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Disaster (Over-)Insurance: The Long-Term Financial and Socioeconomic Consequences of Hurricane Katrina

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Abstract

Federal disaster insurance—in the form of national flood insurance, the Federal Emergency Management Agency (FEMA), and other programs—is designed to nationally distribute large geography-specific shocks such as earthquakes and hurricanes. This study examines how residents were affected on net by the local long-run impacts of Hurricane Katrina and the subsequent policy response. Using a unique fifteen-year panel of 5 percent of adult Americans' credit reports, we find, ten years after the hurricane, higher rates of insolvency and lower homeownership among inundated residents of New Orleans relative to their nonflooded neighbors. Residents of mostly white and mostly black neighborhoods obtain similar short- and long-term outcomes, though residents of white neighborhoods are more likely to have migrated out of the city. Inundated New Orleans residents appear more likely to have migrated to neighboring states but substantially less likely than nonflooded residents to have migrated north. However, we find that residents of the large Gulf Opportunity Zone (GO Zone) surrounding New Orleans, who were also eligible for various federal programs, obtained net financial benefits in the years after Katrina; a decade later, those residents have higher rates of consumption and homeownership and lower rates of bankruptcy and foreclosure than residents outside the GO Zone. These net gains are found to be progressive—favoring young and low-income residents—and are broadly similar across black and white neighborhoods.

Key words: disaster insurance, household finances, homeownership, migration

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1 Introduction

More than two hundred natural disasters with losses exceeding one billion 2016 dollars have occurred in the United States since 1980. Six of the ten costliest disasters were hurricanes, causing over $345 billion in total damages and more than 2,000 deaths (Smith and Katz, 2013). The most deadly and damaging of these storms was Hurricane Katrina, which struck the Gulf coast in August 2005. Hurricanes' economic cost is immediately experienced by the impacted communities through damaged infrastructure and disrupted economic activity, but large federal and private insurance programs exist to spread those costs across the country in the long-run. In this study, we examine the short- and long-term net aggregate effect of Hurricane Katrina and those insurance programs on the consumption, mobility, homeownership, and household composition of individuals whose residences were impacted by the storm.

Because many residents of hurricane-impacted regions relocate in the years after the storm, it is challenging to conduct representative follow-up surveys of impacted residents. As a result, most studies of post-Katrina outcomes have focused on short run effects one or two years after the storm (e.g. Fussell et al 2010, Zissimopoulos and Karoly 2010, Sastry and Gregory 2014). In this study, we analyze data from the Federal Reserve Bank of New York's Consumer Credit Panel (CCP), a quarterly representative panel of most US residents, to follow residents of Katrina-impacted regions from the time of the storm until 2016, ten years later. Based on consumer credit reports, the CCP contains detailed information on individuals' consumption behavior, home- and auto-ownership, credit score (a summary measure of creditworthiness strongly related to income), and household composition as well as their age and location. Individuals randomly drawn into the CCP remain indefinitely, enabling representative analysis of hurricane-impacted residents a decade after Hurricane Katrina.

We break our analysis into three parts. First, we examine outcomes within the city of New Orleans, comparing residents that experienced sustained flooding to those that largely remained above water. With 1.3 million residents, New Orleans had one of the United States' forty most populated metropolitan areas. Individuals hit hardest by Hurricane Katrina faced both a greater shock to their economic and social well-being as well as greater opportunity to receive private, local, and federal insurance protection for their substantial losses; we estimate the net effect of these opposing dynamics relative to individuals whose homes did not flood, but who nevertheless received a substantial shock from the storm (e.g. from disrupted local economic activity).

The second part of our analysis examines post-Katrina migration from New Orleans. In addition to mapping the long-term destinations of former New Orleans residents, we compare inundated and non-inundated residents to estimate migration patterns specific to inundated residents.

Finally, we compare the outcomes of residents of the Gulf Opportunity (GO) Zone, a hurricane-impacted region designated by the federal government in order to target substantial tax incentives to promote economic recovery, to those living in the five states surrounding the GO Zone.[1] The GO

[1]The Hurricane Katrina GO Zone was designated by the federal Gulf Opportunity Zone Act of 2005. The Act also

Zone covered six million residents, or 2.03 percent of the US population. Spanning the entirety of Louisiana, Mississippi, and Alabama as well as parts of Florida and Texas, our Five States analysis estimates the effect of the hurricane on residents of the broader region impacted by Hurricane Katrina. These residents faced a wide range of flooding and wind damage (with a substantial share of residents actually experiencing little or no damage), but were safeguarded by private insurance and substantial emergency aid from the federal government.

From a policy perspective, our framework allows us to test four outcomes of interest of the federal policies that provided *de facto* disaster insurance to regions that experience natural disasters. First, we test the policies' ability to target areas most damaged by the hurricane and provide residents with adequate assistance relative to less-affected residents living in the same region; we call this the policies' *intensive* effectiveness. Second, we test the policies' *extensive* effectiveness, or their ability to stabilize and normalize outcomes for residents of the broadly-affected region, even those minimally impacted by the storm. Third, we test the *breadth* of the policies' effectiveness by estimating heterogeneous outcomes in both regions across three demographic divisions which may have been importantly and differentially affected by the storm: age, race, and income. While we do not directly observe race or income, we proxy income by pre-Katrina credit scores (which are highly correlated with income; see Albanesi and Nosal 2015) and infer black and white residents from the racial distribution of their residential neighborhoods. Finally, our migration analysis assesses the effectiveness of federal policies in limiting long-term population losses and in reversing short-run population outflows from the area hit hardest by Hurricane Katrina.

The region affected by Hurricane Katrina was non-randomly selected, determined by the geographical path of the storm and by topological and engineering features of New Orleans. We use difference-in-differences event study analysis to control for individual- and time-specific variation in the outcomes of interest. Following Hirano et al (2003), we apply propensity score weighting estimated from three years of residents' pre-Katrina socioeconomic characteristics to account for regional differences in those characteristics, and show that nearly all of our weighted outcomes of interest are balanced across treatment group for five years before the hurricane.

Our analysis of the impact of Hurricane Katrina on household finance is related to that of Gallagher and Hartley (2014), who also use the FRBNY Consumer Credit Panel for their analysis, while our analysis of the storm's impact on mobility and household composition is related to Deryugina, Kawano and Levitt (2014), who use tax return data from the Internal Revenue Service. Our study, which in part confirms those earlier papers' findings, augments them in four important ways. First, both of these previous studies focus exclusively on outcomes for the city of New Orleans (where the hurricane was particularly damaging) as a case study of the impact of natural disasters in the United States; the former examines the intensive effectiveness of relief policies, while the latter extensively compares New Orleans outcomes to those of 20 demographically-

designated GO Zones for Hurricanes Rita and Wilma, but all references to the 'GO Zone' below refer to the Katrina GO Zone. Individuals living outside the GO Zone may still have been eligible for some subsidies under an additional law, the Katrina Emergency Tax Relief Act of 2005, which may attenuate our findings.

similar American cities. Our study also examines the broader effect of Hurricane Katrina–and associated governmental subsidy and insurance programs–on the large Gulf Opportunity Zone that was affected by the storm. Second, the previous studies only examined short- and medium-term effects of the storm (3 and 5 years, respectively), whereas we find that there are both sustained and strengthening effects of the storm 10 years after its impact. Third, our analysis of residential outflow from New Orleans in the years following the storm is unique to this paper. Finally, we consider a more comprehensive set of financial outcomes than either study, including bankruptcy and foreclosure filings, insolvency, auto loans and balances, home ownership, consumer debt balances, and credit score.[2]

In New Orleans, we find relatively modest but persistent effects on residents' use of auto and consumer debt, bankruptcy behavior, and credit scores; inundated residents' credit scores immediately and persistently dropped about six points, or 0.05 standard deviations, and consumer debt declined by around $150 per quarter (remaining statistically significant at the 10 percent level as late as 2013). On the other hand, we find large persistent increases in migration and declines in homeownership rates; a decade after the storm, inundated residents were between two and three percentage points less likely to hold a mortgage and seven percentage points less likely to remain in New Orleans. Indeed, inundated residents remained more likely to have recently changed residences (in the past three years) as late as 2011, after which their behavior reverted to that the non-flooded control group. Household size immediately declined (by about 0.15 adults per household), with a marked transition from large extended-family households to single-adult residences (as previously documented by Rendall, 2011), but the gap had largely disappeared a decade after the storm. Among the inundated, older, higher-income, and white residents were more likely than their respective counterparts to evacuate New Orleans immediately after Hurricane Katrina, but we find little additional evidence of heterogeneous impacts across demographic group. In particular, we find no evidence that residents of mostly-black flooded neighborhoods faced more negative consumption, insolvency, homeownership, or partnership outcomes than residents of mostly-white flooded neighborhoods, despite our study's sufficient power to identify such differences.[3]

Overall, our findings suggest a broad success of insurance and government programs in minimizing long-term changes in most income and consumption behavior among those who experienced the greatest impact from Hurricane Katrina, as well as those programs' success in distribut-

[2]Like Deryugina, Kawano, and Levitt, our empirical specification controls for sample selection using propensity scores estimated on a large set of pre-Katrina socioeconomic characteristics, and includes individual and time fixed effects. Gallagher and Hartley control for pre-Katrina socioeconomic characteristics in post-Katrina periods and attempt to directly control for adverse sample selection.

[3]A number of academic (Hamilton, 2015), private foundation (Hamel, Firth, and Brodie 2015), and newspaper (e.g. Rivlin 2015 in the NYT Magazine and Philip 2015 in the Washington Post) reports have found that black New Orleans residents are far less likely to report post-Katrina economic recovery than white New Orleans residents. These reports all rely on current residents belief and perceptions as reported in surveys and interviews instead of actual outcomes, and fail to directly account for large differences in both post-Katrina immigration and emigration by race. Nevertheless, our study examines only one aspect of those studies' broader intentions: while we find no evidence of differential impacts resulting from inundation within the white and black populations of New Orleans, we are unable to test whether *all* black residents of New Orleans fared worse than *all* white residents, independent of pre-hurricane characteristics and hurricane inundation.

ing funding across demographic groups, but suggest a failure to redress the long-term decline in homeownership that remains ten years after the storm.

In the expansive Five States region, we find that Hurricane Katrina had immediate, substantial, and statistically-significant negative effects on consumption and homeownership, with the latter dropping about four percentage points (almost 15 percent) for those residing in the GO Zone when the storm hit. However, these declines were short-lived; by 2015, GO Zone residents were one percentage point *more* likely to own a home than non-residents (significant at 10 percent). The impact also marked the beginning of a medium-term increase in residents' credit scores (a strong proxy for income), along with an increase in auto debt and decreased prevalence of insolvency, foreclosure, and bankruptcy. Moreover, by 2013 those who resided in the GO Zone at the time of the storm tended to have higher average consumer debt–by as much as $160 (5 percent)–than those who lived outside the GO Zone before the storm. Given their lower insolvency rate, these trends suggest that the aftermath of the hurricane provided long-term net consumption benefits for GO Zone residents. This provides some support for the theory that GO Zone residents tended to be financially overcompensated, on average, for the damage caused by Hurricane Katrina, providing them with net subsidies relative to residents of neighboring counties.[4] Moreover, we find that these net subsidies were progressive–somewhat larger for young and low-income residents–and appear broadly similar for residents of black and white GO Zone neighborhoods. Restricting our analysis to counties within about 20 miles of the Go Zone border (with similar results for 10 and 30 mile bands), we find evidence that these net subsidies cannot be wholly explained by the Zone's peripheral residents, suggesting that the region with the largest benefits was in the region closer to (but not including) New Orleans, where flooding and high winds would have been limited (but non-negligible).

Finally, our analysis shows that seven percent of New Orleans residents evacuated the city after Hurricane Katrina *and have yet to return the city ten years later*, with 13 different US states hosting over 500 adult evacuees in 2016. A controlled post-treatment comparison suggests that inundated New Orleans residents were significantly and substantially more likely to move to neighboring and nearby states than their non-inundated neighbors in the year after the storm, and ten years later were more than 60 percent more likely to have migrated to Georgia and other parts of Louisiana, but they were more than 40 percent less likely to have moved north to states like North Carolina and New York; indeed they were 33 percent less likely to have moved to any Mid-Atlantic or New England state.

In Section 2 we provide some background on Hurricane Katrina and the various governmental programs implemented to insure residents against its associated damage. We introduce our dataset, the Consumer Credit Panel, in Section 3 and discuss our empirical approach in Section 4. Sections 5 to 7 present our baseline results for each part of our analysis–the impact on inundated residents within the city of New Orleans, the impact on residents of the GO Zone within the Five States region, and the storm's impact on migration from New Orleans–along with results by age, race,

[4]Our findings are restricted to financial overcompensation, not overcompensation in an overall welfare sense.

and income level. Section 8 concludes.

2 Background

Hurricane Katrina formed as a tropical storm in the Caribbean Sea on August 23rd, 2005. By August 28th, Mississippi, Alabama, Louisiana, and Florida had been declared in states of emergency by President George W. Bush and their respective governors, while Mayor Ray Nagin of New Orleans had ordered the first mandatory evacuation in that city's history. The hurricane made landfall near New Orleans on August 29th as a Category 3 hurricane (sustained winds between 111 and 129 miles per hour) with a storm radius of over 100 miles. New Orleans experienced 14 inches of rain and a series of levee failures that flooded most of the city at depths of up to 16 feet (Kates et al, 2006). In the broader affected region, large portions of Louisiana and Mississippi experienced wind speeds above fifty miles per hour; Katrina rendered 300,000 houses uninhabitable and left at least 2.5 million residents without electricity (Townsend, 2006).

According to the National Weather Service (NWS), Hurricane Katrina was the third most intense (as measured by barometric pressure), third most deadly, and second most costly hurricane to strike the United States since 1851, when reliable record-keeping commenced (Blake and Gibney, 2011). It ranks first in all three of those categories among hurricanes since 1970, and is estimated by NWS to have caused almost $108 billion in damages ($129 billion in 2015 dollars). In short, Hurricane Katrina was highly disruptive to residents of the Gulf Coast, particularly those who lived in New Orleans, and there is ample reason to expect it to constitute a substantial shock to every facet of those residents' lives.

Insurance for damage caused by Hurricane Katrina came in the form of direct aid, disbursements, tax breaks, tax credits, and subsidies from the public and private sectors. According to a 2010 report by the Insurance Information Institute, an industry group, private insurance payouts totaled $41.1 billion towards more than 1.7 million claims across six states. Residents of Louisiana accounted for the majority of private insurance recipients, receiving more than $25 billion; claims were evenly split between individuals (49 percent, for homes and cars) and firms (51 percent, not including an additional $2 billion for offshore energy and marine losses). According to the Foundation Center, as much as $6.5 billion was also made available through private individual and corporate philanthropy, though this includes aid for other 2005 Gulf Coast hurricanes (Lawrence et al, 2007).

The response of the federal government to Hurricane Katrina was manifold. In addition to the typical federal response to natural disasters, including insurance payouts through the National Flood Insurance Program (which totaled more than $16 billion), the federal government implemented three large-scale programs designed to mitigate the long-term socioeconomic impact of the storm. About $20 billion was dispersed through the Department of Housing and Urban Development's Community Development Block Grant program, which targeted infrastructure reconstruction focusing on affordable rental housing, federally assisted housing, and public housing

(Boyd, 2011). An additional $20 billion was dispersed through the Department of Homeland Security's Federal Emergency Management Agency, which provided short-term relief like replacement housing and furniture as well as long-term repair of public infrastructure (FEMA, 2013). These programs also funded most state responses to the storm, like the initiatives of Louisiana's Economic Development Department; for this reason, we hold the federal governments' policies comprehensively responsible for the public insurance portion of the shock caused by Hurricane Katrina.

Finally, the Internal Revenue Service offered substantial tax breaks and subsidies to individuals living and working within a federally-designated three-state Gulf Opportunity (GO) Zone, including additional income deductions, augmented earned income credits and child tax credits, expanded federal mortgage subsidies, business property tax breaks and clean-up deductions, and an employee retention and housing credit (IRS, 2006). These tax exemptions totaled about $3.5 billion. The Gulf Opportunity Zone Act of 2005 also authorized Mississippi, Alabama, and Louisiana to issue special GO Zone tax-exempt bonds totaling $15 billion for use in permanent reconstruction of GO Zone residences and businesses and $8 billion for the advanced refunding of outstanding bonds. Finally, states received additional GO Zone low-income housing tax credits totaling $330 million (Brostek, 2008). The Government Accountability Office noted that:

> *With some process variations, the three eligible states with GO Zones generally allocated bond authority on a first-come, first-served basis without consistently targeting the allocations to assist recovery in the most damaged areas. Officials in Louisiana and Mississippi acknowledged that the first-come, first-served approach led to allocating bond authority to less-damaged areas at the start of the program (Brostek, 2008).*

The total cost of federal and private insurance programs, then, exceeded $100 billion, and was of similar magnitude to the estimated financial cost of the physical damage caused by the storm. In this paper, we examine the net or combined effect of Hurricane Katrina and the public and private responses that attempted to stabilize the socioeconomic livelihood of impacted residents.

3 Data

3.1 The Consumer Credit Panel

The Federal Reserve Bank of New York's Consumer Credit Panel (CCP) is an individual-level longitudinal dataset on consumer liabilities, repayment and location. It is built from anonymized quarterly consumer credit report data collected and summarized by Equifax Inc. Data are collected quarterly since the first quarter of 1999, and the panel is ongoing. Sample members have Social Security numbers ending in one of five arbitrarily selected pairs of digits (for example, 10, 30, 50, 70, or 90), which are assigned randomly within the set of Social Security number holders. Therefore, the sample of approximately 12 million individuals comprises 5 percent of U.S. individuals with

credit reports (and Social Security numbers). The CCP sample design automatically refreshes the panel by including all new reports with Social Security numbers ending in the above-mentioned digit pairs. Therefore the panel remains representative for any given quarter, and includes both representative attrition, as the deceased and emigrants leave the sample, as well as representative entry of new consumers, as young borrowers and immigrants enter the sample.[5]

Each quarter, the CCP includes the birth year and present location of each individual down to the Census Block, in addition to an anonymous street address identifier (allowing us to identify residency change within Census Block).[6] It includes loan counts, balances, and repayment statuses of consumer debt by type–including auto, mortgage (and other home-secured), and consumer credit (credit card, retail, and consumer finance) debt–as well as bankruptcy and foreclosure indicators. We use this information to define homeownership as holding non-zero home-secured debt (including mortgage, HELOC, and home installment loans), and define bankruptcy and foreclosure by an individual's experiencing a bankruptcy or foreclosure event in the past three years.[7] While CCP data are not top-coded, we winsorize the top one percent of debt balances to avoid our estimates' being driven by outliers. The CCP also includes each individual's Equifax risk score, which (like the FICO score) models 24 month default risk as a function of credit report measures, and which is a strong proxy for income.[8] Finally, our data also includes these same characteristics for all sampled individuals' covered household members.[9] The CCP defines household members as individuals with the same full mailing address (as recorded by financial institutions); following Bleemer et al (2014), we define parental coresidence (a possible outcome of interest, signaling economic distress) as an individual who shares a residence with at least one adult between 15 and 45 years older than her. With household members included, the CCP includes credit report data on over 40 million individuals.

While the sample is representative only of those individuals with Equifax credit reports, the coverage of credit reports is fairly complete for American adults. Aggregates extrapolated from the data closely match those based on the American Community Survey, Flow of Funds Accounts of the United States and the Survey of Consumer Finances.[10] In sum, the CCP permits unique insight into questions of geography-specific mobility, debt and consumer behavior, and household composition as a result of the size, representativeness, frequency, and recentness of the dataset. Its sampling scheme allows extrapolation to regional aggregates and spares us most concerns regarding attrition and representativeness over the course of a long panel.

[5] See Lee and van der Klaauw (2010) for details on the sample design.

[6] Nonempty Census Blocks in the US averaged 49 inhabitants in the 2010 Census.

[7] Bankruptcy events include discharges arising from either Chapter 7 or Chapter 13 bankruptcy. Both bankruptcies and foreclosures include those reported at the account level and in public record.

[8] See Appendix II of Albanesi and Nosal (2014), which matches a small subset of CCP data to 2009 income data collected by Equifax Workforce Solutions to show the strength of the Equifax risk score as a proxy for income. The consumer credit score provided by Equifax is based on a different methodology than the FICO score, but it predicts the same probability of severe delinquency over the next 24 months (see Lee and van der Klaauw (2010)).

[9] An individual is covered if she is at least 18 years old and has an Equifax credit report, for which even a loan application or listing on an authorized-user account is sufficient.

[10] See Lee and van der Klaauw (2010) and Brown et al. (2013) for details.

We construct two subsamples of CCP data for our analysis. First, we construct a 1999-2016 panel of all individuals whose mailing addresses were located in Orleans Parish on the 30th of June 2005 (the end of the second quarter), our last data record before Hurricane Katrina. The data's panel structure allows us to follow a random 5 percent of adults who lived in New Orleans when Hurricane Katrina hit, both during the years prior and continuing for 10 years after the storm, tracking the evolution of their consumption behavior, mobility, and household composition. Second, we construct a similar panel of all individuals whose mailing address was located in the Five State Region of our broad analysis–which we define as the full states of Louisiana, Alabama, and Mississippi as well as the Texas and Florida counties with centroids bounded between the 82nd and 99th west meridians–on the 30th of June 2005.[11] To enable analysis of the storm's immediate and longer-term effects, both panels were collected biannually (first and third quarters) in the years immediately before and after Hurricane Katrina, and collected annually (first quarter) thereafter. The total sample size in the second quarter of 2005 is about 19,000 in the city of New Orleans and 1.52 million in the Five States region. In the first quarter of 2016, about 80 percent of the sample continued to be covered by the CCP, with the remainder either deceased, moved outside the US, or without sufficient recent credit history to generate an Equifax credit report (a relatively rare event). Figure 1 shows the set of variables constructed for our analysis of these two panels.

3.2 Additional Data Sources

We use two sources of data to delineate the regions affected by Hurricane Katrina. To identify the New Orleans residents who were hardest-hit by Katrina, we use geospatial flood inundation data estimated by the United States Geological Survey's Center for Earth Resources Observation and Science (see Gesch 2007) and aggregated to the 2000 Census Block level in Orleans Parish by Sastry (2007). Following Sastry, we define a Census Block as inundated if it experienced at least four feet of flooding on 31 August 2005. Though these inundation data are largely estimated from detailed topological data and water level readings from Lake Pontchartrain, the agency notes that they compare well with aerial and satellite photographs from the days after the storm. Figure 1a shows a map of the 49 percent Census Blocks in Orleans Parish (51 percent of households) that were inundated by Hurricane Katrina.

For the Five States region, we define the broad region affected by the storm by the Hurricane Katrina GO Zone defined by the Gulf Opportunity Zone Act of 2005, as discussed above. Figure 1b shows a map of the 89 counties and parishes in the Five State region that fall within the GO Zone (shown in blue), out of 401 total counties in the region.[12] Due to our singular focus on New Orleans above, we exclude New Orleans residents from the Five States analysis.

[11] The 82nd and 99th meridians were chosen to symmetrically include the Hurricane Katrina GO Zone plus additional four degrees longitude for the control group (see Figure 1b). All qualitative results presented below are robust to the inclusion of all of Texas and Florida, and analysis restricted to the GO Zone's 40-mile border provides similar results.

[12] Louisiana 'parishes' correspond with the 'counties' of all other states. We will refer to all such geographical units as 'counties' for the remainder of the paper.

While the CCP provides sufficient information to produce subsamples by age and income (as proxied by credit score), we use 2000 Census data to geographically subsample black and white residents by Census Blocks. Census Blocks are the smallest regional designation assigned by the US Census, and had a mean (median) population of 19 (38) across the Five States region in 2000; even the 7,200 Census Blocks in New Orleans contained an average of 49 residents.[13] The white (black) subsample comprises all residents of 2000 Census Blocks that were at least 75 percent non-Hispanic white (black).[14] About 69 percent of sampled New Orleans residents live in such neighborhoods (50 percent black, 19 percent white), as do 61 percent of residents of the Five States region. Remaining residents–most of whom live in racially-diverse neighborhoods–are omitted from our race subsamples.[15] Because residents non-randomly select their neighborhoods' characteristics, we refer to these subsamples as "White Neighborhoods" and "Black Neighborhoods", which may not broadly represent white and black residents. Table 2 summarizes the observed characteristics of our sample by subpopulation.

4 Empirical Strategy

The goal of our analysis is to estimate the short- to run-long average "treatment effect" of Hurricane Katrina–and the associated policy response–on a large set of economic and demographic statistics measured at regular intervals after the storm. The framework of our analysis will be difference-in-differences regressions, in which we compare outcomes pre- and post-Katrina of those living in the impacted areas to the same outcomes for those living in similar but not- or less-impacted areas. In applying the differences-in-differences approach we use propensity score weighting (Hirano *et al*, 2003; Abadie, 2005) to account for the non-random selection of individuals that were impacted by Hurricane Katrina due to the storm's geographic containment, thereby assuming that geographic residence selection conditional on (financial) observables is independent of long-run outcomes. We follow Hirano *et al* by estimating propensity scores using a logit model relating the likelihood of an individual being impacted by the storm to a large set of observed individual characteristics and outcomes, including consumption, mobility, and household composition levels and changes measured in the first quarters of 2002-2005 (collected before Hurricane Katrina's impact).[16] A complete list of observed characteristics is available in Appendix 2.

Let X_{it} be the vector of economic and demographic variables described in Table 1 for individual i and quarter t, and let Y_{it} be a vector of outcomes (one of the economic and demographic variables) for individual i in time t. Let K_i be an indicator for whether i was living in a location impacted by Hurricane Katrina, either an inundated New Orleans Census Block or a county in the federal

[13] These figures omit unpopulated Census Blocks.

[14] The results presented below are largely insensitive to 10 percentage point changes in these cut-off values.

[15] Fewer than five percent of New Orleans and Five States residents lived in either 75-percent-Hispanic Census Blocks or Blocks that had no residents during the 2000 Census.

[16] Note that by including annual measures of local conditions, our weighting also accounts flexibly for differences in pre-treatment trends.

Katrina GO Zone. We estimate the following model for all observed quarters (the first quarter of every year from 1999–2016 and the second and third quarters of 2005 and 2006), omitting the interaction term between K_i and the indicator dummy for the second quarter of 2005 (the final quarter of data before Hurricane Katrina's impact):

$$Y_{it} = \delta_i + \gamma_t + \sum_{\tau \in [2000,2016] \cap \mathbb{Z}} K_i 1_{\{t=\tau\}} \beta + \epsilon_{it}$$

where the $\{\beta\}$ coefficients–the linear effect of living in an impacted locality in quarter t relative to the second quarter of 2005–are the coefficients of interest.[17] The model includes both individual fixed effects δ_i and time fixed effects γ_t (which will capture aggregate business cycle fluctuations). The regression weights impacted individuals by the inverse propensity of inundation, $\frac{1}{\Pr(\widehat{K_i=1})}$ and non-inundated individuals by the inverse propensity of non-inundation, $\frac{1}{\Pr(\widehat{K_i=0})}$, using propensities estimated by logistic regression. Standard errors for the Five States (New Orleans) model are clustered at the county (Census Block) level.

We conduct two tests to measure the effectiveness of our propensity weight estimation procedure. First, we test the overlap assumption: that all individuals are estimated as having a positive probability of being impacted or not impacted by Hurricane Katrina. We find that no individuals in the New Orleans sample and two individuals in the Five States sample have an impact (or non-impact) probability of less than 0.0001, and omit those individuals from our analysis. Second, we test the common support assumption: that no individual has a propensity score outside the range of propensity scores in the alternative-treatment group. Four individuals in the New Orleans sample and seven in the Five States sample fail the common support assumption, and are omitted. Given our sample's massive size, these results support the applicability of propensity score weighting in our estimation approach.[18] Additional evidence of the weights' effectiveness in balancing the panel is shown in the results below; as expected, nearly all outcomes of interest are balanced in both samples for the five years prior to Hurricane Katrina.

5 New Orleans Impacts

We first present estimated effects of living in an inundated New Orleans Census Block on the various socioeconomic outcomes of interest described in Table 1. Effects are estimated relative to otherwise-similar New Orleans residents who lived in non-flooded regions of the city, who may themselves have sustained substantial water and wind damage in addition to negative externalities from the nearby flooding (for example, through a decline in the local economy). These estimated effects, then, measure only the additional impact of severe inundation in the days following Hur-

[17] We include the second and third quarters of 2005 and 2006 in our analysis to provide finer-detail estimates of the short-term impact of Hurricane Katrina.

[18] Individuals who fail either the overlap assumption or the common support assumption are omitted from our analysis below.

ricane Katrina, net the additional federal and private insurance and aid provided to mitigate that impact. These 'intensive-margin' results can be understood to describe insurance programs' effectiveness in targeting more substantial assistance to residents who were hardest-hit by Hurricane Katrina.

In order to convey the magnitudes of these coefficients, we present them unscaled, which describes the average treatment effect in the units of interest (percentage point, dollars, or risk score). In some cases, we also present coefficients scaled by the contemporaneous level in the non-inundated 'control' Blocks, which describes the ATE as a unitless percent difference.[19] In several figures below we show the estimated coefficients from Equation (2) plotted for various outcomes of interest from 2000 to 2016. The results for 2000-2005, which estimate the difference between inundated and non-inundated neighborhoods before the storm conditional on the set of control variables described above, are presented as a validation exercise; we expect that the controlled pre-Katrina impact of Hurricane Katrina will be 0 in those years, as is nearly always the case.

We first consider estimates of Hurricane Katrina's impact on risk scores (proxy for income) and on new debt originations associated with car purchases or other consumer debt activity (as measures of consumption), some of which are shown in Figure 2. Inundated residents experienced a short-term negative shock to their Equifax risk score after the storm of about 6.7 points (0.05 standard deviations), and recovered very little over the following ten years, with their average score remaining 5.6 points lower ten years after the storm. This short-term decline corresponded with a two percentage point increase in the fraction of inundated residents with subprime risk scores (scores below 640, the bottom third of risk scores nationwide), though the increase fell into statistical insignificance after 2008. This finding, consistent with that of Deryugina, Kawano and Levitt (2014) using IRS income data (Figure 5), suggests that insurance programs failed to meaningfully close the income gap between inundated and non-inundated New Orleans residents caused by Hurricane Katrina in the short- or long-term.[20]

Our analysis of consumption yields results in line with this income finding. We find evidence of a steady decline in consumer credit balances (with time-variation in consumer debt representing a strong proxy for changes in general consumption, excluding very large purchases) in the three years after the hurricane, without any substantial recovery in the following 5-10 years (though the gap is statistically insignificant ten years later). Inundated residents are far more likely to purchase a car immediately after the hurricane–possibly replacing cars damaged by the storm, likely with newer models–with an increase in average auto debt by over $400 per adult, but also become steadily more likely to face insolvency on their auto loans–by more than one percentage point in 2016. Other measures of extreme financial hardship, however, suggest some degree of post-Katrina

[19] We choose to scale by the contemporaneous level in non-inundated regions (the 'control' group), rather than the more typical choice of the level in inundated regions just before Hurricane Katrina, in order to account for city- (and nation-) wide trends in our outcomes of interest in the late 2000s (driven most significantly by the Great Recession).

[20] Using a slightly different definition of inundation, Deryugina, Kawano, and Levitt (2014) find a income gap of about $5000 between inundated and non-inundated residents in 2010, which corresponded to 0.14 standard deviations in New Orleans.

recovery: inundated residents' increased likelihood of falling into consumer credit insolvency returns to statistical and economic insignificance five years after the storm, and inundated individuals are no more likely to declare bankruptcy than their non-inundated neighbors.

Ten years after the storm, then, the consumption behavior of inundated residents had imperfectly recovered since the storm relative to their non-inundated neighbors, with small but persistent gaps in credit-score-proxied income and insolvency.

We turn next to Hurricane Katrina's impact on residential mobility. Figure 3 shows the impact of the hurricane on inundated New Orleans residents' decision to change their residential address, county, or state, either at any time since the storm or specifically in the past three years (a measure of residential 'churn'). Inundation considerably increased residents' likelihood of relocation; within one year, an additional 13.1 percentage points of residents had moved out of Orleans Parish. The effect of the storm peaked in 2006 and diminished thereafter, though by 2016, inundated residents were still 6.7 percentage points more likely to reside outside of Orleans Parish than non-inundated residents. Figure 3 also shows that the hurricane led to substantial three-year residence-churn at the county level through at least 2011, implying that inundated residents were substantially more likely to relocate even 3-6 years after the storm (in some cases returning to New Orleans after years away). Since 2013, however, inundated and non-inundated residents have had similar levels of mobility, suggesting one successful dimension of post-hurricane recovery. Figure 3 shows similar trends for impacts on street-address-level and state-level mobility, with inundated Orleans Parish residents remaining about 2 percentage points more likely to have relocated out of the state ten years after the hurricane.

Homeownership, and especially homeownership among the pre-Katrina homeowners, faced substantial deterioration due to Hurricane Katrina. At the time of the storm, about one in four residents of New Orleans residents were homeowners. The homeownership rate dropped suddenly after the storm in both inundated and non-inundated Blocks, but fell further and recovered less quickly for inundated residents. As shown in Figure 4, one year after the storm, the homeownership rate had fallen by an additional 5.7 percentage points (29 percent) among inundated residents compared to non-inundated residents (who themselves experienced a 2.3 percentage point decline). The gap has slowly narrowed in the intervening decade, but remains around 2 percentage points ten years after the storm. Restricting the sample to pre-Katrina homeowners, the hurricane's impact on homeownership was even more striking, decreasing homeownership by 25.6 percentage points in the short run and 9 percentage points ten years later.

Despite widespread home loss following Hurricane Katrina, the storm had no measurable short- or long-term impact on the proportion of homeowners facing home-secured debt insolvency or foreclosure, though foreclosure was somewhat less common in inundated neighborhoods during the Great Recession.[21] Nevertheless, our analysis of homeownership shows that inundated New Orleans residents faced a substantial and persistent negative short-term homeownership shock after

[21]The decline in foreclosure (conditional on homeownership) during the housing crash may reflect New Orleans subprime homeowners having already lost their homes, by means other than foreclosure, in 2005.

Hurricane Katrina.

In addition to the effect on homeownership, we also find substantial effects of Hurricane Katrina on the household composition of inundated residents. Figure 5 shows that the average household size of inundated New Orleans residents, which was 2.84 adults prior to Hurricane Katrina, declined by about 0.16 adults (6 percent) immediately following the storm and slowly recovered to a null effect ten years later. While the welfare effects of this change are unclear–shrinking household sizes could reflect either the dissolution or the emancipation of nuclear families, or a slower rate of forming or joining multi-person households or extended family households–this is a substantial short-term change in living arrangements caused by Hurricane Katrina. Interestingly, Figure 5 also shows that the decline in household size does not reflect a decline in partner-households (defined as any household with exactly two covered adult members). Instead, we find strong evidence of a rise in the proportion of single-adult households at the expense of larger households; the proportion of inundated residents living alone increased by 20 percent (5.4 percentage points) immediately after the storm relative to non-inundated residents, though the two slowly converged until 2016.

We have shown in this section that inundated residents of New Orleans faced a short-term increase in mobility and decrease in household size relative to their non-inundated neighbors after Hurricane Katrina, but had fully recovered from those changes in the decade after the storm. More pressingly, however, inundated residents also faced a persistent negative shock to homeownership and credit scores along with substantial permanent changes in their residential location. In this section, we exploit the massive size of our dataset by cutting our sample into six subpopulations of interest: youth and elderly residents, under age 40 and over age 60 in 2005; low- and high-income individuals, proxied by having an Equifax risk score below 610 or above 735 (the first and second terciles in New Orleans); and the residents of predominantly-white or predominantly-black neighborhoods (designated at the Census Block level). We estimate the impact of Hurricane Katrina on each subpopulation by modeling each subpopulation independently; the estimates presented below should be interpreted as the impact of the storm on members of a subpopulation relative to non-inundated members of that same sub-population.

Tables 3-5 show treatment heterogeneity for a selection of outcomes of interest one, five, and ten years after Hurricane Katrina. Table 3 shows that Hurricane Katrina increased elderly New Orleans residents' likelihood of leaving New Orleans more than it did youth residents'; ten years after the storm, inundated elderly residents were 13 percentage points less likely to reside in New Orleans than non-inundated elderly residents, while the inundation gap for youth residents was a statistically-insignificant 1.4 percentage points. Youth residents also faced a more negative consumption shock in the medium-term following the storm, while elderly residents actually faced a substantial positive consumption shock; however, the gap between the two had shrunk somewhat by 2016. In general, Table 3 provides evidence that elderly New Orleans residents were more successful in recovering from Hurricane Katrina than youths, possibly in part by leaving the city.

Treatment heterogeneity by credit score follows an expected pattern; Table 4 shows that higher-

income residents were more likely to leave New Orleans following the storm, but were also more likely to lose homeownership and experience a credit score decline (since they had far more to lose). The homeownership gap fails to dissipate, but higher-income residents' credit scores had recovered to the same decline experienced by lower-income residents by 2016. Both groups faced similar impacts in consumption behavior.

Finally, Table 5 displays heterogeneity in Hurricane Katrina's treatment effect across white and black New Orleans neighborhoods. Despite sufficient power to detect relatively-small difference in treatment effect, as we did in our other subsample analysis, we find little evidence of treatment effect heterogeneity across these groups, though residents of white New Orleans neighborhoods are far more likely to have left the city following the storm (15.2 vs. 6.6 percentage points ten years after the storm). Residents of black neighborhoods appear to have faced a smaller negative impact on homeownership than residents of white neighborhoods, while the latter may have experienced a larger decline in consumer debt insolvency, but both differences are statistically insignificant. While these findings are agnostic on whether black residents of New Orleans (in both inundated and non-inundated Blocks) received differential support compared to white residents, they suggest that support targeted at inundated communities similarly-affected white and black New Orleans neighborhoods.

Appendix Figures A1-A6 display event study figures for these selected outcomes of interest for each of the six subpopulations.

6 Five States

In the previous section, we discussed the relative 'intensive' effectiveness of federal and private insurance programs in mitigating long-term negative outcomes for inundated residents of New Orleans relative to their non-inundated neighbors, but found that inundated residents experienced persistent negative shocks in credit score and homeownership and increased outmigration. In this section, we turn to a broader analysis of the net Hurricane Katrina shock, comparing residents of the three-state GO Zone, who bore the brunt of Hurricane Katrina's damage but were eligible for a wide variety of government insurance programs, to residents of the Five States region surrounding the GO Zone. These 'extensive-margin' results can be understood to describe insurance programs' broad effectiveness in providing assistance to *all* individuals impacted by Hurricane Katrina, not only those most-severely impacted. As effectiveness may vary with the severity of the storm's local impact, and given the city's unique circumstances and larger size of the policy response, we exclude New Orleans residents from the Five States analysis.

Some federal GO Zone benefits were available to workers who were employed in the GO Zone, whether or not they resided within it; because we cannot observe work locations, to the (likely-small) degree that GO Zone workers are not residents of the GO Zone, our estimates of the true effect of the GO Zone programs will be biased towards finding a zero impact. As above, we compare GO Zone residents to their counterparts along a wide variety of socioeconomic outcomes

of interest.

We begin with a comparison of the income and consumption behavior of Five States residents. Figure 6 shows that GO Zone residents experienced a small but immediate, persistent, and highly statistically significant rise in risk score by between 1 and 2 points, with the fraction of residents holding subprime risk scores declining about 1.5 percentage points compared to comparable Five States residents. We find higher-magnitude effects on consumer credit balances: short-term average consumer debt balances fell by about $100 for GO Zone residents, but the consumption decline begins to attenuate after 2009, and by 2016 the Hurricane's impact on GO Zone residents has become large and positive, with an additional $160 per month in consumer debt (about 4 percent) compared to other Five States residents. As with inundated New Orleans residents, Hurricane Katrina increased GO Zone residents' average auto debt (by around $400); in addition to a consumption boost, this increase may reflect more frequent replacement of damaged cars with new cars after the storm among GO Zone residents.[22]

Figure 6 also shows substantial long-term positive effects of living in the GO Zone on derogatory credit behavior. Hurricane Katrina (and the associated policy response) made GO Zone residents 0.4 and 0.6 net percentage points less likely to hold insolvent auto or consumer debt during the Great Recession, respectively, suggesting that they were more successful in weathering the recession than others in the Five States region (though these impacts attenuate by 2016). They were also substantially and persistently less likely to declare bankruptcy; the 0.4 percentage point decline constitutes a 25 percentage point decline relative to non-GO Zone residents. These results, along with the long-term increases in income and consumption, suggest substantial net financial benefits of GO Zone residents from Hurricane Katrina when compared to outcomes of similar residents outside the GO Zone, which (given the singular destructiveness of the storm) can likely be attributed to governmental and private over-insurance.

Unlike inundated New Orleans residents, GO Zone residents' mobility decisions were largely unchanged by Hurricane Katrina. Figure 7 shows that the storm had no short-term effect on local or cross-state mobility, though we find some evidence that the storm decreases the likelihood of GO Zone residents leaving the state years after the storm. This decline in mobility may have been related to homeownership benefits provided by GO Zone residency; Figure 8 shows that GO Zone residents experienced substantial homeownership benefits in the long run. Immediately after Hurricane Katrina, homeownership in the GO Zone declined by 3.6 percentage points (12 percent, likely driven by coastal areas), but it rapidly recovered over the following few years; by 2016, GO Zone residents were 1 percentage point more likely than other Five States residents to be homeowners, a three percent increase (though each year's estimate is only statistically significant at the 10 percent level). This result is driven by new homeowners who didn't own homes before the hurricane; when restricting to pre-Katrina homeowners individuals, homeownership was unchanged in the long run when comparing residents inside and outside the GO Zone. These dynamics may

[22] Since GO Zone residents may be replacing older lower-debt cars with newer higher-debt cars, their net automobile wealth may be unchanged.

suggest an (unobserved) drop in GO Zone home prices. Moreover, GO Zone residents experienced large short- and long-term declines in rates of home insolvency (around 1.5 percentage points) and foreclosure (around 0.8 percentage points), each of which constitutes a 25-40 percent decline in their prevalence. Insurance programs, then, were extremely (and over-) successful in mitigating the potential long-term effects of Hurricane Katrina on homeownership (as experienced by inundated residents of New Orleans), instead yielding substantial and statistically significant benefits to individuals impacted by the storm.

Unlike in the case of inundated New Orleans residents, we find no statistically-significant evidence of a change in long-term household size among GO Zone residents caused by Hurricane Katrina, though the proportion of partnerships appears to temporarily fall just after the hurricane. We find some evidence that Hurricane Katrina decreases the likelihood of parental coresidence among GO Zone residents in the short-term (by around 0.3 percentage points), another indication of the minimal economic stress faced by those residents.

One possible extrapolation of the findings presented above is that individuals residing on the periphery of the GO Zone, who likely faced minimal damage from Hurricane Katrina but were nevertheless eligible for governmental support as GO Zone residents, were able to leverage their geographic position to obtain substantial financial gains, while those on the GO Zone's interior experienced minimal net benefits. In order to test this hypothesis, we restrict our sample to residents of GO Zone counties less than twenty-five miles away from a county outside the GO Zone (centroid to centroid), along with the parallel control group (residents of non-GO Zone counties within 25 miles of a GO Zone county). We then conduct our analysis on this 40-mile-wide band around the boundary of the Hurricane Katrina GO Zone (containing 17.8 percent of GO Zone residents). While the complete output from that analysis is available in the Appendix, along with the output from alternative specifications (15- and 35-mile bandwidths), Figure 10 summarizes our findings. In particular, while Hurricane Katrina increased credit scores, decreased insolvency, and increased consumer credit balances among peripheral GO Zone residents, the magnitudes are similar to those estimated for the GO Zone as a whole, suggesting that peripheral residents cannot wholly account for the regional financial impact presented above. However, the peripheral GO Zone residents experienced no increase in auto balances–likely because their cars were very unlikely to have been damaged by the distant storm–and no increase in homeownership, suggesting that these effects must have been largely driven by residents closer to the GO Zone's interior.

Appendix Figures A7-A12 and Appendix Tables A1-A3 show Hurricane Katrina's effect on GO Zone outcomes by subpopulation. Youths tend to benefit more from GO Zone residence than elderly residents, with the latter group failing to obtain any long-run increase in consumer debt or homeownership. The same dynamic is true for lower-income GO Zone residents, who obtain statistically-significant increases in consumer debt and homeownership and decreases in parental coresidence (unlike higher-income residents). Outcomes for the residents of white and black neighborhoods are broadly similar and differences statistically-insignificant, though residents of white GO Zone neighborhoods receive a decline in consumer debt insolvency nor shared by residents of

black neighborhoods.

7 Post-Katrina Mobility

In the previous two sections, we have focused our analysis on two central populations that were directly impacted by Hurricane Katrina. In this section, we specifically consider the subset of New Orleans residents who evacuated the city following the storm, examining their migration decisions geographically. According to the US Census, nearly half of pre-Katrina New Orleans residents no longer resided in (or had not yet returned to) that city two years after the storm (Vigdor 2008). Analysis of the CPS shows that, of all Hurricane Katrina evacuees who had not returned to their county of residence by the end of 2006, the largest proportion of them had moved to Texas, followed by Louisiana and then other states in the American south-east (Groen and Polivka 2008). Figure 11 extends that analysis by mapping the location of the 11 percent of all pre-Katrina New Orleans metropolitan area residents who had fled New Orleans within a year of Hurricane Katrina and remained outside of New Orleans in 2016, ten years after the storm.[23] By that year, around 13,000 New Orleans evacuees who had not returned to the city of New Orleans lived in Texas, with another 12,000 in Louisiana and more than 1,000 evacuees living in each of six other southern states, in addition to California.[24]

In order to estimate the geographic impact of Hurricane Katrina on inundated residents of New Orleans, we extend our model above to estimate the increased likelihood with which inundated residents migrated to each of the 50 states. Since we focus on outmigration of those living in New Orleans at the time of the storm, we must compress our analysis to a single difference, estimating the presence M_{sit} of pre-Katrina residents in each state s and time t using a linear probability model of pre-Katrina socioeconomic characteristics and an inundation indicator:

$$M_{sit} = \alpha_{0st} + K_i\phi_{st} + \sum_{\tau \in [2002,2005] \cap \mathbb{Z}} X_{it}\alpha_{1\tau t} + \epsilon_{it}$$

estimated using weighted least squares with the same propensity score weights as used above and clustering errors by Census Block. While the unavailability of an estimate of pre-hurricane differences in long-run outmigration by inundation limits these estimates' causal interpretation, the extensive financial control variables and propensity weights should absorb most relevant pre-hurricane differences. We estimate effects one, five, and ten years following Hurricane Katrina, without restricting the sample to individuals who evacuated New Orleans immediately after the storm.

Table 6 shows the proportion of pre-Katrina New Orleans residents living in each of the top

[23] About 23 percent of 2005 New Orleans residents no longer lived in New Orleans in 2016, unconditional on evacuating the city between 2005 and 2006. The percent is calculated as a fraction of all individuals who remain in the CCP in 2016; see Section 3.

[24] For analysis of the impact of these evacuees on the local economies to which they relocated, focusing on the city of Houston, see McIntosh (2008) and De Silva *et al* (2010).

ten states to which they migrated one, five, and ten years after the storm, along with the estimated increased likelihood with which inundated residents moved to that state (in brackets). One year after the storm, Texas was by far the most likely state for New Orleans evacuees to reside in (as previously shown using the CPS; see, e.g., McIntosh (2008)), with 6.5 percent of New Orleans residents having shifted their permanent address to that state. Inundated residents appear more than 50 percent more likely to migrate to Texas, Georgia, Mississippi, Alabama, and Louisiana (excluding Orleans Parish) than non-inundated residents within a year after the storm, and remained more than 30 percent more likely to have migrated to those states even ten years after the storm (by which time 8.6 percent of pre-Katrina New Orleans residents lived in Texas). Interestingly, inundated residents appear significantly less likely to have moved to distant states like North Carolina and New York ten years after Hurricane Katrina than non-inundated residents, and indeed were 33 percent less likely to have moved to any New England or Mid-Atlantic state (statistically significant at 1 percent), perhaps another indicator of the long-term economic stress faced by inundated residents (even conditional on outmigration).

8 Conclusion

This study examines the net intensive impact of Hurricane Katrina on inundated residents of New Orleans, the hurricane's net extensive impact on a large federally-insured region surrounding New Orleans, the breadth of those impacts across demographic groups, and the migration outcomes of New Orleans residents in the ten years following the storm. Each of these measured outcomes can be interpreted as the result of a large set of federal, state, and local policies implemented to insure the 'geographically-unlucky' residents of the Gulf Coast following an unusually-damaging hurricane.

We find mixed evidence of these policies in New Orleans, with inundated residents having achieved similar levels of financial distress and household size ten years after the hurricane, but also find that inundated residents maintain lower credit scores and homeownership rates–and are far less likely to remain in New Orleans–than their non-inundated neighbors. Outside of New Orleans, we find substantial evidence of over-insurance, with program-eligible residents enjoying higher consumption and homeownership but far lower rates of bankruptcy and foreclosure ten years after the storm (despite facing more direct hurricane damage than the more-distant comparison group). These effects appear to have been magnified by the Great Recession, with Gulf Coast residents appearing to enjoy effective 'recession insurance' in the name of hurricane insurance in the late 2000s. While older, higher-income, and white residents of New Orleans were more likely to evacuate the city following the storm, we find little evidence of differential policy treatment by race within New Orleans, and find that the broader region's over-insurance most benefited younger and lower-income residents. Finally, we find that inundated New Orleans residents who have moved out of the city were more likely to remain in Louisiana and the surrounding states, while non-inundated residents were more likely to move to the Northeast, suggesting that mobility may

not have provided substantial long-run benefits to inundated residents.

Our study shares a number of limitations with earlier studies. Our intensive and extensive analysis is unable to separately identify common or spillover effects, the presence of which would downwardly bias our estimates. Our subpopulation analysis estimates marginal within-group effects of the hurricane, with data limitations prohibiting the identification of cross-group differences in the hurricane's impact (despite their being of substantial policy interest, especially regarding race). Since we do not observe residents' program-specific eligibility or participation, we cannot identify the treatment effect of individual post-Katrina policies. Perhaps most pressingly, we are unable to define the welfare impact of the storm or its subsequent policy response, instead only observing a large number of social and financial indicators that provide proxies for Gulf Coast residents' post-hurricane welfare. We leave the resolution and transcendence of these limitations to future research.

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Table 1: Pre-Katrina Sample Characteristics and Inverse Propensity Weights

	New Orleans					Five States				
		Unweighted		Weighted			Unweighted		Weighted	
	Overall	Treated	Untreated	Treated	Untreated	Overall	Treated	Untreated	Treated	Untreated
State Change (3 Years)	.11	.11	.11	.112	.11	.11	.102	.113*	.111	.11
County Change (3 Years)	.224	.224	.224	.228	.225	.258	.241	.267*	.263	.259†
Address Change (3 Years)	.392	.399	.387†	.395	.392	.449	.438	.455*	.452	.45
Credit Score	656	633	668*	656	656	663	658	666*	663	663
Subprime Credit Score	.459	.554	.405*	.456	.459	.422	.442	.412*	.422	.422
Homeownership	.246	.213	.266*	.245	.246	.277	.269	.28*	.277	.277
Home Balance	16201	14086	17484*	16477	16329	17283	15920	17928*	17781	17308
Has Derog. Home	.0175	.0248	.0139*	.0179	.0179	.0125	.0137	.012†	.0127	.0126
Has Auto	.228	.192	.25*	.228	.228	.291	.278	.297*	.291	.291
Auto Balance	2697	2266	2959*	2682	2693	3685	3580	3734*	3698	3688
Has Derog. Auto	.0117	.0125	.0113	.0116	.0118	.0153	.0153	.0153	.0154	.0153
Has Consumer Debt	.508	.452	.542*	.511	.509	.524	.513	.53*	.524	.524
Consumer Balance	2633	2325	2819*	2666	2638	2912	2810	2960*	2928	2912
Has Derog. Consumer Debt	.106	.122	.0966*	.105	.106	.0992	.103	.0973*	.0991	.0992
Consumer Derog. Balance	316	324	311	309	315	355	352	356	353	354
Household Size	2.84	2.86	2.83†	2.84	2.84	2.73	2.78	2.71*	2.73	2.73
Live Alone	.192	.208	.182*	.193	.192	.192	.189	.193†	.192	.192
Live with Partner	.301	.279	.315*	.302	.301	.343	.328	.35*	.343	.343
Bankruptcy Rate	.0174	.0173	.0175	.0171	.0173	.0183	.0172	.0188*	.0183	.0183
Foreclosure Rate[a]	.0187	.029	.0137*	.0186	.0187	.0135	.0142	.0132	.0136	.0136
Number of Observations	38640	14584	24056	14583	24053	456267	146557	309710	146553	309705

Weighted and unweighted average values by group and treatment. Inverse propensity weights generated from first-stage logit; see paper. T-tests by treatment (inundation or within GO Zone); * 1%, † 5%. Source: FRBNY Consumer Credit Panel.

[a] Foreclosure rate is conditional on homeownership.

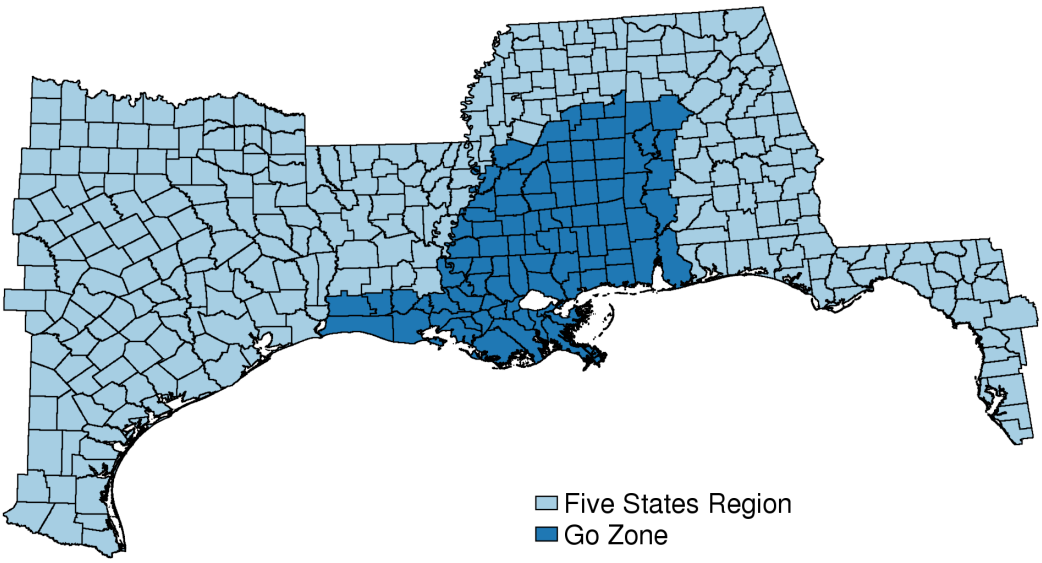
Table 2: Sample Characteristics Pre-Katrina by Demographic Group

	New Orleans						Five States					
	By Age		By Income		By Race		By Age		By Income		By Race	
	18–40	60+	Low	High	White	Black	18–40	60+	Low	High	White	Black
Address Change (3 Years)	.608	.386*	.518	.376*	.437	.407*	.552	.322*	.445	.315*	.35	.395*
State Change (3 Years)	.175	.0941*	.116	.0985*	.119	.0947*	.194	.0764*	.111	.0897*	.0982	.102*
County Change (3 Years)	.361	.263*	.251	.245*	.255	.226*	.329	.221*	.215	.212*	.199	.224*
Credit Score	618	723*	540	782*	691	600*	610	712*	539	783*	706	600*
Subprime Credit Score	.588	.197*	1	0	.31	.692*	.63	.245*	1	0	.248	.698*
Homeownership	.23	.163*	.188	.288*	.33	.147*	.179	.151*	.171	.253*	.309	.167*
Home Bal.	16576	7345*	9759	19020*	21659	5566*	13710	6421*	9034	15979*	21854	7169*
Has Derog. Home	.0159	.00666*	.0564	0*	.00879	.0253*	.0201	.013*	.0745	0*	.00765	.0364*
Has Auto	.344	.141*	.327	.199*	.307	.201*	.267	.109*	.256	.15*	.249	.184*
Auto Bal.	4050	1502*	3534	2372*	3748	2146*	3042	1145*	2725	1688*	2911	2010*
Has Derog. Auto	.0242	.00471*	.0499	0*	.0113	.0247*	.0168	.00343*	.0333	0*	.00543	.0176*
Has Consumer Debt	.653	.476*	.718	.516*	.667	.496*	.602	.462*	.659	.49*	.68	.493*
Consumer Bal.	2972	2113*	3522	1926*	3817	2095*	2536	2024*	2916	1820*	3814	2035*
Has Derog. Consumer Debt	.191	.062*	.439	0*	.105	.228*	.186	.068*	.406	0*	.0787	.216*
Derog. Consumer Bal.	397	186*	1114	.148*	299	449*	369	171*	926	.0010*	222	419*
Household Size	2.83	2.72*	2.95	2.63*	2.64	3.14*	2.86	2.82*	2.96	2.7*	2.73	3.01*
Live Alone	.199	.205*	.205	.191*	.174	.204*	.211	.188*	.208	.188*	.163	.195*
Live with a Partner	.316	.345*	.274	.386*	.385	.239*	.281	.311*	.257	.345*	.353	.251*
Bankruptcy Rate	.0174	.00962*	.0353	.00109*	.0182	.0175	.0187	.00792*	.0346	.0010*	.0137	.0199
Foreclosure Rate[a]	.0157	.00894*	.0583	0*	.0101	.0321*	.0205	.0151*	.0745	0*	.00743	.0385*
Observations	692373	700352	626980	913502	1105712	154481	12525	12251	12887	15300	14361	11519

Unweighted average values by group and subgroup. High (low) income is defined as being in the top (bottom) Equifax riskscore tercile, with break point at 735 (610). Race is defined as individuals living in Census blocks in which, as of the 2000 Census, at least 75 percent of residents were white or black. T-tests within subgroups; * 1%, † 5%. Source: FRBNY Consumer Credit Panel.

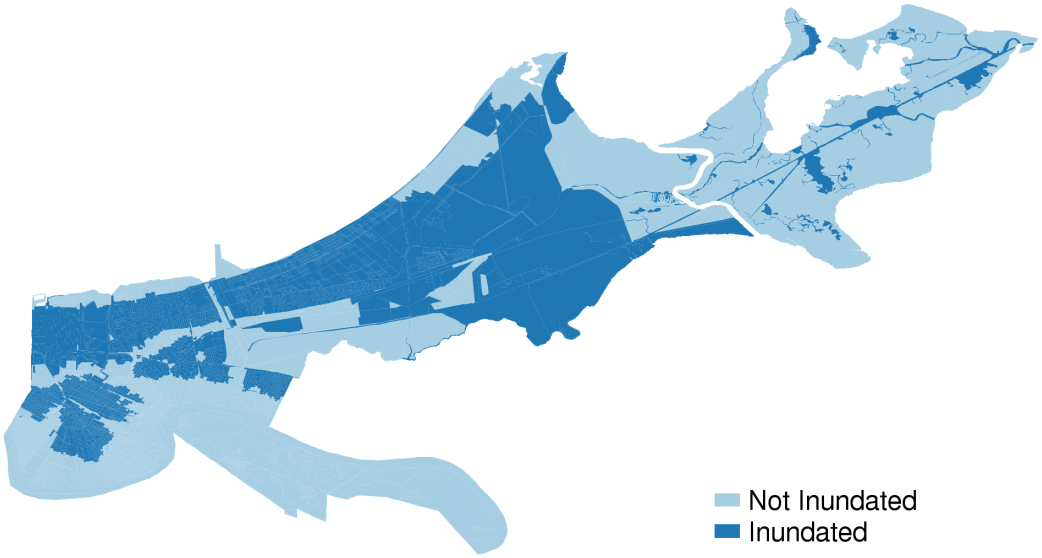
[a] Foreclosure rate is conditional on homeownership.

Figure 1a: GO Zone in the Five States Region, by County



The 'Five States' region includes the portions of Texas, Louisiana, Mississippi, Alabama, and Florida within four degrees longitude of the Gulf Opportunity (GO) Zone defined by the GO Zone Act of 2005. The region includes 401 counties, about 20 percent of which were in the GO Zone. Source: The Gulf Opportunity Zone Act of 2005.

Figure 1b: Inundation Region of Orleans Parish, by Census Tract

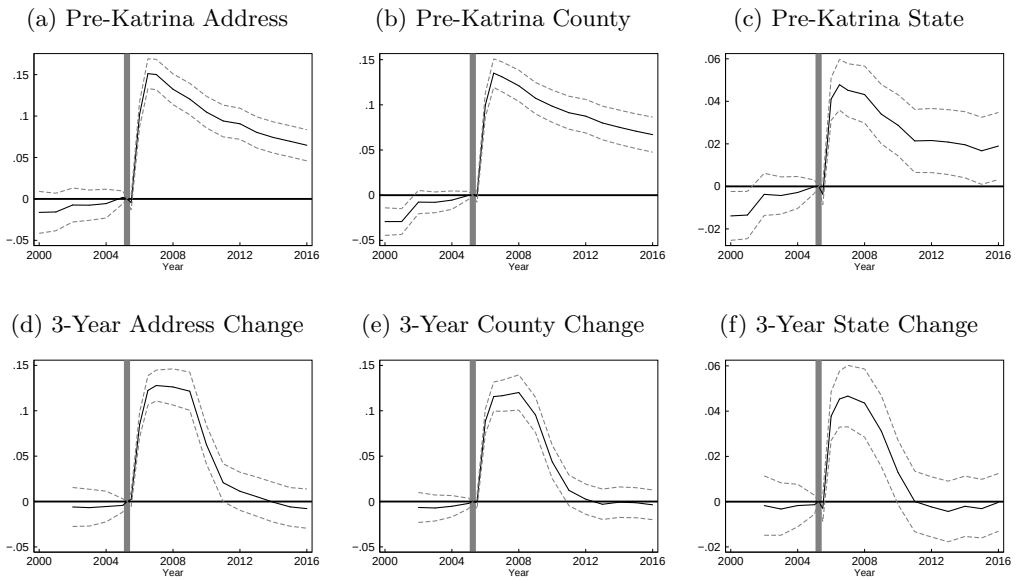


For reference, the most-populous area of Orleans Parish is the western portion of the city, directly below Lake Pontchartain and above the Mississippi River. In 2005, there were about 7,200 Census Blocks in New Orleans, half of which were inundated. Source: GCR and Associates, Inc.; available from RAND.

Figure 2: Income and Consumption Outcomes, New Orleans

Event study effects around Hurricane Katrina. Standard errors clustered by Census tract. Credit Score measures an individual's Equifax risk score, which is comparable to a FICO credit score. Consumer debt includes credit and bank cards, retail debt, and consumer finance debt. A loan is insolvent if it is more than 90 days past due. Bankruptcy indicates chapter 7 and 11 filings in the past three years. Source: FRBNY Consumer Credit Panel.

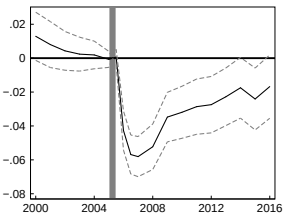
Figure 3: Mobility Outcomes, New Orleans



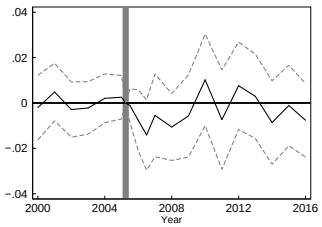
Event study effects around Hurricane Katrina. Standard errors clustered by Census tract. Top three figures show the likelihood of having a different residence location than that of June 30 2005, while the bottom three figures show the likelihood of having changed residence locations in the previous three years. Source: FRBNY Consumer Credit Panel.

Figure 4: Homeownership Outcomes, New Orleans

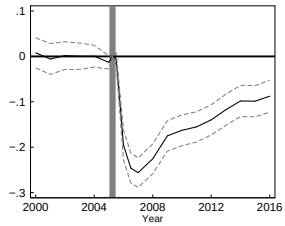
(a) Homeownership



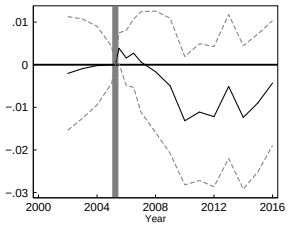
(b) Home Insolvency



(c) Homeownership (Condit. on Pre-Pre-Katrina Owner)



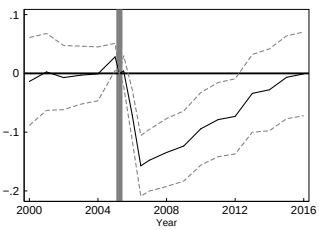
(d) Foreclosure (Condit. on Pre-Katrina Owner)



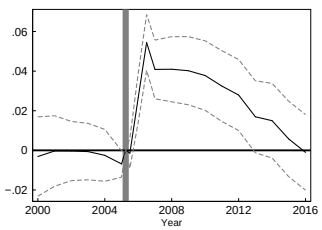
Event study effects around Hurricane Katrina. Standard errors clustered by Census tract. Homeownership is defined as having an active mortgage. Home insolvency and foreclosure are conditional on homeownership. A loan is insolvent if it is more than 90 days past due. Conditional homeownership restricts the sample to June 30 2005 homeowners.The foreclosure indicator indicates having foreclosed on a mortgage in the past three years. Source: FRBNY Consumer Credit Panel.

Figure 5: Household Composition Outcomes, New Orleans

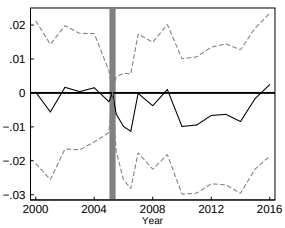
(a) Adults in Household



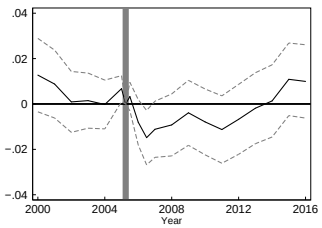
(b) Only Adult



(c) Partnership



(d) Live with Parents



Event study effects around Hurricane Katrina. Standard errors clustered by Census tract. Adults in household includes all individuals covered by Equifax (see the paper). Partnership is defined as living with only one additional covered individual. Parental co-residence is defined as living with at least one individual between 16 and 45 years older. Source: FRBNY Consumer Credit Panel.

Table 3: Treatment Heterogeneity by Age in New Orleans

Outcome	One Year After			Five Years After			Ten Years After		
	18-40	60+	p-Value	18-40	60+	p-Value	18-40	60+	p-Value
Consumer Bal.	-114.304	-33.852	0.521	-226.086	267.8	0.045	-278.287	143.4	0.187
	(94.1)	(82.7)		(166.5)	(181.0)		(206.2)	(244.4)	
Derog. Consumer Bal.	48.70	45.22	0.922	2.43	38.40	0.626	22.77	34.38	0.865
	(25.9)	(24.6)		(56.5)	(47.5)		(49.3)	(47.7)	
Change County, Ever	0.069	0.108	0.015	0.048	0.148	0.000	0.014	0.130	0.000
	(0.01)	(0.01)		(0.01)	(0.01)		(0.01)	(0.02)	
County Change (3 Years)	0.044	0.098	0.001	-0.004	0.001	0.827	-0.010	-0.017	0.749
	(0.01)	(0.01)		(0.02)	(0.01)		(0.02)	(0.01)	
Live with a Partner	-0.000	-0.020	0.325	-0.020	-0.008	0.646	0.001	-0.010	0.705
	(0.01)	(0.01)		(0.02)	(0.02)		(0.02)	(0.02)	
Homeownership	-0.024	-0.032	0.499	-0.010	-0.014	0.838	-0.022	-0.000	0.315
	(0.01)	(0.01)		(0.01)	(0.01)		(0.01)	(0.02)	
Credit Score	-4.091	-8.840	0.027	-7.536	-5.233	0.536	-10.467	-2.287	0.063
	(1.5)	(1.6)		(2.4)	(2.8)		(2.6)	(3.5)	

Within-subgroup event study estimates of the impact of Hurricane Katrina on the stated outcome one, five, and ten years after the storm. Subgroups defined by individual's years of birth. Standard errors clustered by county. P-values from pairwise t-tests assuming independence across subgroup. Source: FRBNY Consumer Credit Panel.

Table 4: Treatment Heterogeneity by Credit Score in New Orleans

Outcome	One Year After			Five Years After			Ten Years After		
	Low CS	High CS	p-Value	Low CS	High CS	p-Value	Low CS	High CS	p-Value
Consumer Bal.	49.18	-16.320	0.591	-35.523	-107.652	0.756	27.52	-32.195	0.841
	(78.4)	(93.3)		(152.0)	(175.9)		(189.4)	(230.6)	
Derog. Consumer Bal.	41.59	8.31	0.363	-20.010	-13.517	0.921	-29.746	7.05	0.569
	(35.5)	(8.9)		(60.3)	(24.5)		(58.9)	(26.3)	
Change County, Ever	0.046	0.153	0.000	0.055	0.119	0.001	0.027	0.099	0.001
	(0.01)	(0.01)		(0.01)	(0.01)		(0.01)	(0.01)	
County Change (3 Years)	0.045	0.130	0.000	0.012	-0.001	0.499	-0.009	-0.020	0.564
	(0.01)	(0.01)		(0.01)	(0.01)		(0.01)	(0.01)	
Live with a Partner	-0.005	-0.038	0.068	-0.003	-0.028	0.312	0.018	-0.009	0.293
	(0.01)	(0.01)		(0.02)	(0.02)		(0.02)	(0.02)	
Homeownership	-0.015	-0.054	0.002	-0.009	-0.052	0.014	0.002	-0.034	0.074
	(0.01)	(0.01)		(0.01)	(0.01)		(0.01)	(0.02)	
Credit Score	-2.764	-8.465	0.003	-0.421	-5.924	0.053	-3.524	-3.535	0.997
	(1.4)	(1.4)		(2.3)	(1.7)		(2.6)	(2.0)	

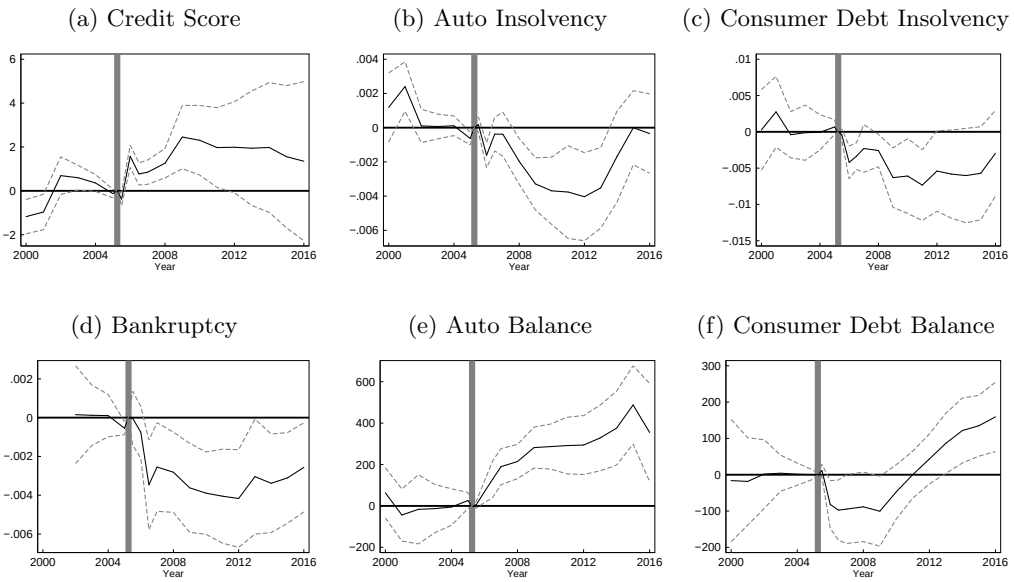
Within-subgroup event study estimates of the impact of Hurricane Katrina on the stated outcome one, five, and ten years after the storm. Subgroups defined by Equifax risk score terciles in 2005 New Orleans (high-income is the top tercile; low-income is the bottom tercile). Standard errors clustered by Census tract. P-values from pairwise t-tests assuming independence across subgroup. Source: FRBNY Consumer Credit Panel.

Table 5: Treatment Heterogeneity by Race in New Orleans

Outcome	One Year After			Five Years After			Ten Years After		
	White	Black	p-Value	White	Black	p-Value	White	Black	p-Value
Consumer Bal.	-77.737	-70.388	0.973	-104.695	77.26	0.669	163.7	242.0	0.885
	(204.2)	(63.3)		(395.8)	(155.2)		(506.6)	(190.4)	
Derog. Consumer Bal.	-18.876	28.70	0.228	-52.239	-47.945	0.961	-119.342	22.10	0.054
	(31.5)	(23.7)		(71.5)	(50.0)		(58.1)	(44.8)	
Change County, Ever	0.238	0.043	0.000	0.195	0.086	0.000	0.152	0.066	0.004
	(0.02)	(0.01)		(0.03)	(0.01)		(0.03)	(0.01)	
County Change (3 Years)	0.177	0.043	0.000	0.051	0.020	0.402	0.003	0.002	0.950
	(0.02)	(0.01)		(0.04)	(0.01)		(0.02)	(0.01)	
Live with a Partner	-0.029	-0.010	0.465	-0.030	-0.006	0.425	0.020	0.007	0.679
	(0.02)	(0.01)		(0.03)	(0.02)		(0.03)	(0.02)	
Homeownership	-0.046	-0.030	0.351	-0.018	-0.012	0.797	-0.017	0.011	0.294
	(0.01)	(0.01)		(0.02)	(0.01)		(0.02)	(0.01)	
Credit Score	-5.082	-3.748	0.562	-1.425	0.741	0.567	0.946	-1.018	0.664
	(1.8)	(1.4)		(3.0)	(2.3)		(3.8)	(2.4)	

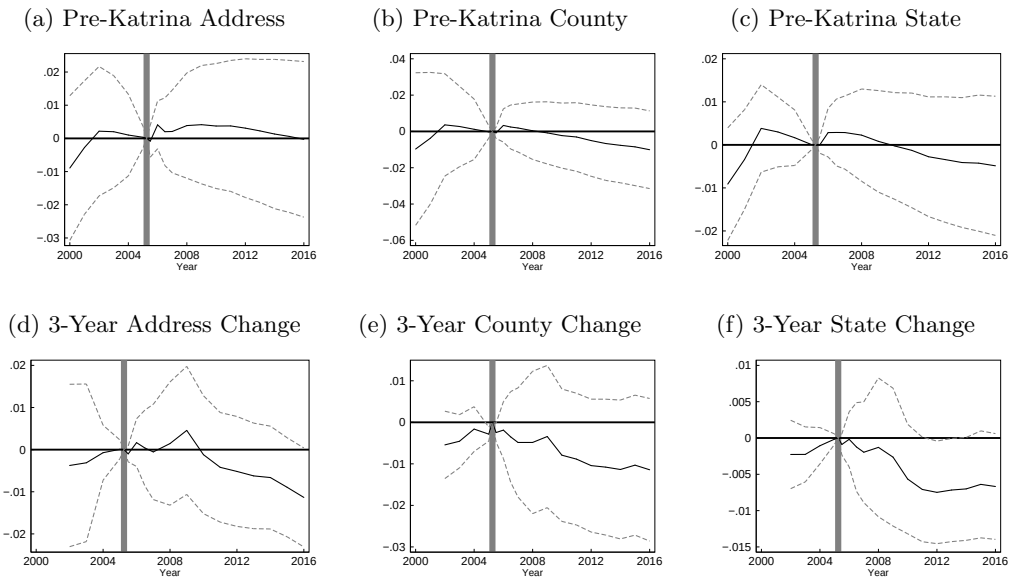
Within-subgroup event study estimates of the impact of Hurricane Katrina on the stated outcome one, five, and ten years after the storm. Subgroups defined by individuals' neighborhoods: an individual is assumed to be of a certain race if 75 percent of individuals who resided in their 2005 Census block belonged to that race (as of the 2000 Census). Standard errors clustered by Census tract. P-values from pairwise t-tests assuming independence across subgroup. Source: FRBNY Consumer Credit Panel.

Figure 6: Income and Consumption Outcomes, Five States Region



Event study effects around Hurricane Katrina. Standard errors clustered by county or parish. Credit Score measures an individual's Equifax risk score, which is comparable to a FICO credit score. Consumer debt includes credit and bank cards, retail debt, and consumer finance debt. A loan is insolvent if it is more than 90 days past due. Bankruptcy indicates chapter 7 and 11 filings in the past three years. Source: FRBNY Consumer Credit Panel.

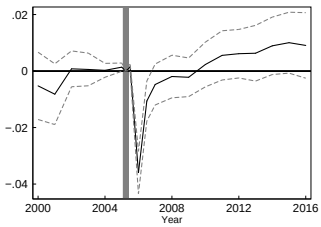
Figure 7: Mobility Outcomes, Five States Region



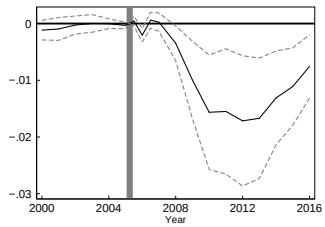
Event study effects around Hurricane Katrina. Standard errors clustered by county or parish. Top three figures show the likelihood of having a different residence location than that of June 30 2005, while the bottom three figures show the likelihood of having changed residence locations in the previous three years. Source: FRBNY Consumer Credit Panel.

Figure 8: Homeownership Outcomes, Five States Region

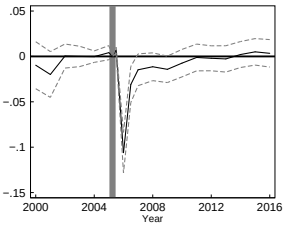
(a) Homeownership



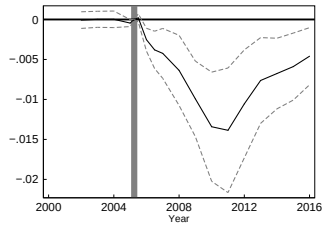
(b) Home Insolvency



(c) Homeownership (Condit. on Owned)



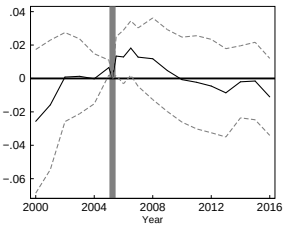
(d) Foreclosure (Condit. on Owned)



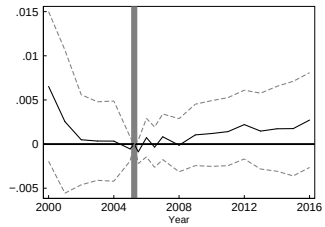
Event study effects around Hurricane Katrina. Standard errors clustered by Census tract. Homeownership is defined as having an active mortgage. Home insolvency and foreclosure are conditional on homeownership. A loan is insolvent if it is more than 90 days past due. Conditional homeownership restricts the sample to June 30 2005 homeowners.The foreclosure indicator indicates having foreclosed on a mortgage in the past three years. Source: FRBNY Consumer Credit Panel.

Figure 9: Household Composition Outcomes, Five States Region

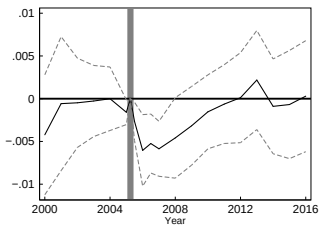
(a) Adults in Household



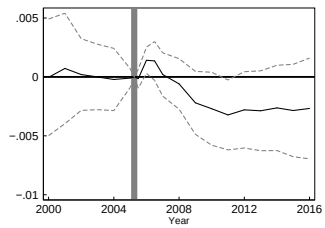
(b) Only Adult



(c) Partnership

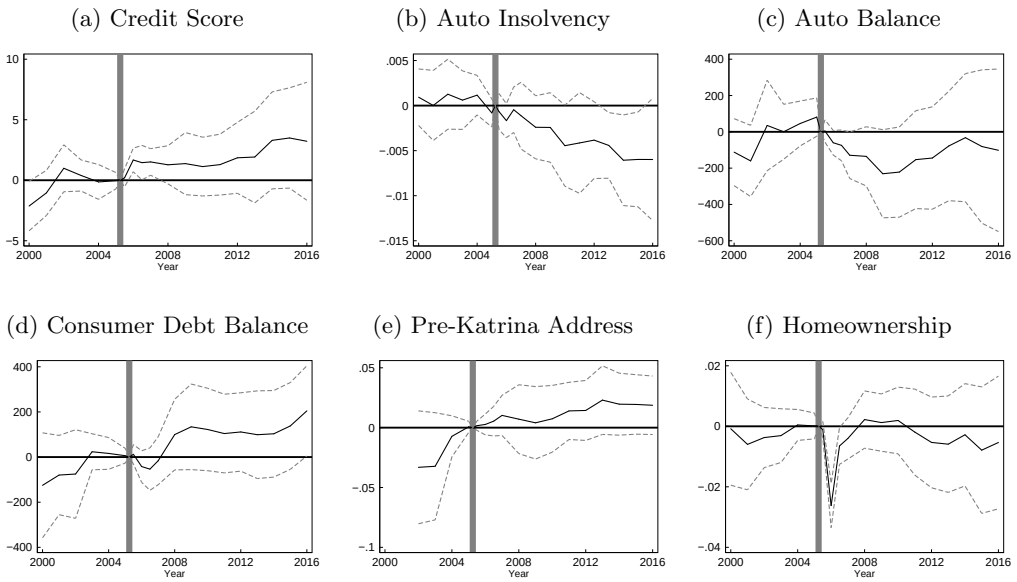


(d) Live with Parents



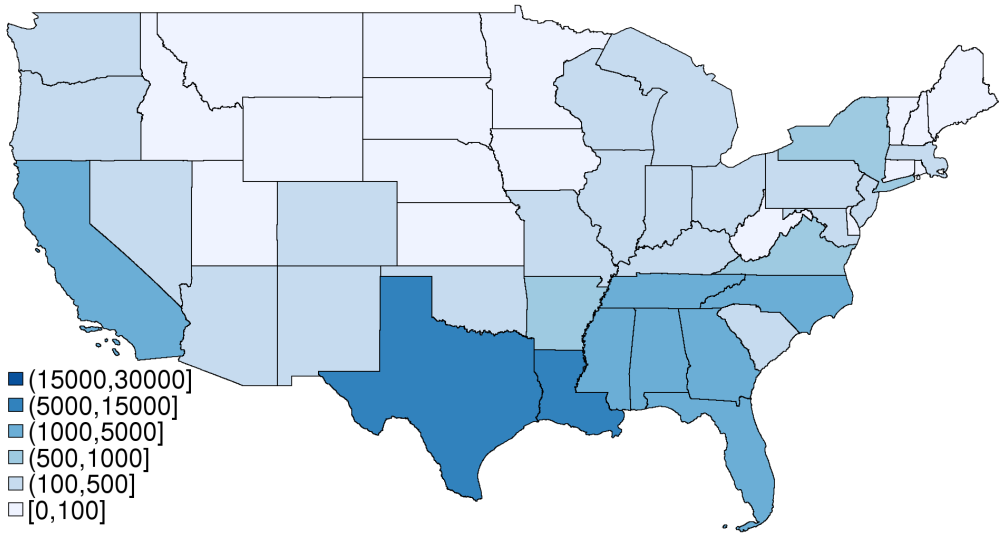
Event study effects around Hurricane Katrina. Standard errors clustered by county or parish. Adults in household includes all individuals covered by Equifax (see the paper). Partnership is defined as living with only one additional covered individual. Parental co-residence is defined as living with at least one individual between 16 and 45 years older. Source: FRBNY Consumer Credit Panel.

Figure 10: Outcomes Along the Outer Border of the GO Zone



Event study effects around Hurricane Katrina. Standard errors clustered by county or parish. Sample defined as non-Go-Zone (Go Zone) counties or parishes with centroids within 25 miles of the centroid of a county or parish (not) in the Go Zone. See series-specific notes above. Source: FRBNY Consumer Credit Panel.

Figure 11: Residence States of Hurricane Katrina Evacuees from New Orleans, March 2016



State map displaying the estimated number New Orleans evacuees living in each state (outside of New Orleans) ten years after Hurricane Katrina. Evacuees are those who resided in New Orleans immediately prior to the hurricane but outside New Orleans one year later. Source: FRBNY Consumer Credit Panel.

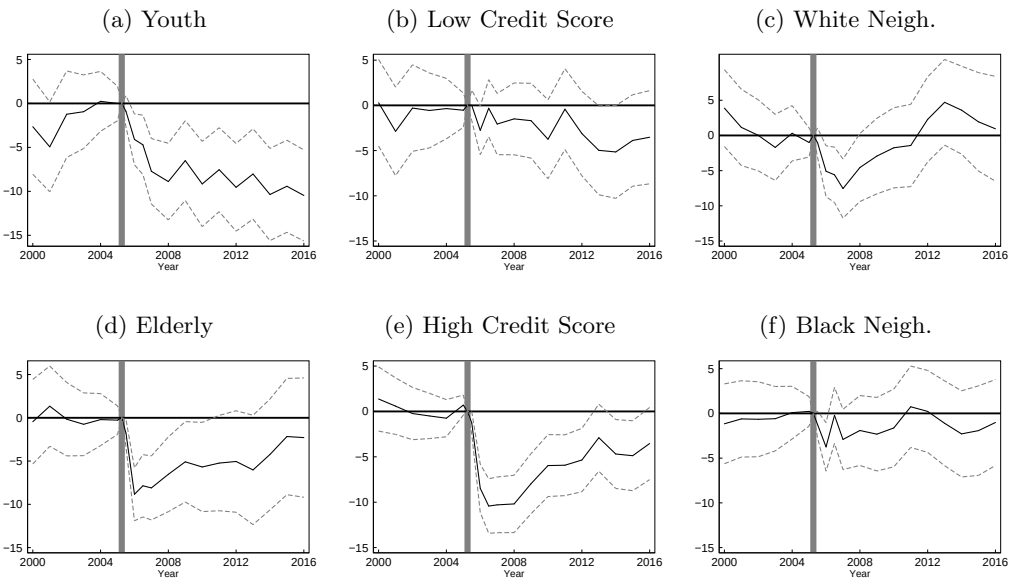
Table 6: Migration Destinations from New Orleans after Hurricane Katrina

One Year After		Five Years After		Ten Years After	
State	Percent Mig.	State	Percent Mig.	State	Percent Mig.
Texas	6.5% **[61%*]**	Texas	8.0% **[39%*]**	Texas	8.6% **[32%*]**
Louisiana	4.7% **[97%*]**	Louisiana	5.4% **[80%*]**	Louisiana	5.5% **[66%*]**
Georgia	2.0% **[81%*]**	Georgia	2.1% **[51%*]**	Georgia	2.1% **[65%*]**
Mississippi	0.97% **[81%*]**	Mississippi	1.2% **[54%*]**	Mississippi	1.2% **[36%†]**
Florida	0.73% **[-5%]**	Florida	0.97% **[-17%]**	Florida	1.1% **[-15%]**
California	0.71% **[12%]**	California	0.97% **[-11%]**	California	1.0% **[-11%]**
Alabama	0.45% **[151%*]**	Tennessee	0.66% **[-8%]**	Tennessee	0.64% **[-10%]**
Tennessee	0.44% **[39%]**	Alabama	0.62% **[70%*]**	Alabama	0.61% **[43%]**
N. Carolina	0.32% **[-35%]**	N. Carolina	0.51% **[-41%†]**	N. Carolina	0.49% **[-44%*]**
Virginia	0.29% **[-22%]**	New York	0.47% **[-32%]**	New York	0.45% **[-42%*]**

Top ten destination states of New Orleans migrants one, five, and ten years after Hurricane Katrina. The estimated increased likelihood of inundated New Orleans residents migrating to each state is included in brackets (single-difference event study coefficient divided by non-inundated average in that year, with standard errors for the former clustered by Census tract). Time periods are September 2006, March 2011, and March 2016. Louisiana excludes New Orleans. * $p < 0.01$, † $p < 0.05$. Source: FRBNY Consumer Credit Panel.

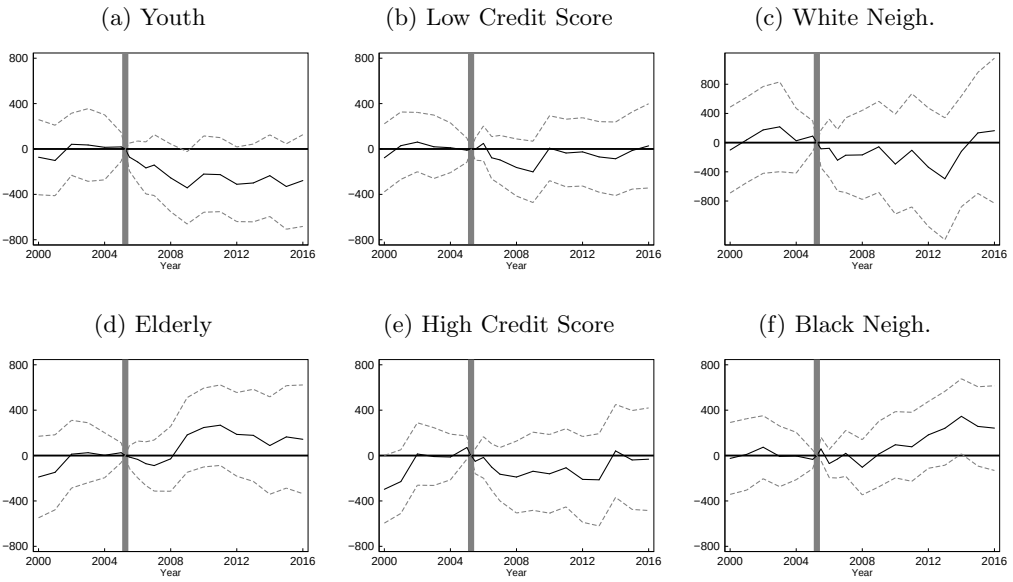
A Appendix for Online Publication

Figure A1: Heterogeneity in Credit Score Outcomes, New Orleans



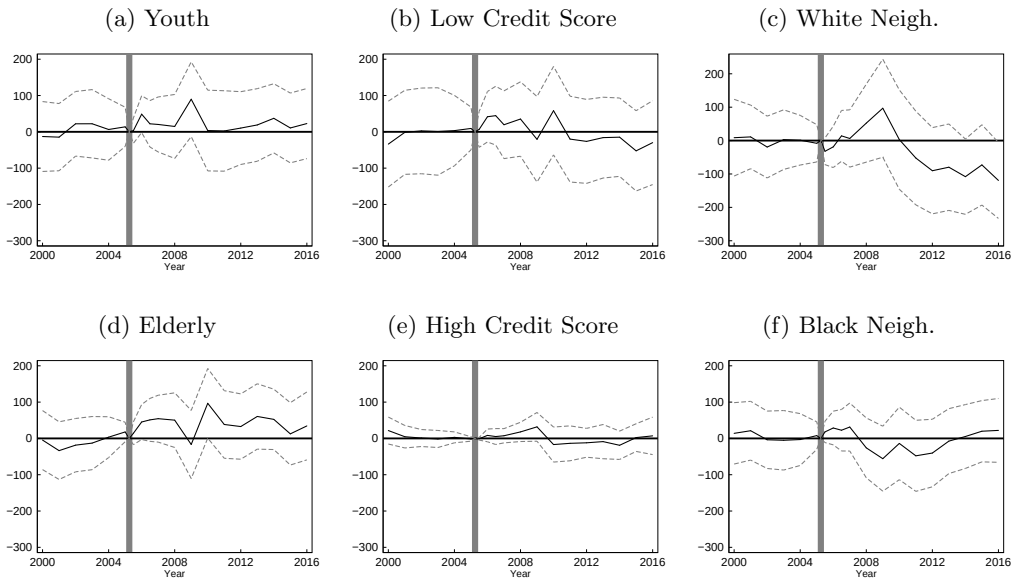
Within-subgroup event study estimates of Hurricane Katrina. Credit scores measure an individual's Equifax risk score, which is comparable to a FICO credit score. Youths age 18-40 in 2005; Elders over age 60 in 2005. High (low) credit score individuals are in the top (bottom) tercile of Equifax risk scores. Individuals live in a White or Black neighborhood if 75 percent of residents of their 2005 Census block belonged to that race (in the 2000 Census). Source: FRBNY Consumer Credit Panel.

Figure A2: Heterogeneity in Consumer Debt Balance Outcomes, New Orleans



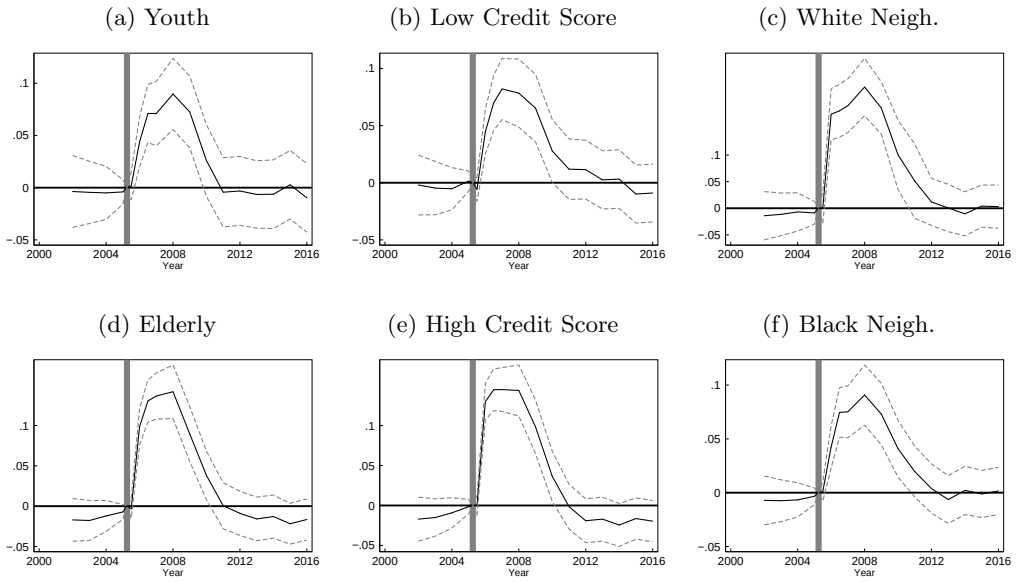
Within-subgroup event study estimates of Hurricane Katrina. Consumer debt includes credit and bank cards, retail debt, and consumer finance debt. Youths age 18-40 in 2005; Elders over age 60 in 2005. High (low) credit score individuals are in the top (bottom) tercile of Equifax risk scores. Individuals live in a White or Black neighborhood if 75 percent of residents of their 2005 Census block belonged to that race (in the 2000 Census). Source: FRBNY Consumer Credit Panel.

Figure A3: Heterogeneity in Consumer Debt Insolvency Outcomes, New Orleans



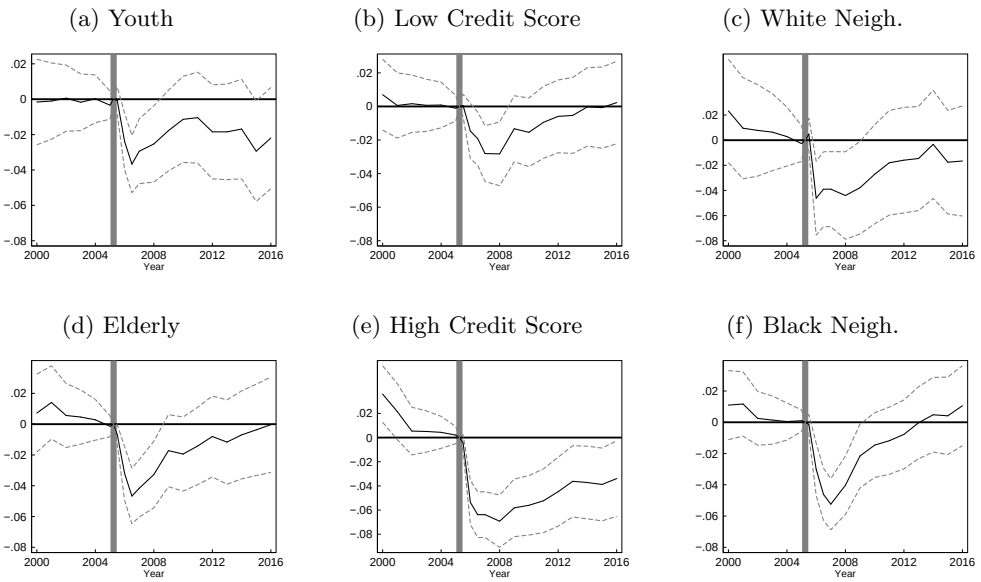
Within-subgroup event study estimates of Hurricane Katrina. Consumer debt includes credit and bank cards, retail debt, and consumer finance debt. A loan is insolvent if it is more than 90 days past due. Youths age 18-40 in 2005; Elders over age 60 in 2005. High (low) credit score individuals are in the top (bottom) tercile of Equifax risk scores. Individuals live in a White or Black neighborhood if 75 percent of residents of their 2005 Census block belonged to that race (in the 2000 Census). Source: FRBNY Consumer Credit Panel.

Figure A4: Heterogeneity in County Mobility Outcomes, New Orleans



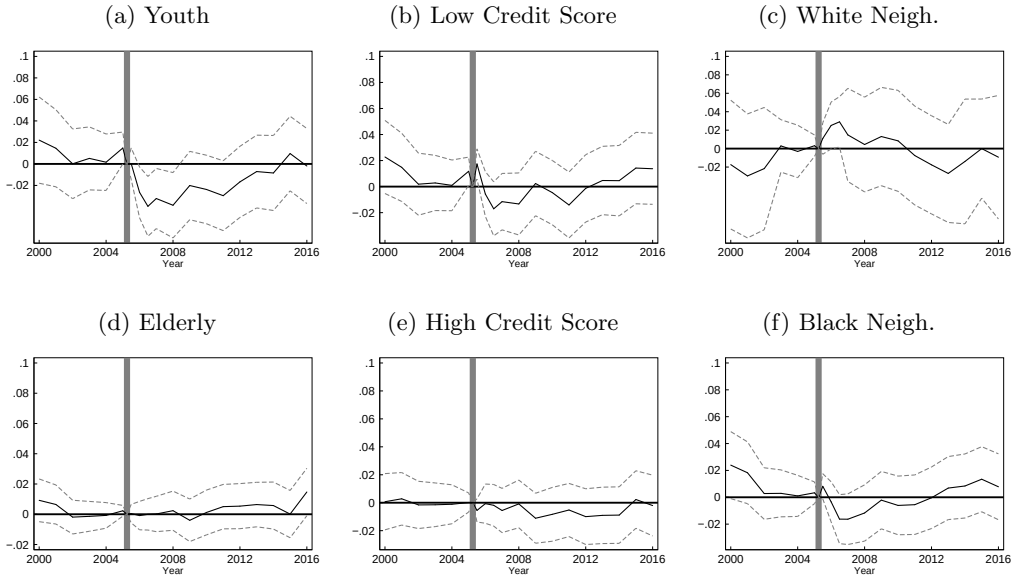
Within-subgroup event study estimates of Hurricane Katrina. County mobility indicates the likelihood of having changed counties of residence in the previous three years. Youths age 18-40 in 2005; Elders over age 60 in 2005. High (low) credit score individuals are in the top (bottom) tercile of Equifax risk scores. Individuals live in a White or Black neighborhood if 75 percent of residents of their 2005 Census block belonged to that race (in the 2000 Census). Source: FRBNY Consumer Credit Panel.Source: FRBNY Consumer Credit Panel.

Figure A5: Heterogeneity in Homeownership Outcomes, New Orleans



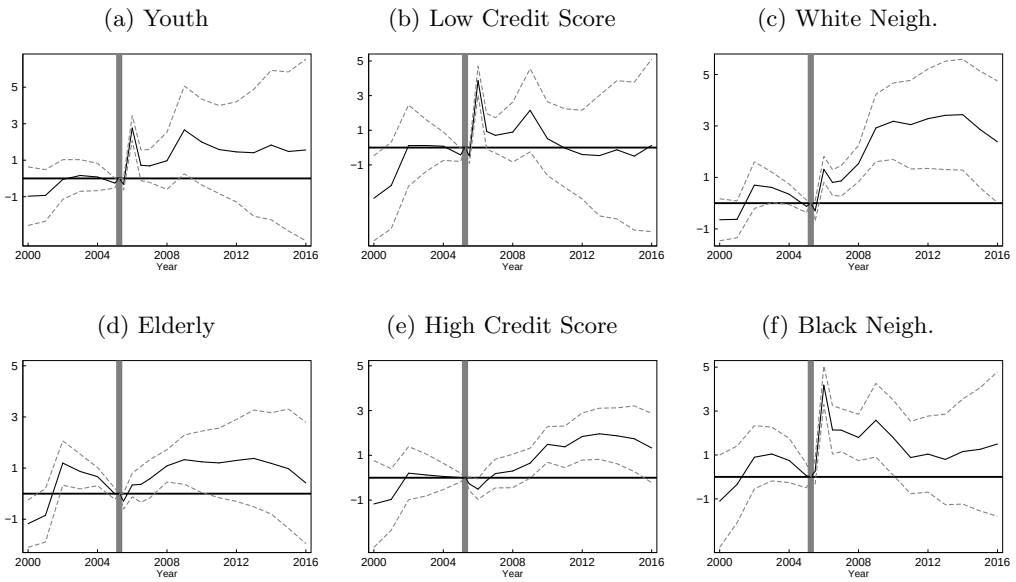
Within-subgroup event study estimates of Hurricane Katrina. Homeownership is defined as having an active mortgage. Youths age 18-40 in 2005; Elders over age 60 in 2005. High (low) credit score individuals are in the top (bottom) tercile of Equifax risk scores. Individuals live in a White or Black neighborhood if 75 percent of residents of their 2005 Census block belonged to that race (in the 2000 Census). Source: FRBNY Consumer Credit Panel.Source: FRBNY Consumer Credit Panel.

Figure A6: Heterogeneity in Parental Coresidence Outcomes, New Orleans



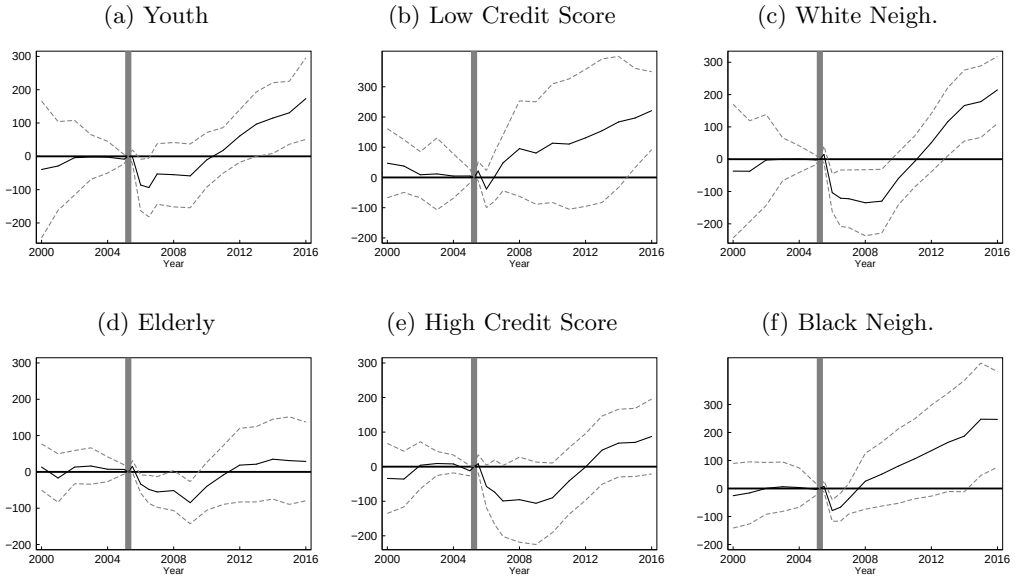
Within-subgroup event study estimates of Hurricane Katrina. Parental co-residence is defined as living with at least one individual between 16 and 45 years older. Youths age 18-40 in 2005; Elders over age 60 in 2005. High (low) credit score individuals are in the top (bottom) tercile of Equifax risk scores. Individuals live in a White or Black neighborhood if 75 percent of residents of their 2005 Census block belonged to that race (in the 2000 Census). Source: FRBNY Consumer Credit Panel.

Figure A7: Heterogeneity in Credit Score Outcomes, Five States



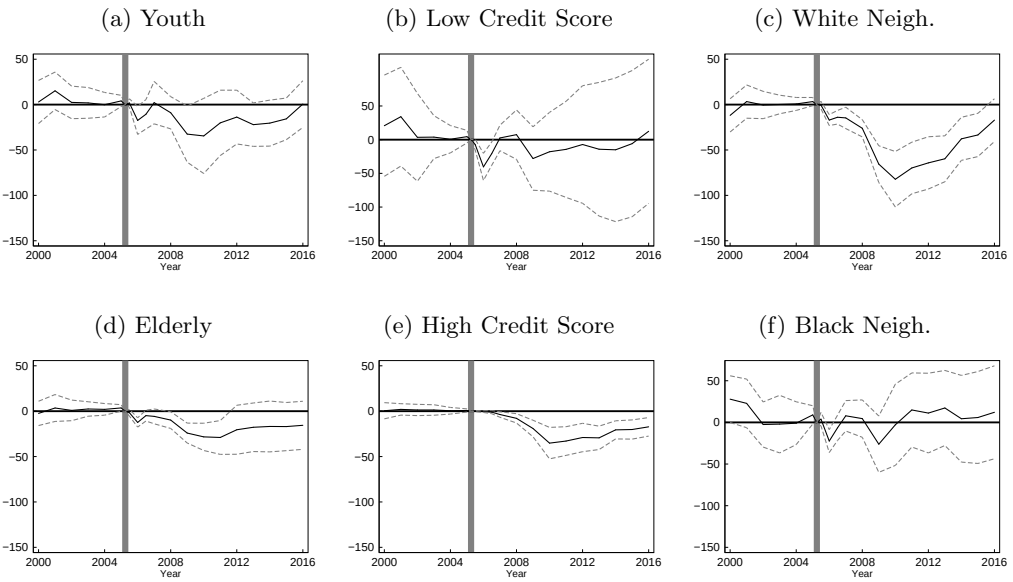
Within-subgroup event study estimates of Hurricane Katrina. Credit scores measure an individual's Equifax risk score, which is comparable to a FICO credit score. Youths age 18-40 in 2005; Elders over age 60 in 2005. High (low) credit score individuals are in the top (bottom) tercile of Equifax risk scores. Individuals live in a White or Black neighborhood if 75 percent of residents of their 2005 Census block belonged to that race (in the 2000 Census). Source: FRBNY Consumer Credit Panel.

Figure A8: Heterogeneity in Consumer Debt Balance Outcomes, Five States



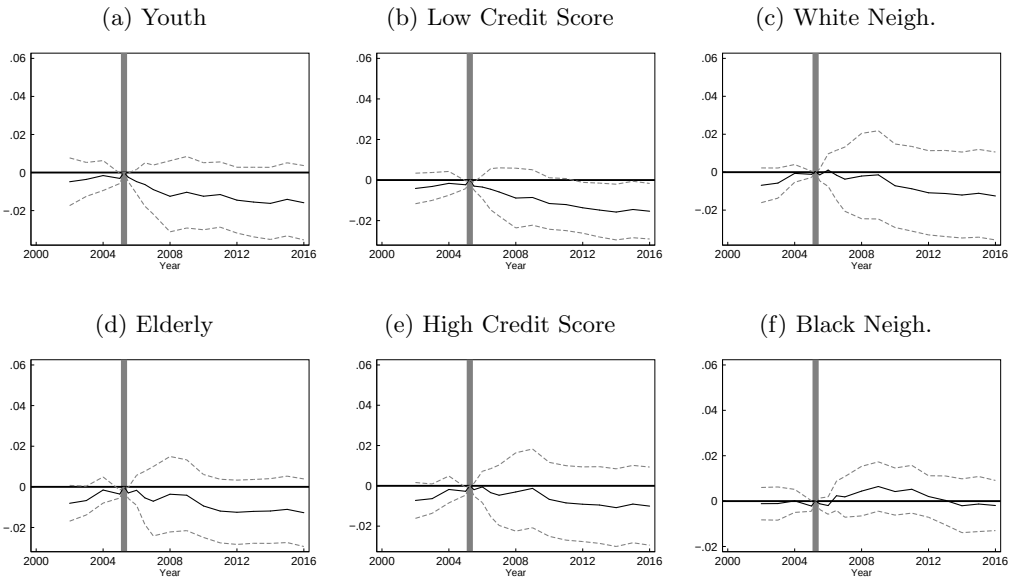
Within-subgroup event study estimates of Hurricane Katrina. Consumer debt includes credit and bank cards, retail debt, and consumer finance debt. Youths age 18-40 in 2005; Elders over age 60 in 2005. High (low) credit score individuals are in the top (bottom) tercile of Equifax risk scores. Individuals live in a White or Black neighborhood if 75 percent of residents of their 2005 Census block belonged to that race (in the 2000 Census). Source: FRBNY Consumer Credit Panel.

Figure A9: Heterogeneity in Consumer Debt Insolvency Outcomes, Five States



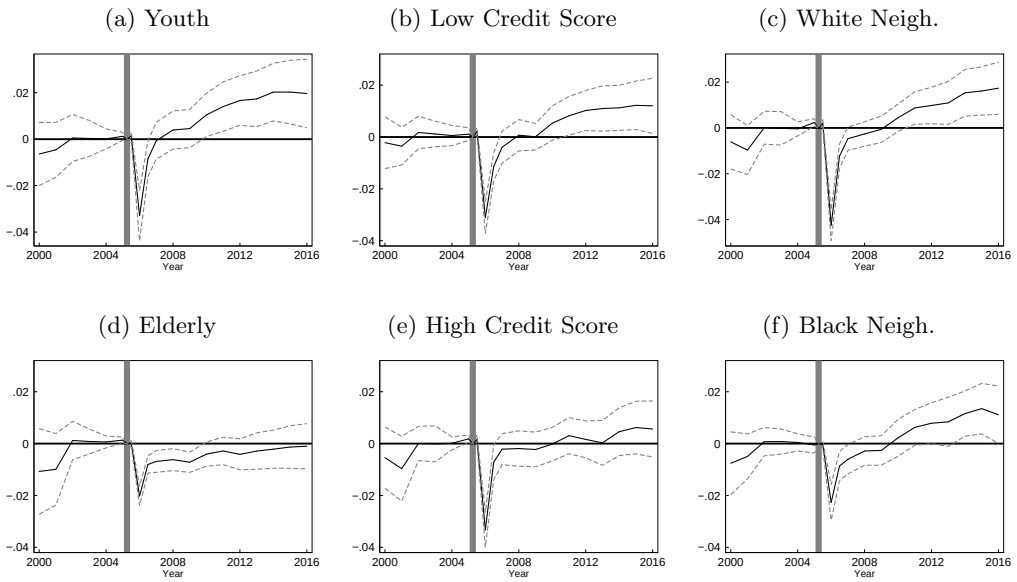
Within-subgroup event study estimates of Hurricane Katrina. Consumer debt includes credit and bank cards, retail debt, and consumer finance debt. A loan is insolvent if it is more than 90 days past due. Youths age 18-40 in 2005; Elders over age 60 in 2005. High (low) credit score individuals are in the top (bottom) tercile of Equifax risk scores. Individuals live in a White or Black neighborhood if 75 percent of residents of their 2005 Census block belonged to that race (in the 2000 Census). Source: FRBNY Consumer Credit Panel.

Figure A10: Heterogeneity in County Mobility Outcomes, Five States



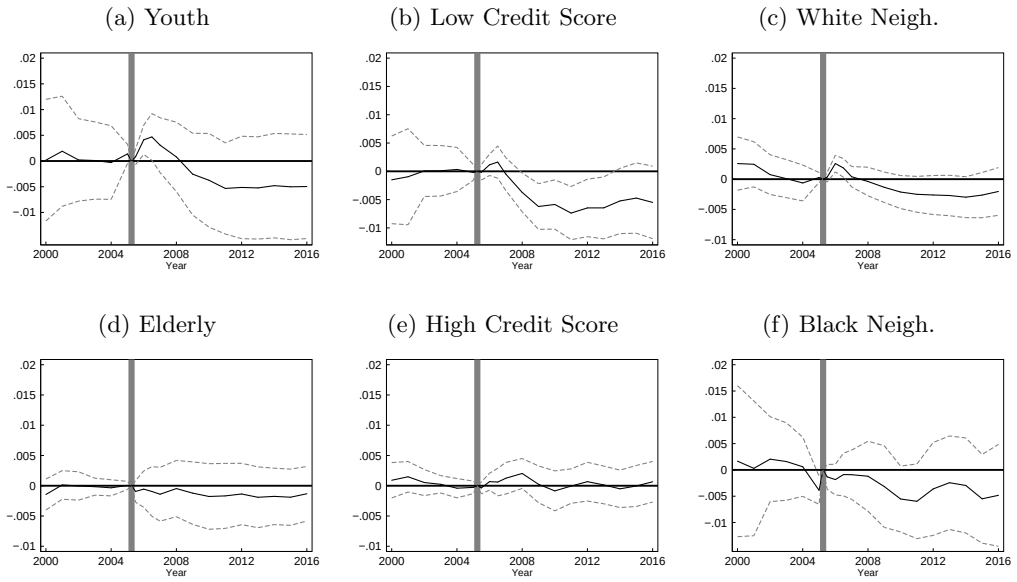
Within-subgroup event study estimates of Hurricane Katrina. County mobility indicates the likelihood of having changed counties of residence in the previous three years. Youths age 18-40 in 2005; Elders over age 60 in 2005. High (low) credit score individuals are in the top (bottom) tercile of Equifax risk scores. Individuals live in a White or Black neighborhood if 75 percent of residents of their 2005 Census block belonged to that race (in the 2000 Census). Source: FRBNY Consumer Credit Panel.

Figure A11: Heterogeneity in Homeownership Outcomes, Five States



Within-subgroup event study estimates of Hurricane Katrina. Homeownership is defined as having an active mortgage. Youths age 18-40 in 2005; Elders over age 60 in 2005. High (low) credit score individuals are in the top (bottom) tercile of Equifax risk scores. Individuals live in a White or Black neighborhood if 75 percent of residents of their 2005 Census block belonged to that race (in the 2000 Census). Source: FRBNY Consumer Credit Panel.

Figure A12: Heterogeneity in Parental Coresidence Outcomes, Five States



Within-subgroup event study estimates of Hurricane Katrina. Parental co-residence is defined as living with at least one individual between 16 and 45 years older. Youths age 18-40 in 2005; Elders over age 60 in 2005. High (low) credit score individuals are in the top (bottom) tercile of Equifax risk scores. Individuals live in a White or Black neighborhood if 75 percent of residents of their 2005 Census block belonged to that race (in the 2000 Census). Source: FRBNY Consumer Credit Panel.

Table A1: Treatment Heterogeneity by Age in the Five States region

Outcome	One Year After			Five Years After			Ten Years After		
	18-40	60+	p-Value	18-40	60+	p-Value	18-40	60+	p-Value
Consumer Bal.	-86.185	-33.438	0.203	18.08	-8.633	0.621	173.3	28.94	0.084
	(39.5)	(12.6)		(34.9)	(41.2)		(62.5)	(55.3)	
Derog. Consumer Bal.	-17.437	-12.395	0.542	-20.124	-28.960	0.669	0.579	-15.546	0.392
	(7.9)	(2.6)		(18.4)	(9.5)		(13.1)	(13.5)	
Change County, Ever	-0.001	0.004	0.493	-0.017	0.001	0.365	-0.027	-0.005	0.338
	(0.01)	(0.00)		(0.02)	(0.01)		(0.02)	(0.01)	
County Change (3 Years)	-0.005	-0.002	0.538	-0.012	-0.012	0.976	-0.016	-0.013	0.810
	(0.00)	(0.00)		(0.01)	(0.01)		(0.01)	(0.01)	
Live with a Partner	-0.003	-0.007	0.225	0.002	-0.001	0.543	0.000	0.008	0.274
	(0.00)	(0.00)		(0.00)	(0.00)		(0.00)	(0.01)	
Homeownership	-0.033	-0.020	0.029	0.014	-0.003	0.005	0.020	-0.001	0.018
	(0.01)	(0.00)		(0.01)	(0.00)		(0.01)	(0.00)	
Credit Score	2.76	0.341	0.000	1.58	1.20	0.789	1.56	0.420	0.686
	(0.35)	(0.24)		(1.2)	(0.69)		(2.5)	(1.2)	

Within-subgroup event study estimates of the impact of Hurricane Katrina on the stated outcome one, five, and ten years after the storm. Subgroups defined by individual's years of birth. Standard errors clustered by county. P-values from pairwise t-tests assuming independence across subgroup. Source: FRBNY Consumer Credit Panel.

Table A2: Treatment Heterogeneity by Credit Score in the Five States region

Outcome	One Year After			Five Years After			Ten Years After		
	Low CS	High CS	p-Value	Low CS	High CS	p-Value	Low CS	High CS	p-Value
Consumer Bal.	-38.429	-57.246	0.671	110.4	-41.546	0.207	220.9	87.29	0.120
	(31.4)	(31.2)		(109.9)	(49.2)		(65.8)	(55.3)	
Derog. Consumer Bal.	-40.369	-0.479	0.000	-14.381	-32.900	0.619	12.41	-17.242	0.589
	(10.3)	(0.47)		(36.4)	(8.1)		(54.6)	(5.2)	
Change County, Ever	0.000	0.005	0.512	-0.012	0.006	0.285	-0.024	0.004	0.167
	(0.01)	(0.00)		(0.02)	(0.01)		(0.02)	(0.01)	
County Change (3 Years)	-0.003	-0.001	0.554	-0.012	-0.008	0.752	-0.015	-0.010	0.662
	(0.00)	(0.00)		(0.01)	(0.01)		(0.01)	(0.01)	
Live with a Partner	-0.005	-0.007	0.518	-0.000	-0.001	0.831	-0.002	0.004	0.314
	(0.00)	(0.00)		(0.00)	(0.00)		(0.00)	(0.00)	
Homeownership	-0.031	-0.033	0.637	0.008	0.003	0.326	0.012	0.006	0.409
	(0.00)	(0.00)		(0.00)	(0.00)		(0.01)	(0.01)	
Credit Score	3.87	-0.511	0.000	-0.031	1.38	0.259	0.125	1.33	0.650
	(0.43)	(0.23)		(1.2)	(0.47)		(2.5)	(0.79)	

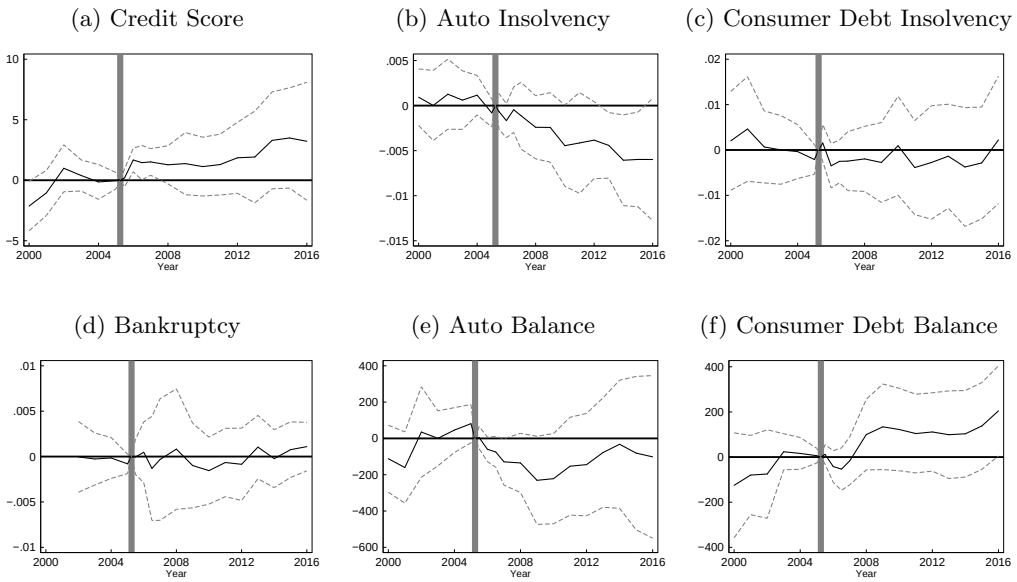
Within-subgroup event study estimates of the impact of Hurricane Katrina on the stated outcome one, five, and ten years after the storm. Subgroups defined by credit score terciles in 2005 New Orleans (high-income is the top tercile; low-income is the bottom tercile). Standard errors clustered by Census tract. P-values from pairwise t-tests assuming independence across subgroup. Source: FRBNY Consumer Credit Panel.

Table A3: Treatment Heterogeneity by Race in the Five States region

Outcome	One Year After			Five Years After			Ten Years After		
	White	Black	p-Value	White	Black	p-Value	White	Black	p-Value
Consumer Bal.	-103.362	-78.739	0.490	-6.465	106.2	0.176	214.5	246.8	0.751
	(29.8)	(19.7)		(40.3)	(72.9)		(52.9)	(87.0)	
Derog. Consumer Bal.	-17.041	-22.401	0.484	-69.796	14.92	0.002	-17.099	12.14	0.344
	(3.1)	(7.0)		(14.5)	(22.7)		(12.0)	(28.5)	
Change County, Ever	0.007	0.002	0.380	0.005	0.003	0.852	-0.001	-0.004	0.855
	(0.00)	(0.00)		(0.01)	(0.01)		(0.01)	(0.02)	
County Change (3 Years)	0.001	-0.002	0.524	-0.009	0.005	0.267	-0.013	-0.002	0.418
	(0.00)	(0.00)		(0.01)	(0.01)		(0.01)	(0.01)	
Live with a Partner	-0.007	-0.002	0.154	0.001	0.002	0.812	0.005	-0.004	0.184
	(0.00)	(0.00)		(0.00)	(0.00)		(0.00)	(0.01)	
Homeownership	-0.042	-0.023	0.000	0.009	0.006	0.625	0.017	0.011	0.441
	(0.00)	(0.00)		(0.00)	(0.00)		(0.01)	(0.01)	
Credit Score	1.31	4.18	0.000	3.05	0.883	0.075	2.38	1.50	0.669
	(0.26)	(0.45)		(0.88)	(0.84)		(1.2)	(1.7)	

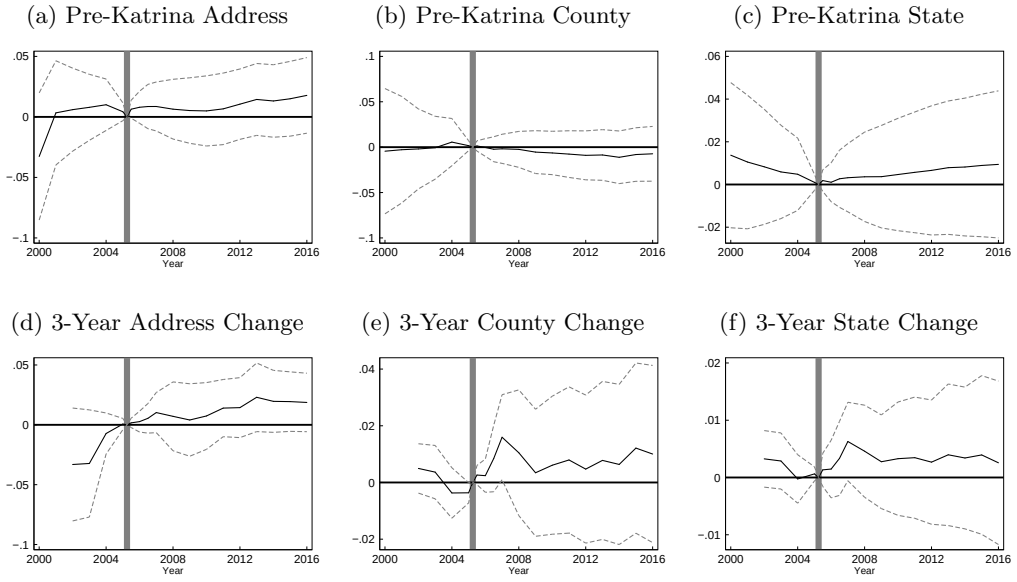
Within-subgroup event study estimates of the impact of Hurricane Katrina on the stated outcome one, five, and ten years after the storm. Subgroups defined by individuals' neighborhoods: an individual is assumed to be of a certain race if 75 percent of individuals who resided in their 2005 Census block belonged to that race (as of the 2000 Census). Standard errors clustered by county. P-values from pairwise t-tests assuming independence across subgroup. Source: FRBNY Consumer Credit Panel.

Figure A13: Income and Consumption Outcomes, 25-Mile GO Zone Boundary



Event study effects around Hurricane Katrina within 25 miles of the GO Zone boundary. Standard errors clustered by Census tract. Credit Score measures an individual's Equifax risk score, which is comparable to a FICO credit score. Consumer debt includes credit and bank cards, retail debt, and consumer finance debt. A loan is insolvent if it is more than 90 days past due. Bankruptcy indicates chapter 7 and 11 filings in the past three years. Source: FRBNY Consumer Credit Panel.

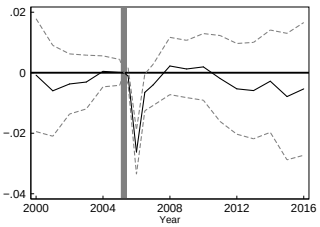
Figure A14: Mobility Outcomes, 25-Mile GO Zone Boundary



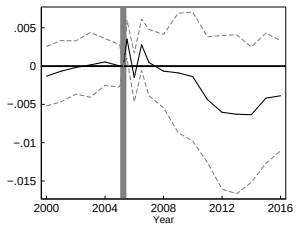
Event study effects around Hurricane Katrina within 25 miles of the GO Zone boundary. Standard errors clustered by Census tract. Top three figures show the likelihood of having a different residence location than that of June 30 2005, while the bottom three figures show the likelihood of having changed residence locations in the previous three years. Source: FRBNY Consumer Credit Panel.

Figure A15: Homeownership Outcomes, 25-Mile GO Zone Boundary

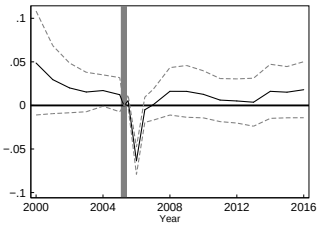
(a) Homeownership



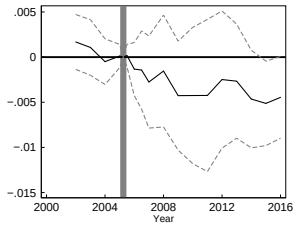
(b) Home Insolvency



(c) Homeownership (Condit. on Pre-Pre-Katrina Owner)



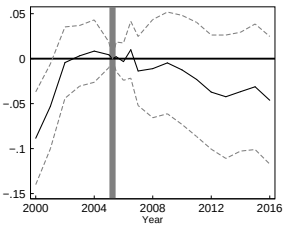
(d) Foreclosure (Condit. on Pre-Katrina Owner)



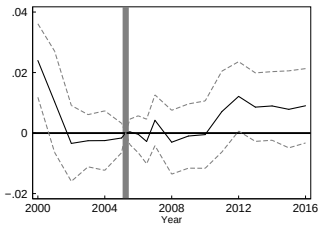
Event study effects around Hurricane Katrina within 25 miles of the GO Zone boundary. Standard errors clustered by Census tract. Homeownership is defined as having an active mortgage. A loan is insolvent if it is more than 90 days past due. Conditional homeownership restricts the sample to June 30 2005 homeowners.The foreclosure indicator indicates having foreclosed on a mortgage in the past three years. Source: FRBNY Consumer Credit Panel.

Figure A16: Household Composition Outcomes, 25-Mile GO Zone Boundary

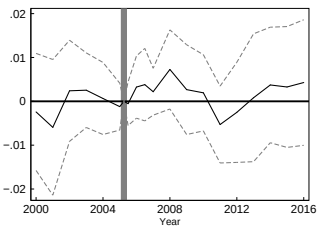
(a) Adults in Household



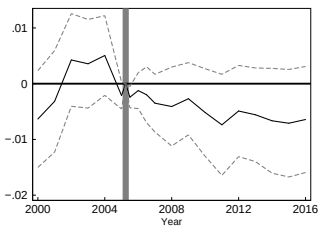
(b) Only Adult



(c) Partnership



(d) Live with Parents



Event study effects around Hurricane Katrina within 25 miles of the GO Zone boundary. Standard errors clustered by Census tract. Adults in household includes all individuals covered by Equifax (see the paper). Partnership is defined as living with only one additional covered individual. Parental co-residence is defined as living with at least one individual between 16 and 45 years older. Source: FRBNY Consumer Credit Panel.