The Economic Impact of Hurricane Katrina on its Victims: Evidence from Individual Tax Returns

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Hurricane Katrina destroyed over 200,000 homes and led to massive economic and physical dislocation. Using a panel of tax return data, we provide one of the first comprehensive analyses of the hurricane's long-term economic impact on its victims. Hurricane Katrina had large and persistent impacts on where people live, but small and surprisingly transitory effects on employment and income. Within just a few years, Katrina victims' incomes actually surpass that of controls from similar unaffected cities. The strong economic performance of Hurricane Katrina victims is particularly remarkable given that the hurricane struck with essentially no warning.

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Hurricane Katrina is arguably the most destructive natural disaster ever to strike the United States. The 2005 storm killed nearly 2,000 people and destroyed more than 200,000 homes. Property damage was estimated to exceed $100 billion. The population of New Orleans plummeted and has not returned to its pre-hurricane levels. Parts of the city have never been rebuilt. Despite the magnitude of the disaster, remarkably little is known about its long-term ramifications for the victims. To date, the research on Hurricane Katrina victims has focused primarily on their immediate mobility patterns[1] and the impact of Katrina evacuees on surrounding areas.[2]

Much less is known about the economic impact of the disaster on victims, in large part because of data limitations. One source of information is the Bureau of Labor Statistics' Current Population Survey (CPS), which was revised to include questions that identified Katrina evacuees from October 2005 through October 2006 (Cahoon et al. 2006, Groen and Polivka 2008a).[3] Using these data, Vigdor (2007) documents an initial negative impact of Hurricane Katrina on the labor market participation of evacuees, with the effect being most pronounced for those who were unable to quickly return to their homes. In the medium-run, the labor market outcomes for those who eventually came back to New Orleans returned to their pre-Katrina levels, but negative effects persisted for those who were living in the worst hit areas. A key disadvantage of the CPS data is that it

[1] Approximately 60 percent of evacuees from Louisiana returned to their pre-hurricane addresses within 14 months (Groen and Polivka 2008b). Gregory (2014) estimates that the Louisiana state government's Road Home program, which provided money to residents to rebuild and protect their homes from future storm damage, increased the rate of rebuilding damaged homes by 8 percent. Those who did not return were more likely to be black, have lower levels of education, have a low family income, and were unlikely to be homeowners (Groen and Polivka 2010). Those who did return had moved a median of two times before 2009 (Geaghan 2011).

[2] Several papers have also studied the effect of Hurricane Katrina on Houston: the influx of Katrina evacuees increased Houston's population by over 3 percent (McIntosh 2008) and is estimated to have decreased wage levels (De Silva 2010, McIntosh 2008).

[3] The American Housing Survey also added questions related to Hurricane Katrina. However, we are not aware of any relevant research that uses these data.

can only be used to identify *evacuees*, who may not be representative of the average Katrina victim. Moreover, because the CPS stopped tracking evacuees in October 2006, it cannot be used to evaluate longer-run effects. We are unaware of any other publicly available data that can be used to identify individuals who were affected by the hurricane and link them to post-Katrina outcomes.

We use a previously untapped data source—individual tax returns—to undertake one of the first systematic analyses of the long-term social and economic consequences of Hurricane Katrina. Four features of these administrative data allow us to comprehensively analyze the long-run impacts of the hurricane. First, tax and third-party information returns contain addresses, which allow us to reliably identify those living in New Orleans before the storm. Second, we can link tax records over time to construct a panel of households that spans fifteen years (1999-2013), with Hurricane Katrina occurring roughly in the middle of that period. Third, we can track New Orleans residents who do not file a tax return using information returns (forms W-2 and 1099-MISC). Thus, we are able to study the economic experiences of the vast majority of the pre-Katrina population of New Orleans, including its poorest residents. Finally, tax records contain precise information about incomes from different sources, such as wages and salaries, self-employment, unemployment insurance, the Social Security Disability Insurance program, and individual retirement accounts. We also use the tax returns to infer geographic mobility and changes in household composition (e.g., number of children, marriage, and divorce).

Even with excellent data, empirical challenges remain. Estimating the causal impact of Hurricane Katrina requires finding a credible comparison group to serve as a counterfactual for the experiences of New Orleans residents in the absence of the hurricane. Finding such a group is difficult. Ideally, we would compare those hit by the hurricane (the treatment group) to a set of similar people who were unaffected (the control group). An obvious strategy would be to select a

set of control cities that resembled New Orleans prior to the storm. Unfortunately, New Orleans is unique in many ways, making it difficult to find good matches. Additionally, the diaspora out of New Orleans in response to the hurricane appears to have affected labor market conditions in other cities (De Silva 2010, McIntosh 2008). A comparison of New Orleans residents whose homes are directly affected by the flood to those who were spared (e.g., because the homes were built on high ground) is contaminated by the general equilibrium effects of the flood: the combination of massive outmigration, destruction of housing stock, and lost tourism could have affected the economic circumstances even for those whose homes were untouched.

In light of these difficulties, our preferred empirical approach is to first select U.S. cities that are reasonably similar to New Orleans prior to 2005 using data from the U.S. Census and the American Community Survey. We construct a panel of control households using a random sample from these cities and use inverse propensity score weighting in our analysis (Hirano et al. 2003). The richness of our data allows us to use a number of characteristics to construct the propensity score, including age, marital status, employment and homeownership statuses, number of kids, wage income, and adjusted gross income (AGI) for each year between 1999 and 2004.[4] We then examine how a wide range of economic and social outcomes changed for Katrina victims relative to the control group.

A number of key results emerge. First, the hurricane had large and persistent impacts on where people live. Over one-fourth of New Orleans households were displaced by the storm in 2005-2006. As of 2013, over a third of those displaced had not returned to New Orleans. Second, and more surprisingly, we find only small and transitory impacts on the labor income (the sum of wage and salary earnings and non-employee compensation) and total income of the

[4] As we discuss below, our basic findings are robust to a wide range of assumptions regarding this procedure.

victims. In 2006, the year after the storm, labor income for the average Katrina victim in our sample is roughly $2,300 lower than their matched counterparts. Remarkably, the earnings gap is erased the following year. Starting in 2008, the average hurricane victim actually has *higher* incomes than control households, and even those who lived in the most damaged areas do not suffer earnings losses in the long run. Third, consistent with these earnings responses, we find that while unemployment receipts and non-employment among the Hurricane Katrina victims spike after the storm, the differences disappear by 2007 and 2009, respectively. Fourth, savings appear important for weathering the storm: retirement account withdrawals increased throughout the post-Katrina period as households took advantage of a special exemption from the early withdrawal penalty. Finally, we also observe greater (but transient) reliance on social safety nets, as uptake of Social Security Disability Insurance (SSDI) and unemployment insurance compensation increase temporarily. For some groups, however, the increase in SSDI enrollment is persistent.

There are three leading explanations for the surprising increase in nominal wages, and we find evidence for each of them in our setting.[5] The first explanation is a rise in the cost of living, such that nominal wages rise but real wages are unchanged or even reduced. This could happen through a combination of New Orleans residents moving to areas that are more expensive or prices rising in New Orleans. The data on local cost of living, especially for New Orleans in this time period, are unfortunately quite poor. We provide suggestive evidence

[5] In addition to these three explanations, the diverse sources of aid (e.g. direct disaster relief, unemployment insurance, special tax credits, charitable donations) made in the wake of Hurricane Katrina are another likely contributor to the economic recovery of Hurricane Katrina victims. Over $100 billion in government aid was awarded in response to Hurricanes Katrina and Rita (Hoople, 2013), which represents a large share of the estimated $120 billion they caused in direct damage (Knabb et al. 2006a, b). Deryugina (forthcoming) shows that this fact holds for other, less devastating, U.S. hurricanes as well. Unfortunately, we do not observe aid disbursement at a sufficiently detailed level to know how well losses of particular subgroups were compensated. Aid cannot easily explain, however, higher incomes many years later.

both that people leaving New Orleans moved to less expensive areas and that housing prices and the overall cost of living increased in New Orleans. Our best, albeit imperfect, estimates suggest that even after adjusting for cost of living, those affected by the hurricane have higher real wages.

The second possible explanation is that the widespread changes induced by Hurricane Katrina strengthened the New Orleans labor market. We also find suggestive evidence for this hypothesis, as prevailing wages in New Orleans rise significantly and persistently in the aftermath of Hurricane Katrina relative to our control cities.

The third possible explanation is that strong ties to a place, especially one with limited economic opportunities such as New Orleans, have adverse economic consequences.[6] When forced by an exogenous shock to migrate, people are able to choose from a wide range of possible locations, and they seem to choose places that offer them better economic opportunities. Consistent with this hypothesis, we find that the increase in labor income was highest for those who left and never returned to New Orleans. Further support for this claim comes from Sacerdote (2012), who finds that forced school switches because of Hurricane Katrina had an immediate negative impact on school outcomes for displaced children followed by positive long-run effects on test scores. Importantly, our results do not imply that the utility of storm victims improved. We cannot measure the non-pecuniary costs of the disruption created by Hurricane Katrina,

[6] Such rationales have been used in support of the Federal Moving to Opportunity (MTO) program, a randomized experiment that provided vouchers to households in high-poverty areas so that they could relocate. Overall, analyses of the MTO indicate that there was little immediate impact of moving on economic outcomes, although the program had some non-pecuniary benefits (Kling, Liebman, and Katz 2007). Recent work using administrative tax returns has re-examined the longer-run impact of MTO, finding substantial gains for young children (Chetty, Hendren and Katz 2016). Nakamura et al. (2016) show that younger individuals induced to move by a natural disaster in Iceland experienced large lifetime gains in education and earnings, while those older than 25 experienced small but insignificant earnings losses.

but the fact that people tend to stay in a particular place when not hit by exogenous shocks suggests that these costs are high.

A few existing papers also examine the longer-run effects of Hurricane Katrina using high-quality longitudinal data. Our wage findings are consistent with Groen et al. (2016), a study that was carried out independently and in parallel to our research. They use Longitudinal Employer-Household Dynamics data to follow a broader set of Hurricane Katrina and Rita victims residing in 63 counties/parishes in Alabama, Louisiana, Mississippi, and Texas. They find long-term earnings gains across all major age, gender, education, and race/ethnicity categories. They also observe individuals' pre-Katrina industry, and find that only workers who worked in healthcare and tourism suffered long-term earnings losses. However, due to the nature of their data, the only outcome they can consider is wage earnings. An advantage of our data is that we are able to study a broader range of outcomes.

Gallagher and Hartley (forthcoming) use credit agency data to study the effects of Hurricane Katrina on New Orleans residents' household debt and financial distress in 2005-2008. According to their estimates, victims residing in the most flooded areas of New Orleans experience a short-run increase in credit card balances and delinquencies, but a longer-run fall in total debt relative to those in areas that were not flooded. The authors conclude that the most likely explanation for this surprising pattern is that homeowners used flood insurance payments to pay down their mortgages. Our findings that Hurricane Katrina victims immediately increased their reliance on retirement savings is highly complementary to theirs.

Our findings speak to the appropriate level of *ex ante* mitigation spending (Becker, Murphy, and Topel 2011). The longer the effects of shocks like Hurricane Katrina last, the larger the economic and welfare losses and, correspondingly, the benefit of public mitigation measures, such as investments in

stronger levees. While we cannot measure the magnitude or duration of *utility* losses, the highly transitory nature of the income losses caused by Hurricane Katrina suggests that the long-run reductions in worker productivity should not have been included as a significant consideration for *ex ante* mitigation spending decisions in this particular case.

The remainder of the paper is structured as follows. Section I provides additional background on Hurricane Katrina. Section II describes the data sources used in the analysis, with emphasis on the tax return data, and details our estimation strategy. Section III presents the main findings. We test and discuss mechanisms for the main findings in Section IV, and conclude in Section V.

I. Background on Hurricane Katrina

Tropical Depression 12 developed on August 23, 2005.[7] It quickly grew in size and strength, and by the following day it was named Tropical Storm Katrina. Katrina developed into a Category 1 hurricane as it traveled northwest across the Bahamas.[8] It first made landfall August 25 on the coast of Florida, causing only a handful of deaths. It then moved westward across the Gulf of Mexico and at its peak strength was a Category 5 storm with wind speeds clocked at over 170 miles per hour. By the time Hurricane Katrina reached the Louisiana coast on August 29, it had sustained winds that placed it as a strong Category 3 storm. In New Orleans, wind speeds were well over 100 miles per hour.

The government realized early on that Hurricane Katrina had the potential to be the "perfect storm," causing massive wind damage and storm surges. New Orleanians had long known that a direct hit on New Orleans might have

[7] The basic facts about Hurricane Katrina cited throughout are from publications of the National Oceanic and Atmospheric Administration.

[8] Meteorologists categorize hurricanes on a scale from 1 to 5. A Category 1 hurricane has wind speeds ranging from 74 to 95 miles per hour, while a Category 5 storm has wind speeds over 155 miles per hour, causing extensive property damage, power outages, and potentially high fatality and injury rates (Schott et al. 2012).

catastrophic results. The city is situated largely below sea level, protected from flooding by a system of canals and levees along the Mississippi River to the south and east, and Lake Pontchartrain to the north. A breach in the levees would cause massive flooding. Once flooded, ridding the city of water would be a massive undertaking because New Orleans sits at the bottom of a bowl-shaped area of land.

New Orleans Mayor Ray Nagin issued a voluntary evacuation order the evening of August 25, four days before the storm struck the Louisiana coast. The following morning, he changed the order to the city's first ever mandatory evacuation. President George W. Bush urged residents to prepare for the worst.[9] Two days before landfall, the city converted all highway lanes to outbound. Even so, evacuees faced gridlock. With all signs pointing toward a catastrophic storm, the great majority of city residents evacuated. Still, nearly 100,000 stayed and prepared much as they had done in the past: by boarding their windows, stocking up on nonperishable foods, and throwing hurricane parties.[10]

Hurricane Katrina reached Louisiana's coast on August 29. Lake Pontchartrain breached the area's levees. Water pumps and the sewage system couldn't keep up with the deluge, leaving 80% of New Orleans under water. Figure 1 shows a map of the New Orleans area, with deeper flooding captured by a darker shade, and median household income denoted with cross-hatching. The worst flooding–more than nine feet of standing water—occurred near Lake Pontchartrain and in the lower ninth ward, but serious flooding was seen

[9] In another New Orleans evacuation first, meteorologist Nash Roberts himself left the city; in his over 50 years as the local authority on hurricanes, Roberts had not once evacuated.

[10] In previous years, voluntary evacuations had been called for hurricanes that had caused minimal damage. Just the year before, Hurricane Ivan had fizzled out before reaching Louisiana. Locals also thought they had already seen—and survived—the worst, 1965's Hurricane Betsy. A Category 3 storm, Hurricane Betsy killed approximately 75 people in Louisiana and incurred over $10 billion in damage in present-day dollars (Sugg 1966). It was also the reason for New Orleans' supposedly improved levee system—the very system that Hurricane Katrina breached (*National Geographic News* 2005).

throughout the city. The least flooded areas tended to have higher owner-occupied home values, a lower share of black residents, and higher educational attainment (see Table A1 in the Online Appendix). However, there was no systematic pattern with respect to flooding and median incomes or poverty rates, suggesting that neither wealthy nor poor residents were immune from the storm's impact.

[FIGURE 1 ABOUT HERE]

Nearly 60,000 members of the National Guard were sent to help with rescue and recovery, in an effort that one command sergeant referred to as "far more difficult that anything we faced in Iraq."[11] Soon thereafter, President Bush declared Hurricane Katrina "one of the worst natural disasters in our nation's history" (*Washington Post* 2005). Statistics back up this statement. Not since the devastating Florida hurricane of 1928 had a natural disaster claimed as many American lives. Hurricane Katrina ranks as the most expensive storm, causing over $100 billion in damage, more than twice as much as the next storm, Hurricane Andrew (Blake, Landsea, and Gibney 2011). Nearly two years later, over 600,000 individuals had yet to return to their homes in the broader affected areas.

The aid response to Hurricane Katrina was massive. We estimate that there was roughly $50 billion in infrastructure reconstruction, aid and insurance payments directed to the city of New Orleans and those who resided there at the time of the storm – roughly $100,000 per pre-Katrina resident.[12]

II. Data and Estimation Strategy

A. *Administrative Tax Data and Treatment Group Construction*

[11] The PBS NewsHour, September 8, 2005.

[12] Including Katrina-affected areas outside of New Orleans and Hurricane Rita, which also struck in 2005, would make the aid figure substantially larger (Hoople 2013). We detail the sources and our estimates of the various relief channels in the Online Appendix.

Our data are drawn from the universe of individual Federal tax returns and third-party information returns filed between 1999 and 2013. We use two criteria to identify households living in New Orleans prior to Hurricane Katrina (the "treatment group"). First, for households who filed a 2004 tax return (due to be filed in April 2005), we use the filing zip code to identify those with a New Orleans address. Second, for individuals who did not file a tax return, we use the zip codes on Form W-2, which employers submit to the IRS for wage and salary income, and on Form 1099-MISC, which businesses submit to the IRS for non-employee compensation (e.g., independent contract income, honoraria, etc.). The payee's address on these forms typically corresponds to his or her residence. We consider any non-filer to be a 2004 New Orleans resident if he or she earned at least half of his or her 2004 "labor income" (the sum of W-2 and 1099-MISC income) in New Orleans. To focus on the working-age population, we drop tax filers who are under 16 or over 64 years old at the end of 2004.

The resulting sample appears to quite effectively capture the pre-Katrina New Orleans population. Summing over the number of adults who are represented on a tax return and non-filers who are aged 25-64, we identify 221,756 New Orleans residents for the 2004 tax year - nearly 85% of the city's population in that age range that year.[13] Average incomes for our New Orleans sample in 2004 are similar to average incomes reported in the 2000 Census Public Use Microdata Sample data: average total household income reported in tax data is $43,040, compared to $45,306 in the 2000 Census; average wage and salary income in our data is $29,553, compared to $33,654 reported in the 2000 Census. According to Census Bureau estimates, the New Orleans population was 53% smaller in July of 2006 than before the Hurricane. Similarly, roughly 52% of all pre-Katrina New Orleans residents that we identify (including those under 16 or over 64 in 2004)

[13] The Surveillance, Epidemiology, and End Results (SEER) database reports the number of 2005 New Orleans residents aged 25 through 64 to be 261,376.

filed their 2005 tax return or received the majority of their labor income from outside of New Orleans.[14]

We construct a panel of tax returns and earnings histories spanning 1999 to 2013. The income variables drawn from tax returns are household-level wage and salary income, self-employment (Schedule C) income (or losses), unemployment insurance compensation (which has been taxable since 1987), gross retirement account distributions (which does not include Social Security), and adjusted gross income (AGI).[15] We also collect individual-level earnings information and Social Security Disability Insurance (SSDI) transfers from third-party information returns (Forms W-2, 1099-MISC and 1099-SSA, respectively). These data are linked to primary and secondary filers for households that file a tax return.[16] Our main earnings measure is "labor income," defined as the sum of W-2 wage and salary income and 1099-MISC non-employee compensation. Because such income is reported by third-parties, it is available even if an individual does not file a tax return. Other outcomes that are based on tax returns are missing for years in which an individual is not listed on a tax return. To reduce the influence of outliers, we winsorize all income measures at their 1st and 99th percentiles.

We additionally collect the demographic characteristics that can be obtained from tax records: filing status, the number of child and parent dependents, and filing address. We use filing status to infer marital status. We define a movement from married filing jointly to any other filing status as a divorce, and the opposite movement as a new marriage. Lastly, we use

[14] Among our working-age sample, only 33% filed their 2005 tax return or received the majority of their 2005 labor income at a residence outside of New Orleans.

[15] If a household does not file a tax return in a particular year, it will be missing in our analysis of all outcomes except labor income and SSDI. If there are no related information forms in a given year, we assume that person had zero income of that type.

[16] If the 2004 primary and secondary filers appear on different returns in a particular year, we treat those filers as being in separate households. A previous version of this paper (Deryugina et al. 2014) only tracked primary filers and did not use third-party information returns. The results in that version are qualitatively very similar for most outcomes.

information on non-business real estate taxes paid and mortgage interest payments from Schedule A and Form 1099 to infer home-ownership status.[17]

Summary statistics for the resulting treatment group of New Orleans residents in the years prior to Hurricane Katrina (1999-2004) are presented in Table 2. The average New Orleans household AGI among filing households (after winsorizing) is $34,961, with more than 80 percent of that income coming from W-2 wages. About 24 percent of the household-year observations have no income taxes filed, as reflected in the higher number of observations for the wage income variables. Roughly 13 percent of households have no labor income, 3.8 percent receive UI benefits and 2.3 percent are on SSDI in any given year. The typical filer/earner in our sample is in their late thirties and claimed 0.71 dependents. About 20 percent of New Orleans residents are married and 30 percent own homes on which they are making mortgage payments.

B. *Control Group Construction*

New Orleans is a unique city in many ways, with a high reliance on tourism, low income levels and employment rates, and a high percentage of black residents. Thus, it is not possible to identify a set of cities such that a weighted average mirrors New Orleans in the pre-period, along the lines of Abadie et al. (2010). Consequently, we take a two-step approach to construct a control group. First, we identify ten cities that most closely resemble New Orleans. Then, we turn to inverse propensity score weighting at the individual level (Hirano et al. 2003). This methodology allows us to compare the outcomes of individual Hurricane Katrina victims to controls while accounting for differences in their observable characteristics.[18]

[17] Thus, we do not rely on households itemizing deductions to infer home-ownership.

[18] A closely related method, propensity score matching, where a Hurricane Katrina victim is matched to the control individual with the closest propensity score (Rosenbaum and Rubin 1983), yields very similar results.

To choose the set of cities that share basic traits with New Orleans, we focus on three pre-Katrina dimensions: median earnings, the population growth rate, and the percent of population that is black. The first two variables are meant to capture the general economic environment in the household's city of residence. The last variable is important because we do not observe race in tax return data. If there are race-specific trends and we do not have a sample that is balanced along this dimension, our results may be biased.

We start with all U.S. cities that have populations of over 100,000 and compute the within-year differences between each potential control city and New Orleans for each of the three outcomes. We normalize each outcome by its standard deviation in that year to make the magnitudes comparable, and square the normalized measure to penalize large deviations. For each city, we compute the sum of these differences relative to New Orleans across the five years and three outcomes and rank cities according to this measure to select the ten most closely resembling New Orleans. The cities from which we draw controls are: Baltimore, MD; Birmingham, AL; Detroit, MI; Gary, IN; Jackson, MS; Memphis, TN; Newark, NJ; Portsmouth, VA; Richmond, VA; and St. Louis, MO. Table 1 presents descriptive statistics for these cities, and Figure 2 shows them on a map. Essentially, these are the blackest and poorest large cities in the U.S., but on average they are slightly less black and slightly richer than New Orleans.

[TABLE 1 ABOUT HERE]

[FIGURE 2 ABOUT HERE]

As with our treatment group, we identify tax filers from the set of control cities just before Hurricane Katrina, using filing zip codes on a 2004 tax return, supplemented with individual non-filers who have at least half of their third-party-reported labor income associated with a control city address. Due to the large size of the data, we draw a random 10% sample of these households to form

the basis of our control group. We collect data spanning 1999-2013 for these households in the same fashion as our sample of 2004 New Orleans residents.

Next, we calculate a propensity score using the primary tax filer's (or non-filer's) age, the secondary tax filer's age (if available), marital status, employment and homeownership statuses, the number of kids claimed, wage and salary income reported on a tax return, AGI, wage income from W-2s, and non-employee compensation for each year between 1999 and 2004. We also include annual tax filing indicators for each household and replace missing values for other outcomes with zeroes.[19] Thus, we do not require that the person file a tax return in each year of our data in order to assign them a propensity score.

We then use inverse propensity score weighting in our analysis. Our preferred specification omits individuals whose propensity scores lie outside the range of propensity scores in the other group (the "common support" restriction). A key advantage of propensity score weighting over propensity score matching is that the former utilizes the full sample instead of restricting the number of controls to be equal to the number of treated units, thus increasing power. Another important advantage is that inverse propensity score weighting takes into account how similar the control units are to the treated ones. However, our results are robust to employing one-to-one matching.

C. *Estimation Strategy*

Having identified a control group for the pre-Katrina New Orleans residents in our sample, we simply run regressions of the form:

$$(1) \qquad Y_{it} = \sum_{\tau=1999,\tau\neq2004}^{2013} \beta_\tau * \mathbf{1}[t=\tau] * NO_i^{2004} + \alpha_i + \lambda_t + \varepsilon_{it}$$

[19] It does not matter what value we set the missing variables equal to because the non-filing indicator will absorb that variation.

where *i* indexes households and *t* is the filing year. The variable *Y* corresponds to one of our outcome variables. The indicator $\mathbf{1}[t = \tau]$ is equal to one if the observation falls in year τ, while NO_i^{2004} is an indicator variable equal to one if the household lived in New Orleans in 2004. We include household- and year-fixed effects, denoted by α_i and λ_t, respectively, and cluster standard errors by the household's 2004 zip code. We weight each regression by the household's inverse propensity weight, which is a function of its estimated propensity score.

The key coefficients in equation (1) are the time-varying β_τ's, which capture any systematic differences between the outcomes of those who lived in New Orleans prior to Katrina and the control individuals. If the control group is properly selected, the pre-2005 β_τ's on each outcome should be close to zero, while the post-2005 β_τ's will reflect post-Katrina differences between those who lived in New Orleans at the time of the storm and the controls.

To summarize the effects of Hurricane Katrina more concisely, we also estimate a more parsimonious version of equation (1) that groups the post-Katrina coefficients into three post-periods and omits the pre-period coefficients:

$$
\begin{aligned}
(2) \qquad Y_{it} = \; & \beta_s * \mathbf{1}[t = 2005 - 2006] * NO_i^{2004} \\
& + \beta_m * \mathbf{1}[t = 2007 - 2008] * NO_i^{2004} \\
& + \beta_l * \mathbf{1}[t = 2009 - 2013] * NO_i^{2004} \\
& + \alpha_i + \lambda_t + \varepsilon_{it}
\end{aligned}
$$

The indicator $\mathbf{1}[t = Y_1 - Y_2]$ is equal to 1 if the year is equal to or is between Y_1 and Y_2. The choice of which years to group together is driven partly by the patterns of coefficients we see in the flexible specification of equation (1). In equation (2), β_s reflects the short-run effects of the hurricane, while β_m captures the transition period to the longer-run effect, summarized by β_l. Finally, we

estimate a version of equation (2) with a single post-period, replacing the three interaction terms with $\mathbf{1}[t = 2005 - 2013] * NO_i^{2004}$.

III. Main Results

A. *Effects of Hurricane Katrina on the Average New Orleans Resident*

Estimates and corresponding 95% confidence intervals for key outcomes are presented graphically in Figures 3 and 4.[20] Each sub-graph corresponds to a different dependent variable, as indicated above each plot. In each case, the effect in 2004 is normalized to zero. We include a vertical line in 2005, which corresponds to the year of Hurricane Katrina. We also add a horizontal line at zero to provide a reference point. Overall, we see that for many of our outcome variables, there are little or no statistical differences between our treatment and control groups prior to 2005. The similarities indicate that our selection of control cities and propensity score weighting techniques are doing a reasonable job of finding a comparable counterfactual for Hurricane Katrina victims.

Our results reveal that the hurricane had significant and notable effects on labor market outcomes. In panel (a) of Figure 3, prior to 2005 there is almost no difference in the labor incomes of the New Orleans residents and the controls. This close correspondence is partly mechanical because our propensity score includes pre-2005 labor income. In the year of Katrina, New Orleans residents experience a negative labor income shock of approximately $2,000, or almost 6.5 percent of the in-sample mean. The decline is understated because W-2's and 1099-MISC's provide an annual measure of income; if we attribute the entire loss to the last four months of the calendar year, this negative shock appears much more severe. The gap in income increases to about $2,300 in the following year

[20] Point estimates, standard errors, and other regression output corresponding to Figure 3 and 4 can be found in the Online Appendix. Estimates corresponding to Figure 5 are available upon request.

but, remarkably, disappears just two years after the storm. By 2008, labor incomes are $1,300 *higher* among the New Orleans group; this difference exceeds $2,300 by 2013.[21] Overall, the later income gains more than offset the initial drop.

[FIGURE 3 ABOUT HERE]

We next consider two measures of unemployment that can be detected in our data: non-employment, as measured by whether the household had any reported labor income (panel (b)), and the receipt of unemployment insurance compensation (panel (c)). Both of these measures corroborate the evidence found in our labor income measure: a short-run decline in labor market outcomes followed by a quick recovery. There is a small effect on non-employment in 2005 (about 0.9 percentage points), which is again an artifact of annualized labor market outcome measures; much of the 2005 tax year predates the storm. In 2006 and 2007, Hurricane Katrina victims are, respectively, 4.2 and 2.1 percentage points more likely to have no labor income than the control group. By 2009, the difference disappears as non-employment returns to its pre-Katrina levels. Panel (c) shows that Hurricane Katrina victims experience a 27 percentage point increase in the probability of unemployment insurance receipt in 2005 and an 11 percentage point increase in 2006. The large magnitude of the increase in unemployment receipt likely reflects mass layoffs reported in the aftermath of Hurricane Katrina as well as individuals qualifying for the federal Disaster Unemployment Assistance program, which is available to those who become unemployed because of a disaster. Additionally, in 2006 Congress passed legislation granting Hurricane Katrina and Rita victims up to 13 extra weeks of

[21] Results using AGI, which is only observed for the tax filing population and includes other sources of income such as capital gains, dividends, and unemployment benefits, are similar (see Online Appendix Figure A3). Results using the natural log of labor income or the natural log of AGI are also similar and available upon request.

unemployment benefits.[22] The spike in unemployment receipts is short-lived: in 2007-2013, Katrina victims are 1.8-3.5 percentage points *less* likely to receive unemployment benefits.

In panel (d), we consider whether the negative impacts of Hurricane Katrina on wage and salary employment were mitigated by transitions into self-employment. Following a drop of about $130 in 2005, we find a significant $140 rise in self-employment income in 2006, which corresponds to 12.6 percent of the mean self-employment income in our sample. Self-employment income remains elevated throughout our sample period, although the point estimate ceases to be statistically significant in 2013. Given the low frequency of self-employment in our sample, however, this increase does not augment total income very much on average. In addition, Hurricane Katrina led to a roughly one-percentage point decrease in the probability of having any self-employment income that persisted until 2010 (see Online Appendix Figure A3).

Our data also allow us to (imperfectly) observe the extent to which Hurricane Katrina victims drew on their savings to weather the storm's impact. To do so, we consider gross distributions from retirement savings accounts, depicted in panel (e) of Figure 3. Typically, these accounts are given preferential tax treatment to incentivize saving for retirement and have penalties associated with tapping into these funds prior to a specific age. Between August 25, 2005 and January 1, 2007, however, Hurricane Katrina victims could withdraw up to $100,000 from their retirement accounts without incurring the early withdrawal penalty. They could also spread taxes on these withdrawals over a three-year

[22] Louisiana also loosened documentation requirements in the aftermath of the storm, raising the possibility that some individuals who did not qualify for any unemployment program received compensation fraudulently.

period.[23] These policies were meant to provide easier access to retirement savings to buffer the shock of Hurricane Katrina when other savings proved insufficient. It appears that people took advantage of this opportunity: retirement account withdrawals by Hurricane Katrina victims increase by almost $100 in 2005 and almost $680 in 2006, a large increase compared to the pre-Katrina sample mean of $747 (Table 2). Annual withdrawals remain higher than those of the controls throughout the post-Katrina period, although the differences are not always statistically significant. The sum of the coefficients implies that Hurricane Katrina led to extra retirement account withdrawals of almost $2,500 per household over the sample period. In Figure A3 of the Online Appendix, we show that this increase is mostly driven by the extensive margin of more individuals withdrawing money from retirement accounts. The increases in retirement account withdrawals are not accompanied by increases in Social Security benefit claims (results available upon request), suggesting that withdrawals are being used to replace lost income and destroyed assets, rather than indicating transitions into retirement.

Finally, we consider an important social safety net: the Social Security Disability Insurance (SSDI) program, which provides cash transfers to previously employed adults who become unable to work due to a disability. There is considerable evidence that SSDI enrollment responds strongly to economic conditions (Black, Daniel and Sanders, 2002; Autor and Duggan, 2003; Duggan and Imberman, 2009), but less is known about how it responds to natural disasters. In panel (f), we see that SSDI enrollment does not increase immediately after the hurricane. However, in 2007, those affected by Hurricane Katrina are 0.21 percentage points more likely to be receiving SSDI payments. The increase

[23] The special provision was announced on October 17, 2005. See http://www.irs.gov/uac/Tax-Favored-Treatment-for-Early-Distributions-from-IRAs-and-other-Retirement-Plans-for-Victims-of-Hurricane-Katrina.

peaks in 2008 at 0.30 percentage points above pre-Katrina levels (a 7.7 percent increase over the mean) and subsequently returns to zero. This pattern is consistent with individuals turning to disability insurance after failing to find new employment. Because the rate at which individuals leave SSDI is fairly low (Autor and Duggan 2003, Autor 2015), one explanation for the non-monotonic effects is that the hurricane caused those who would have eventually enrolled in SSDI to do so sooner. Alternatively, as we discuss later, heterogeneous treatment effects where some groups become more likely to enroll over time and others become less likely to enroll could also produce the observed pattern.

Table 3 shows estimates from equation (2) corresponding to the outcomes presented in Figure 3. Panel A presents a single post-Katrina effect (2005-2013), and Panel B shows the corresponding short (2005-2006), medium (2007-2008), and long (2009-2013) run estimates. Unsurprisingly, these yield similar conclusions to the event study. In the short run, labor income for Katrina victims falls by almost $2,300. The change in income is not statistically significant in the medium run but income is $2,500 higher for Hurricane Katrina victims in the longer run. Labor income is about $1,000 higher over the entire post-Katrina period, although the point estimate is not statistically significant. The probability of non-employment is higher in the short and medium run and marginally lower in the long run. Unemployment claims spike by almost 20 percentage points in the short run, but are significantly lower in the medium and long run. Self-employment income is higher throughout the post-Katrina period (by $138 on average), as are retirement account withdrawals (by $400 on average). SSDI receipt is higher in the medium run, but not in the short or long run.

[TABLE 3 ABOUT HERE]

Our estimates imply that, on aggregate, Hurricane Katrina led to earnings losses of slightly over $860 million in 2005-2006 ($2,266 per household per year $\times$ 189,893 households $\times$ 2 years). However, later gains more than made up for

these losses: in 2005-2013 as a whole, New Orleans victims earned $1.8 billion more than the counterfactual ($1,066 per household per year × 189,893 households × 9 years). Overall, the income losses in the immediate aftermath of the storm are relatively small compared to direct damage.

We next turn to effects of Hurricane Katrina on mobility and family composition (Figure 4). Panel (a) reports whether the household moved cities between the current and previous years. Relative to control households, New Orleans residents were 29 percentage points more likely to leave the city in 2005 and 7.1 percentage points more likely to switch cities in 2006. Starting in 2008, however, mobility rates are somewhat smaller for Hurricane Katrina victims relative to control households.[24] The long-run decrease indicates that the Hurricane may have led those who would have moved in the near future to leave New Orleans sooner. In panel (b), we look at the probability of being in the 2004 city of residence. Relative to matched pairs, an extra 18-27 percent of New Orleans residents did not live in their 2004 city of residence in 2005 and 2006. Over time, that gap falls by almost a third, to 9 percentage points, as people move back to New Orleans.

[FIGURE 4 ABOUT HERE]

Panels (c)-(f) of Figure 4 shows the estimated impact of Hurricane Katrina on household composition. There are fewer child dependents claimed among New Orleans residents in 2005-2009 (panel(c)), but the estimated impact is relatively small (0.010-0.016 fewer children per household). Because Hurricane Katrina struck in August of 2005, the drop in the number of children in that tax filing year cannot correspond to deliberate fertility decisions. Some of this decline may be the result of temporary absences from the household or an increased reliance on

[24] The estimated coefficients are nearly identical when we look at movement between zip codes as opposed to between cities, i.e. there is little differential within-city movement of New Orleans residents relative to the controls.

some social safety net programs, both of which may make a child ineligible to be claimed as a dependent on a tax return.[25] Consistent with this hypothesis, we find in our heterogeneity analysis (Online Appendix Table A11) that the largest and most persistent declines in the number of children claimed occurs in households living in the areas with the most severe physical damages from the storm. This result also suggests that some of this decline may be the result of higher infant or child mortality. We further postulate that this decline partly reflects changes in living arrangements: our heterogeneity analysis reveals that short-run declines in the number of children claimed are observed among the oldest households in our sample. This suggests, perhaps, that some older children move out on their own and some children previously living with grandparents find alternate living arrangements. We also see an overall increase in the number of children claimed by households that migrate out of New Orleans. These households may support the children of their relatives who remained in or returned to New Orleans.

Next, we look at the probability that the tax filer is married, as proxied by a "married, filing jointly" status (panel (d)). While we see no immediate effects on marriage, the probability of being married declines throughout the post-Katrina period. By 2013, Katrina victims are about 1.3 percentage points less likely to be married, a 5 percent reduction relative to the mean. To understand the source of this decrease, the next two panels show results corresponding to whether the tax return status indicates a new marriage or a divorce. New Orleans residents are 0.17 percentage points more likely to get divorced in 2005. After that, flows both into and out of marriage are higher for those affected by Hurricane Katrina.

Table 4 summarizes these results with the more concise specification of equation (2). Mobility is on average 4.1 percentage points higher throughout the

[25] In order to be a qualifying child, the child must have lived with a taxpayer for more than half of the year and must have relied on the taxpayer for more than half of his or her financial support. Social Security benefits, such as SSDI, are considered to be provided by the recipient.

post-Katrina period, driven by a short-run spike in moving rates of over 19 percentage points and a long-run decline of 1.8 percentage points. On average, Hurricane Katrina victims are 15 percentage points less likely to be living in their 2004 city than the control group. We see no statistically significant changes in the number of children, the probability of being married, or new marriages. Divorce rates increase by about 0.15 percentage points, with the largest increase (0.19 percentage points) corresponding to 2007-2008.

[TABLE 4 ABOUT HERE]

B. *Heterogeneity Within New Orleans*

We explore five key dimensions across which one might expect the economic impact of the Hurricane to be heterogeneous: (1) whether a household's own home was severely affected by the storm, (2) pre-Katrina income, (3) age, (4) homeownership, and (5) whether the household left New Orleans. These measures are not unrelated: for example, those who lived in the worst affected areas also had lower incomes, on average. For this reason, we construct our heterogeneity estimates by including all characteristics simultaneously. Here, we focus on four key economic outcomes: labor income, non-employment, retirement withdrawals, and SSDI receipt. Results for other outcomes can be found in the Online Appendix (Tables A4-A11).

While we cannot directly observe the Hurricane's impact on a New Orleans' resident's house, we can use the location of the home as a proxy for the likely severity of property damages. On December 9, 2005, FEMA issued an announcement classifying 10 New Orleans zip codes as "look and stay" zip codes and 7 as "look and leave."[26] The residents of "look and stay" zip codes were permitted to return to their homes permanently at that time. Those who resided in

[26] The full text of the announcement can be found on http://www.fema.gov/news-release/residents-17-orleans-parish-zip-codes-may-return-home-inspect-damage.

the "look and leave" zip codes, which had the greatest damage, could return during the day to conduct repairs as often as they wished but were not allowed to spend the night. Two other New Orleans zip codes had no restrictions.[27]

Another determinant of how well people were able to cope with the storm may be their pre-Katrina wealth. Tax returns unfortunately do not measure a household's stock of wealth, but they do contain AGI, which includes many income sources, such as wage earnings, business income, capital gains, and income from savings. This income flow measure should be correlated with a household's stock of wealth. We classify each household into a "below median" or "above median" income category depending on whether its average 1999-2004 AGI was above or below the median among treated households where the primary tax filer was of the same age. We do not require that the household file a tax return in each of these years, but it must file in at least one year.

We also classify the households in our sample into three groups, based on the age of the primary filer in 2004: (1) those 25 or younger, (2) those aged 25-44, and (3) those 45 or older. Finally, we consider heterogeneity by whether the household left New Orleans or not. Specifically, we classify a household as having left New Orleans if they filed both their 2005 and 2006 tax returns from a non-New Orleans zip code and had over 50% of their labor income reported to a non-New Orleans zip code in those years. This restriction ensures that we are not classifying households who were temporarily displaced as having moved.[28] We further divide this group into those who returned and those who did not return: if a household that left filed a tax return from New Orleans in any year between

[27] The "look and leave"/"look and stay" classifications closely correspond to the extent of flooding. Using post-Katrina flood maps published by FEMA, we calculate that the mean flood depth exceeded 4 feet in each "look and leave" zip code, but did so only in one "look and stay" zip code. One of the two zip codes with no restrictions and three "look and stay" zip codes experienced little or no flooding.

[28] Note that we do not restrict the "stayers" group to be in New Orleans in the entire post-Katrina period, only 2005-2006.

2007-2013 or had the majority of its labor income reported to a New Orleans address during that time period, we consider it as having returned. We classify about 62% of our 2004 New Orleans households as "stayers," 13% as "returners," and 25% as "never-returners."

To summarize, the characteristics we consider consist of the following indicators: household resided in a "look and leave" zip code, household resided in a "look and stay" zip code, household left and returned to New Orleans, household left and did not return to New Orleans, household had below median income in 2004, household head was younger than 25 in 2004, household head was 45 or older in 2004, and household was a non-homeowner in 2004. The reference category is thus a New Orleans household that owned its home, had a household head who was between 25 and 44 years old in 2004, had above median income, did not live in a look-and-leave or a look-and-stay zip code, and did not leave the city in 2005-2006. To estimate heterogeneous treatment effects along these dimensions, we augment equation (2) by replacing the interaction terms $\mathbf{1}[t = Y_1 - Y_2] * NO_i^{2004}$ with interactions between $\mathbf{1}[t = Y_1 - Y_2] * NO_i^{2004}$ and each of the characteristics listed above. We estimate the resulting equation with all the characteristics included simultaneously. We also estimate a variant of this equation with only a single post-period. To ensure that our estimates are not driven by differential group trends that are common to both New Orleans and the controls, we replace year fixed effects with year-by-income-category, year-by-age-category, and year-by-homeowner-category fixed effects.

The results for labor income are shown in Table 5. The first column presents results for a single post-Katrina period, and the next three columns present results for the short-, medium- and long-run post-periods (estimated jointly). The effect of Hurricane Katrina on the reference category, which is composed of prime-age and relatively well-off homeowners who did not suffer much damage from the storm, is large and positive. On average, these individuals

make over $5,000 more in the post-Katrina period than before. They suffer no earnings losses in the short run and have gains in excess of $7,200 in the long run.

[TABLE 5 ABOUT HERE]

A high degree of correlation exists between the physical damage caused by the storm and the negative impact on labor earnings of residents in those areas. Those who lived in look-and-stay areas lose about $2,000 relative to the reference category in 2005-2006, but this difference is only marginally significant. Nonetheless, because of the large gains of the reference category, look-and-stay residents still out-earn the control group in the medium and long run. The drop in income is much larger among those who lived in areas with the greatest damage: relative to the reference group, the labor income of look-and-leave residents is over $4,700 lower in the short run, almost $5,500 lower in the medium run, and almost $6,700 lower in the long run. In the long run, the 2004 look-and-leave residents' earnings are not statistically distinguishable from the control group.

Similarly, the impact of Hurricane Katrina on labor income is highly correlated with the short-run displacement from New Orleans and later decision of whether to return. However, because mobility decisions may not be independent of outcomes, these estimates should be interpreted with caution. The short-run labor income loss of those who did not return is $775 larger than the reference group (which stayed in New Orleans), and their long-run labor income gains are over $1,700 larger. On average, they earn $750 more throughout the post-Katrina period than similar individuals who did not leave. Those who leave and return, on the other hand, suffer much larger short-run income losses and much smaller long-run income gains; on average, their income gains are almost $3,000 lower than the reference category. Combining the returnees and non-returnees into a single "leaver" category yields long-run income gains that are statistically indistinguishable from the reference group but significantly larger than the control group (results available upon request).

Surprisingly, there is little difference in short-run or medium-run income changes by income or age group. In the longer-run, however, we find smaller income gains among lower-income and younger households relative to the reference group, by almost $2,100 and $1,800, respectively. The labor income gains for the oldest individuals are not statistically different from the reference category, although the point estimates are positive. Finally, controlling for all other characteristics, we see no significant differences in labor income trajectories between non-homeowners and homeowners. Overall, the degree of physical damage a household faced and its mobility choice appear to be the largest determinants of the changes to labor income experienced by Katrina victims. We explore potential explanations for these patterns in Section IV.

Next, we consider heterogeneity in the probability of not having any labor income (Table 6). The reference category is 1.5-2.4 percentage points *more* likely to have labor income throughout the post-Katrina sample period. Non-employment is even lower for those who were younger than 25 in 2004 (by 3-4 percentage points) and for those who were non-homeowners (by 0.007-0.013 percentage points). There are no long-run differences in non-employment for those who were 45 or older in 2004 and for those who had below median income. All other groups experience a long-run increase in non-employment relative to the reference group. Those who leave New Orleans experience a larger increase in non-employment in 2005-2006 than the reference group (which may have caused them to leave). The non-employment probability of those who never return remains elevated throughout the post-Katrina period, making their earnings gains even more remarkable.

[TABLE 6 ABOUT HERE]

In Table 7, we consider heterogeneity in retirement distributions. These estimates capture differences not only in disaster-driven need but also in the availability of retirement savings across groups. The reference group withdraws

slightly over $400 in the short run, but does not utilize retirement savings in the medium or long run. By contrast, those who likely faced the greatest relocation costs (i.e., those in look-and-leave zip codes and those who did not return to New Orleans) and older households with a longer horizon to have built up retirement assets show a persistently higher reliance on retirement savings than both the reference and the control groups throughout the post-Katrina period. Those with below median income withdraw substantially less money from retirement savings throughout, while non-homeowners and those younger than 25 withdraw less in the short run but not in the medium or long run. The differences for look-and-stay and returnees are small and largely statistically insignificant.

[TABLE 7 ABOUT HERE]

Finally, we look at heterogeneity in the probability of receiving SSDI (Table 8). The reference category is less likely to be receiving SSDI on average and in the medium and long run. Those living in look-and-leave and look-and-stay zip codes are significantly less likely to receive SSDI in the short run, but no less likely to be receiving it in the medium and long run. Increases in the propensity to receive SSDI are concentrated in those who left New Orleans, and the long-run point estimates are similar in magnitude for those who returned and did not return. Together with the labor income findings, these results suggest that, while many individuals who left New Orleans were able to attain higher earnings, others increased their reliance on the social safety net. Those who had below median incomes or were 45 years or older in 2004 were also more likely than the reference group to be receiving SSDI in the long run. The timing of the positive and negative effects suggests that the non-monotonic pattern of SSDI enrollment for the whole sample may be driven by heterogeneous treatment effects rather than merely changes in the timing of SSDI enrollment.

[TABLE 8 ABOUT HERE]

In the Online Appendix, we present heterogeneity results for unemployment insurance receipt, self-employment income, mobility, and family composition (Tables A4-A11). We highlight some key results here. We find that unemployment insurance receipts rise among households that we might expect to be the most vulnerable to job separations following the storm: those living in areas with physical damage, who left New Orleans after the storm, who are older, or who are poorer. The rise in self-employment income appears to be driven by higher-income households in their prime working years, and those who are least impacted by the storm (e.g., living in areas without physical damage or in look-and-stay areas). Mobility is correlated with neighborhood damage: households experiencing the greatest physical damage are persistently more likely to experience year-on-year moves and less likely to live in New Orleans. Households in the reference group, which contain those who suffered the least physical damage due to the storm, do not move at a higher rate than the control group in the short run, and are *less* likely to move in the medium and long run. They are as likely as the control group to be in their 2004 city of residence throughout the post-Katrina period. Moving in the short run and remaining outside of New Orleans is more prevalent among renters and lower-income households. Younger households are more likely to remain in New Orleans.

C. *Robustness of the Results*

While our labor income and SSDI measures reflect the entire population in New Orleans in 2004, selective filing can bias our results for other variables, especially if Hurricane Katrina changed the probability of filing a tax return. Indeed, in Figure A3 of the Online Appendix, we show that New Orleans residents became less likely to file a tax return in 2005-2008. However, restricting the sample to individuals who file each year does not substantially affect most the results, with the exception of eliminating the post-Katrina increase in divorces

(Online Appendix Figure A1). We have also replicated our estimates without using propensity score weighting or restricting the sample to have common support. Our results for labor income, non-employment, and other outcomes are very similar to the weighted estimates (Online Appendix Figure A2).

Our results are also similar when we use nearest neighbor matching instead of propensity score weighting, matching each New Orleans resident with the control individual who has the closest propensity score, with and without imposing the common support restriction. We have also verified that using Mahalanobis matching, where the pairs are matched using the pre-Katrina characteristics themselves rather than the propensity score, does not change the results meaningfully. Calculating the propensity score using only 1999-2002 data likewise leads to very similar results.

Our results will be biased if external events that happened after 2005 affected New Orleans residents differently than those from the control cities. For example, in April of 2010, the *Deepwater Horizon* oil rig, which was operating in the Gulf of Mexico, exploded and sank, leaving the oil well uncapped. It took responders months to seal the well, during which time spilling oil drastically curtailed fishing and tourist activities in Louisiana and neighboring states. It is reasonable to wonder whether this event had a separate impact on Hurricane Katrina victims' incomes, biasing out long-run estimates. However, we see no discontinuity in 2010, either in levels or in trends, suggesting our estimates are not affected by this event.

Similarly, it is worth considering whether the U.S. recession that began in December of 2007 would have had a similar impact on New Orleans as it did on the controls. In particular, several cities in the control group, such as Detroit and Gary, have a more industrial economy than New Orleans. The impact of the recession could have been larger for these cities. Although the question of how New Orleans would have weathered the recession absent Hurricane Katrina is

fundamentally unanswerable, it is possible to see whether the industrial cities in our control group were disproportionately affected by the recession. We use Regional Economic Information System (REIS) data published by the Bureau of Economic Analysis (BEA) to look at the relative impact of the recession on the counties in which our control cities are located.[29] Except for Portsmouth and Baltimore, all of the cities experience a drop in real per capita income between 2007 and 2009. The largest falls (ranging from 8.2 to 8.6 percent) are in Memphis, Birmingham, and Richmond. Detroit has the largest fall in the average wage income, however, losing 4.3 percent between 2007 and 2009. It is followed by Jackson, Newark, St. Louis, and Memphis, where wage income falls by 1.4-2.1 percent, suggesting that the recession's impact was not necessarily worse for more industrial cities. Nevertheless, we exclude Detroit from our control sample as a robustness check. The estimated effects for key outcomes are very similar. In addition, we see no sharp changes in the estimates in either 2008 or 2009, suggesting that heterogeneous impacts of the recession are not driving our long-run estimates.

IV. What Explains Higher Post-Katrina Labor Income for Storm Victims?

Our results are surprising in two ways: (1) the labor market shocks for the storm victims are small and very transitory and (2) in just a few years the income of those hit by the hurricane *exceeds* those of the controls. These findings stand in stark contrast to studies that track workers over time and find large and long-lasting wage declines following job losses caused by plant closings, sectoral declines, trade shocks, or more stringent environmental regulation (e.g., Ruhm 1991; Jacobson et al. 1993; Neal 1995; Schoeni and Dardia 2003; Kodrzycki 2007; von Wachter et al. 2009; Couch and Placzek 2010; Walker 2013; Autor,

[29] Detailed results available upon request. Baltimore, Portsmouth, Richmond, and St. Louis are independent cities. For them, REIS provides personal income information at the city level.

Dorn, and Hansen 2016). A weather-induced shock like Hurricane Katrina is, of course, different from these economic shocks, most of which devalue a worker's industry-specific human capital. Thus, one might plausibly predict that wage incomes of those hit by the hurricane would eventually equilibrate.[30] What is harder to explain is why income outpaces the controls.

One possibility is that the income increase is nominal as opposed to real. Two non-exclusive mechanisms can produce such an effect. First, living in New Orleans may have become more expensive after the storm. A substantial fraction of the housing stock was destroyed, and regulatory restrictions were placed on new structures. The reduced supply of housing could increase the rental rate of housing, if not offset by reduced demand. Second, if New Orleans had a low cost of living before the storm relative to locations where the displaced New Orleans residents settle, then observed nominal wage incomes might be expected to rise, even though real wages are unchanged.

To assess the mechanisms behind the long-run income gains, we perform several tests.[31] First, we estimate changes in prevailing New Orleans wages after Hurricane Katrina. Using county-level data on average annual pay from the BEA, we see large increases in the New Orleans wage compared to the control cities after 2005. Relative to 2004, the difference in average annual pay ranges from $5,100 to $8,300 in 2006-2011 before falling to $2,400-$2,900 in 2012-2013. Using average annual pay in one's county of residence as the dependent variable, we find that the reference group, which remained in New Orleans after the hurricane, experienced a $3,900 increase in average prevailing pay in the long

[30] Although our unscientific poll suggests this is not what economists predict. In conversation, we have asked roughly 20 academic economists what their prediction is regarding the income path of Katrina victims. Virtually every economist has predicted a larger immediate income decline, greater persistence in income losses, and a steady state with permanent income losses.
[31] See the Online Appendix for the exact estimates.

run. This pattern may explain why those who lived in undamaged areas of New Orleans and who did not leave it also experienced long-run income gains.[32]

To examine whether an increase in the cost of living in New Orleans could explain the income increase among the individuals in our sample and in the city as a whole, we compare post-Katrina housing prices in New Orleans and in our control cities using the Federal Housing Finance Agency (FHFA) housing price index.[33] The seasonally-adjusted housing price indices for New Orleans and the control cities are shown in Figure 5. We normalize the June 30, 2005 index values to 100 for both groups.[34] The vertical dashed line corresponds to August 29, 2005, when hurricane Katrina hit. Prior to Hurricane Katrina, housing prices in New Orleans were on average 4% higher than the control cities, although the two series appear to have been converging. Hurricane Katrina clearly led to a sudden and persistent housing price increase in New Orleans: in the 21 full quarters following the hurricane, New Orleans house prices are nearly 10% higher than the control group. The difference grows over time, reaching about 15% in 2010.[35] This

[32] One possible explanation for the strengthening of the labor market is that New Orleans became a less pleasant (but no more or less productive) place to live. In that case, a basic spatial equilibrium model would predict that real wages would increase to compensate for reduced amenity values, all else equal (Roback 1982). Unfortunately, it is not clear how one would test this for this explanation.

[33] The FHFA index is quarterly and is constructed from repeat transactions on single-family homes, excluding loans that do not conform to Fannie Mae or Freddie Mac loan limits. The geographic areas in the FHFA index are slightly larger than our control cities. For example, in the FHFA data, New Orleans is combined with neighboring Metairie and Kenner. For more details, see the FHFA Technical Documentation and the FHFA FAQ website.

[34] Data for the FHFA index are collected monthly from Freddie Mae and Fannie Mac; thus, Hurricane Katrina will not have affected the June 30th index value.

[35] Our results are very similar if we use the Freddie Mac housing price index or the seasonally unadjusted version of the FHFA index. Using the ACS, we estimate a percentage increase in monthly rents paid by renters that is roughly twice the magnitude of the increase in housing values. One explanation for this difference is that home owners perceive the rise in housing values to be temporary and therefore anticipate future price depreciation relative to other markets. If that is the case, home owners demand a higher short-run rental rate in order to be willing to hold the depreciating asset.

difference in housing prices is close to the average income gains of the reference category (who stayed in New Orleans) and of those who returned.

[FIGURE 5 ABOUT HERE]

Housing is, of course, only one component of overall living costs. Unfortunately, the Cost of Living Index (COLI) published by The Council for Community and Economic Research, which to our knowledge is the most comprehensive local cost-of-living dataset available during this time period, is missing data for New Orleans in 2006-2008 and in 2010-2012. The missing data is surely related to Hurricane Katrina, as other large cities have very few data gaps. Because the majority of Hurricane Katrina victims do not leave New Orleans or return within a few years of the hurricane, our results will be sensitive to the assumptions about the New Orleans cost of living in years with missing data. We linearly interpolate the cost of living in New Orleans using the observed cost of living in 2005, 2009, and 2013. For other locations with at least one year of non-missing data, we fill in missing information with predicted values from a model with location fixed effects and state-by-year fixed effects. Finally, for locations without COLI data, we assume that their cost of living is equal to the minimum observed in the state of their location in each year. The justification for this choice is that locations that are never present in the COLI data are much less urban on average and thus have a lower cost of living. The results when we deflate labor income by the local cost of living are qualitatively similar to our baseline result. We still see a long-run increase in the real wage, although the point estimate is smaller (about $1,500 in 2013) and not significant. Heterogeneity analysis reveals that, in the long run, the reference group is earning over $4,400 more in real terms than the controls. Using the COLI value for one's current city of residence as the dependent variable, we find that the cost of living for the reference group increases by over 4 percent in the long run relative to the

controls. Together, the three analyses discussed above suggest that the income gains for those who stayed in New Orleans were partly nominal and partly real.

Next, we turn to the long-term labor income gains among the movers. A possible explanation for the long-term income gains of this group is the large fixed cost of moving (either financial or psychological). If moving costs are high, then people will rationally forego higher earnings available elsewhere unless the expected benefit of moving is large enough. Under this hypothesis, the forced relocation caused by the hurricane required displaced residents to pay the moving costs, leading to higher wages (although potentially lower utility levels). Kennan and Walker (2010) estimate these fixed costs of moving to be enormous: roughly $300,000 in their sample of white U.S. males. This means that, with reasonable discount rates, a worker might forego as much as $10,000 a year in income if it requires relocation. The magnitude of the wage increase we see empirically is well within that range. The New Orleans labor market was chronically weak prior to Hurricane Katrina. Using labor market data from the Bureau of Labor Statistics and population data from SEER, we compare 1999-2004 unemployment and labor force participation rates in New Orleans to 528 other US counties that have a mean population of at least 100,000, controlling for year fixed effects. The unemployment rate in New Orleans was 1 percentage point higher, relative to a mean of 4.9 percent. Labor force participation as a percent of individuals aged 16-64 was 15 percentage points lower, relative to a mean of 77 percent. A chronically weak labor market combined with high moving costs can in theory explain large earnings gains following an exogenous shock that forces people to move.

One prediction of a model with high fixed costs of moving is that we should observe higher incomes for people who leave New Orleans. Indeed, this is what we see in the data: the increases in labor income are larger for those who left New Orleans and never returned than for those who either stayed in New Orleans or eventually returned. Combining those who did and did not return into a single

"leaver" category also yields long-run nominal income increases over the controls. Those who leave and do not return experience cost of living *decreases* of over 6.5 percent relative to the controls. In real terms, those who leave New Orleans are earning $3,300 more in the long run than those who remain. One reason for this income gain is that they are moving to stronger labor markets, as the prevailing pay in their county of residence is over $3,700 higher in the long run than that of the controls. Thus, relocation away from New Orleans, the strengthening of the New Orleans labor market, and higher living costs in New Orleans all appear to be important drivers of the long-run earnings gains.

A third possible explanation for the earnings growth of Katrina victims is that Hurricane Katrina and its aftermath changed people in a fundamental way. For instance, exposure to tragedy might affect a person's values, identity, level of risk aversion, and so on. These changes might be associated with a greater commitment to the labor market.[36] One manifestation of this phenomenon might be increased investment in education, which would also be consistent with a story in which the temporary lack of jobs makes the opportunity cost of obtaining education lower. Given the limits of our data, it is not obvious how to convincingly test this hypothesis.

A final explanation for the patterns observed – which again is not easy to test in our data – is that the storm destroyed assets which were not fully insured, which increased the marginal benefit of work. The fact that earnings in neighborhoods that were essentially unaffected by Katrina also outpace earnings in the control group, while the earnings of those worst affected do not (see Table 5) provides indirect evidence against this explanation.

V. Conclusion

[36] Anecdotally, it is said that those who grew up in the Great Depression had a lifelong commitment to frugality. Malmendier and Nagel (2011) show that stock market returns during individuals' lifetimes are strongly predictive of their investment behavior.

Hurricane Katrina massively and unexpectedly disrupted the lives of New Orleans residents. The local economy essentially shut down, and hundreds of thousands of people were forced out of their homes. It is not surprising that the immediate economic experiences of the storm victims were negative. What is remarkable, however, is the rapidity with which their economic situation recovered. Undoubtedly, there were enormous non-pecuniary costs borne by the storm's victims; but in our data, within just a handful of years, the income of those affected by the storm actually surpasses those of a matched control group. This rebound appears to be driven both by victims moving to stronger labor markets and by the strengthening of the labor market in New Orleans itself. What makes the strong economic recovery even more remarkable is that the storm struck without warning. In settings where economic agents have more time to prepare for adverse events (e.g. long term climatic changes that make an area less habitable), the adjustment costs would be expected to be lower.

Our findings add to the recent body of literature that empirically demonstrates the economic benefits of relocation (Chetty et al. 2016, Chetty and Hendren 2016, Nakamura et al. 2016). What is different about our findings is that the long-run earnings gains are seen in all age groups and not just younger individuals. In fact, the smallest gains accrue to those who were younger than 25 when the storm hit.

Table 1. Summary Statistics, New Orleans and Control Cities

	Total Population	Median Household Income, 1999	Employment Rate	Median Age	% Black	% Hispanic
		2000				
New Orleans, Louisiana	484,674	$ 31,809	57.80%	33.1	67.25%	3.06%
All Control Cities	370,244	$ 34,603	59.03%	33.0	64.79%	5.27%
Baltimore city, Maryland	651,154	$ 35,261	56.60%	35.0	64.34%	1.70%
Birmingham city, Alabama	242,820	$ 31,342	58.60%	34.3	73.46%	1.55%
Detroit city, Michigan	951,270	$ 34,614	56.30%	30.9	81.55%	4.96%
Gary city, Indiana	102,746	$ 31,882	55.90%	33.6	84.03%	4.93%
Jackson city, Mississippi	184,256	$ 35,655	62.20%	31.0	70.64%	0.79%
Memphis city, Tennessee	650,100	$ 37,849	63.00%	31.9	61.41%	2.97%
Newark city, New Jersey	273,546	$ 31,551	52.70%	30.8	53.46%	29.47%
Portsmouth city, Virginia	100,565	$ 39,557	62.10%	34.5	50.61%	1.74%
Richmond city, Virginia	197,790	$ 36,484	62.40%	33.9	57.19%	2.57%
St. Louis city, Missouri	348,189	$ 31,836	60.50%	33.7	51.20%	2.02%
		2005				
New Orleans, Louisiana	437,186	$ 30,711	55.30%	35.2	66.85%	3.13%
All Control Cities	343,381	$ 31,357	55.31%	33.7	65.32%	6.99%
Baltimore city, Maryland	608,481	$ 32,456	56.40%	35.7	64.89%	2.28%
Birmingham city, Alabama	222,154	$ 27,020	55.10%	34.1	75.52%	2.88%
Detroit city, Michigan	836,056	$ 28,069	45.80%	32.5	81.81%	5.62%
Gary city, Indiana	97,057	$ 25,496	47.20%	32.9	82.64%	--
Jackson city, Mississippi	163,928	$ 31,177	57.50%	31.9	77.42%	--
Memphis city, Tennessee	642,251	$ 33,244	59.90%	33.0	62.91%	4.14%
Newark city, New Jersey	254,217	$ 30,665	56.90%	30.1	50.57%	32.87%
Portsmouth city, Virginia	95,183	$ 40,172	56.50%	35.8	51.73%	1.86%
Richmond city, Virginia	180,757	$ 34,396	61.10%	35.9	55.17%	3.76%
St. Louis city, Missouri	333,730	$ 30,874	56.70%	35.4	50.57%	2.48%

Notes: 2000 and 2005 demographic data are from the 2000 Census and the 2005 American Community Survey. Median household income is calculated in 2005 dollars.

Table 2: Pre-Katrina summary statistics for New Orleans residents

	Mean	Obs.
Panel A: income variables		
Labor income (W-2 and 1099-MISC)	24,171	1,016,952
W-2 income	22,425	1,016,952
W-2 income for filers	28,754	769,897
Adjusted Gross Income	34,961	769,897
Self-employment income	1,009	769,897
Retirement distributions	747	769,897
Percent with no labor income	12.54	1,016,952
Percent with no self-employment income	85.87	769,897
Percent with no retirement distributions	96.5	769,897
Percent with no Social Security income	98.95	769,897
Percent receiving UI	3.78	769,897
Percent receiving SSDI	2.32	1,016,952
Panel B: demographic and household variables		
Age of primary filer	38.21	769,897
Age of secondary filer	43.43	143,813
Percent married	19.69	769,897
Number of kids	0.71	769,897
Percent newly married	1.44	592,709
Percent divorced	1.33	592,709
Percent who own a home	30.16	769,897
Percent that moved cities	16.58	702,090
Percent who are in 2004 city	78.49	1,016,952

Unit of observation is tax filer-year.

Table 3: Economic effects of Hurricane Katrina, full sample

	Labor income	No labor income (×100)	Receives UI (×100)	Self-employment income	Retirement account withdrawals	Receives SSDI (×100)
	Panel A: one post-period					
(2005-2013) x NO in 2004	1,066	0.39	2.64***	138**	400***	0.037
	(1036)	(0.41)	(0.39)	(63)	(72)	(0.135)
	Panel B: three post-periods					
(2005-2006) x NO in 2004 (short run effect)	-2266***	2.40***	19.15***	61*	458***	-0.090
	(662)	(0.35)	(1.21)	(36)	(46)	(0.061)
(2007-2008) x NO in 2004 (medium run effect)	813	1.57***	-2.54***	163***	341***	0.192*
	(930)	(0.42)	(0.17)	(58)	(65)	(0.099)
(2009-2013) x NO in 2004 (long run effect)	2501**	-0.89*	-2.70***	163**	399***	0.026
	(1240)	(0.46)	(0.19)	(80)	(92)	(0.189)
Dep. var. mean	32,823	13.14	7.52	1,142	1,596	3.81
Observations	5,082,810	5,082,810	4,141,733	4,141,733	4,141,733	5,082,810

Standard errors (clustered by 2004 zip code) in parentheses. Significance levels: * 10 percent, ** 5 percent, *** 1 percent. Each regression also includes individual and year fixed effects. Number of observations and dependent variable mean are the same in both panels.

Table 4: Effect of hurricane Katrina on household outcomes, full sample

	Moved cities (×100)	In 2004 city (×100)	Number of kids	Married (×100)	Newly married (×100)	Divorced (×100)
	Panel A: one post-period					
(2005-2013) x NO in 2004	0.041***	-0.152***	-0.009	-0.577	-0.006	0.150***
	(0.009)	(0.021)	(0.010)	(0.439)	(0.062)	(0.044)
	Panel B: three post-periods					
(2005-2006) x NO in 2004 (short run effect)	0.194***	-0.213***	-0.007	0.016	0.014	0.154***
	(0.023)	(0.029)	(0.004)	(0.184)	(0.100)	(0.051)
(2007-2008) x NO in 2004 (medium run effect)	0.007	-0.193***	-0.010	-0.317	-0.005	0.193***
	(0.006)	(0.024)	(0.008)	(0.332)	(0.079)	(0.044)
(2009-2013) x NO in 2004 (long run effect)	-0.018***	-0.111***	-0.010	-0.972	-0.016	0.130***
	(0.005)	(0.018)	(0.014)	(0.634)	(0.061)	(0.048)
Dep. var. mean	0.141	0.709	0.728	25.5	1.93	1.24
Observations	4,074,740	5,082,810	4,141,733	4,141,733	3,640,588	3,640,588

Standard errors (clustered by 2004 zip code) in parentheses. Significance levels: * 10 percent, ** 5 percent, *** 1 percent. Each regression also includes individual and year fixed effects. Number of observations and dependent variable mean are the same in both panels.

Table 5: Heterogeneity in the effects of Hurricane Katrina on labor income

	2005-2013	2005-2006 (short run effect)	2007-2008 (medium run effect)	2009-2013 (long run effect)
Reference category	5066**	432	4258**	7244***
(11,244 households)	(2022)	(1352)	(1887)	(2359)
Look-and-stay	-2,155	-2060*	-1,919	-2,289
(91,715 households)	(1629)	(1055)	(1528)	(1924)
Look-and-leave	-5981***	-4722***	-5452***	-6697***
(73,138 households)	(1583)	(1027)	(1470)	(1861)
Did not return to N.O.	753*	-775***	-134	1718***
(46,822 households)	(407)	(196)	(382)	(517)
Returned to N.O.	-2960***	-2306***	-3151***	-3144***
(24,023 households)	(372)	(261)	(340)	(455)
Below median income in 2004	-1376*	91	-1,068	-2085**
(90,824 households)	(801)	(512)	(740)	(957)
Younger than 25 in 2004	-1086**	329	-739*	-1791***
(30,572 households)	(435)	(346)	(418)	(584)
45 or older in 2004	1,247	639	942	1,612
(76,800 households)	(1450)	(719)	(1132)	(1882)
Non-home owner in 2004	-183	371	387	-632
(139,324 households)	(712)	(552)	(787)	(776)
Dep. var. mean	32,823		32,823	
Observations	5,082,810		5,082,810	
R-squared	0.103		0.105	

Standard errors (clustered by 2004 zip code) in parentheses. Significance levels: * 10 percent, ** 5 percent, *** 1 percent. Each regression also includes the following fixed effects: individual, year-by-income-category, year-by-age-category, and year-by-homeowner category. Estimates in columns 2-4 are from a single regression. Reference category is a New Orleans homeowner who was between 25 and 44 years old in 2004, had above median income, did not live in a look-and-leave or a look-and-stay zip code, and did not leave the city in 2005-2006.

Table 6: Heterogeneity in the effects of Hurricane Katrina on the probability of not having labor income

	2005-2013	2005-2006 (short run effect)	2007-2008 (medium run effect)	2009-2013 (long run effect)
Reference category	-0.020***	-0.015***	-0.015***	-0.024***
(11,244 households)	(0.004)	(0.003)	(0.004)	(0.005)
Look-and-stay	0.009**	0.005	0.010***	0.010**
(91,715 households)	(0.004)	(0.003)	(0.004)	(0.005)
Look-and-leave	0.016**	0.005	0.018***	0.019**
(73,138 households)	(0.007)	(0.005)	(0.007)	(0.008)
Did not return to N.O.	0.071***	0.082***	0.073***	0.066***
(46,822 households)	(0.003)	(0.003)	(0.003)	(0.003)
Returned to N.O.	0.033***	0.099***	0.030***	0.008***
(24,023 households)	(0.003)	(0.006)	(0.003)	(0.003)
Below median income in 2004	0.001	0.014***	0.003	-0.005
(90,824 households)	(0.003)	(0.003)	(0.004)	(0.004)
Younger than 25 in 2004	-0.033***	-0.038***	-0.042***	-0.028***
(30,572 households)	(0.004)	(0.005)	(0.005)	(0.004)
45 or older in 2004	0.011*	0.016***	0.021***	0.005
(76,800 households)	(0.006)	(0.004)	(0.006)	(0.007)
Non-home owner in 2004	-0.011***	-0.007**	-0.008**	-0.013***
(139,324 households)	(0.004)	(0.003)	(0.004)	(0.005)
Dep. var. mean	0.131		0.131	
Observations	5,082,810		5,082,810	
R-squared	0.096		0.097	

Standard errors (clustered by 2004 zip code) in parentheses. Significance levels: * 10 percent, ** 5 percent, *** 1 percent. Each regression also includes the following fixed effects: individual, year-by-income-category, year-by-age-category, and year-by-homeowner category. Estimates in columns 2-4 are from a single regression. Reference category is a New Orleans homeowner who was between 25 and 44 years old in 2004, had above median income, did not live in a look-and-leave or a look-and-stay zip code, and did not leave the city in 2005-2006.

Table 7: Heterogeneity in the effects of Hurricane Katrina on retirement distributions

	2005-2013	2005-2006 (short run effect)	2007-2008 (medium run effect)	2009-2013 (long run effect)
Reference category	94	405***	38	-25
(11,244 households)	(135)	(115)	(119)	(169)
Look-and-stay	93	103	36	113
(91,715 households)	(91)	(93)	(68)	(117)
Look-and-leave	377***	228**	311**	474**
(73,138 households)	(143)	(99)	(123)	(190)
Did not return to N.O.	359***	441***	403***	301***
(46,822 households)	(61)	(73)	(73)	(65)
Returned to N.O.	3	25	83*	-44
(24,023 households)	(48)	(44)	(50)	(67)
Below median income in 2004	-233***	-300***	-235***	-198**
(90,824 households)	(81)	(53)	(83)	(98)
Younger than 25 in 2004	-74**	-161***	-39	-53
(30,572 households)	(35)	(27)	(32)	(47)
45 or older in 2004	648***	444***	619***	762***
(76,800 households)	(209)	(123)	(200)	(267)
Non-home owner in 2004	-167	-338***	-111	-111
(139,324 households)	(114)	(79)	(111)	(147)
Dep. var. mean	1,596		1,596	
Observations	4,141,733		4,141,733	
R-squared	0.029		0.029	

Standard errors (clustered by 2004 zip code) in parentheses. Significance levels: * 10 percent, ** 5 percent, *** 1 percent. Each regression also includes the following fixed effects: individual, year-by-income-category, year-by-age-category, and year-by-homeowner category. Estimates in columns 2-4 are from a single regression. Reference category is a New Orleans homeowner who was between 25 and 44 years old in 2004, had above median income, did not live in a look-and-leave or a look-and-stay zip code, and did not leave the city in 2005-2006.

Table 8: Heterogeneity in the effects of Hurricane Katrina on the probability of receiving SSDI

	2005-2013	2005-2006 (short run effect)	2007-2008 (medium run effect)	2009-2013 (long run effect)
Reference category	-0.532**	-0.039	-0.301*	-0.821***
(11,244 households)	(0.210)	(0.119)	(0.173)	(0.286)
Look-and-stay	-0.053	-0.290***	-0.153	0.083
(91,715 households)	(0.208)	(0.101)	(0.141)	(0.302)
Look-and-leave	0.081	-0.208**	-0.109	0.273
(73,138 households)	(0.221)	(0.105)	(0.154)	(0.318)
Did not return to N.O.	1.177***	0.897***	1.366***	1.214***
(46,822 households)	(0.136)	(0.093)	(0.118)	(0.176)
Returned to N.O.	1.082***	0.674***	1.093***	1.240***
(24,023 households)	(0.156)	(0.099)	(0.158)	(0.221)
Below median income in 2004	0.390***	0.186*	0.428***	0.456**
(90,824 households)	(0.148)	(0.104)	(0.148)	(0.190)
Younger than 25 in 2004	-0.007	-0.097	-0.129	0.079
(30,572 households)	(0.185)	(0.162)	(0.177)	(0.217)
45 or older in 2004	0.441*	-0.118	0.510**	0.637*
(76,800 households)	(0.248)	(0.117)	(0.204)	(0.343)
Non-home owner in 2004	-0.292	-0.239**	-0.333**	-0.297
(139,324 households)	(0.181)	(0.111)	(0.170)	(0.251)
Dep. var. mean	3.81		3.81	
Observations	5,082,810		5,082,810	
R-squared	0.026		0.026	

Standard errors (clustered by 2004 zip code) in parentheses. Significance levels: * 10 percent, ** 5 percent, *** 1 percent. Each regression also includes the following fixed effects: individual, year-by-income-category, year-by-age-category, and year-by-homeowner category. Estimates in columns 2-4 are from a single regression. Reference category is a New Orleans homeowner who was between 25 and 44 years old in 2004, had above median income, did not live in a look-and-leave or a look-and-stay zip code, and did not leave the city in 2005-2006.

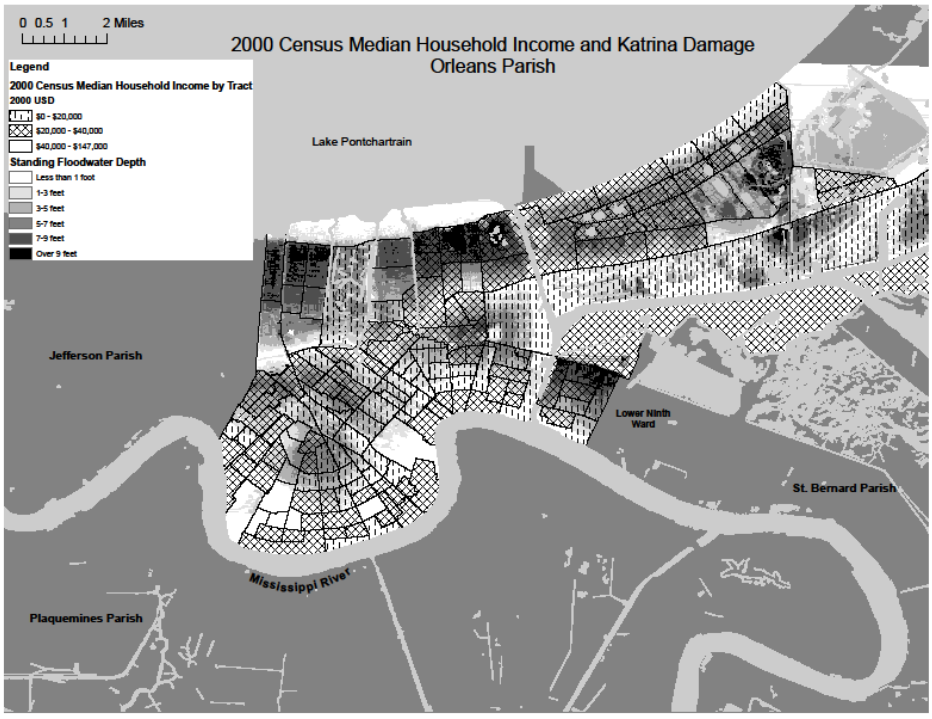
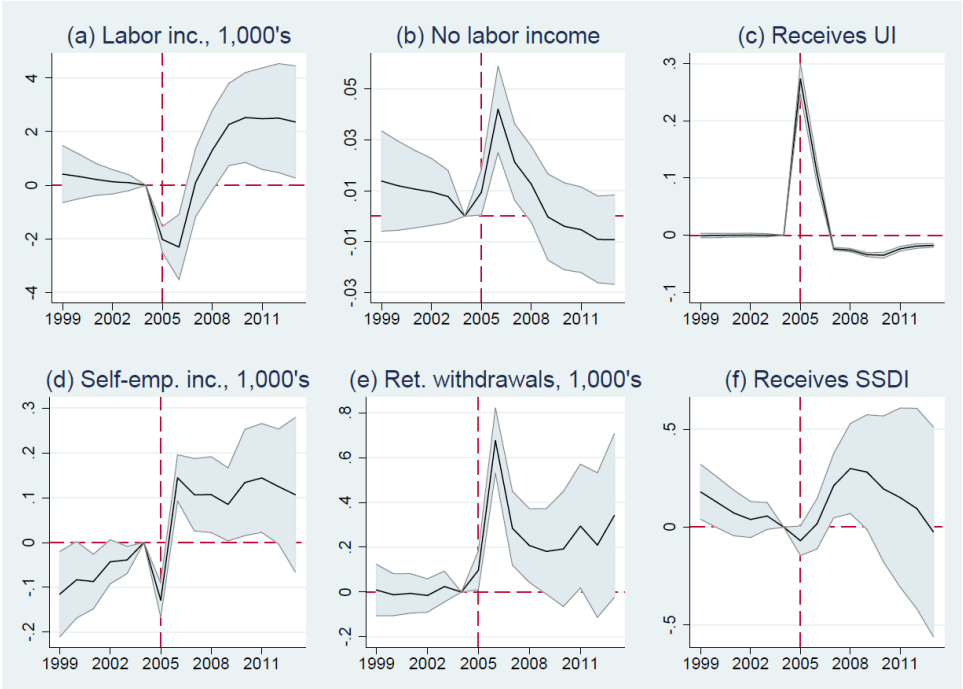

0 0.5 1 2 Miles
2000 Census Median Household Income and Katrina Damage
Orleans Parish
Legend
2000 Census Median Household Income by Tract
2000 USD
$0 - $20,000
$20,000 - $40,000
$40,000 - $147,000
Standing Floodwater Depth
Less than 1 foot
1-3 feet
3-5 feet
5-7 feet
7-9 feet
Over 9 feet
Lake Pontchartrain
Jefferson Parish
Lower Ninth Ward
St. Bernard Parish
Mississippi River
Plaquemines Parish

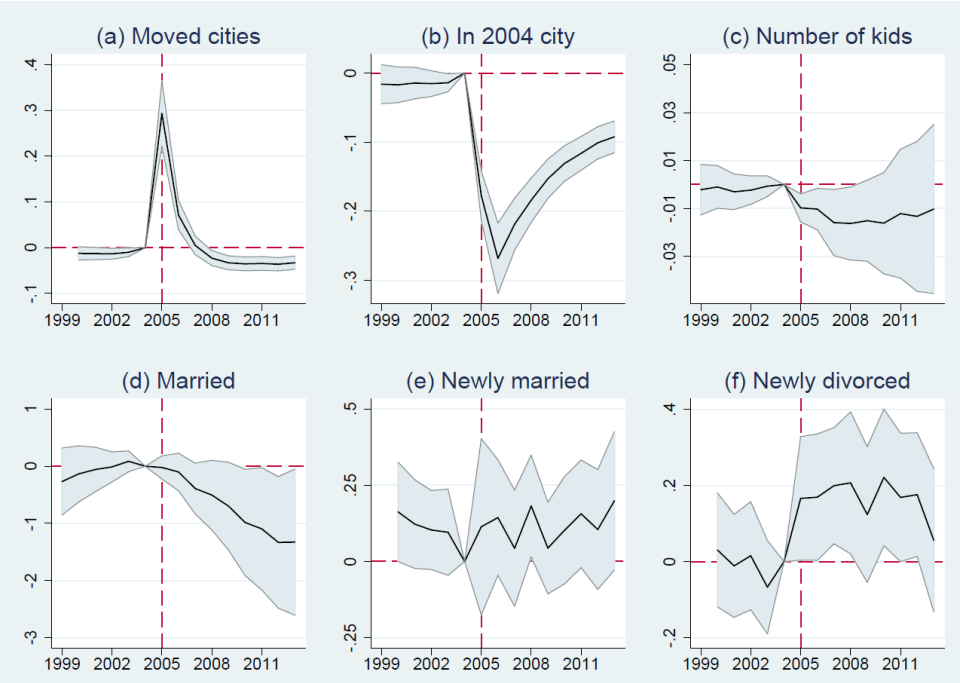
Figure 2. Map of control cities and New Orleans

Figure 3. Average economic effects of Hurricane Katrina



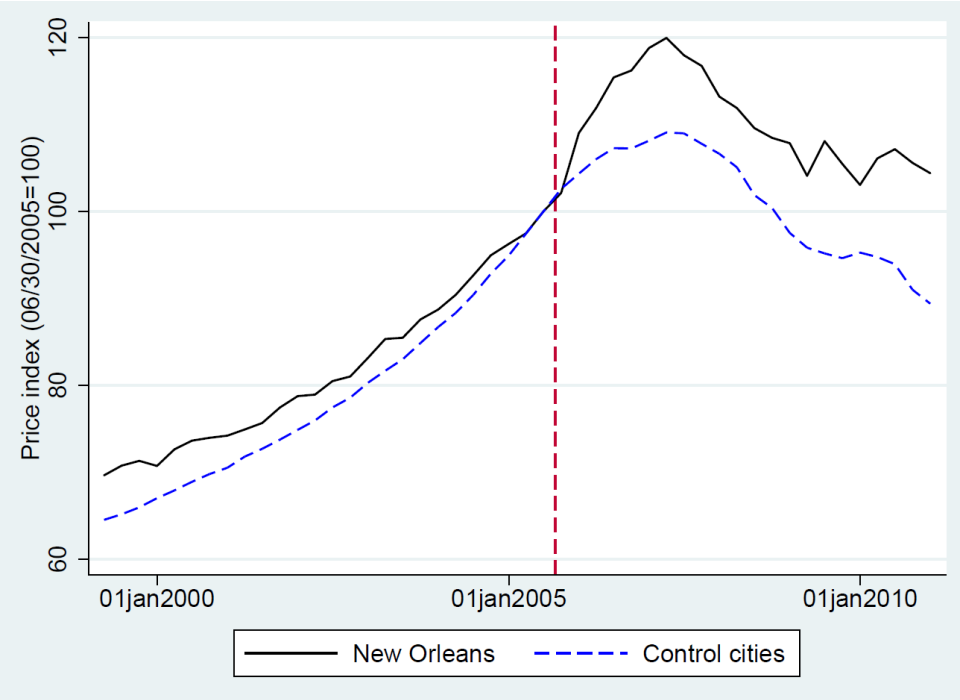
Outcome variables shown above graphs. Filled in areas represent 95 percent confidence intervals. Estimates for "Receives SSDI" are scaled by 100.

Figure 4. Average non-economic effects of Hurricane Katrina



Outcome variables shown above graphs. Filled in areas represent 95 percent confidence intervals. Estimates for married, newly married, and divorced are scaled by 100.

Figure 5. Changes in New Orleans housing prices



Source: Federal Housing Finance Agency (FHFA). Graph shows the quarterly, seasonally-adjusted FHFA housing price indices for New Orleans (solid line) and the other control cities (dashed line), with June 30, 2005 normalized to 100 for both series.

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