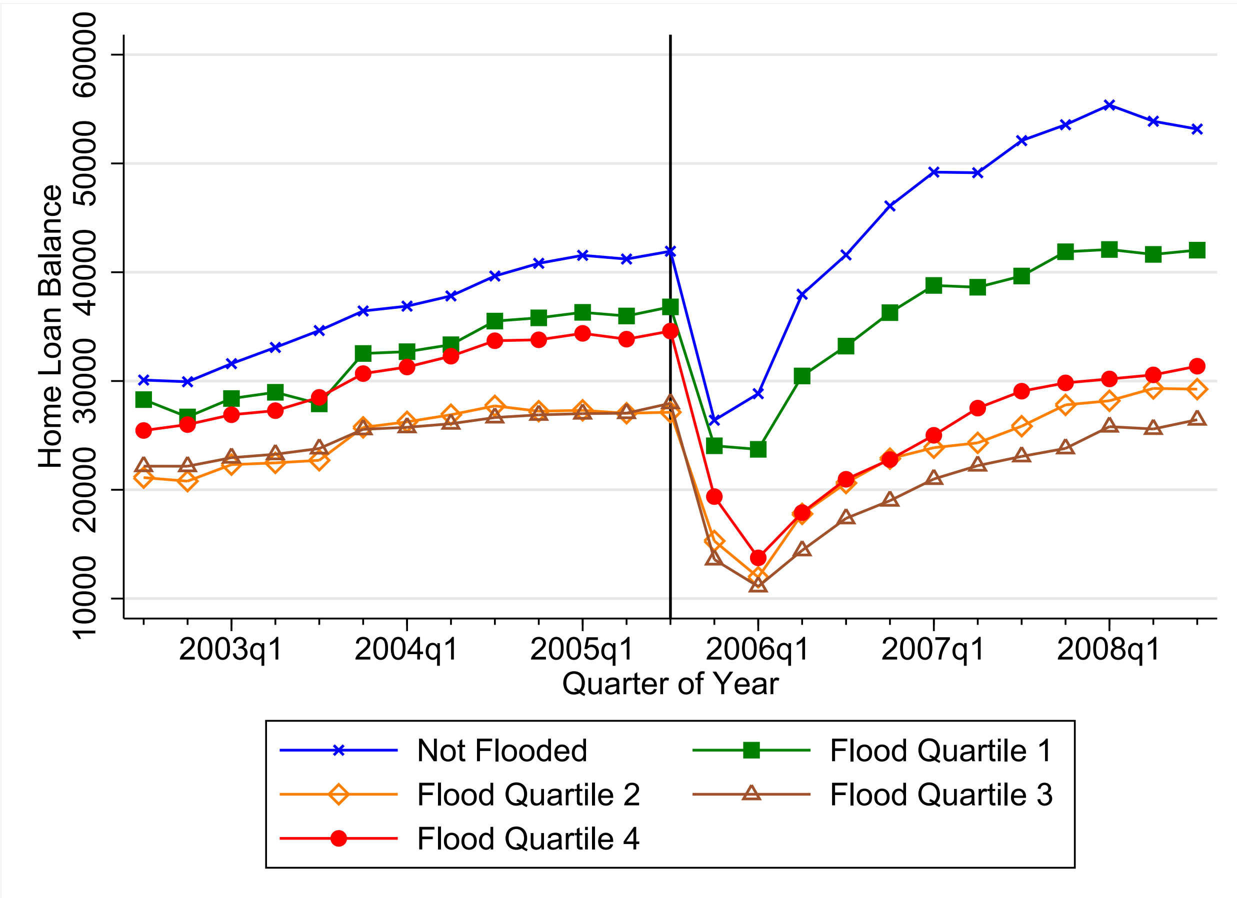
The figure plots the (uncorrected) share of residents with a home loan for the five New Orleans flood groups as well as residents of Memphis, and St. Louis. Please refer to the Appendix Section B for more details.

Figure 6: Share of Residents with a Home Loan (Imputed)



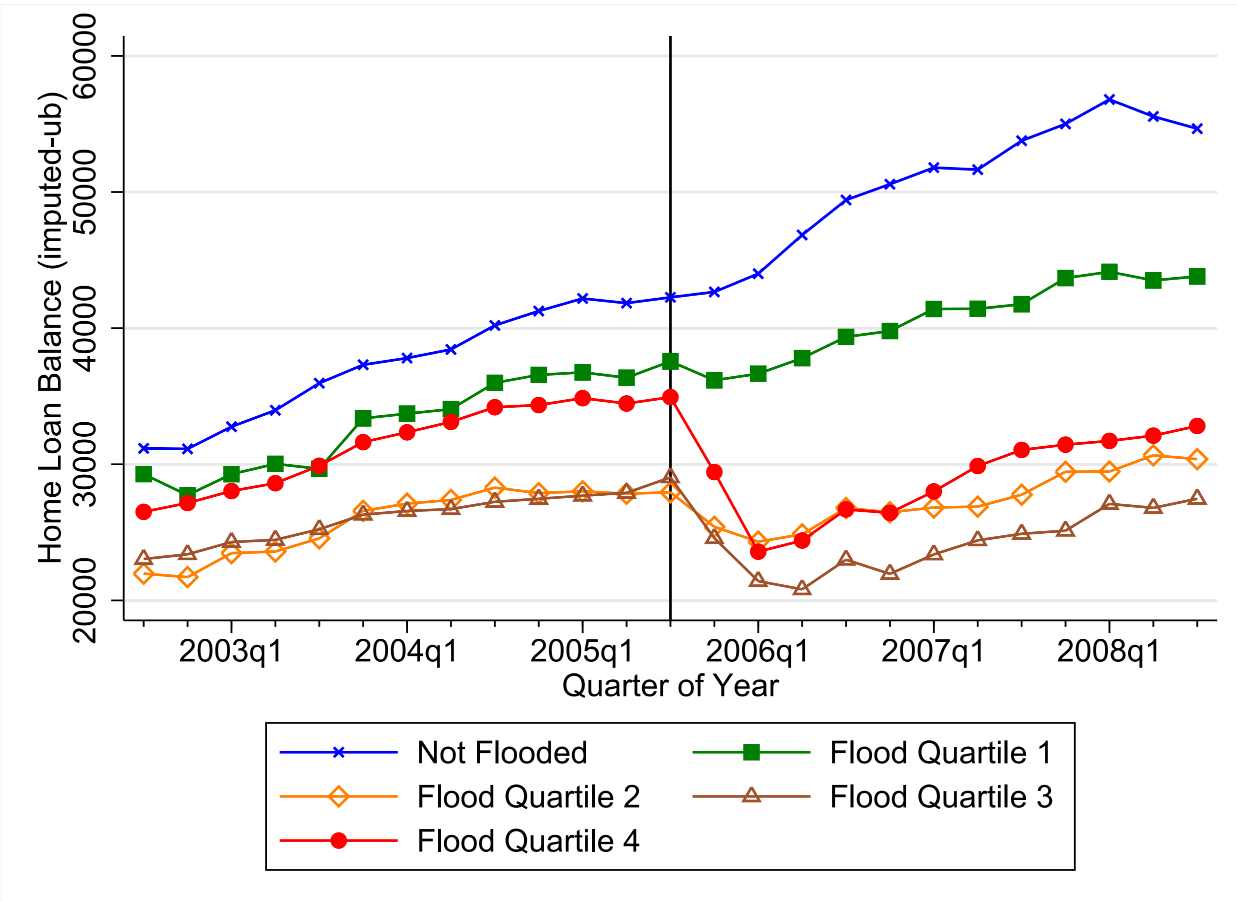
The figure plots the share of residents with a non-reported home loan for the five New Orleans flood groups as well as residents of Memphis, and St. Louis. The home loan share is corrected for non-reporting home loans. A non-reporting loan is defined as one that disappears for at least a quarter, but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

Figure 7: Home Loan Balances (Not Corrected)



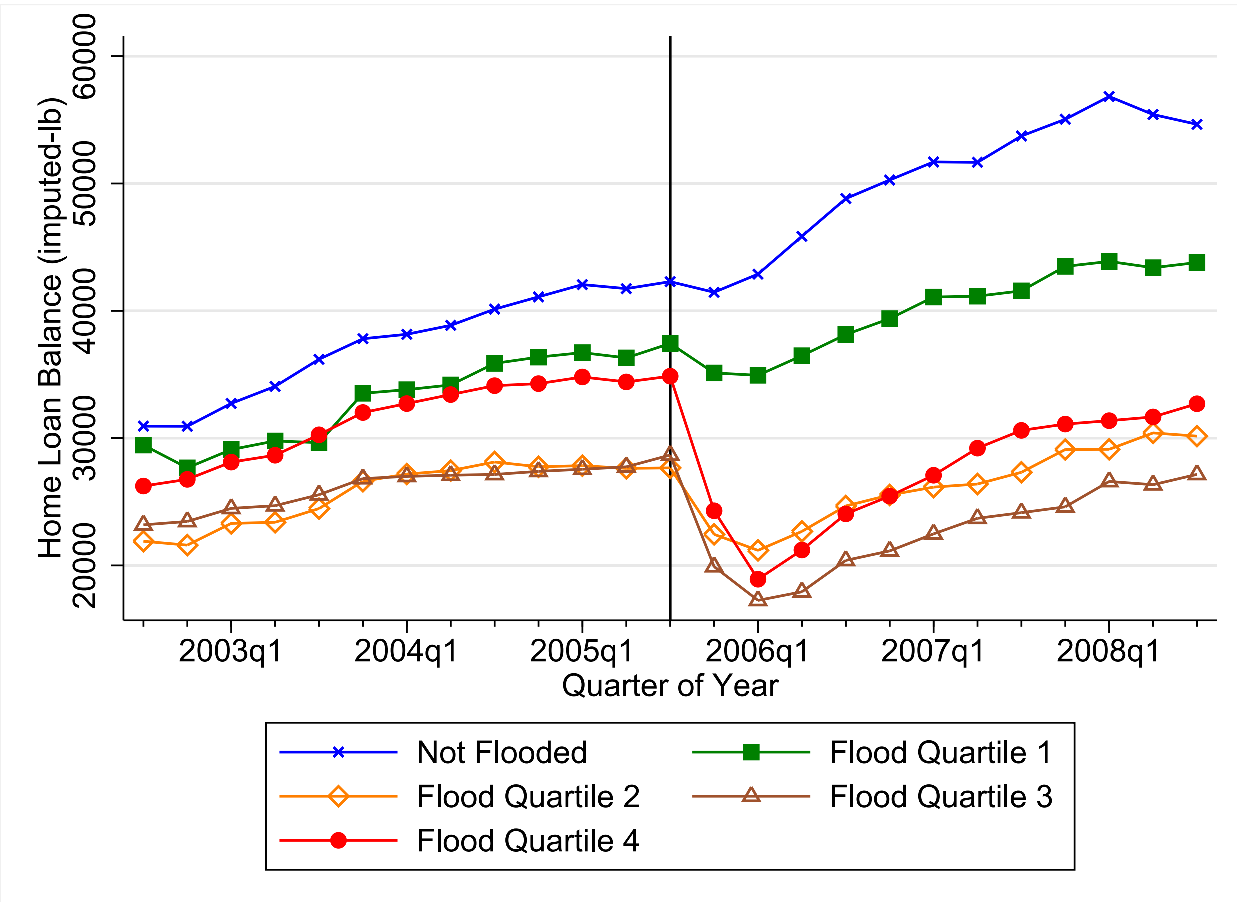
The figure plots home loan balances in dollars for the five New Orleans flood groups. The figure does not correct for missing account information due to non-reporting. Please refer to the Appendix Section B for more details.

Figure 8: Home Loan Balances, Corrected Using Last Reported Balance



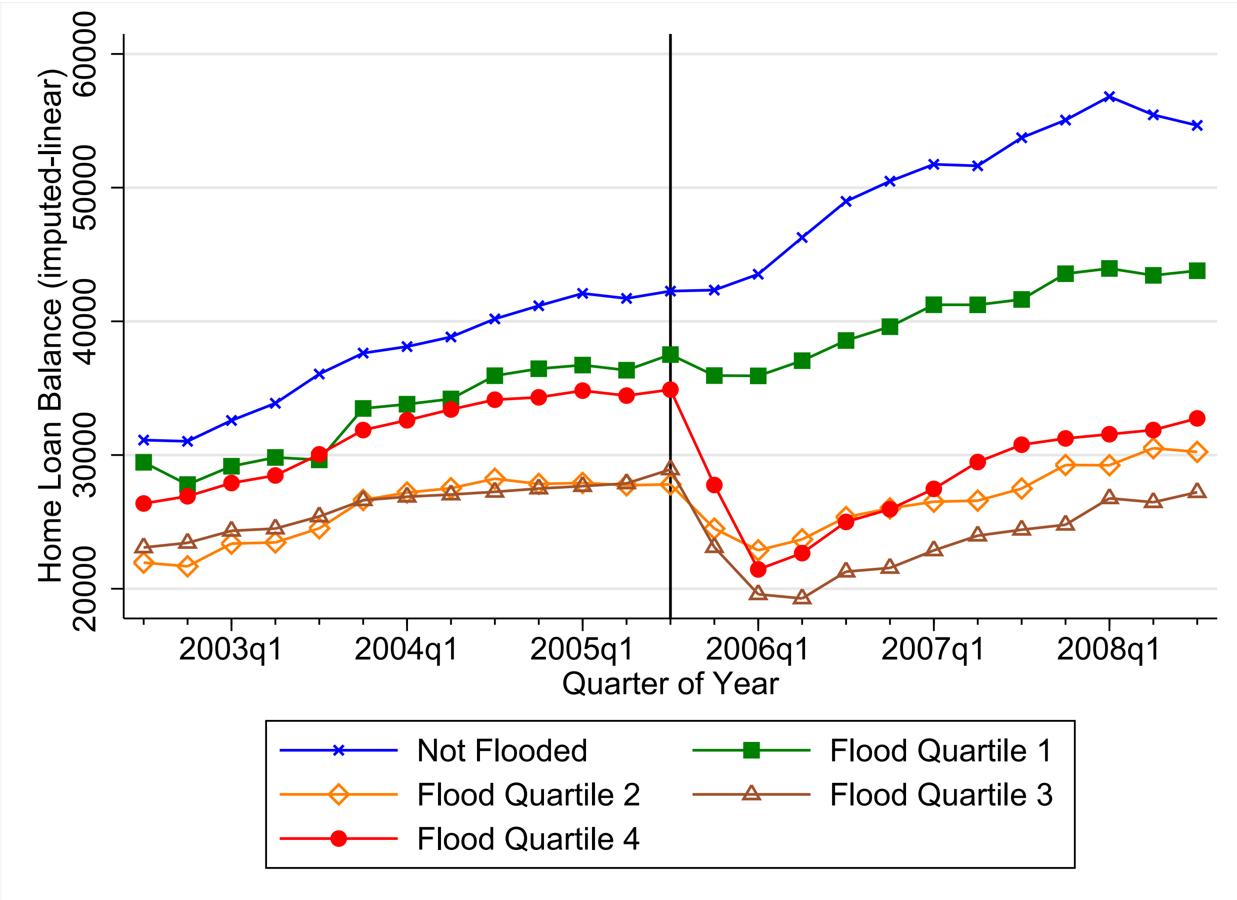
The figure plots corrected home loan balances in dollars for the five New Orleans flood groups. We correct loan balances by imputing the last reported loan balance for non-reporting home loans for the quarters that the home loan is non-reported. A non-reporting loan is defined as one that disappears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

Figure 9: Home Loan Balances, Corrected Using Next Reported Balance



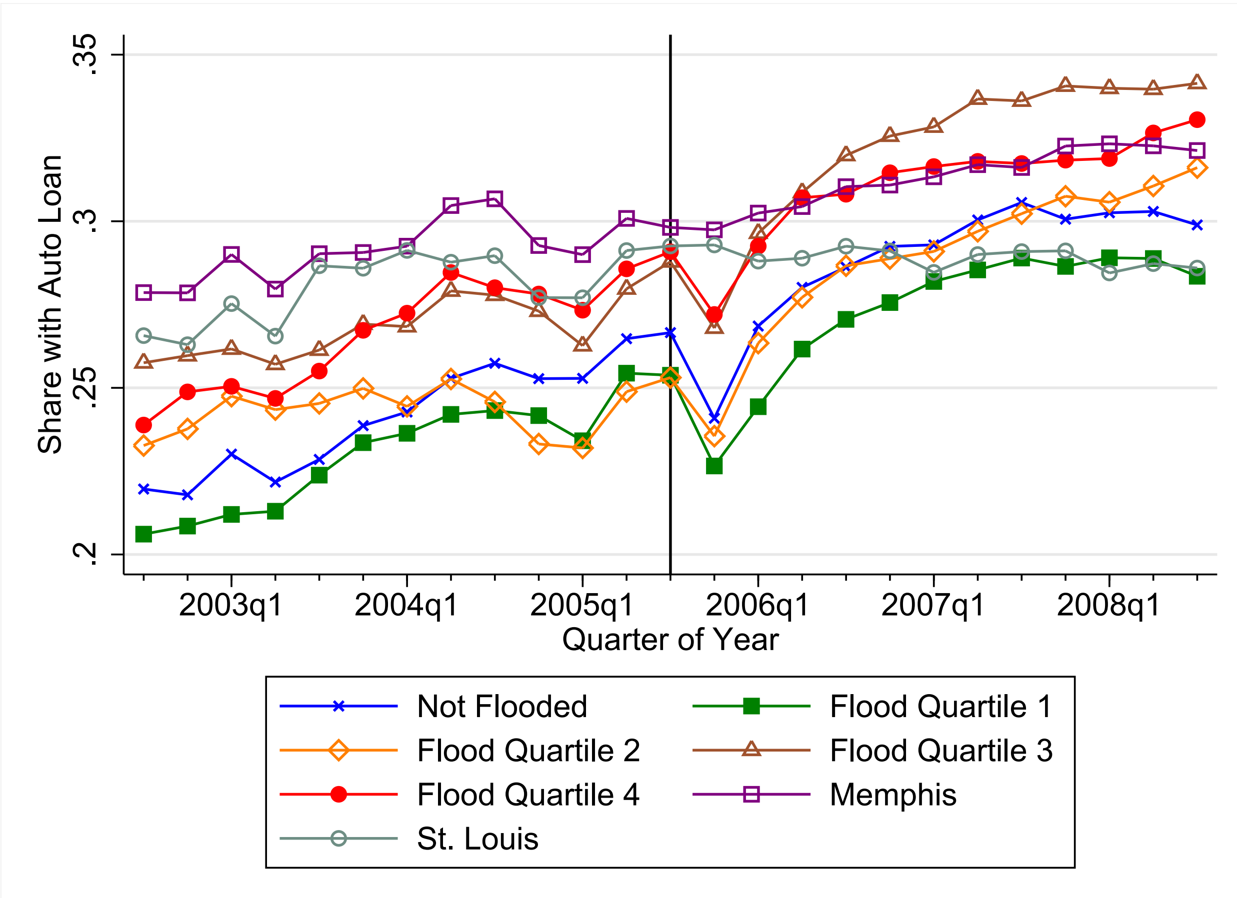
The figure plots corrected home loan balances in dollars for the five New Orleans flood groups. We correct loan balances by imputing the first reported loan balance once a home loan reappears for non-reporting home loans for the quarters that the home loan is non-reported. A non-reporting loan is defined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

Figure 10: Home Loan Balances, Corrected Using a Linear Interpolation



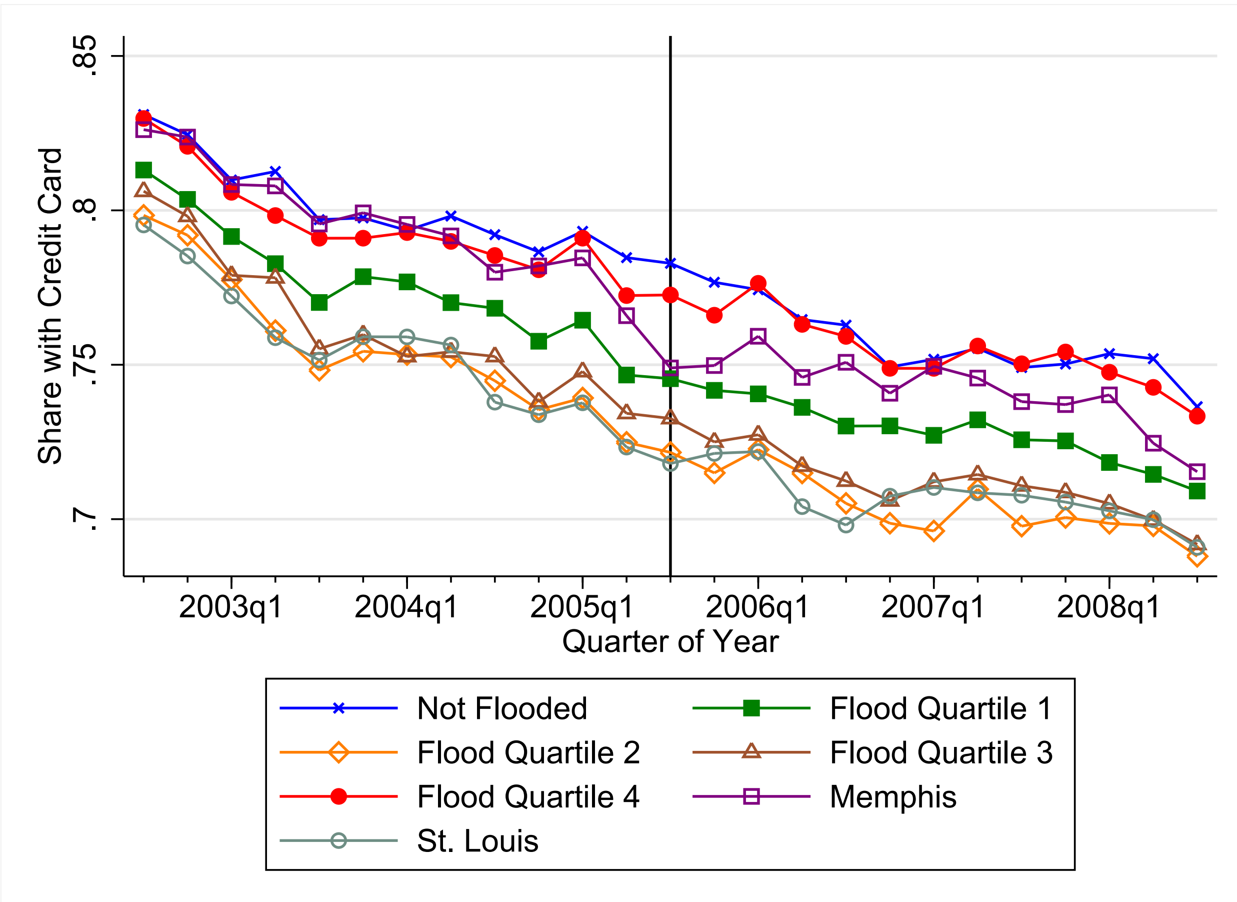
The figure plots corrected home loan balances in dollars for the five New Orleans flood groups. We correct loan balances by linearly interpolating between the last reported loan balance before a non-reporting home loan disappears and the first reported loan balance once the non-reporting home loan reappears.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

Figure 11: Share with a Auto Loan (Not Corrected)



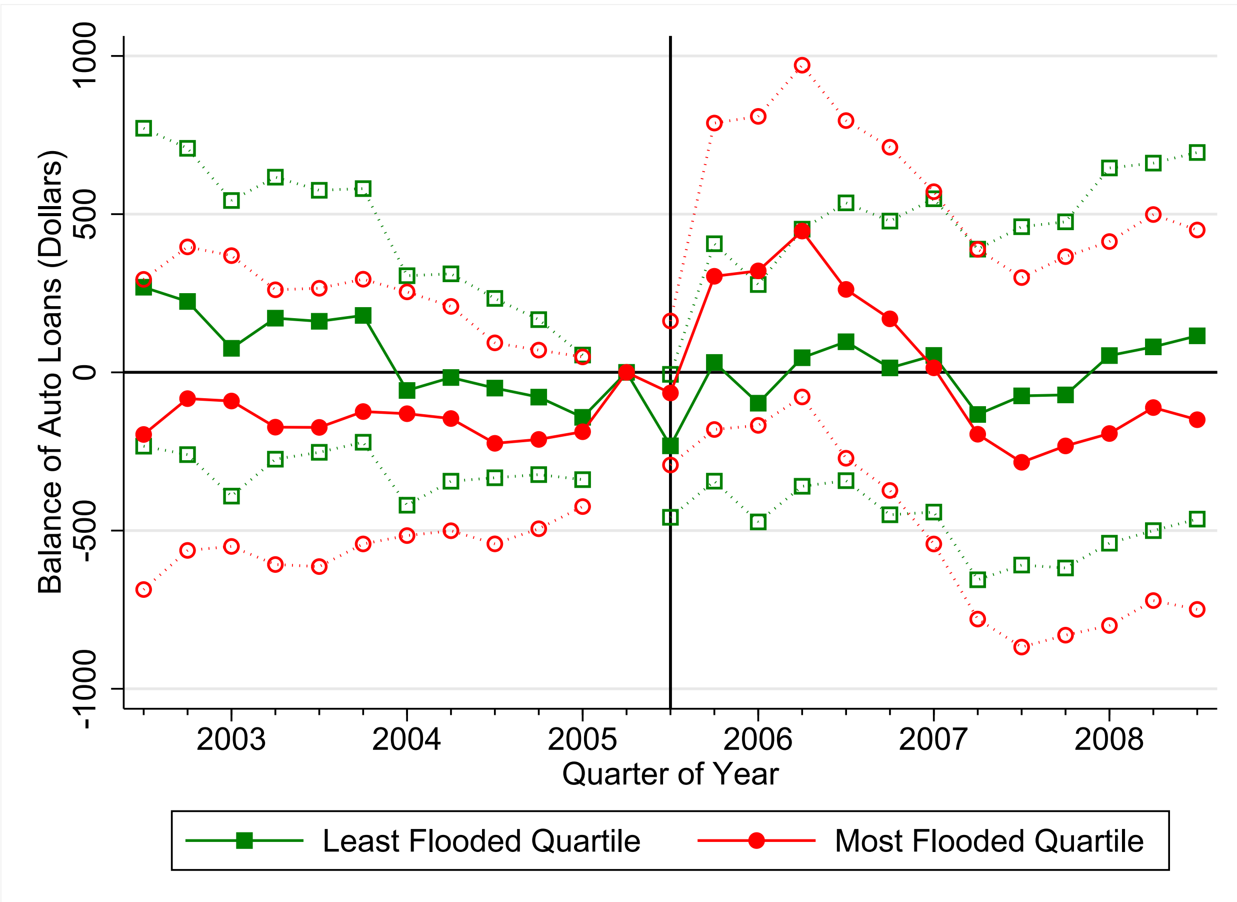
The figure plots the share with auto loans for the five New Orleans flood groups as well as residents of Memphis, and St. Louis. Please refer to the Appendix Section B for more details.

Figure 12: Share with a Credit Card



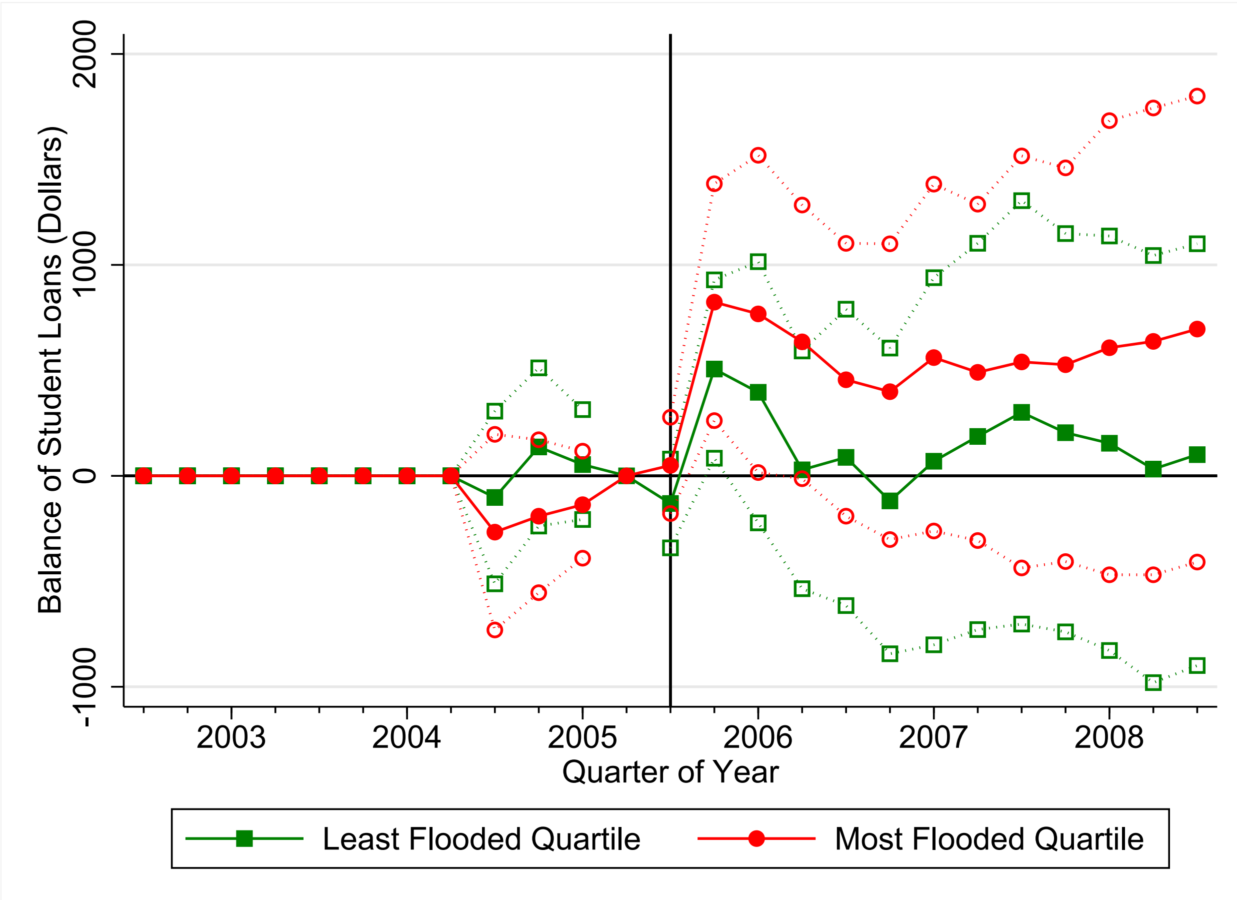
The figure plots the share of residents with a credit card for the five New Orleans flood groups as well as residents of Memphis, and St. Louis. Please refer to the Appendix Section B for more details.

Figure 13: Effect of Flooding on Auto Loan Balance



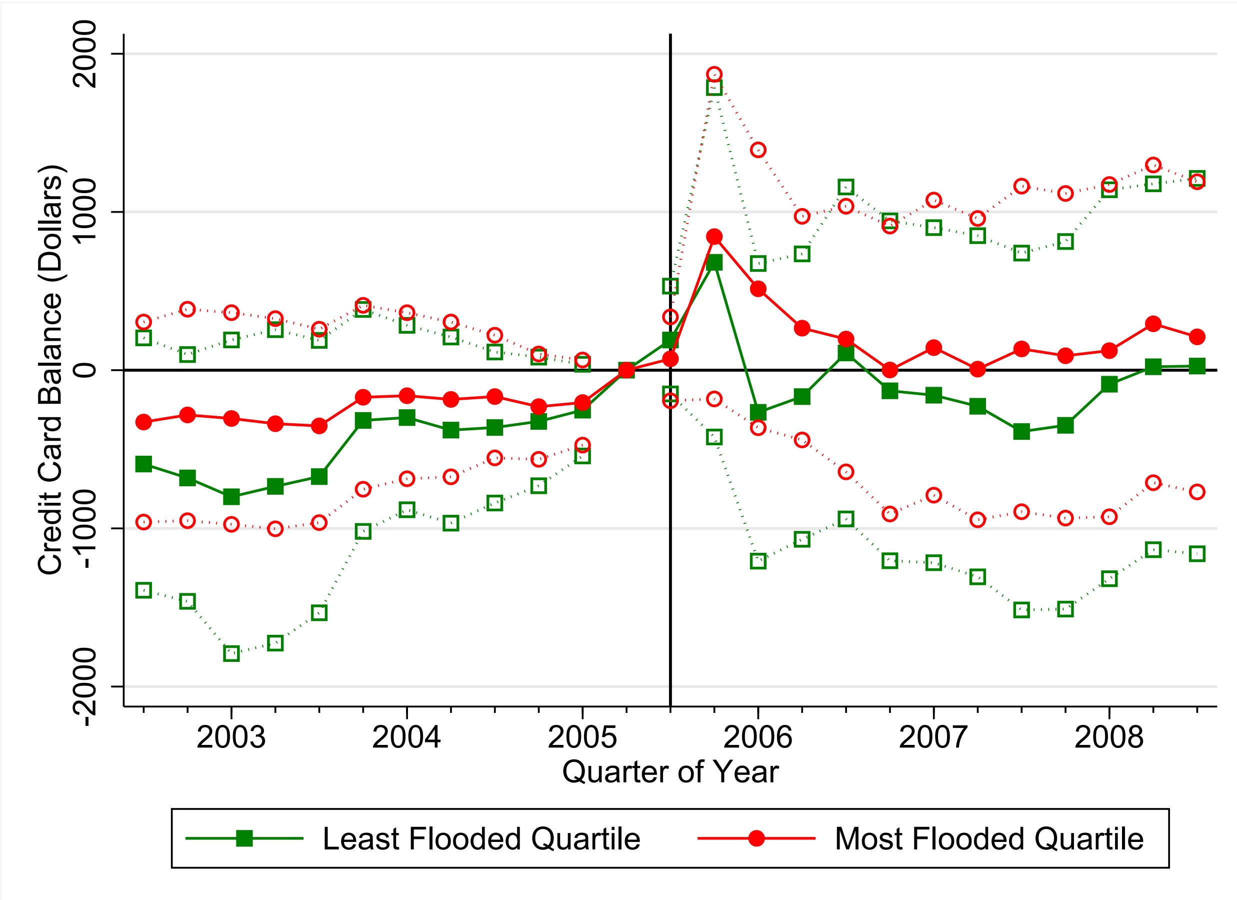
The figure plots difference-in-differences event time coefficients and 95% confidence intervals from the estimation of a version of Equation 2 in the text that replaces the pre/post Katrina indicator with quarterly indicators. The dependent variable in the model is total auto balance. All coefficients 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 block mean of the peak flood depth was less than 1.3 feet. The circles are point estimates for residents living in the most flooded blocks where the block mean of the peak flood depth was greater than 5.4 feet. Standard errors are robust to heteroskedasticity and clustered by the Census block of residence in 2005Q3.

Figure 14: Effect of Flooding on Student Loan Balance



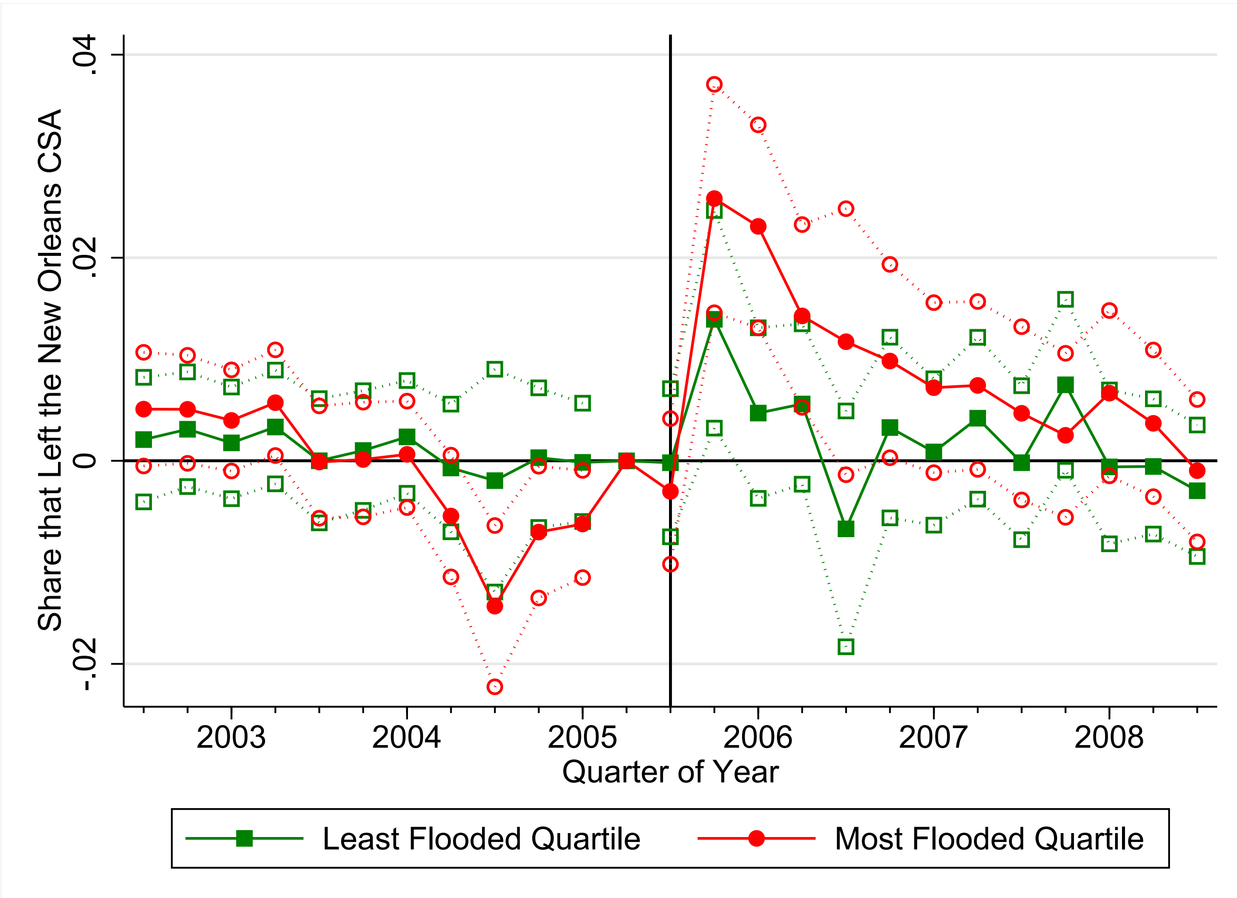
The figure plots difference-in-differences event time coefficients and 95% confidence intervals from the estimation of a version of Equation 2 in the text that replaces the pre/post Katrina indicator with quarterly indicators. The dependent variable in the model is total student loan debt balance. All 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 block mean of the peak flood depth was less than 1.3 feet. The circles are point estimates for residents living in the most flooded blocks where the block mean of the peak flood depth was greater than 5.4 feet. Standard errors are robust to heteroskedasticity and clustered by the Census block of residence in 2005Q3.

Figure 15: Effect of Flooding on Credit Card Balance for Above Median Credit Score Sample



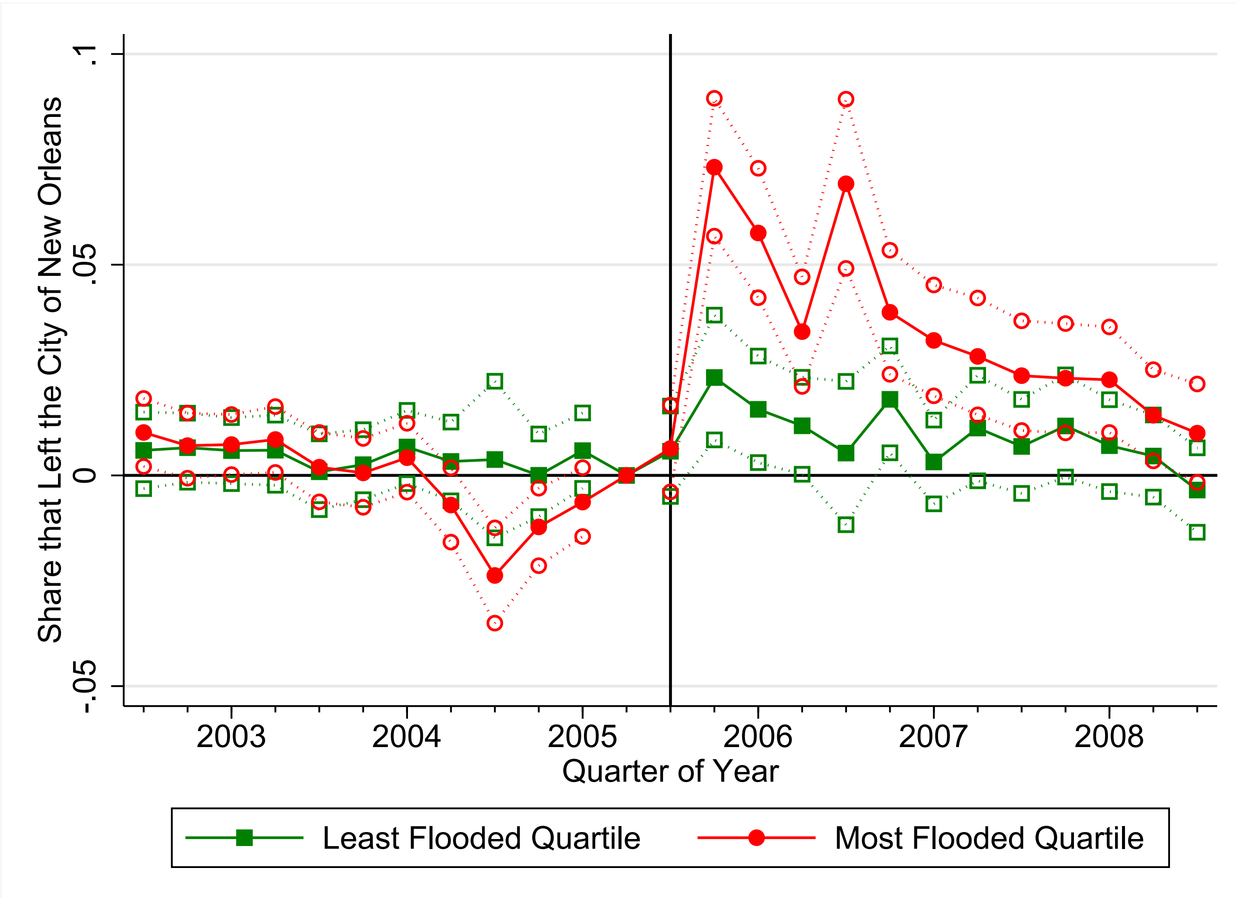
The figure plots difference-in-differences event time coefficients and 95% confidence intervals from the estimation of a version of Equation 2 in the text that replaces the pre/post Katrina indicator with quarterly indicators. The dependent variable in the model is total credit card balance. The sample is limited to individuals that are less likely to be credit constrained, those with an above-median Equifax Risk Score (TM) in the quarter before Katrina (2005Q2). 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. Standard errors are robust to heteroskedasticity and clustered by the Census block of residence in 2005Q3.

Figure 16: Effect of Flooding on Migration (3 Year) from New Orleans CSA



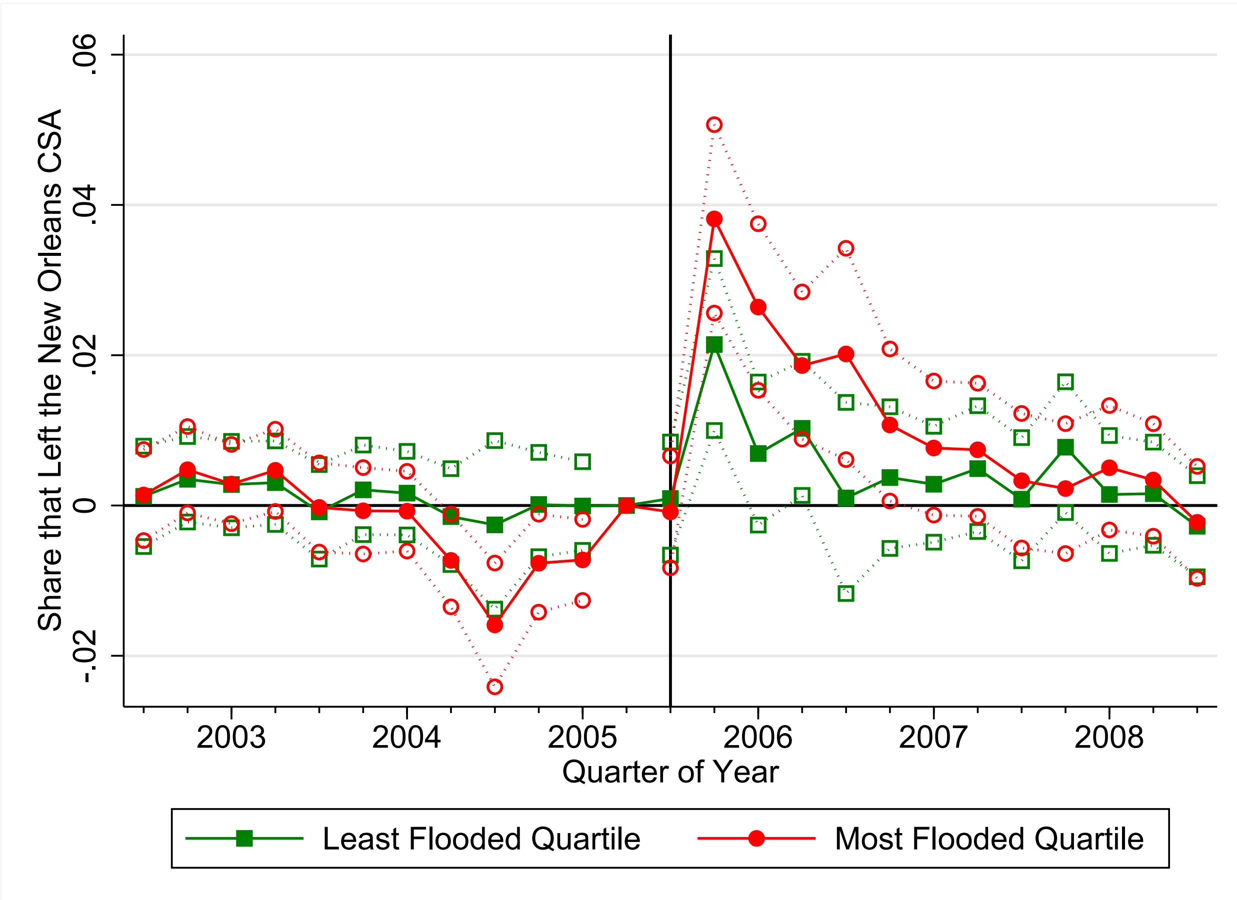
The figure estimates the effect of flooding on the quarterly migration rate using block of residence data from the CCP and a version of Equation 2 in the text. The sample includes all individuals in the CCP who resided in New Orleans for at least one quarter during our sample period. Migration is defined as living in New Orleans during the quarter and then leaving the New Orleans CSA for the next three years. We plot the migration rate for individuals living in blocks that are among those least and most flooded by Katrina. The migration rate is relative to that for individuals living in blocks that are not flooded by Katrina, and is normalized to the quarter before Katrina. Standard errors are robust to heteroskedasticity and clustered by the Census block of residence in 2005Q3.

Figure 17: Effect of Flooding on Migration (3 Year) from The City of New Orleans



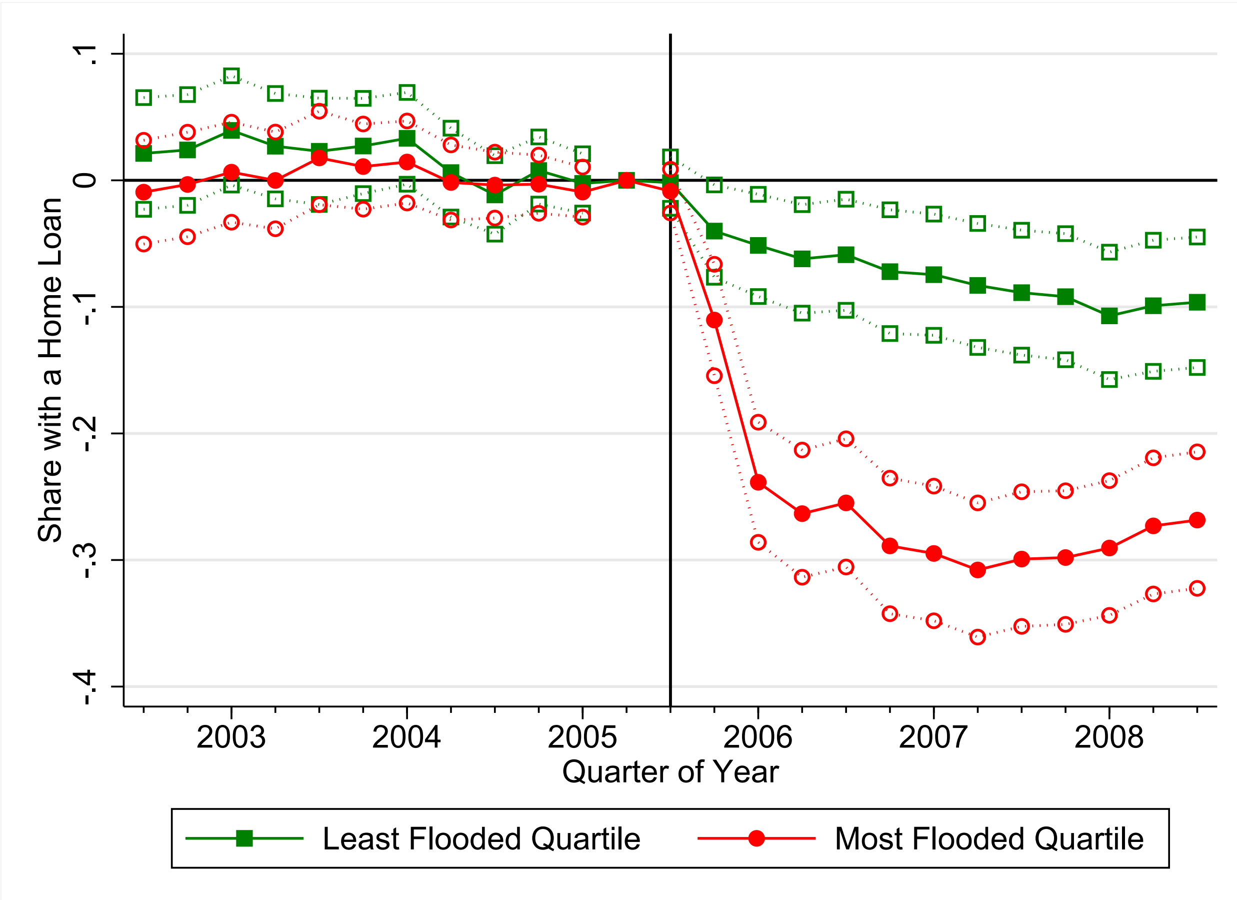
The figure estimates the effect of flooding on the quarterly migration rate using block of residence data from the CCP and a version of Equation 2 in the text. The sample includes all individuals in the CCP who resided in New Orleans for at least one quarter during our sample period. Migration is defined as living in New Orleans during the quarter and then leaving New Orleans for the next three years. We plot the migration rate for individuals living in blocks that are among those least and most flooded by Katrina. The migration rate is relative to that for individuals living in blocks that are not flooded by Katrina, and is normalized to the quarter before Katrina. Standard errors are robust to heteroskedasticity and clustered by the Census block of residence in 2005Q3.

Figure 18: Effect of Flooding on Migration (1 Year) from New Orleans CSA



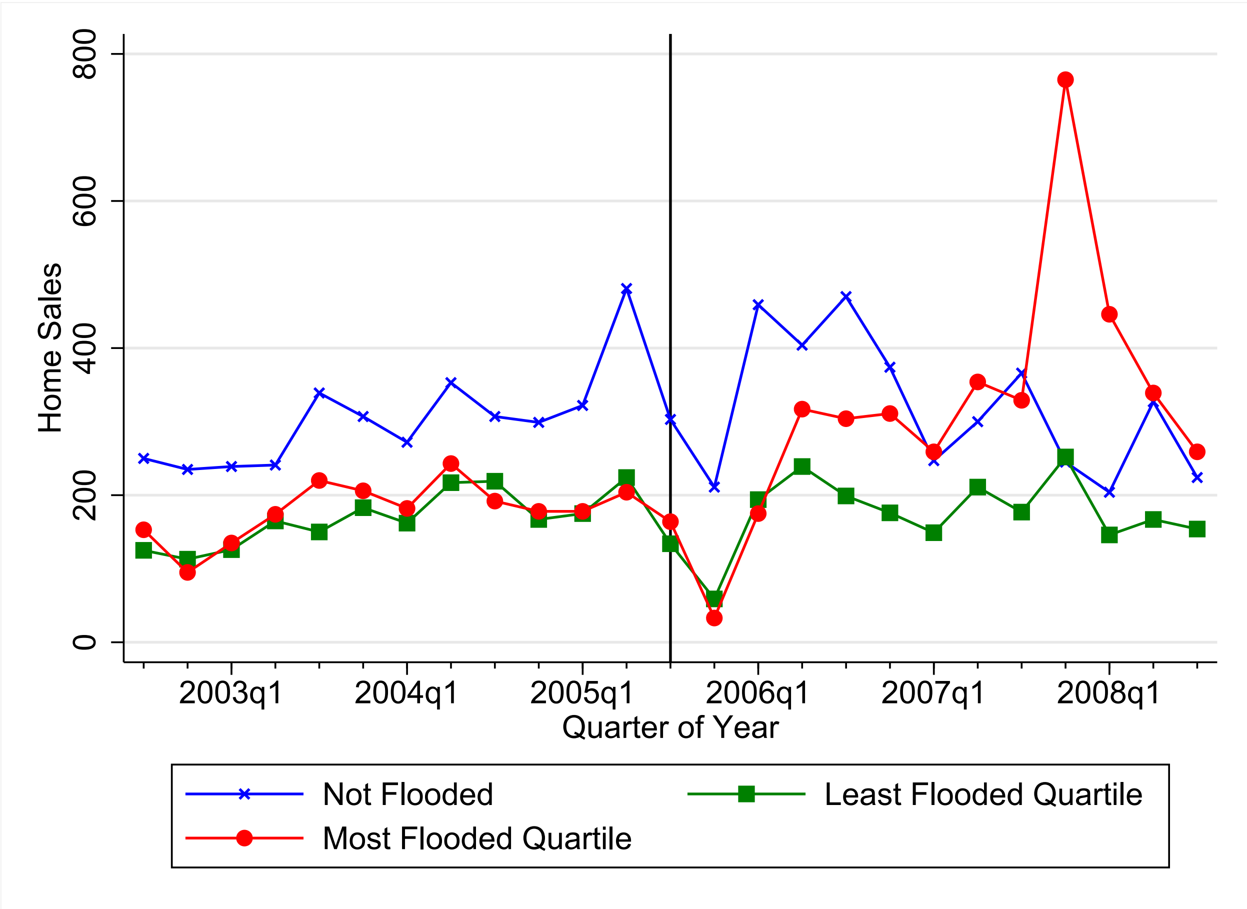
The figure estimates the effect of flooding on the quarterly migration rate using block of residence data from the CCP and a version of Equation 2 in the text. The sample includes all individuals in the CCP who resided in New Orleans for at least one quarter during our sample period. Migration is defined as living in New Orleans during the quarter and then leaving the New Orleans CSA for one year. We plot the migration rate for individuals living in blocks that are among those least and most flooded by Katrina. The migration rate is relative to that for individuals living in blocks that are not flooded by Katrina, and is normalized to the quarter before Katrina. Standard errors are robust to heteroskedasticity and clustered by the Census block of residence in 2005Q3.

Figure 19: Effect of Flooding on Having a Home Loan Conditional on Having a Home Loan in 2005Q3



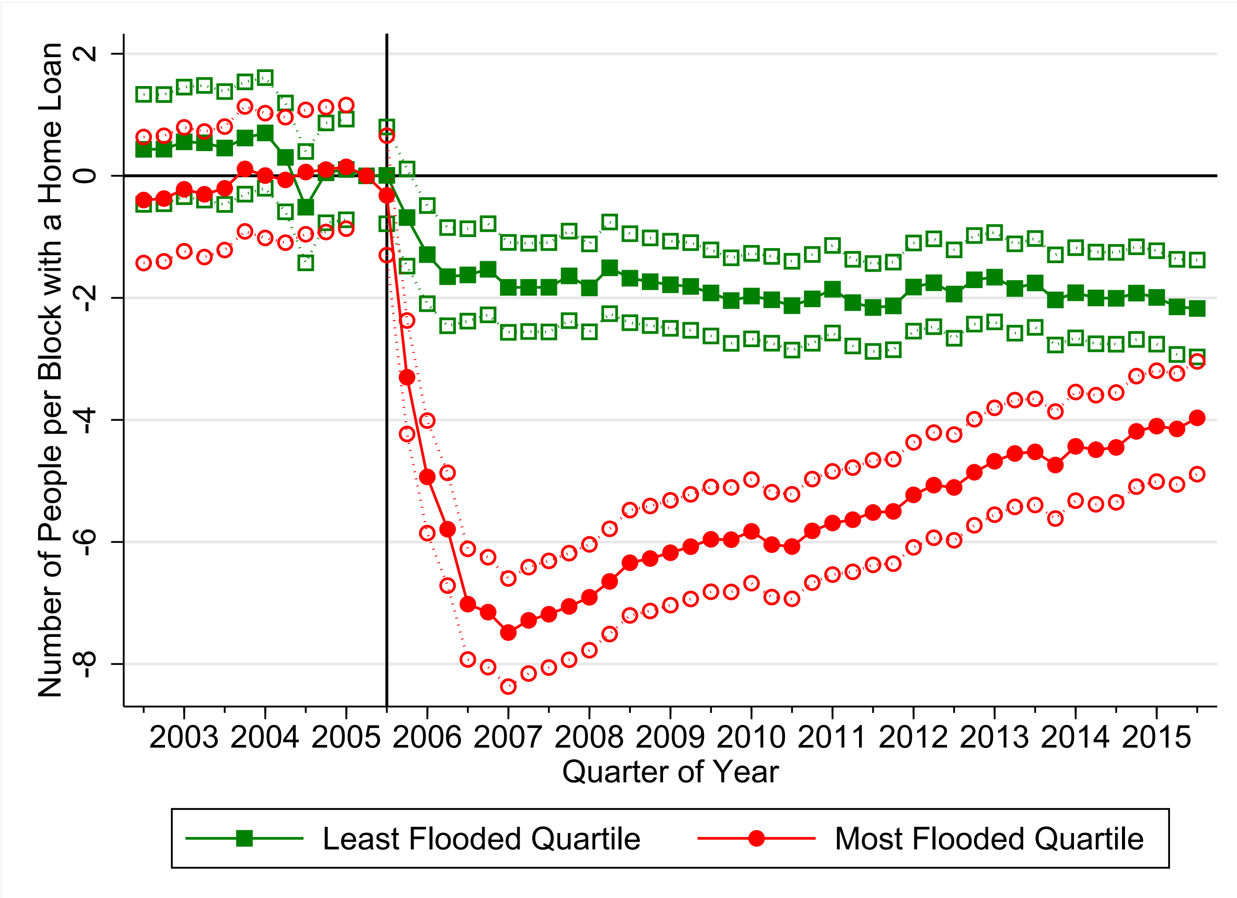
The figure plots difference-in-differences event time coefficients and 95% confidence intervals from the estimation of a version of Equation 2 in the text that replaces the pre/post Katrina indicator with quarterly indicators. The dependent variable is an indicator variable equal to one if the individual 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. Standard errors are robust to heteroskedasticity and clustered by the Census block of residence in 2005Q3.

Figure 20: Quarterly Number of Home Sales in New Orleans by Flood Depth



The figure plots the number of residential real estate sales per quarter in the non-flooded blocks, the least flooded blocks (those in the lowest quartile of flooding depth), and the most flooded blocks (those in the highest quartile of flooding depth). The data come from the records of the Orleans Parish Assessors Office. Please refer to Section 5.2 of the text for a discussion of this figure and Appendix Section A for sales data details.

Figure 21: Effect of Flooding on the Number of People per Census Block with a Mortgage



The figure plots difference-in-differences event time coefficients and 95% confidence intervals from the estimation of a version of Equation 2 in the text that replaces the pre/post Katrina indicator with quarterly indicators. The main difference is that instead of the balanced panel of individuals from the CCP, here the unit of observation is the Census block - quarter. Our sample is a balanced panel of the Census blocks in our flood depth coverage area and runs from 2002Q3 through 2015Q3. The dependent variable is equal to 20 times the number of individuals in the CCP living in the Census block that have at least one home loan. We multiply by 20 to account for the fact that the CCP is a 5% sample of the population. The specification includes Census block fixed effects and interactions of all engineering and Census socioeconomic variables (listed in the note to Table 2 of the text) with a post-Katrina indicator variable. In this way, the specification is similar to a block-level version of our preferred specification shown in column 7 of Table 3 of the text. All coefficients can be interpreted as the change in the number of people with a home loan in flooded blocks, as compared to non-flooded blocks, relative to the quarter before Hurricane Katrina. Standard errors are robust to heteroskedasticity and clustered by the Census block of residence in 2005Q3.

F.2 Tables

Table 1: Comparison of CCP Population Coverage to US Census by Depth of Flooding

Flood Depth Quartile	No Flooding	1	2	3	4
Census Population	110,875	100,111	115,948	119,750	118,209
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%

The 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 four quartiles for flooded blocks. Quartile 1 are flooded blocks with the lowest block mean of peak flood depth, while quartile 4 are flooded blocks with the highest block mean of peak flood depth. All proportions are frequency weighted by census block population. Please refer to Appendix Section A.2 for details.

Table 2: Impact of Flooding on Total Debt Balance: Robustness Specifications

Model Specification:	Table 3 Column 7 (1)	Alternative Sample (2)	Only Quartiles 1 and 4 (3)	Linear Flood Depth (4)
1st Quartile * Post Flood	-4,489**	-4,107**	-4,191*	
	(2,191)	(2,009)	(2,282)	
2nd Quartile * Post Flood	-6,677***	-5,973***		
	(2,029)	(1,865)		
3rd Quartile * Post Flood	-9,736***	-8,761***		
	(2,045)	(1,872)		
4th Quartile * Post Flood	-11,092***	-10,036***	-11,132***	
	(2,249)	(2,070)	(2,521)	
Flooded * Post Flood				-4,685***
				(2,047)
Depth * Post Flood				-893***
				(333)
Post	-33,192	-29,594	-114,729*	-32,090
	(49,081)	(44,927)	(66,260)	(49,095)
N	390,714	419,150	229,065	390,714
R^2	0.731	0.732	0.744	0.731

This table presents robustness specifications for regressions of the total debt balance (from the CCP) on flood depth. 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. There are 16,573 individuals in columns 1 and 4, 16,766 individuals in column 2, and 9,699 individuals in column 3. Column 1 of this table repeats the preferred specification in the text (Table 3 column 7). All four specifications in the above table include the same control variables as in Table 3 column 7. Column 2 expands the sample slightly by making the assumption that individuals with a record in the CCP, but with missing values for the number of accounts variable have no debt. Column 3 drops individuals from depth quartiles 2 and 3 from the sample. Column 4 replaces all flood depth indicator terms with a linear measure of flood depth interacted with a post-Katrina indicator. Robust standard errors clustered by census block of residence in 2005Q3 are shown in parentheses. Significance level: *** 1%, ** 5%, * 10%. Please refer to Section 4.1 of the text and Appendix Section D for more details.

Table 3: Credit Constraints and Credit Card Debt

Dependent Variable:	New Inquiries	New Accounts	New Accounts Cond'l on Inquiries	Balance High Credit Score	Balance Low Credit Score	Balance High Credit Available	Balance Low Credit Available
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1st Quartile * Post Flood	0.032	-0.006	-0.015	324	177	347	125
	(0.023)	(0.009)	(0.010)	(380)	(223)	(421)	(158)
2nd Quartile * Post Flood	0.099***	-0.006	-0.022**	-205	-89	-247	-21
	(0.025)	(0.009)	(0.010)	(396)	(200)	(444)	(143)
3rd Quartile * Post Flood	0.126***	-0.013	-0.030***	-3	97	-85	141
	(0.026)	(0.009)	(0.010)	(386)	(204)	(425)	(134)
4th Quartile * Post Flood	0.114***	-0.025**	-0.041***	441	42	477	73
	(0.028)	(0.010)	(0.012)	(482)	(239)	(499)	(173)
N	343,444	388,620	311,066	190,165	187,297	166,803	223,911
R^2	0.244	0.102	0.116	0.573	0.680	0.579	0.625

This table presents estimates from seven different regressions using our preferred differences-in-differences model (Table 3 column 7 in the text) on several dependent variables. Robust standard errors clustered by census block of residence in 2005Q3 are shown in parentheses. Significance level: *** 1%, ** 5%, * 10%. See Table 3 column 7 in the text for the complete list of control variables. The dependent variable in column 1 is the number of consumer initiated credit inquiries in the past 3 months. The dependent variable in columns 2 and 3 is a proxy for the number of new accounts. The proxy is equal to total accounts this quarter minus total accounts last quarter, if that difference is positive, and zero otherwise. The specification in column 3 adds the inquiries variable and the 3 most recent quarterly lags of the inquiries variable as a controls for credit demand (over the past year) on the right hand side of the equation. Columns 4 and 5 estimate the same specification using credit card debt balances as the dependent variable for residents above and below the median (in 2005Q2) Equifax Risk Score (TM). Columns 6 and 7 also use credit card debt balances as the dependent variable, but split the sample into residents that are more than $500 and less than $500 away from their (2005Q2) credit limit, respectively. The source of all credit data is the CCP.

Table 4: New Orleans Neighborhood Socioeconomic and Demographic Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Neighborhood:	New Orleans East	9th Ward	Lake View, Gentilly	Algiers	Uptown, Carrollton, Garden Dist.	CBD, Mid-City, French Quarter	Arabi (St. Bernard Parish)	Metairie (Jefferson Parish)
Panel A: Census Characteristics								
Median Household Income	33,270	19,567	38,324	35,624	25,931	19,052	36,377	37,916
Prop Housing Owner Occupied	0.57	0.46	0.65	0.55	0.38	0.29	0.75	0.59
Poverty Rate	0.19	0.35	0.16	0.21	0.28	0.35	0.14	0.10
Prop w/ College Degree	0.18	0.10	0.25	0.21	0.26	0.15	0.11	0.24
Prop Hispanic	0.02	0.02	0.03	0.04	0.03	0.04	0.05	0.05
Prop African American	0.83	0.89	0.48	0.56	0.55	0.74	0.07	0.10
Prop Age 65 or Older	0.09	0.12	0.16	0.11	0.12	0.11	0.14	0.18
Panel B: CCP Characteristics								
Equifax Risk Score	617	598	671	638	649	619	670	696
Prop w/ Account 90+ Days Delinquent	0.32	0.35	0.21	0.27	0.23	0.30	0.18	0.15
Age	51.2	51.8	50.9	48.9	50.2	51.8	48.0	49.8
Number of Zip Codes	4	1	2	2	4	4	5	3
CCP Population	3,127	1,431	2,192	1,678	3,283	1,942	2,160	530

The table shows zip code level housing characteristics for eight geographic areas or “neighborhoods” of New Orleans. The zip code level data are weighted by the CCP population when combining zip codes into neighborhoods. Panel A and Panel B display socioeconomic and demographic characteristics from the 2000 US Decennial Census and the CCP. These variables are used as control variables in the OLS regressions that test the homeowner rebuilding decision framework discussed in Section 5.1 of the text. Appendix Tables 5 and 6 display the main coefficients from the regressions. The Census data used for the table are originally aggregated at the zip code level. The CCP data are originally at the census block level and aggregated up to the zip code. All dollar values are adjusted (when necessary) to 2005 dollars using the Consumer Price Index. Please refer to Section 5.1 of the text or Appendix Section C more details.

Table 5: Flood Insurance, Home Value, Mortgage Balance, and the Likelihood of not Moving after Katrina

Dependent Variable: Same Block 3 Years After Katrina	(1) Zip Code-Level	(2)	(3) Individual-Level	(4)
Claim to Value	-0.154**	-0.284**	-0.122***	-0.078***
	(0.070)	(0.117)	(0.021)	(0.024)
Log Mortgage Balance	0.024	0.083	0.001	-0.004
	(0.045)	(0.122)	(0.006)	(0.007)
Flood Depth	-0.014	-0.020	-0.031***	-0.036***
	(0.020)	(0.021)	(0.003)	(0.003)
Flood Policies per Housing Unit	-0.349*	0.438	-0.167***	-0.023
	(0.195)	(0.274)	(0.057)	(0.066)
Socioeconomic and Demographic Control Variables		X		X
Observations	25	25	4,486	4,486
R Squared	0.740	0.938	0.087	0.103

This table presents estimates from four different OLS regressions, where the dependent variable for each specification is whether a resident living in New Orleans at the time of Katrina is living in the same Census block 3 years after Katrina. The table evaluates the predictions of the housing rebuilding decision framework discussed in Section 5.1 of the text. A prediction of that framework is that there will be a negative correlation between living in the same block 3 years after Katrina and the flood insurance claims to home value ratio. Columns 1 and 2 of the table use zip code-level data (comparable to Table 6 in the text), while columns 3 and 4 use individual-level data. The table combines data from the CCP, NOAA, the NFIP, and the US Decennial Census. Appendix Table 4 provides the list of socioeconomic and demographic control variables. All four models use robust standard errors. The standard errors for columns 3 and 4 are clustered at the block level. Significance level: *** 1%, ** 5%, * 10%.

Table 6: Flood Insurance, Home Value, Mortgage Balance, and the Likelihood of Rebuilding

Dependent Variable: Rebuild	(1)	(2)	(3)	(4)
	Zip Code-Level		Parcel-Level	
Claim to Value	0.155	0.018	-0.005	-0.152***
	(0.166)	(0.391)	(0.033)	(0.039)
Log Mortgage Balance	0.169	0.083	0.002	-0.002
	(0.130)	(0.123)	(0.006)	(0.006)
Flood Depth	0.023	0.072	-0.010***	-0.010***
	(0.029)	(0.080)	(0.002)	(0.002)
Flood Policies per Housing Unit	-0.512	-0.511**	0.076**	0.191***
	(0.483)	(0.219)	(0.034)	(0.039)
Socioeconomic and Demographic Control Variables		X		X
Observations	21	21	19,895	19,895
R Squared	0.117	0.852	0.005	0.041

This table presents estimates from four different OLS regressions, where the dependent variable for each specification is whether a severely damaged home is rebuilt. The table evaluates the predictions of the housing rebuilding decision framework discussed in Section 5.1 of the text. A prediction of that framework is that there will be a negative correlation between rebuilding and the flood insurance claim to home value ratio. Columns 1 and 2 of the table use zip code-level data (comparable to Table 6 in the text), while columns 3 and 4 use parcel level data. The table combines data from the CCP, NOAA, the NFIP, the US Decennial Census, and Parish assessor data provided by CoreLogic. Appendix Table 4 provides the list of socioeconomic and demographic control variables. All four specifications use robust standard errors. The standard errors for columns 3 and 4 are clustered at the block level. Significance level: *** 1%, ** 5%, * 10%.

Table 7: Local Versus Nonlocal Lenders: Robustness Specifications

Model Specification:	Table 7 Column 5 (1)	Loan Value (2)	Branch in New Orleans CSA (3)	Drop if Pre-1997 Mortgage (4)	Clustered SEs C.T. (5)
Q1 * Post	-0.123	-0.128	-0.138*	-0.132	-0.123
	(0.087)	(0.087)	(0.080)	(0.092)	(0.101)
Q2 * Post	-0.201***	-0.196**	-0.175**	-0.167**	-0.201**
	(0.080)	(0.080)	(0.073)	(0.081)	(0.099)
Q3 * Post	-0.324***	-0.325***	-0.301***	-0.308***	-0.324***
	(0.077)	(0.077)	(0.075)	(0.079)	(0.095)
Q4 * Post	-0.356***	-0.359***	-0.372***	-0.337***	-0.356***
	(0.089)	(0.089)	(0.087)	(0.091)	(0.121)
Q1 * Post * Local Share	0.454	0.463	0.318*	0.483	0.454
	(0.335)	(0.329)	(0.184)	(0.350)	(0.389)
Q2 * Post * Local Share	0.583*	0.548*	0.280	0.477	0.583
	(0.328)	(0.321)	(0.182)	(0.332)	(0.391)
Q3 * Post * Local Share	0.786**	0.774**	0.415**	0.702**	0.786**
	(0.319)	(0.313)	(0.192)	(0.326)	(0.399)
Q4 * Post * Local Share	0.686*	0.682*	0.460**	0.638*	0.686
	(0.370)	(0.362)	(0.215)	(0.377)	(0.468)
Equifax Risk Score (TM)	X	X	X	X	X
African American Blocks	X	X	X	X	X
Flood Insurance Coverage	X	X	X	X	X
N	113,883	113,883	113,883	97,153	113,883
R^2	0.383	0.383	0.383	0.368	0.383

This table presents estimates of robustness specifications for the non-local lender results in Table 7 of the text. Column 1 of the table repeats the preferred specification of the text (Table 7 column 5). Recall that this specification uses the number of loans to calculate the local loan share measure. Column 2 considers how the estimates change if we calculate the local share using the dollar share of loans (rather than the number of loans). Column 3 defines lenders as local if they have a branch in the New Orleans CSA. Column 4 repeats the specification in Column 1, except drops individuals from the sample whose mortgage was originated before 1997. Column 5 clusters the standard errors at the Census tract-level (rather than Census block-level). Standard errors clustered by Census block of residence in 2005Q3 are shown in parentheses. Significance level: *** 1%, ** 5%, * 10%. Please refer to Section 5.2 in the text and Appendix Section D for more details.

Table 8: Impact of Flooding on Total Debt Balance: Robustness Specifications using Propensity Score

Model Specification:	Propensity Score Trimmed (1)	Propensity Score Trimmed and Weighted (2)	Trimmed and Weighted with Controls (3)
1st Quartile * Post Flood	-6,636***	-4,708*	-3,796
	(2,057)	(2,413)	(2,510)
N	138,428	138,428	138,428
R^2	0.003	0.002	0.767
2nd Quartile * Post Flood	-10,920***	-7,130***	-5,673**
	(1,940)	(2,266)	(2,526)
N	131,015	131,015	131,015
R^2	0.009	0.003	0.721
3rd Quartile * Post Flood	-14,195***	-11,091***	-9,697***
	(2,056)	(2,395)	(3,086)
N	120,370	120,370	120,370
R^2	0.009	0.007	0.713
4th Quartile * Post Flood	-15,406***	-15,573***	-15,152***
	(2,424)	(3,118)	(3,339)
N	108,595	108,595	108,595
R^2	0.005	0.009	0.729

This table provides a robustness check using propensity score sample trimming and re-weighting for the estimate of flooding on total debt balance (Table 3 of the text). There are four panels and three columns in the table that together display the difference-in-differences estimate from 12 separate regressions. Each panel corresponds to a different flood group (as compared to the non-flooded group). Column 1 includes model estimates using each propensity score trimmed sample. Observations are dropped from the sample if the propensity score is outside the interval [0.1, 0.9]. Column 2 uses the propensity score to re-weight the trimmed samples. Non-flooded individuals in each sample are re-weighted by the ratio of propensity score over one minus the propensity score. Column 3 adds the full set of control variables from our preferred specification (Table 3 column 7) to the trimmed, re-weighted samples. Standard errors clustered by Census block of residence in 2005Q3 are shown in parentheses. Significance level: *** 1%, ** 5%, * 10%. Sections 3 and 4 of the text and the footnotes to Table 3 of the text provide more details on the difference-in-differences specification. Appendix Section D.2 provides further details on the propensity score estimation.

Table 9: Impact of Flooding on Total Debt Balance: Robustness Specifications using Quantile Regression

Estimation:	(1) Mean	(2) 25th	(3) 50th	(4) 75th	(5) Mean	(6) 25th	(7) 50th	(8) 75th
	Full Sample of New Orleans Residents				Conditional on Having a Home Loan			
1st Quartile * Post Flood	-4,067*	-35	-1,263**	-6,969**	-11,118*	-16,310***	-13,356***	-16,689***
	(2,138)	(55)	(564)	(2,750)	(5,987)	(4,179)	(4,320)	(6,131)
2nd Quartile * Post Flood	-6,781***	-42	-1,675***	-7,757***	-22,738*	-20,418***	-22,494***	-21,077***
	(1,970)	(62)	(596)	(2,613)	(5,144)	(3,785)	(4,274)	(5,682)
3rd Quartile * Post Flood	-9,536***	-124*	-2,762***	-13,251***	-25,182***	-25,914***	-33,191***	-28,815***
	(1,985)	(70)	(680)	(2,786)	(5,188)	(3,982)	(4,547)	(6,416)
4th Quartile * Post Flood	-10,999***	-144*	-3,074***	-15,533***	-31,012***	-26,473***	-42,786***	-34,046***
	(2,188)	(78)	(775)	(2,845)	(5,432)	(4,013)	(4,566)	(6,774)
N	390,714	390,714	390,714	390,714	117,580	117,580	117,580	117,580
R^2	0.115	0.069	0.082	0.109	0.207	0.135	0.187	0.203

This table displays quantile regression coefficients for the effect of flooding on total debt balances for the 25th, 50th, and 75th quantiles. We estimate the quantile regression coefficients for our complete sample (columns 2-4) and for the roughly 30% of our sample population that had a home loan at the time of Katrina (columns 6-8). We also include the OLS difference-in-differences coefficient estimate for both samples (columns 1 and 5). The quantile and OLS specifications include the set of control variables from Table 3 column 4 in the text. Note that the estimate for the 50th percentile for the full sample is actually the 51st percentile. The 50th percentile estimate did not converge. Standard errors are robust to heteroskedasticity and clustered at the Census block-level. Significance level: *** 1%, ** 5%, * 10%.