

**THE LOCATION OF DISPLACED NEW ORLEANS RESIDENTS
IN THE YEAR AFTER HURRICANE KATRINA**

by

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Abstract

Using individual data from the restricted version of the American Community Survey, we examined the displacement locations of pre-Katrina adult residents of New Orleans in the year after the hurricane. Over half (53%) of adults had returned to—or remained in—the New Orleans metropolitan area, with just under one-third of the total returning to the dwelling in which they resided prior to Katrina. Among the remainder, Texas was the leading location with almost 40% of those living away from the metropolitan area (18% of the total), followed by other locations in Louisiana (12%), the South region of the US other than Louisiana and Texas (12%), and elsewhere in the U.S. (5%). Black adults were considerably more likely than nonblack adults to be living elsewhere in Louisiana, in Texas, and elsewhere in the South. The observed race disparity was not accounted for by any of the demographic or socioeconomic covariates in the multinomial logistic regression models. Consistent with hypothesized effects, we found that young adults (25–39 years of age) were more likely to move further away from New Orleans and that adults born outside Louisiana were substantially more likely to have relocated away from the state.

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INTRODUCTION

On the morning of 29 August 2005, Hurricane Katrina made landfall on the coast of Louisiana. The hurricane—and, especially, the subsequent levees failure—led to the evacuation of New Orleans and the displacement of virtually the entire population of the city. For many, the displacement was temporary, but for others it lasted for an extended duration and was possibly permanent.

The return to New Orleans among residents of the city displaced by Hurricane Katrina has been described and analyzed by a number of studies (Fussell, Sastry, and VanLandingham, 2010; Groen and Polivka, 2010; Paxson and Rouse, 2008; Sastry and Gregory, 2012). For example, Sastry and Gregory (2012) found a lower likelihood of return to New Orleans in the year after Katrina for blacks, residents of flooded areas, young adults, non-citizens, those born outside of Louisiana, and renters. These findings suggest that displaced residents who faced greater costs and fewer benefits from returning were less likely to do so, consistent with general and post-disaster theories about migration decision making (e.g., Morrow-Jones and Morrow-Jones, 1991; Greenwood, 1993; Hunter, 2005).

Information about the locations of displaced New Orleans residents who did not return to the city and knowledge about the factors that shaped location choices away from New Orleans are, however, almost entirely missing from the literature. Reports from the National Academy of Sciences (2007) and Briggs (2006) note that little is known regarding the whereabouts of displaced New Orleans residents. Examining the location of displaced residents—and the demographic and socioeconomic factors associated with moves to particular types of displacement locations—addresses a number of important gaps that are the consequence of displacement on this scale being a relatively rare event, particularly in the U.S. Although natural

disasters occur infrequently, it is crucial to understand whether migration theory in general—and the hypothesized relationships between migration and key demographic and socioeconomic factors—operate as expected or whether the theory and hypotheses need to be modified to account for significant differences. The results may help to reduce future disparities in displacement experiences by race or ethnicity, socioeconomic status, and other factors that may reflect negative outcomes among disadvantaged groups.

There have been only a handful of studies, most of them preliminary or exclusively descriptive, that have investigated where displaced residents from New Orleans resided in the post-Katrina period. The earliest of these studies were based on U.S. Postal Service change of address records in the initial months after the hurricane (e.g., Tizon and Smith, 2005) and reports from the Federal Emergency Management Authority (FEMA) and news sources (e.g., Nigg, Barnshaw, and Torres, 2006). These studies found that many displaced households remained close to New Orleans. However, residents from poorer and predominately black areas of the city were more likely to have been displaced to more distant locations, with the main destinations outside the New Orleans metropolitan area being Houston, Baton Rouge, Dallas, and Atlanta (Tizon and Smith, 2005). The leading initial evacuation site was Houston, from where evacuees were resettled to other locations in Texas, such as Dallas and San Antonio, and to other states, such as Arkansas (Nigg, Barnshaw, and Torres, 2006). By the end of September 2005, Nigg and colleagues determined that evacuees were registered in every state and almost half the zip codes of the U.S., although three-quarters were within 250 miles of New Orleans. While FEMA records provided timely initial information about the location of displaced individuals after Hurricane Katrina, the agency only released tabulated counts of displaced residents by metropolitan area and did not release counts for finer geographic areas or individual-level data

(Plyer, Bonaguro, and Hodges, 2010).

In a descriptive analysis that drew on public use data from the American Community Survey and migration data from the Internal Revenue Service, Frey, Singer, and Park (2007) found that, in the 2006 calendar year, black and low-income displaced residents were more likely to be living in distant locations, while whites and higher-income movers were more likely to have been displaced to near-by locations. The primary destinations for blacks and whites were, respectively, the Houston and New Orleans metropolitan areas. Most remaining studies that examined the location of displaced residents were based on small and select samples (e.g., Li et al., 2010) and hence do not provide generalizable results. Other studies (e.g., Hori, Schafer and Bowman, 2009) focused on displacement within a circumscribed geographic area—the 18 parishes in Louisiana affected by Hurricane Katrina in the case of Hori, Schafer and Bowman’s (2009) analysis—and only described aggregate migration flows. These latter studies highlight one of the key limitations associated with studies of the demographic effects of disasters—namely, the lack of representative and detailed individual-level data (Stallings, 2006). To the best of our knowledge, there have been no studies investigating the relationship between the locations choices of displaced New Orleans residents and individual characteristics hypothesized to shape these choices.

In this paper, we use detailed individual data from the restricted version of the U.S. Census Bureau’s American Community Survey (ACS) to examine the displacement locations of pre-Katrina residents of New Orleans in the year after the hurricane. We address a number of unanswered research questions about the effects of Hurricane Katrina on the New Orleans population, such as: where did displaced New Orleanians reside in the year following the hurricane? What factors influenced where people lived and, in particular, how did the location

of displaced residents vary by demographic and socioeconomic characteristics? The restricted ACS provides a unique opportunity to examine the geographic dispersion of New Orleans residents in the year after Hurricane Katrina: it has a nationally representative sample which includes a large number of individuals who lived in New Orleans prior to Katrina regardless of where in the U.S. they had relocated.

CONCEPTUAL ISSUES AND BACKGROUND

Long-term displacement or resettlement due to natural or human-caused disasters has little precedent in the U.S. and other industrialized countries. Bates (2002) is typical in characterizing natural disasters as “acute disruptions” that produce “short-term” displacements of people from a “geographically limited area” (p. 469). In this sense, the large-scale population displacement due to Hurricane Katrina was largely unimagined, even while destruction of this scale for New Orleans was considered by some to have been only a matter of time in coming (e.g., Fischetti, 2001). Prior to Katrina, Hurricane Andrew of 1992 had been by far the costliest natural disaster of recent history. It led to the evacuation of 350,000 residents of Dade County, Florida, although only about 40,000 residents were permanently displaced and, of these, approximately half relocated to neighboring Broward County (Smith and McCarty, 1996). In contrast, the entire population of New Orleans—comprising of 454,000 inhabitants—was displaced by Hurricane Katrina; our results suggest that about half of this population was displaced away from the New Orleans metropolitan area in the year after the hurricane.

There are generally two types of migration following a natural disaster: forced migration (evacuation), which may be mandated and is typically temporary, and voluntary migration due to an increase in “push factors” (Hunter, 2005). In contrast to the generally positive selection of internal migrants under normal circumstances (Greenwood, 1993)—i.e., the higher likelihood of

moving among those with, for example, higher socioeconomic status and better health—permanent migrants in response to natural disasters in the U.S. have typically been negatively selected—especially those who move longer distances. In particular, people who move due to a natural disaster tend to be older, race or ethnic minorities, socioeconomically disadvantaged, and from female-headed households (Morrow-Jones and Morrow-Jones, 1991).

Although a natural disaster may force people to move, migrants are often still able to choose their destination—if not initially, then usually at a subsequent move. News accounts have suggested, for example, that Katrina evacuees in Atlanta may differ from evacuees in Houston, because the former contains more evacuees who chose Atlanta as a destination, rather than being sent there by authorities (Ellison, 2006). People’s cost-benefit decisions about their migration destinations (Sjaastad, 1962; Lee, 1966) are likely to be influenced by characteristics such as age, sex, marital status, number of children, employment, occupation, and previous migration experience (Greenwood, 1985; Long, 1992), as well as by social networks (Stark and Bloom, 1985) and by contextual factors. Groen and Polivka (2010) and others (e.g., Landry et al., 2007; Sastry and Gregory, 2012) have outlined a conceptual framework that has been widely used to analyze post-Katrina migration decision making. This conceptual framework expands and modifies the standard human-capital investment approach to analyzing migration by accounting for the nature of the initial displacement event; location-specific capital, services, and amenities in New Orleans compared to other places; and the costs and uncertainty associated with return and rebuilding. We adopt this conceptual framework, and briefly describe the distinct ways it applies to analyzing the locations of displaced New Orleans residents.

Low levels of human capital are strongly related to the high rates of poverty and disadvantage among the pre-Katrina population of New Orleans which, in turn, were likely to

have affected evacuation destinations, displacement locations, and the likelihood of return. And the choice of where to evacuate to may have been constrained in possibly unexpected ways among poor families.

New Orleans population trends prior to Hurricane Katrina are likely to have played a role in determining post-disaster outcomes. The New Orleans metropolitan area comprises of seven parishes, of which Orleans Parish, with 454,863 inhabitants in 2005, had the largest pre-Katrina population; the city accounted for about one-third of the total population of 1,338,000 for the metropolitan area (U.S. Census Bureau, 2005). The Orleans Parish boundaries correspond precisely with the incorporated limits of the City of New Orleans, and we use these two names interchangeably. In the years prior to Katrina, New Orleans was steadily losing population. Between 1970 and 2000, the city's population declined by 18%, from 594,000 to 485,000 inhabitants (U.S. Census Bureau, 2001), and it decreased by a further 6% (down 30,000 residents) from 2000 to 2005 (U.S. Census Bureau, 2005). As a result, there were established migration flows to the leading destinations and networks of friends and contacts in those cities. This situation potentially reduced the cost for residents of New Orleans displaced by Katrina to resettle in these new sites. Declining population in New Orleans also meant that many people may have been considering leaving the city and, after being forced to evacuate, may have planned not to return. Findings from research on previous natural disasters—such as Hurricane Andrew (Solecki, 1999)—suggest that existing demographic trends were accelerated by these events.

The composition and characteristics of the New Orleans population at the time of Hurricane Katrina also shaped the effects of the hurricane on the city's population. According to the 2004 ACS, the majority (69%) of New Orleans residents were black. Whites accounted for

28% of the city's population and Asians 2%. New Orleans experienced high rates of poverty prior to Katrina, with 28% of the city's residents living in poverty—a rate that was among the highest in the nation (U.S. Census Bureau, 2000); as elsewhere, such high rates of poverty were associated with crime, shortfalls in the provision of basic services such as health care and education, illiteracy, substandard housing, and lack of opportunity. High rates of poverty and disadvantage among the pre-Katrina population of New Orleans, in particular, were likely to have affected the displacement experience and the likelihood of return. The choice of where to evacuate and resettle may have been constrained among poor families because of their limited resources. This may have made it challenging for them to reestablish connections with displaced friends; and because they could not afford the cost of return visits to the city, they may have been constrained in interacting with neighbors who had returned. Another issue is that there were downsides to returning to the concentrated poverty neighborhoods in New Orleans, particularly for many poor people who experienced better neighborhood environments, job opportunities, schools, and amenities in their new locations. A final issue is that low rates of homeownership among the poor placed a significant barrier for returning to the city because of the difficulty of finding rental housing in New Orleans. Of course, homeowners who were poor faced considerable challenges in either renovating or selling their houses in New Orleans.

In summary, the locations in the year after Katrina among New Orleans residents displaced by the hurricane are likely to have been strongly related to basic socioeconomic and demographic factors. As described below, certain of these basic factors, such as place of birth, also provide clues about underlying social processes that are hypothesized to affect location decisions.

DATA AND METHODS

Data for this study come from the restricted version of the U.S. Census Bureau's American Community Survey, which provides a unique source of information for examining post-Katrina migration location decisions. The ACS includes a large sample of pre-Katrina residents of New Orleans whose residential locations throughout the country are observed in the year after the hurricane. We reweighted this sample to more accurately match the pre-Katrina population of New Orleans and to overcome a concern that the post-Katrina sample may underrepresent certain segments of the population due to differential non-response, choices about dwelling type and living arrangements, and other factors.

The ACS was designed to replace the long form of the decennial census. It is based on a series of monthly national samples and is fielded continuously (U.S. Census Bureau, 2006). The annual sample comprises of 2.3% of households in the U.S., for a total of approximately three million units. The ACS is primarily a mail survey, although there is a telephone follow-up for non-respondents to the mailed questionnaire and an in-person follow-up for non-respondents to the telephone interview. The ACS includes 25 housing and 42 population questions, covering topics such as basic demographic characteristics, schooling, employment, disability, commuting, and dwelling characteristics. An identical set of questions was included in each year of the ACS from 2003 to 2006. The ACS questionnaire is generally completed by one household respondent, who is a member of the household at least 18 years of age. The ACS achieves a 98% response rate and data quality and completeness are very high (National Academy of Sciences, 2007).

Residence rules for the ACS, which determine who is considered a resident at a sampled address, are based on a modified *de facto* rule. Everyone who is currently living or staying at a

sampled address is considered a resident, except for people staying there only for a short period of time (defined as two months or less). The two-month rule might have led to displaced New Orleans residents being missed by the ACS except that, in the aftermath of Hurricane Katrina, respondents were asked to consider as residents any evacuees who were in the household.

Our analysis is based on ACS restricted data from the 10-month period in the first year after the hurricane, from November 2005 to August 2006. The restricted ACS data include the interview date, allowing us to precisely identify those who lived in New Orleans prior to Katrina. Another major advantage of the ACS restricted data is that they provide approximately two-and-a-half times as many cases as the public use data. Finally, the restricted ACS provides unaltered data, in contrast to the public use version that include recodes and edits to protect respondent confidentiality.

For each person in an ACS household reported to have been living in a different dwelling one year previously, the respondent was asked for the location of that previous residence. The response to this question provided the necessary information for identifying every person in an ACS household, from throughout the entire U.S., who was living in Orleans Parish one year previously. To this group, we added people who were currently residing in Orleans Parish and who reported living in the same dwelling one year previously. We thus were able to construct a complete sample of individuals in the ACS from the year after Katrina who were living in New Orleans prior to the hurricane.

The ACS is well-suited to our analysis of place of residence in the year after Katrina, although it has some limitations. First, households selected for the ACS are interviewed only once in the study period and do not provide either retrospective reports on residential locations or durations or information on whether their current location is temporary or permanent; thus, the

pattern of rapid, short-term migration across multiple locations that is likely to have occurred for at least some individuals in the year after Katrina are missed by the survey. A second limitation is that our analysis is based on pooled data for the 10-month period between November 2005 and August 2006, and hence covers initial displacement moves as well as more permanent resettlement. Pooling over the study period provides valuable information about the weighted “average” location of displaced New Orleans residents and is necessary to maximize the sample size for the analysis; stratifying the sample (even into two groups) by date of interview to examine differences in displacement locations over time leads to loss of precision in the estimates.

Propensity Score Weights

We constructed propensity score weights (DiNardo et al., 1996; Rosenbaum and Rubin, 1983) to reweight our analysis sample and address potential concerns about the representativeness of the post-Katrina sample of pre-hurricane New Orleans residents. The reweighting approach allowed us to adjust for differences in the distributions of observed individual characteristics between the constructed post-Katrina sample and a reference sample comprising of all actual residents of New Orleans in the ACS from a 20-month period between January 2004 and the date of Hurricane Katrina in August 2005. The main assumption underlying propensity score reweighting is that there are no unobserved effects (operating to influence the likelihood of an observation appearing in the post-Katrina sample compared to the pre-Katrina sample) that are correlated with the disturbance terms in the migration model.

The estimated propensity score is a number in the unit range and represents the probability that an observation is from the post-Katrina period, given the observed set of characteristics. The propensity score was estimated by pooling the pre- and post-Katrina cross-

sectional data and estimating a logistic regression model that incorporated the ACS person sampling weights. The model included categorical variables that were time-invariant (e.g., sex and race/ethnicity) and that were not affected by the hurricane (e.g., age in five-year intervals and educational attainment). Because the representativeness of the post-Katrina sample may have varied over time, we estimated a separate propensity score model for each two-month interval in the post-Katrina period. The propensity score was calculated as the predicted probability that an observation came from the post-Katrina cross-section, which was then used to construct the associated weight.

The estimated propensity score weights were well-behaved. The underlying models fit the data well and the covariates were plausibly exogenous. If the covariates used in the propensity score model were strongly correlated with whether an observation appeared in the pre- or post-Katrina cross-section, then the estimated weights may take on extremely large values for some individuals. Variability in weights is a potential problem because individuals with large weights can dominate the weighted analysis and this can lead to large variances of the estimates. We examined variability in the weights and found this not to be a problem.

For our analyses, we used the product of the estimated propensity score weights, w_i , and the ACS person sampling weights, s_i . We normalized these weights so that the mean of the products of the two weights equals one.

Preliminary Analysis of ACS Data

Our preliminary analysis of the ACS data focused on several issues. First, we investigated the representativeness of the post-Katrina sample through discussions with Census Bureau staff and an analysis of the ACS data. Second, we examined characteristics of the sample and the survey measures in order to determine what types of restrictions to the analysis

sample were necessary.

The disruption associated with Hurricane Katrina and its aftermath obviously had a major effect on fieldwork operations for the ACS. We determined that ACS data for September and October 2005 were not reliable. But, by November 2005, ACS operations in the region affected by Katrina were back to normal and the new instructions to include any evacuees due to Hurricane Katrina in the list of household residents were operating effectively.

We restricted both the pre- and post-Katrina analysis samples to those aged 25+ years as of December 31, 2005. Because most adults have completed their schooling by this age (or have entered the highest education category), this restriction allowed us to consider educational attainment as an age- and time-invariant characteristic and to use it as a proxy for socioeconomic status. The ACS has very high levels of item completeness, which resulted in almost no observations needing to be dropped because of missing information on key variables.

Our analysis focuses on the place of residence in the year after Hurricane Katrina among the pre-hurricane population of New Orleans, and is based on individuals' reported location at the time of the ACS interview. Individuals outside of Louisiana were classified first by state and then, based on a preliminary analysis, into three separate locations—Texas, elsewhere in the South Census Region other than Louisiana and Texas,¹ and elsewhere in the U.S. outside of the South Region. Among individuals within Louisiana, we classified those in the New Orleans metropolitan area separately from those elsewhere in the state. This final set of location categories represents five distinct geographic areas. Although the categories are not strictly ordered by distance from New Orleans, they reflect the predominant locations of displaced residents that balance the size of each category against its geographical distinctiveness.

¹ Oklahoma, Arkansas, Tennessee, Mississippi, Kentucky, Alabama, West Virginia, Virginia, South Carolina, North Carolina, Maryland, Georgia, Florida, the District of Columbia, and Delaware.

Variables

Independent variables for our analysis include basic demographic characteristics, such as each individual's age, race, and sex; background variables, such as place of birth and citizenship; and socioeconomic status, measured by educational attainment. These variables represent the basic underlying factors that shape migration decision making, and reflect the limits to the types of measures collected in the ACS. However, certain of these variables provide insights into other processes hypothesized to affect choices regarding place of residence—for example, the place of birth variable that identifies Louisiana-born adults indicates the likelihood of having stronger local family and friendship ties.

Summary statistics for the independent variables are presented in Table 1. The two columns in this table both show estimates for the same population—namely, the pre-Katrina adult population of New Orleans aged 25+ years—based on two independent samples. The first column shows estimates for the period prior to the hurricane (based on a total of 3,525 observations), while the second column shows estimates for the post-hurricane period (2,784 separate observations). The pre-Katrina estimates are weighted using the ACS person sampling weights; the post-Katrina estimates are weighted using the ACS person sampling weights and the propensity score weights. The first result to note is the similarity between the estimates in these two columns. Although there are a few minor differences, in general the sampling weights and the propensity score weights yield close estimates of characteristics for the same population at two different points in time.

[TABLE 1 ABOUT HERE]

The estimates themselves show that almost two-thirds of the pre-Katrina adult population of New Orleans was black. Just under half of adults had a high-school diploma or less

education, about 20% had some college, and the remaining 30% had a bachelor's or graduate degree. Just under one-third of the adult population was young adults aged 25 to 39 years, 45% were prime-aged adults aged 40 to 59 years, and the remaining one-quarter were 60+ years of age. The population had more females (55%) than males (45%). About three-quarters of pre-Katrina adult residents of New Orleans were born in the state and well over 90% were U.S. citizens.

Statistical Models

We estimated weighted multinomial regression models to examine the location of displaced New Orleans residents in the year after Hurricane Katrina based on the five location categories. We report robust standard error estimates, which adjust for the clustering of individuals by household.

RESULTS

We present results of a descriptive analysis first, before turning to the results of our regression analysis.

Descriptive Results

Table 2 shows that over half (53%) of pre-Katrina adult residents of New Orleans had returned to—or remained in—the New Orleans metropolitan area in the year after the hurricane, with just under one-third of the total returning to the dwelling in which they resided prior to Katrina. One-quarter of those who returned to Orleans Parish (13% of the total) did so to a different dwelling, while the remainder (15% of the returned; 8% of the total) resided in a different dwelling in the metropolitan area outside of Orleans Parish.

There were major disparities in return rates by race, with blacks substantially less likely to return to the New Orleans metropolitan area than nonblacks (44% vs. 67%), with larger

differences by race in returning to the same dwelling (22% for blacks vs. 46% for nonblacks) than in returning to a different dwelling in the city or in the metropolitan area outside of Orleans Parish.

[TABLE 2 ABOUT HERE]

In the year after the hurricane, just under half (47%) of pre-Katrina adults from New Orleans were displaced—which we define as residing away from the metropolitan area. Texas was the leading location of displaced residents, with almost 40% of those who were living away from the metropolitan area (18% of the total). The numbers in Texas exceeded those who had relocated to another place in Louisiana (about one-quarter of those away from the New Orleans metropolitan area; 12% of the total). The South Region of the U.S. (other than Louisiana and Texas) was the location of about one-quarter of the displaced population (12% of the total), with the leading locations being Georgia (3.4% of the total), Alabama (1.8%), Mississippi (1.7%), and Florida (1.7%). Of note is the small percentage of displaced adult residents in neighboring states other than Texas: only 2% of adults from New Orleans were in Arkansas or Mississippi in the year after Katrina. In contrast, more than four-out-of-five (83%) adults from New Orleans were in either Louisiana or Texas in the year following the hurricane. Finally, states outside the South Region were the location of just 5% of pre-Katrina adult residents of New Orleans, with California (1.1% of the total), New York (0.5%), and Ohio (0.4%) being the three leading destinations.

Blacks were moderately more likely than nonblacks to be living elsewhere in Louisiana in the year after Katrina (15% vs. 9%), but were substantially more likely than nonblacks to be residing in Texas (25% vs. 7%). A higher percentage of nonblacks than blacks were residing outside the South Region in the study period (8% vs. 4%).

Regression Results

Our multinomial regression results are presented in Tables 3 and 4. There are four panels in Table 3, corresponding to each of the comparisons between the baseline (omitted) outcome of staying or returning to the New Orleans metropolitan area with the four other outcomes: residing elsewhere in Louisiana, in Texas, elsewhere in the South Region (other than Louisiana or Texas), or elsewhere in the U.S. Each panel shows the results for race and education from six different model specifications. The models examine the effects of race alone (Model 1), education alone (Model 2), race and education (Model 3), the full set of individual covariates (Model 4), race-education interactions alone (Model 5), and the full set of individual covariates with interactions between race and all of the covariates except citizenship and veteran status (Model 6). In Table 4 we present the full set of estimated results for all of the covariates in Model 4.

The entries in Tables 3 and 4 show the exponentiated parameter estimates, along with robust standard errors (in parentheses) and an indicator of the statistical significance of each parameter estimate. The exponentiated parameters are interpreted as ratios of relative risks. Thus, the first entry in Table 3 shows that, compared to blacks (the omitted category), nonblacks had a relative risk of residing elsewhere in Louisiana compared to residing in the New Orleans metropolitan area that was lower by 0.387 times, or by 61%. The three asterisks indicate that this coefficient is statistically significant at the .001 level. For models with interactions, we presented parallel parameter estimates for blacks and nonblacks and discuss the estimated interaction effects (and statistical tests of these effects) in the text.

[TABLE 3 ABOUT HERE]

We begin by examining differences by race in the post-Katrina location of adult New Orleanians from Model 1 in Table 3. Compared to blacks, nonblacks were substantially less

likely to be residing elsewhere in Louisiana, in Texas, or elsewhere in the South relative to residing in the New Orleans metropolitan area; however, there were no statistically significant differences by race in the likelihood of residing elsewhere in the U.S. relative to living in the New Orleans metropolitan area. In other words, nonblacks were much more likely than blacks to have returned to (or remained in) the New Orleans metropolitan area in the year after Katrina, but, conditional on not having returned, nonblacks were more likely to have relocated outside of the South Region.

Model 2, which examines differences in post-Katrina locations by educational attainment, shows that, taken together, there was a statistically significant set of differences. This result is driven by contrasts between residing in the New Orleans metropolitan area compared to residing elsewhere in Louisiana or in Texas. Adults with greater educational attainment were substantially less likely to be residing in either of these latter two areas than in metropolitan New Orleans. In both cases, adults who completed a college or graduate degree were about half as likely than those with just a high school diploma to be residing elsewhere in Louisiana or in Texas compared to residing in the New Orleans metropolitan area. There were no differences by educational attainment in the likelihood of residing elsewhere in the South or elsewhere in the U.S. relative to living in the New Orleans metropolitan area.

When we controlled for both race and education in Model 3, there was essentially no change in the estimated location differences by race; however, the effects by education disappeared. In particular, not only was the joint effect of education in Model 3 statistically insignificant, but there were no individually significant parameter estimates either. Thus, the observed differences in post-Katrina locations by education are entirely due to differences by race rather than by education itself.

Model 4, which adds all of the remaining covariates to the previous model, yielded the same pattern of results for the effects of race and education on the post-Katrina locations of adults from New Orleans. Although there were minor changes in the effects of some parameters, race differences continued to be statistically significant while education differences were insignificant.

Interactions between race and education are featured in Model 5, with a parallel set of estimates for blacks and nonblacks displayed. The nonblack effects shown are the sums of the main effects (for blacks) and the interaction effect (representing the differential effect for nonblacks compared to blacks). At the bottom of each panel, we also present the total effect of race, which summarizes differences between blacks and nonblacks by calculating a weighted average across each of the education categories (with the weights based on the distribution of the population by category) and factoring in the race main effect.

The general findings from Model 5 are the presence of some statistically significant educational differences in post-Katrina locations for nonblacks, but essentially no effects of education for blacks. A consistent result is the higher likelihood of displacement among the least educated nonblacks (i.e., those who are high school dropouts): they were 6.7 times more likely to than those with a high school diploma to be living elsewhere in Louisiana relative to living in the New Orleans metropolitan area; 2.9 times more likely to be living in Texas; and 3.5 times more likely to be living elsewhere in the South. There is also evidence that nonblack adults with some college education were more likely to have relocated away from the New Orleans metropolitan area than nonblack adults with a high school diploma. Finally, nonblack adults with a college education were less likely to reside in Texas than in any other location, although the effect was statistically significant only for those with a bachelor's degree. The total effects for nonblacks in

Model 5 reveal a set of findings very similar to those from the previous models—particularly the results from Model 3, which controlled for education but without an interaction by race.

Model 6 includes the full set of covariates as well as race interactions for all variables except citizenship and veteran's status (because of small cell sizes with race interactions for these two variables). The findings from the previous models generally hold, with one difference being the appearance of stronger covariate effects for nonblacks than for blacks. This was the case for education in the previous model, but even this effect is strengthened: nonblacks with the highest educational attainment (i.e., with a bachelor or graduate degree) were even less likely (than in the previous model) to be living in Texas relative to living in New Orleans compared to nonblacks with a high school diploma. No similar pattern emerged for blacks.

Finally, the total disparity by race in the likelihood of living in any of the three out-of-state locations (Texas, elsewhere in the South, or elsewhere in the U.S.) relative to living in New Orleans was higher in Model 6 than in any of the earlier models. For example, the likelihood of living elsewhere in the South rather than in the New Orleans metropolitan area was 70% lower for nonblacks than for blacks in Model 6; in contrast, the observed difference by race (from Model 1) indicated that nonblacks had only a 49% lower observed likelihood of this outcome. This finding suggests that among the covariates in Model 6—age, sex, place of birth, marital status, citizenship, and veteran status—the covariate values that occur more frequently among blacks are together associated with a higher likelihood of remaining in New Orleans compared to relocating to these other locations; thus, after controlling for these covariates, the observed disparities by race become larger.

We next turn to the results in Table 4, which show the estimated effects for all of the covariates. Several of the covariates had statistically significant associations with post-Katrina

locations. There were significant effects of age, with young adults substantially more likely than middle-aged adults to be in each location away from the New Orleans metropolitan area. Compared to middle-aged adults (aged 40–59 years), those aged 25–39 years were 60 percent more likely to be living elsewhere in Louisiana relative to living in metropolitan New Orleans, between 75 and 80 percent more likely to be living in Texas or elsewhere in the South, and almost three times more likely to be elsewhere in the U.S.

Adults born outside of Louisiana were three-times more likely than those born in Louisiana to have relocated away from Louisiana and Texas relative to remaining in metropolitan New Orleans, with similar likelihoods of being elsewhere in the South or elsewhere in the U.S. Finally, non-citizens were substantially more likely than U.S. citizens to be living in Texas relative to living in the New Orleans metropolitan area; they were also more likely to be living elsewhere in Louisiana or elsewhere in the U.S. relative to living in metropolitan New Orleans, although these effects were only statistically significant at the .10 level. These statistically significant results for the other covariates in Table 4 correspond closely to the hypothesized effects from the standard human-capital investment model of migration.

CONCLUSIONS

We used data from the restricted version of the U.S. Census Bureau’s American Community Survey to examine the post-Katrina locations of adults aged 25 years and older who lived in New Orleans before the hurricane. Our analysis focused on outcomes during a 10-month period in the first year after the hurricane, from November 2005 to August 2006, among all individuals throughout the country who reported living in New Orleans one year previously. We generated a set of modified weights, based on a propensity score analysis, that balanced the post-Katrina population against a pooled sample of pre-Katrina residents who lived in the city and

were interviewed for the ACS between January 2004 and August 2005. Although the pre-Katrina and post-Katrina samples were quite similar, the propensity score weighting procedure further enhanced the comparability between the two samples.

Our analysis addressed a number of unanswered research questions regarding the effects of Hurricane Katrina on the New Orleans population. First, we described the locations where displaced adult New Orleanians resided in the year after the hurricane. Although just over half (53%) had returned to (or stayed in) metropolitan New Orleans, two-thirds of those who were displaced were living elsewhere in Louisiana or in Texas. Thus, the vast majority of adult residents of New Orleans at the time of Katrina remained relatively close to the city. Just 17% of adults were outside these two states and, among that group, 70% were elsewhere in the South Census Region in states such as Georgia, Alabama, Mississippi, and Florida. This result has implications for policies and programs to encourage displaced residents to return to the city; for example, the close proximity to New Orleans suggests that financial and non-pecuniary costs for relocating back to the city might be reasonable for many displaced residents. The high fraction of displaced blacks who were in Texas suggest that policies to ensure a racial balance in return rates might have targeted this state in order to increase the number of blacks who returned to New Orleans, and that policies intended to reduce disparities in return migration following future disaster-related population dislocations might target areas that similarly receive a large share of evacuees whose location choices were strongly influenced by government-coordinated evacuation efforts.

Second, we investigated the demographic and socioeconomic factors influencing where pre-Katrina residents lived in the year after the hurricane, using a sequence of multinomial regression models. One goal was to determine whether migration theory in general—and the

hypothesized relationships between migration and key demographic and socioeconomic factors—operates as expected. Our results suggest that the hypothesized relationships do indeed hold for this event. A major focus was on differences between blacks and nonblacks, based on previous research that found major race disparities (favoring nonblacks) in the likelihood of returning to New Orleans in the year after the hurricane (Fussell, Sastry, and VanLandingham, 2010; Groen and Polivka, 2010; Paxson and Rouse, 2008; Sastry and Gregory, 2012).

We found that blacks were considerably more likely than nonblacks to be living elsewhere in Louisiana, in Texas, and elsewhere in the South in the year after Katrina. The observed race disparity was not accounted for by any of the demographic or socioeconomic covariates in the models. Factors other than the measured characteristics from the ACS apparently account for differences by race in post-Katrina location decisions. Based on previous research, barriers to returning to New Orleans—such as a flood-damaged dwelling—were likely to have been among the key unmeasured factors.

Young adults (25–39 years of age) were more likely to have moved further away from New Orleans. This finding is consistent with the hypothesized age effect, which indicates that young adults will invest in such moves because they have a longer period over which to accrue returns. Younger nonblacks were more likely to move further away from New Orleans than were younger blacks.

Consistent with hypothesized effects of social and family networks on migration patterns, we found that adults born outside of Louisiana were substantially more likely to have relocated away from the state. This effect was stronger for nonblacks than for blacks. Although this is an important effect, its impact for New Orleans is balanced by the fact that the city had among the highest proportion of the population born in-state of any major U.S. city (based on our analysis

of data from the 2000 Census).

The main indicator of socioeconomic status—educational attainment—had no effect on the post-Katrina locations of blacks. However, for nonblacks there was a consistent finding that the least advantaged socioeconomic group (high school dropouts) was more likely to be displaced to any location outside New Orleans. This latter finding matches results from previous disaster research (Morrow-Jones and Morrow-Jones, 1991).

When looking at the characteristics of displaced New Orleans residents by location, we found that the groups most likely to be residing in Texas or elsewhere in Louisiana were, respectively, blacks and the least educated nonblacks. Texas was the prime destination for black adults—and, in particular, for young black adults. Texas was notably not a destination for nonblacks of higher socioeconomic status. Locations in Louisiana outside the New Orleans metropolitan area were where a disproportionately large fraction of the least educated nonblacks were living in the year after Katrina. Displaced New Orleans residents found in locations outside of these two states were considerably more likely to have been born outside of Louisiana and to be younger (aged 25–49 years) adults. Taken together, these findings describe a relatively clear set of location preferences among displaced New Orleans residents, which follow the pre-Katrina migration streams from the city (see Frey, Singer, and Park, 2007).

This paper has provided the first set of detailed analytical results regarding the locations of displaced New Orleans residents in the year after Hurricane Katrina. The analysis has also highlighted the considerable value of the ACS for studying migration and, especially, the demographic effects of large-scale human-caused and natural disasters. The ACS, which has replaced the long form of the decennial census in the U.S., provides excellent opportunities for studying migration behavior. The status of the ACS as a continuous, on-going national survey

also makes it uniquely positioned for examining the population effects of large-scale human caused and natural disasters. Although it is straightforward to create comparable samples from before and after an event, the use of enhancements such as propensity score reweighting lead to more accurate and reliable comparisons between pre-disaster and post-disaster populations.

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Table 1. Descriptive Statistics for Pre-Katrina Adult Residents of New Orleans in 2004–2005 (Pre-Katrina) and in 2005–2006 (Post-Katrina)

Variable	2004–2005 ACS		2005–2006 ACS	
Race				
Black	62.7%	(1.5%)	61.6%	(1.5%)
Nonblack	37.3%	(1.5%)	38.4%	(1.5%)
Education				
HS dropout	17.5%	(1.0%)	17.2%	(1.0%)
High school	29.8%	(1.3%)	29.1%	(1.2%)
Some college	22.2%	(1.0%)	22.6%	(1.1%)
Bachelor's	19.2%	(1.1%)	19.8%	(1.1%)
Graduate	11.3%	(0.7%)	11.3%	(0.7%)
Age				
25–39	30.6%	(1.3%)	30.3%	(1.3%)
40–59	44.3%	(1.3%)	44.6%	(1.3%)
60+	25.0%	(1.1%)	25.1%	(1.1%)
Sex				
Female	55.6%	(0.9%)	54.9%	(1.0%)
Male	44.4%	(0.9%)	45.1%	(1.0%)
Place of birth				
Louisiana	73.1%	(1.2%)	73.1%	(1.2%)
Elsewhere	26.9%	(1.2%)	26.9%	(1.2%)
Marital status				
Ever married	70.7%	(1.2%)	70.1%	(1.3%)
Never married	29.3%	(1.2%)	29.9%	(1.3%)
Citizenship				
U.S.	92.9%	(0.8%)	93.2%	(0.8%)
Non-U.S.	7.1%	(0.8%)	6.8%	(0.8%)
Veteran				
Yes	89.8%	(0.6%)	87.3%	(0.8%)
No	10.2%	(0.6%)	12.7%	(0.8%)
Observations	3,525		2,784	

Notes: Standard errors in parentheses. The 2004–2005 ACS estimates are based on individuals residing at the time in the City of New Orleans and are weighted using the ACS weights; the 2005–2006 ACS estimates are based on individuals throughout the U.S. who reported living in the City of New Orleans one year previously and are weighted using the product of the ACS weights and the propensity score weights.

Table 2. Residential Location After Katrina of Pre-Katrina Adult Residents of New Orleans

Location	All	Race	
		Black	Nonblack
New Orleans metropolitan area	52.5%	43.6%	66.8%
Pre-Katrina dwelling	31.4%	22.3%	46.0%
Different dwelling in City of New Orleans	13.2%	14.8%	10.6%
Metropolitan New Orleans, outside City of New Orleans	7.9%	6.5%	10.3%
Elsewhere in Louisiana	12.3%	14.6%	8.7%
Texas	18.3%	25.5%	6.8%
South Region outside of Louisiana and Texas	11.7%	12.8%	10.0%
Georgia	3.4%		
Alabama	1.8%		
Mississippi	1.7%		
Florida	1.7%		
Maryland	0.7%		
Arkansas	0.7%		
Tennessee	0.6%		
South Carolina	0.4%		
Other state in South Region ^[a]	0.9%		
U.S. outside of South Region	5.2%	3.5%	7.7%
California	1.1%		
New York	0.5%		
Ohio	0.4%		
Other state in the U.S.	3.1%		
Total	100.0%	100.0%	100.0%
Observations	2,784	1,434	1,350

Notes: Estimates based on 2005–2006 ACS respondents from throughout the U.S. who reported living in the City of New Orleans one-year previously.

[a] Oklahoma, Kentucky, North Carolina, West Virginia, Virginia, Delaware, and the District of Columbia.

Table 3. Multinomial Logistic Regression Models of Residential Location among pre-Katrina Adult Residents of New Orleans

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
A. Elsewhere in Louisiana compared to New Orleans Metro						
Race						
Black†						
Nonblack	0.387*** (0.087)		0.437*** (0.108)	0.446*** (0.107)	0.136*** (0.062)	0.129*** (0.067)
Education					<i>Black</i>	<i>Nonblack</i>
HS dropout	1.034 (0.271)	1.037 (0.280)	1.106 (0.294)	0.707 (0.193)	6.703** (4.567)	0.793 (0.221)
High school†						6.354** (4.094)
Some college	1.108 (0.269)	1.224 (0.300)	1.198 (0.299)	0.997 (0.300)	3.893** (1.821)	0.973 (0.297)
Bachelor's	0.544* (0.155)	0.770 (0.228)	0.740 (0.215)	0.717 (0.349)	2.135 (1.030)	0.713 (0.338)
Graduate	0.460** (0.133)	0.689 (0.199)	0.704 (0.207)	0.626 (0.289)	1.991 (0.968)	0.713 (0.335)
Total effect						
Black†						
Nonblack					0.387*** (0.097)	0.402*** (0.102)
B. Texas compared To New Orleans Metro						
Race						
Black†						
Nonblack	0.175*** (0.037)		0.190*** (0.046)	0.142*** (0.035)	0.256** (0.115)	0.166*** (0.085)
Education					<i>Black</i>	<i>Nonblack</i>
HS dropout	1.161 (0.236)	1.167 (0.252)	1.245 (0.266)	0.920 (0.208)	2.920* (1.543)	1.026 (0.232)
High school†						2.494# (1.325)
Some college	1.021 (0.201)	1.199 (0.251)	1.151 (0.247)	1.223 (0.280)	0.603 (0.326)	1.180 (0.275)
Bachelor's	0.442*** (0.115)	0.823 (0.235)	0.801 (0.232)	1.159 (0.384)	0.295* (0.151)	1.177 (0.395)
Graduate	0.429*** (0.110)	0.901 (0.254)	0.869 (0.256)	1.131 (0.427)	0.617 (0.310)	1.262 (0.501)
Total effect						
Black†						
Nonblack					0.190*** (0.042)	0.134*** (0.033)

Continued

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
C. Elsewhere in South compared to New Orleans Metro						
Race						
Black†						
Nonblack	0.506*** (0.106)		0.478*** (0.111)	0.302*** (0.081)	0.364* (0.150)	0.218** (0.123)
Education					<i>Black</i>	<i>Nonblack</i>
HS dropout	0.928 (0.256)	0.931 (0.260)	0.950 (0.270)	0.613 (0.202)	3.418** (1.567)	0.639 (0.215)
High school†						3.320** (1.476)
Some college	1.348 (0.321)	1.475 (0.355)	1.364 (0.346)	1.334 (0.384)	1.953# (0.789)	1.263 (0.379)
Bachelor's	0.964 (0.279)	1.319 (0.392)	1.226 (0.383)	1.394 (0.631)	1.567 (0.598)	1.422 (0.649)
Graduate	0.734 (0.212)	1.054 (0.323)	0.865 (0.273)	1.925# (0.766)	0.831 (0.366)	1.955# (0.772)
Total effect						
Black†						
Nonblack					0.496*** (0.110)	0.293*** (0.080)
D. Elsewhere in U.S. compared to New Orleans Metro						
Race						
Black†						
Nonblack	1.426 (0.346)		1.395 (0.357)	0.730 (0.233)	0.740 (0.361)	0.486 (0.338)
Education					<i>Black</i>	<i>Nonblack</i>
HS dropout	1.002 (0.323)	1.000 (0.322)	0.927 (0.299)	0.841 (0.317)	1.663 (1.036)	0.833 (0.296)
High school†						1.365 (0.878)
Some college	1.401 (0.446)	1.335 (0.407)	1.249 (0.398)	0.547 (0.253)	3.135* (1.478)	0.557 (0.267)
Bachelor's	1.244 (0.378)	1.078 (0.326)	0.992 (0.319)	1.022 (0.548)	1.594 (0.717)	2.595# (1.288)
Graduate	1.331 (0.476)	1.133 (0.408)	0.905 (0.348)	1.811 (1.055)	1.482 (0.755)	1.035 (0.533)
Total effect						
Black†						
Nonblack					1.318 (0.350)	0.735 (0.249)
Joint F-tests					<i>Black</i>	<i>Nonblack</i>
Education	2.463**	0.706	0.685	1.137	3.024***	0.925
						3.614***

Notes: Standard errors with household-level clustering in parentheses; † Reference category; # $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$; N=2,784. Estimated using restricted data from American Community Survey for November 2005 through the one-year anniversary of Hurricane Katrina and using ACS weights and estimated propensity score weights (see text for details). Not shown for Models 4 and 6 are estimated parameters for age, sex, place of birth, marital status, citizenship, and veteran status and, for Model 6, interactions between race and each of these covariates except for citizenship and veteran status.

Table 4. Multinomial Logistic Regression Model of Residential Location after Katrina among pre-Katrina Adult Residents of New Orleans

Variable	A. Elsewhere in Louisiana compared to New Orleans Metro	B. Texas compared to New Orleans Metro	C. Elsewhere in South compared to New Orleans Metro	D. Elsewhere in U.S. compared to New Orleans Metro
Race				
Black†				
Nonblack	0.446*** (0.107)	0.142*** (0.035)	0.302*** (0.081)	0.730 (0.233)
Education				
HS dropout	1.106 (0.294)	1.245 (0.266)	0.950 (0.270)	0.927 (0.299)
High school†				
Some college	1.198 (0.299)	1.151 (0.247)	1.364 (0.346)	1.249 (0.398)
Bachelor's	0.740 (0.215)	0.801 (0.232)	1.226 (0.383)	0.992 (0.319)
Graduate	0.704 (0.207)	0.869 (0.256)	0.865 (0.273)	0.905 (0.348)
Age				
25–39	1.602* (0.332)	1.796** (0.361)	1.746** (0.350)	2.647*** (0.730)
40–59†				
60+	0.706 (0.165)	0.698# (0.141)	0.713 (0.168)	1.140 (0.325)
Sex				
Female†				
Male	1.126 (0.150)	0.963 (0.141)	0.951 (0.139)	1.128 (0.216)
Place of birth				
Louisiana†				
Elsewhere	0.639# (0.156)	1.386 (0.284)	3.141*** (0.665)	3.285*** (0.918)
Marital status				
Ever married†				
Never married	0.724 (0.161)	1.137 (0.221)	1.180 (0.230)	1.166 (0.298)
Citizenship				
U.S.†				
Non-U.S.	2.669# (1.339)	2.758* (1.109)	1.258 (0.486)	1.923# (0.720)
Veteran				
No†				
Yes	1.128 (0.262)	1.201 (0.291)	1.274 (0.337)	1.226 (0.412)

Notes: Standard errors with household-level clustering in parentheses; † Reference category; # $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$; N=2,784. Estimated using restricted data from American Community Survey for November 2005 through the one-year anniversary of Hurricane Katrina and using ACS weights and estimated propensity score weights (see text for details).