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Race, socioeconomic status, and return migration to New Orleans after Hurricane Katrina

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Abstract Hurricane Katrina struck New Orleans on the 29th of August 2005 and displaced virtually the entire population of the city. Soon after, observers predicted the city would become whiter and wealthier as a result of selective return migration, although challenges related to sampling and data collection in a post-disaster environment have hampered evaluation of these hypotheses. In this article, we investigate return to the city by displaced residents over a period of approximately 14 months following the storm, describing overall return rates and examining differences in return rates by race and socioeconomic status. We use unique data from a representative sample of pre-Katrina New Orleans residents collected in the Displaced New Orleans Residents Pilot Survey. We find that black residents returned to the city at a much slower pace than white residents even after controlling for socioeconomic status and demographic characteristics. However, the racial disparity disappears after controlling for housing damage. We conclude that blacks tended to live in areas that experienced greater flooding and hence suffered more severe housing damage which, in turn, led to their delayed return to the city. The full-scale survey of displaced residents being fielded in 2009–2010 will show whether the repopulation of the city was selective over a longer period.

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Introduction

Hurricane Katrina made landfall near New Orleans, Louisiana, on the morning of August 29, 2005. The vast majority of the city's population had already left the city, following Mayor Ray Nagin's declaration of a mandatory evacuation as the hurricane approached. By the end of the first week of September, when those who had stayed behind were evacuated, the population of New Orleans was skeletal, comprised of perhaps a few thousand residents.

Hurricane Katrina caused moderate wind damage but led to extensive flood damage when several levees were breached and floodwaters submerged 80% of the city (McCarthy et al. 2006). It took several weeks before the levees were repaired and the floodwaters were drained. Displaced residents were first allowed to return to the city at the end of September 2005. Initially, only residents of unflooded areas were allowed back. As recovery efforts progressed, residents of the more heavily affected areas were allowed to return, although many found their homes severely damaged or destroyed by the floodwaters and rendered uninhabitable.

From a very small population just after the disaster, the best documented evidence suggests that the population of New Orleans rose to between 100,000 and 160,000 by the beginning of 2006 and between 170,000 and 225,000 by mid-2006 (VanLandingham 2007). Post-Katrina population estimates for New Orleans remain in flux and in dispute. Initial official estimates by the Census Bureau have subsequently been revised downwards (to 210,198 for mid-year 2006) and upwards (to 288,113 for mid-year 2007); the initial official estimate for mid-year 2008 is 311,853 (U.S. Census Bureau 2009). None of these estimates identified the proportion of the city's post-Katrina population who were new residents, which is necessary for estimating the number of pre-Katrina residents of New Orleans who returned to the city and the number who continued to live away. The Census Bureau's mid-2007 estimate of the city's population represents approximately 63% of the pre-hurricane total of 455,046 (U.S. Census Bureau 2009), suggesting that even by this point more than a third of the pre-hurricane residents of New Orleans had not returned to the city. Little is known about the current location or characteristics of displaced New Orleans residents (National Academy of Sciences 2007).

New Orleans was particularly vulnerable to the effects of a hurricane because of the eroding coastline along the Gulf of Mexico, the city's fragile levee system, and the social and economic characteristics of its inhabitants (Cutter and Emrich 2006). The city's population included a high proportion of individuals of low socioeconomic status. These individuals were concentrated in New Orleans as part of a century-long process of residential segregation by race and socioeconomic status that was seen throughout the country (Farley and Frey 1994; Massey and Denton 1987).

New Orleans has always had a substantial black population, although historically it was the least segregated of large American cities (Spain 1979; Fussell 2007). But by 2000, the standard index of black–white segregation showed New Orleans to have

reached, and even gone a bit beyond, the national average (Mumford Center 2001). This increase in racial segregation in New Orleans goes against regional trends (Logan et al. 2004) but was associated with a rise in the spatial concentration of poverty in New Orleans and nationally during this period. Economic disadvantage for blacks compared to whites also mirrors national patterns, but the relative magnitude of this disadvantage for New Orleans compared to other cities is sensitive to the specific measure employed. While the black poverty rate in New Orleans of 35% was the highest among all large cities in the country (U.S. Census Bureau 2000), the difference between black and white incomes in the city is right at the national median among large metropolitan areas with significant black populations (Logan 2002).[1]

Since the 1970s, the number of concentrated poverty neighborhoods in New Orleans grew by two-thirds, even though the poverty rate remained stable (Berube and Katz 2005). By the time Katrina struck, almost all of the extreme-poverty neighborhoods in New Orleans were predominantly black and these racially and economically segregated areas bore the brunt of the disaster. A block-by-block analysis of census data and flood maps reveals that about half of the city's white residents experienced serious flooding, compared with three-quarters of black residents (Brazile 2006).

The disproportionate impact of Hurricane Katrina on black and low-income residents of New Orleans has been widely discussed in the literature (e.g., Brunsma et al. 2007; Elliott and Pais 2006; Falk et al. 2006; Hartman and Squires 2006; Lavelle and Feagin 2006; Logan 2006; Sharkey 2007). In this article, we investigate disparities by race and socioeconomic status in the return to New Orleans among residents displaced from the city by Hurricane Katrina. We examine, in particular, whether blacks and individuals of low socioeconomic status were displaced from the city for longer durations and investigate the role of the higher rates of housing damage experienced by blacks and disadvantaged individuals.

We begin, in the following section, by describing our conceptual framework and reviewing previous research. Next, we describe data from the Displaced New Orleans Residents Pilot Survey that we used to examine return migration in the first 14 months after Hurricane Katrina. We then describe our specific measures and analysis methods, which include a survival analysis of the duration that residents were displaced from the city. Our results indicate that race and socioeconomic status were strongly related to the duration of displacement, with substantially slower rates of return for those with lower levels of education and, especially, for blacks. Results from our survival analysis indicate that race disparities in return rates were largely due to differences in housing damage. We discuss the implications of these results in the final section.

Conceptual framework and previous research

Our conceptual approach for studying return migration among New Orleans residents displaced by Hurricane Katrina is based on multiple theories of migration

[1] The absolute difference in household incomes between non-Hispanic blacks and non-Hispanic whites in the 50 metropolitan areas with the largest black populations in 2000 was $20,705 for New Orleans compared to a median of $20,451, which is the value for Los Angeles (Logan 2002).

as well as past research. None of the theories fits precisely the dynamics of return migration after the complete displacement of a population because this situation is so rare. Nevertheless, each provides helpful insights and together they provide a useful framework for reviewing previous research relevant to post-disaster return migration.

The main conceptual perspective is migrant selectivity, which is based, in turn, on viewing migration as a choice behavior constrained by contextual, in this case environmental, factors. When a large-scale hazard, such as a tsunami, hurricane, or earthquake, forces the population out of an area and causes widespread destruction, the initial evacuation represents a forced migration; the migration choice in this situation, from which the selectivity emerges, is whether or not a displaced individual returns. The decision to return is shaped by demographic and socioeconomic characteristics of the individual and is constrained by both the pre-disaster circumstances and the post-disaster context (Hunter 2005). Previous research on return migration to New Orleans following Hurricane Katrina has shown major disparities by race and socioeconomic status, with whites, Vietnamese, and those of higher socioeconomic status more likely to return to the city (Elliott and Pais 2006; Groen and Polivka 2008a; Paxson and Rouse 2008; Vu et al. 2009).

The literature on migration as an economic decision, which is based on individuals' cost-benefit calculations about a potential move (Sjaastad 1962; Lee 1966), finds that migrants are positively selected on both observed and unobserved characteristics. Greenwood (1993) identifies at least two ways in which economic behavior leads to positive selectivity of voluntary migrants. First, when migration is seen as an investment, individuals with the most to gain in any context will be the most likely to invest in moving. Second, individuals who invest in migration also tend to invest in other kinds of human capital, and so they may be individuals who expect higher returns from the move. In contrast, forced moves—or forced non-moves, in the case of displaced migrants who are unable to return—are associated with negative selectivity. Morrow-Jones and Morrow-Jones (1991) find that individuals who were forced to move after a disaster are less advantaged with respect to recouping their losses in the disaster-affected area: they tend to be older, members of female-headed households, socioeconomically disadvantaged, and are disproportionately black. Hunter (2005) notes that when disasters occur that do not force a mass displacement, advantaged individuals are most likely to perceive the risk and to voluntarily leave the area, leaving less advantaged individuals to cope with the effects of the disaster and future risks. In these ways, disaster-induced migration leaves the disadvantaged more vulnerable to loss compared to more advantage groups.

There are other events that may force or constrain a move from which we can gain useful insights about involuntary migration. The study of "tied movers" in family migration is one relevant example. Tied movers are individuals whose primary reason for moving is that their fellow family member, usually their spouse, is moving. These moves tend to be less beneficial for the tied member than for the primary migrant, and are possibly less beneficial for the tied mover compared to not moving (Sell 1983). A growing number of studies find exactly this result, with a negative effect on the employment rate for tied spouses of primary movers

(e.g., Boyle et al. 2001; Taylor 2006). The disruptive effect of disaster-induced migration on evacuees' well-being may have parallels with other negative exogenous events, such as plant closings or being laid off from a job. This case is examined by Raphael and Riker (1999), who find positive effects on earnings of being laid off for those who subsequently move, but negative effects for those who remain in the same area. In previous Katrina-related research, Groen and Polivka (2008b), Karoly and Zissimopoulos (2007), and Vigdor (2007), using data from the Current Population Survey, found that displaced evacuees who had not returned to New Orleans had poorer labor market outcomes than those who returned to the city, and, furthermore, appeared to be worse-off compared to their situation before the hurricane. These findings suggest that displaced residents who do not return are negatively selected compared to those who do return.

Circumstances and context shape migration decisions beyond the effects of individual and family characteristics, and these factors are especially relevant for disaster-related migration (Hunter 2005). Among displaced New Orleans residents, the choice of whether or not to return may be constrained by the amount of place-specific capital a person has available in the city, such as a habitable home, employment, and an intact social network. Previous multivariate analyses of return migration among displaced New Orleans residents found that the lower likelihood of return for blacks and residents of low socioeconomic status was largely explained by the more severe housing damage that these individuals experienced (Groen and Polivka 2008a; Paxson and Rouse 2008). The direct effect of housing damage on return migration occurred because displaced residents lacked a place to live if they returned. However, housing damage was largely due to flooding and hence was associated with widespread neighborhood destruction. Return migration thus may have also been deterred by place-specific concerns, such as the disamenities of living in a post-disaster environment with poorly functioning schools, hospitals, clinics, public services, and infrastructure, as well as scarce and costly rental housing and elevated crime rates. Weighing these considerations against the potentially more predictable and possibly more attractive amenities of their evacuation destination may have led evacuees to choose not to return.

One way in which disaster-induced migrants differ from voluntary migrants is that they typically move as part of a large, networked group responding to an exogenous "push" factor (Drabek and Boggs 1968). Using information transmitted through a social network, evacuees choose locations that match their needs for place-based resources such as disaster assistance, affordable housing, employment opportunities, neighborhood amenities, and public services. This behavior is reflected in the new economics of migration theory which incorporates the insights that: (1) migratory decisions are made within groups of interrelated people and (2) these people act collectively to maximize gains and minimize risks to income and well-being (Stark and Bloom 1985; Stark and Taylor 1991; Taylor 1986; Massey 1999). Social networks, which are based on family, friendship, work, and place of residence, affect migration decisions by demonstrating the feasibility of a move, by providing information and resources that increase the expected benefits, and by reducing the costs and uncertainty associated with a move (Massey 1990; Stark 1991; Taylor 1986). Systematic differences in social networks by age, sex, marital

status, education, employment, and previous migration experience suggest that these factors may affect migration directly, by affecting the costs and benefits of the move (Greenwood 1975, 1985; Long 1992), and indirectly, by shaping the types of information and resources exchanged within social networks.

The social network perspective suggests that socially homogenous and networked groups tend to concentrate in specific places, so that certain types of people are more likely to return to New Orleans while others concentrate in new locations. Support for this perspective has been provided by Paxson and Rouse (2008) in their analysis of return migration among a sample of low-income parents enrolled in community colleges in New Orleans. They found that among those who lived in a flooded neighborhood there was little that distinguished returnees and non-returnees. However, among those who lived in an unflooded neighborhood, blacks and those who attended church regularly were less likely to return while homeowners were more likely to return. Paxson and Rouse's findings suggest that blacks and regular church attendees from unflooded neighborhoods found that being close to others like them was more important than being back in New Orleans.

A final perspective is provided by disaster scholars, who have noted that disasters exacerbate pre-existing inequalities, by socioeconomic status, race, and age (Barnshaw and Trainor 2007; Blaikie et al. 1994; Erikson 1976; Klinenberg 2002; Sen 1981). Minorities and the poor tend to suffer the worst outcomes as a result of natural disasters due to predisposing factors, their actual experiences during and in the aftermath of the disasters, and their limited capacity to recover. Previous studies of Hurricane Katrina have indeed found that the poor, the elderly, and blacks suffered the worst outcomes (e.g., Sharkey 2007; Elliott and Pais 2006).

Disparities by socioeconomic status and race in the effects of a disaster may grow with time. Tierney (2006) describes such a "Matthew effect" that occurs when the least-affected residents rebound more quickly while the more-affected residents remain displaced longer and their losses compound. Emerging research on return migration to New Orleans lends support to this view (Pais and Elliott 2008). Case studies of neighborhood recovery show that more-advantaged neighborhoods before Katrina have higher rates of return, and even gain new residents, while disadvantaged neighborhoods remain sparsely populated (Elliott et al. 2009). This perspective further supports the importance of examining disparities in post-Katrina return migration by socioeconomic status and race and over time.

Our analysis of return migration among New Orleans residents displaced by Hurricane Katrina builds on the theoretical perspectives and previous research reviewed here. We examine disparities by race and education and focus on the timing of return migration using survival curves and hazard models. We are aware of no previous study that has examined the duration of displacement and differences in how quickly various groups of residents returned to the city after the hurricane. Our analysis investigates the extent to which observed disparities in return migration by race and education are explained by differences in demographic characteristics, other indicators of socioeconomic status, housing characteristics, and housing damage. Our analysis provides insights into possible contextual and social network effects, although these are not assessed directly.

Data

Data for this study are from the Displaced New Orleans Residents Pilot Study (DNORPS), which was fielded during the fall of 2006 approximately 1 year after Hurricane Katrina. The principal goal of DNORPS was to determine the feasibility of collecting representative data on the current status of people who resided in the City of New Orleans, the central city in the New Orleans metropolitan area, at the time of Hurricane Katrina. We concluded that this task, while formidable, is feasible (Sastry 2009). In this article, we pursue our secondary goal for DNORPS, which is to examine the location, well-being, and plans of this population.

DNORPS is based on a stratified, area-based probability sample of pre-Katrina dwellings in the City of New Orleans in order to provide representative information on pre-hurricane residents. Fieldwork for DNORPS was conducted between mid-September 2006 and November 2006. For sampling purposes, New Orleans was divided into three strata based on flood depth: no flooding, low-flood depth (<4 ft of flooding), and high-flood depth (>4 ft of flooding). DNORPS used an implicit stratification procedure to achieve an even distribution of the sample within each stratum by three potentially important factors: geographic location (based on Census tract), racial composition (using the percent of the population at the block level that was black), and homeowners versus renters (based on the block-level proportion of dwellings that were owner-occupied). Dwellings were the primary sampling unit and there was no geographic clustering of cases, which provides high statistical power for a given sample size because design effects are minimized.

DNORPS drew a sample of 344 pre-Katrina residences in New Orleans. Fieldwork focused on tracing the sampled respondents using mail, telephone, and in-person contacts, and drew on an extensive array of electronic database searches and state-of-the-art tracing techniques to obtain updated information on respondents' whereabouts. Approximately two-thirds of the sampled cases were located, and 80% of the located cases were successfully contacted and asked to complete a questionnaire. Among cases that were contacted, 88% successfully completed a questionnaire—a very high cooperation rate. The overall response rate, calculated according to AAPOR (2006) guidelines and adjusted for subsampling of cases in the final phase of fieldwork (see Sastry 2009, for details), was 51%.

The main reason for not completing an interview was that the case could not be located after multiple attempts. DNORPS was unable to locate about one-third of all eligible cases (some of whom may, in fact, be ineligible). The remaining non-interviewed cases consist of refusals, unable-to-contact cases, and cases on which work had stopped because the study ended. It was more difficult to locate respondents in areas that had flooded because a higher fraction of these respondents no longer resided in the sampled dwellings. However, there was little variation across strata in contact rates or cooperation rates.

The area-based sample design of DNORPS supported a multivariate logistic regression analysis of fieldwork outcomes, with covariates based on area-characteristics at the block and block-group level from the 2000 Census (see Sastry 2009). This analysis found few systematic differences in outcomes across any of the fieldwork stages—with the exception of locating sampled cases. The rate of

locating cases was higher for cases in blocks with a higher median age of residents and in tracts with a lower fraction of non-family households. None of the covariates describing race or socioeconomic status were statistically significant.

The final DNORPS sample comprises 147 respondents. Each respondent completed a short paper-and-pencil interview by mail, by telephone, or in-person. It took respondents approximately 15 min, on average, to complete the ten-page questionnaire. The DNORPS questionnaire obtained a roster of all pre-Katrina household residents and collected information on their evacuation and resettlement experience, current location, plans to return to or remain in New Orleans, and health and well-being. Information was also collected on residents' basic demographic and socioeconomic characteristics and on housing characteristics and damage. Respondents provided information on the return migration experience of a total of 291 adults aged 18+ years residing in 147 sampled households prior to Hurricane Katrina.

Measures

Our analysis examines return migration to New Orleans among pre-Katrina residents of the city who were 18 years of age or older at the time of survey. Virtually our entire sample evacuated the city, with only a handful reported to have remained in New Orleans through the storm and its immediate aftermath. We distinguish between individuals who ever resided in the city following Katrina and those who never returned. For those who returned, we know the month and year of their initial return and we used this information to create an indicator of the length of time, in months, that they were displaced from the city.[2] We also created a variable indicating whether the person had never returned to the city—in which case their return date was censored. This information allowed us to undertake the survival analysis described below.

Our analysis includes individual and household variables that we hypothesize are related to the duration of displacement from New Orleans. Race and education are our two variables of central interest, with the latter serving as our principal indicator of socioeconomic status. Background demographic characteristics of individual household members include age, sex, state of birth, pre-hurricane marital status, and pre-hurricane employment status, which provides an additional indicator of socioeconomic status. Household level variables are housing tenure and housing damage due to Hurricane Katrina and the subsequent flooding.

Weighted summary statistics for the covariates are presented in the first column of Table 1. Over half of the DNORPS sample (62%) is black, with the remainder white or another race. Because there were very few respondents in the "other" race category, this group was combined with whites. Fewer than one-third of the sample (31%) had a 4-year college degree, while over two-thirds (69%) had less than a

[2] The DNORPS respondent was asked to report, for residents of the pre-Katrina household who were currently living in New Orleans "when did each person return to New Orleans *after Katrina* to live or stay most of the time?" The response was either a date or a report that the person did not leave the city during the storm or its aftermath.

Table 1 Summary statistics for pre-Katrina residents of New Orleans aged 18+ years

Variable	Percent in category		*Z*-test statistic
	DNORPS	ACS 2005	
Race			
Black	62%	63%	0.33
White/other	38%	37%	
Education[a]			
Less than college graduate	69%	70%	0.35
College graduate	31%	30%	
Age			
<40 years	46%	40%	1.96*
≥40 years	54%	60%	
Sex			
Female	54%	55%	0.32
Male	46%	45%	
State of birth			
Louisiana	75%	74%	0.37
Other state	25%	26%	
Marital status[a]			
Not married	59%	63%	1.32
Married	41%	37%	
Employment status[a]			
Employed	67%	58%	2.93***
Unemployed or out of labor force	33%	42%	
Housing tenure[a]			
Owned	65%	57%	2.59***
Rented	35%	43%	
Housing damage due to Katrina			
Undamaged	5%	–	–
Damaged but habitable	28%	–	
Uninhabitable	45%	–	
Destroyed	22%	–	
Observations	291	2153	

Source: Authors' calculations using data from the 2006 Displaced New Orleans Residents Pilot Survey (DNORPS) and the 2005 American Community Survey (U.S. Census Bureau 2005)

[a] Pre-Katrina status

* $p < .10$; ** $p < .05$; *** $p < .01$

college diploma—i.e., some college education or a high school education or below. Over half of the sample (54%) was 40 years of age or older while 46% were 18–40 years of age. Females comprised slightly more than half the sample (54%). Three-quarters of the sample were born in Louisiana. At the time of Hurricane Katrina, three-fifths of the sample (59%) was unmarried—i.e., single, divorced, separated, or widowed. In the month prior to the hurricane, two-thirds (67%) of the sample was employed, with the remaining 33% unemployed or out of the labor force (mostly retirees or students). Most people lived in owner-occupied housing (65%) in New Orleans prior to Katrina, with only one-third being renters. Finally, there were extremely high rates of housing damage—only 5% of the sample lived in

dwellings that were undamaged by Hurricane Katrina or the flooding. About one-quarter of the sample (28%) had lived in a dwelling that was damaged but habitable while the remaining two-thirds of the sample had lived in dwellings that were rendered either uninhabitable (45%) or were destroyed (22%) by the hurricane.

To assess the representativeness of the DNORPS sample, in Table 1 we present a matching set of summary statistics for adult residents of New Orleans using data from the 2005 American Community Survey (ACS). The DNORPS results closely match those from the ACS for most variables. The two surveys report very similar distributions for race, education, sex, state of birth, and marital status. There are statistically significant differences only by age (at the 0.10 significance level), employment status, and housing tenure. These differences may be due to the reported challenge in DNORPS of finding young adults and residents of non-family households (Sastry 2009), who were more likely to have been renters. However, the differences are not large, and similarities between the two samples according to respondents' basic demographic characteristics mean that the results of our analysis are unlikely to be affected greatly by these results.

Analysis methods

Our analysis of return migration among New Orleans residents displaced by Hurricane Katrina, and disparities in return migration by race and socioeconomic status, proceeds in three steps. We first examine graphs and summary statistics that describe the duration of displacement from New Orleans among pre-Katrina residents of the city. Next, we examine weighted cross-tabulations of return status for each of the covariates and assess the statistical significance of observed differences based on Rao–Scott (1984) sample design-based F-tests. Finally, we estimate hazard models to control for race and socioeconomic status simultaneously and to examine factors that may account for the observed disparities in return rates.

Hazard models have the advantage of being able to accommodate changes in the risk of return over time and censored observations. We use a variant of the standard model that considers events in discrete time. Although the underlying migration hazard—i.e., the risk of returning to New Orleans, conditional on living away from the city—is continuous, we group the return dates by month because for most people who returned we know the month of return but the specific day of return was missing. We therefore consider the risk of return migration to be constant within a given month and combine adjacent months if their hazard rates are similar. This provides us with a simple specification of the baseline hazard, which is represented by a step function. This feature of the model has led to it being known as the piecewise exponential hazard model.

We assumed that model covariates had a multiplicative effect on the baseline hazard and hence that the hazard rates were proportional for different groups. This assumption provides a parsimonious model specification, while allowing us to model covariate effects efficiently and capture the changing shape of the baseline hazard. This standard model feature can be relaxed by estimating stratified models or models that include interactions with the baseline hazard. However, the modest

sample size of DNORPS precludes us from being able test the proportional hazards assumption.

Our statistical analysis incorporates several additional features. First, we include DNORPS sampling weights in all the analyses and also adjust the standard error estimates for the stratified sampling scheme. Second, the standard errors account for the clustering of adults from the same household. In the case of the regression models, the robust standard errors adjust for clustering using jackknife estimation.

Results

We describe the duration of displacement from New Orleans for the entire sample over the 14-month period following Hurricane Katrina in Fig. 1 using Kaplan–Meier survival curves. Overall, one-quarter of pre-Katrina residents of the city had returned within 2 months of the hurricane and half had returned to live in the city by the 7-month mark following the storm (see Table 2). At the end of the study period, only slightly more than half of the pre-Katrina residents had returned. Figure 2 shows the dramatic decline in return-rates over the 14-month study period based on weighted kernel-density estimates of the return migration hazard. Return migration rates rose initially, peaking about 4 months after the hurricane. These rates subsequently declined dramatically, and both Figs. 1 and 2 show that the likelihood of displaced residents returning to the city was very low for those who were displaced for 9 months or more.

Race and socioeconomic status are strongly related to the duration of residents' displacement. Table 2 and Fig. 3 show that one-quarter of white residents had returned to the city within 2 months of Hurricane Katrina, whereas it took an

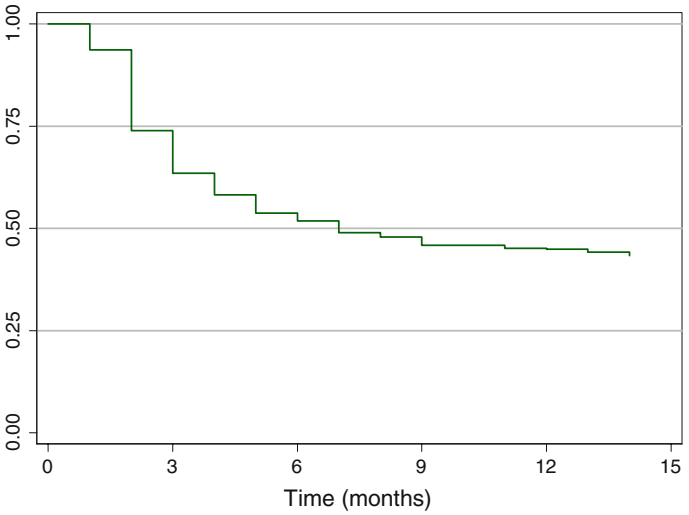

Fig. 1 Kaplan–Meier estimate of duration displaced from New Orleans for pre-Katrina residents aged 18+ years

Table 2 Duration of displacement from New Orleans for pre-Katrina residents aged 18+ years

Variable	25th Percentile	50th Percentile
Total (months)	2	7
Race		
Black (months)	3	>14
White/other (months)	2	3
Education		
Less than college graduate (months)	3	14
College graduate (months)	2	4
Observations	291	

Source: Authors' calculations using data from the 2006 Displaced New Orleans Residents Pilot Survey (DNORPS)

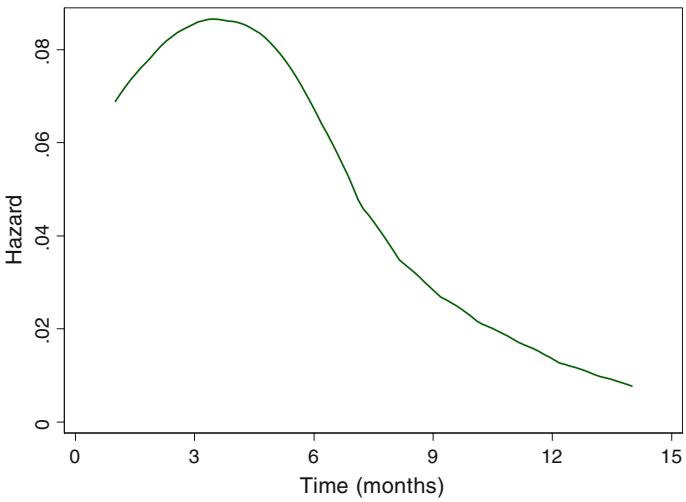

Fig. 2 Smoothed return migration hazard estimate for displaced pre-Katrina residents of New Orleans aged 18+ years

additional month for one-quarter of the black residents to return. The durations at which half of the pre-hurricane population of blacks and whites returned to New Orleans differ greatly. In particular, half of white residents had returned within 3 months of the storm; on the other hand, fewer than half of black residents had returned by the time of the survey which occurred 14 months after the hurricane. Figure 3 shows that whites returned rapidly to the city in the initial months following the displacement; after Month 5 (January 2006), however, when approximately two-thirds of whites had returned to New Orleans, very few additional whites returned to the city. The pace of return was much slower—although more steady—for blacks. These different patterns for blacks and whites are especially apparent in Fig. 4, which shows the hazard of returning to the city conditional on living away. For whites, the hazard of returning peaked 3 months

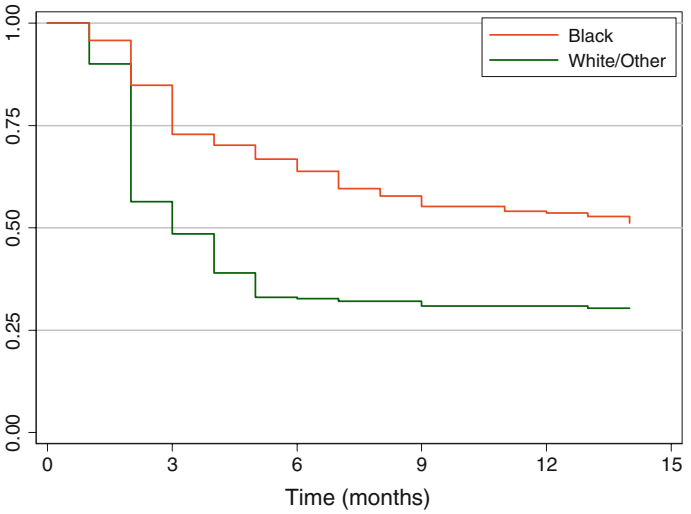

Fig. 3 Kaplan–Meier estimate of duration displaced from New Orleans for pre-Katrina residents aged 18+ years, by race

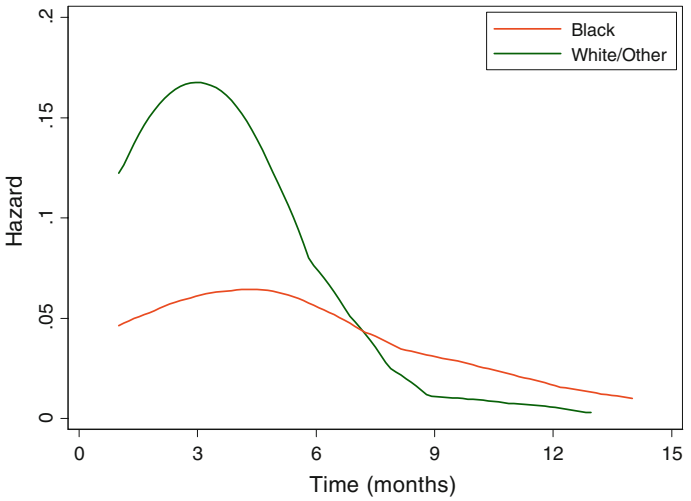

Fig. 4 Smoothed return migration hazard estimate for displaced pre-Katrina residents of New Orleans aged 18+ years, by race

after Katrina and then declined very rapidly over the subsequent 6 months. The return hazard for whites remained close to zero after Month 9 (May 2006) indicating that few, if any, whites who had not returned to the city by that time were likely to do so. For blacks, on the other hand, the hazard of returning peaked at about 5 months following the hurricane, and declined relatively modestly over the subsequent months. By the end of the study period, the return hazard for blacks,

although low, was considerably higher than for whites, indicating that blacks continued to return to the city in small numbers.

There are also major disparities in the duration of displacement by education, our indicator of socioeconomic status (see Table 2). One-quarter of pre-Katrina residents of New Orleans with a college degree had returned within 2 months and half had returned within 4 months of the hurricane. In contrast, it took an additional month for the first 25% of adults without a college degree to return to the city and 14 months for half to return.

We present a complementary descriptive analysis of return migration in Table 3, which shows the percentage of pre-Katrina residents of New Orleans who had returned to the city by the survey date for all of the covariate values and for the entire sample. Overall, 58% of pre-Katrina residents had returned to the city by December 2006, whereas 42% remained displaced. Consistent with other findings that Hurricane Katrina differentially affected residents according to their race and socioeconomic status, the results in Table 3 show that only 51% of black residents had returned to New Orleans by the time of the survey compared to 71% of non-blacks, a difference that was statistically significant at the 0.05 level. Likewise, only 52% of residents without a college degree had returned to the city compared with 71% of those with at least a college degree, also a statistically significant difference at the 0.05 level. Among the other covariates describing background demographic and social characteristics, the only variable that has a statistically significant relationship with returning to the city was age. Only half of pre-Katrina residents under 40 years of age had returned to the city, compared to two-thirds of those who were 40+ years of age.

We find a strong, statistically significant relationship between housing damage and return migration. Table 3 shows that only 30% of residents whose homes were completely destroyed had returned to New Orleans during the first 14 months following the hurricane, whereas 54% of residents whose home were uninhabitable had returned. In contrast, 81% of residents whose homes were damaged but habitable and 96% of residents whose homes were not damaged had returned. The large difference in return rates between those whose homes were destroyed and those whose homes were uninhabitable most likely reflects the fact that many residents whose homes were uninhabitable had by that time received FEMA trailers, which allowed them to live at their former properties or in a nearby trailer park as they rebuilt their homes. On the other hand, residents whose homes were completely destroyed were more likely to have lived in a thoroughly devastated area where rebuilding made little sense given the extent of damage to the neighborhood. For residents with damaged but habitable homes or undamaged homes, there was little to prevent them from returning.

The timing of return was likely to have been affected by unmeasured variables of respondent's socioeconomic status, such as their pre-Katrina income and current income or wealth, their receipt and amount of disaster-related assistance, labor market characteristics in respondent's current locations, and school openings in New Orleans. Measures of income and wealth are poorly reported or omitted in surveys such as this so we chose not to include these measures. We opted instead to use education as a measure of socioeconomic status. Ascertaining the labor market

Table 3 Percent of displaced New Orleans residents aged 18+ years returned to New Orleans

Variable	Returned to New Orleans?		Total	Design-based *F*-test
	Yes	No		
Race				
Black	51%	49%	100%	4.07**
White/other	71%	29%	100%	
Education[a]				
Less than college graduate	52%	48%	100%	4.24**
College graduate	71%	29%	100%	
Age				
<40 years	50%	50%	100%	3.79*
≥40 years	66%	34%	100%	
Sex				
Female	62%	38%	100%	
Male	54%	46%	100%	2.52
State of birth				
Louisiana	54%	46%	100%	2.48
Other state	70%	30%	100%	
Marital status[a]				
Not married	57%	43%	100%	0.13
Married	60%	40%	100%	
Employment status[a]				
Employed	63%	37%	100%	2.35
Unemployed or out of labor force	49%	51%	100%	
Housing tenure[a]				
Owned	62%	38%	100%	1.25
Rented	51%	49%	100%	
Housing damage due to Katrina				
Undamaged	96%	4%	100%	10.48***
Damaged but habitable	81%	19%	100%	
Uninhabitable	54%	46%	100%	
Destroyed	30%	70%	100%	
Full sample	58%	42%	100%	
Observations		291		

Source: Authors' calculations using data from the 2006 Displaced New Orleans Residents Pilot Survey (DNORPS)

[a] Pre-Katrina status

* $p < .10$; ** $p < .05$; *** $p < .01$

characteristics in respondent's current locations and whether respondent's children's schools had reopened in New Orleans was beyond the scope of this pilot survey.

We turn now to the results of the hazard model analysis of return migration. We present estimates from five different models in Table 4. All models include a basic

Table 4 Hazard model regression estimates of duration displaced from New Orleans for pre-Katrina residents aged 18+ years

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Months after Katrina					
<2 months[a]	–	–	–	–	–
2 months	1.96** (0.63)	1.95** (0.62)	1.96** (0.63)	1.99** (0.63)	2.07** (0.63)
3–5 months	2.25** (0.71)	2.20** (0.70)	2.27** (0.72)	2.39*** (0.75)	2.60*** (0.78)
6–8 months	0.95 (0.40)	0.91 (0.38)	0.96 (0.41)	1.03 (0.44)	1.24 (0.51)
9–14 months	0.36** (0.17)	0.35** (0.16)	0.37** (0.17)	0.40** (0.18)	0.49 (0.22)
Race					
Black[a]	–	–	–	–	–
White/other	1.79** (0.43)		1.60* (0.42)	1.61* (0.40)	1.07 (0.28)
Education[b]					
Less than college graduate[a]		–	–	–	–
College graduate		1.63** (0.35)	1.34 (0.32)	1.26 (0.31)	1.20 (0.28)
Age					
<40 years				0.63** (0.14)	0.65** (0.14)
≥40 years[a]				–	–
Sex					
Female[a]				–	–
Male				0.78 (0.12)	0.83 (0.12)
State of birth					
Louisiana[a]				–	–
Other state				1.19 (0.28)	1.28 (0.30)
Marital status[b]					
Not married[a]				–	–
Married				0.74 (0.19)	0.77 (0.20)

Table 4 continued

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Employment status[b]					
Employed[a]				–	–
Unemployed or out of labor force				0.71 (0.17)	0.73 (0.17)
Housing tenure[b]					
Owned[a]				–	–
Rented				0.89 (0.26)	0.82 (0.24)
Housing damage due to Katrina					
Undamaged					3.16** (1.41)
Damaged but habitable					1.85** (0.51)
Uninhabitable[a]					–
Destroyed					0.50* (0.19)
Model *F*-test (df1;df2)	5.90*** (5;140)	5.69*** (5;140)	5.33*** (7;139)	3.54*** (13;133)	5.86*** (16;130)
Observations	291	291	291	291	291

Source: Authors' calculations using data from the 2006 Displaced New Orleans Residents Pilot Survey (DNORPS)

[a] Reference category

[b] Pre-Katrina status

* $p < .10$; ** $p < .05$; *** $p < .01$; Jackknife standard errors in parentheses

specification of the baseline hazard, which collapsed adjacent periods that were substantively and statistically indistinguishable from each other. However, the results are robust to changes in the specification of the baseline hazard function.

The first two models in Table 4 include the effects of race and education alone (along with the baseline hazard), whereas Model 3 includes both variables simultaneously. Model 4 adds all of the remaining demographic and socioeconomic covariates to Model 3, and Model 5 includes all of the covariates and, in particular, adds indicators of housing damage to Model 4. The results in Table 4 show exponentiated parameter estimates or relative risks. Robust standard errors calculated using the jackknife method are shown in parentheses and statistically significant parameter estimates are indicated using asterisks. The model *F*-tests, shown at the bottom of Table 4, indicate that all models provide a good fit to the data.

Model 1 shows that non-blacks have a 79% higher risk of returning to New Orleans, compared to blacks, an effect that is statistically significant at the 0.05 level. Model 2 shows that the likelihood of returning to New Orleans is 63% greater for displaced college graduates than for those with less than this level of education. These are very large effects, and reflect the dramatic differences in return rates shown in the descriptive analysis above.

There are two interesting findings in Model 3, which includes the race and education variables simultaneously. First, the effect of education declines by about half and is no longer statistically significant. Second, the effect of race on return migration rates is reduced only modestly and the effect is statistically significant at the 0.10 level. Observed differences by education in return migration to New Orleans appear to be due in large part to underlying differences in education between blacks and non-blacks.

Model 4 investigates the effects on return migration of the other demographic and social variables, including age, sex, state of birth, marital status, employment status, and housing tenure. Age is the only statistically significant covariate in this group. The estimated parameter shows that the relative risk of return for residents between the ages of 18 and 39 years is 38% less than it is for those 40 years of age and older. The most important finding from Model 4 is that the effect of race remains unchanged and statistically significant at the 0.10 level even with these additional controls. Specifically, the estimated relative risk for race shows that non-blacks have a 61% higher likelihood of returning to New Orleans, an effect that is essentially identical to the estimate in Model 3 and only slightly lower than the observed effect in Model 1. Thus, none of the covariates included in Model 4 appear to account for the higher rates of return migration to New Orleans among non-blacks compared to blacks during the first 14 months following Hurricane Katrina.

Model 5 includes a control for housing damage as well as all other covariates. Our descriptive results above showed that housing damage appeared to have a strong association with return migration. Results from this model indicate that housing damage has a major effect on return rates to New Orleans among residents displaced by Hurricane Katrina, even after controlling for all of the other covariates. A joint-test of the three housing damage covariates indicates that these coefficients are statistically significant at the 0.01 level (F-test = 4.83, with 3 and 142 degrees

of freedom). The relative risk of return for residents whose homes were destroyed is 50% lower than for residents whose homes were severely damaged but not destroyed. The relative risks of return for residents with damaged but habitable homes or undamaged homes were 85 and 216% higher, respectively, than for residents whose homes were uninhabitable.

The effect of the race covariate was statistically insignificant and substantively small in Model 5. Thus, after controlling for differences in housing damage there was essentially no difference in return rates between blacks and non-blacks displaced from New Orleans by Hurricane Katrina. Importantly, none of the other covariates in the model—except housing damage—appeared to account for the large observed disparity in return migration rates between blacks and non-blacks. The likelihood of having a home damaged or destroyed by Katrina was significantly ($p < 0.01$) higher for blacks in the sample (81%) compared to non-blacks (47%). Thus, the lower observed rates of return to New Orleans for blacks compared to non-blacks were accounted for in large part by blacks experiencing higher rates of severe housing damage than non-blacks.

Conclusions

Our results suggest that housing damage was the major factor slowing the return of displaced New Orleans residents, particularly among black residents and those of low socioeconomic status. This is consistent with previous studies that show that there were disparities in the effects of Hurricane Katrina by race and socioeconomic status at multiple stages of the disaster, including the process of returning to the city among displaced residents (Groen and Polivka 2008a; Elliott and Pais 2006; Paxson and Rouse 2008; Vu et al. 2009). We believe that both historical processes and the uneven recovery of neighborhoods explain why black and less educated residents were more vulnerable to housing damage and delayed or failed to return to the city.

Patterns of land development and residential segregation that occurred in New Orleans and the rest of the country over the twentieth century concentrated black residents in the lower-lying sections of the city, which led directly to their experiencing high rates of housing damage when the levees broke and floodwaters settled in the lowest parts of the city. On the other hand, our analysis suggests that blacks who did not live in these lower sections were no less likely to return to New Orleans than others. In our final multivariate model, the estimated differences in return rates between blacks and non-blacks were statistically insignificant and substantively small. In other words, the race of individuals was not the overriding factor in explaining why black residents were less likely to return during the first year after Hurricane Katrina. Rather, blacks were less likely to return to New Orleans because they experienced higher rates of severe housing damage. This may, in turn, have been caused by residential patterns of blacks compared to non-blacks—that is, by blacks living in neighborhoods that were more likely to have been flooded (as suggested by Logan 2006)—or by blacks living in dwellings that were more prone to flood damage—such as having a slab foundation rather than a raised foundation.

Flooding and housing damage may be associated with several other factors that were not measured directly for our analysis. For example, there was a direct relationship between flood damage and the date on which neighborhoods were reopened for residents to return. Neighborhoods were opened by zip code beginning on September 29, 2005, and initially included the unflooded neighborhoods of Algiers, the Central Business District, the French Quarter, and Uptown (City of New Orleans 2005). Flooded neighborhoods reopened much later. Reopening of the Lower Ninth Ward, the most devastated areas of the city where the majority of the homeowners were black, was only completed in May of 2006 (City of New Orleans 2006). This process suggests that residents of the more-damaged areas of the city were displaced longer at least in part because their neighborhoods were slower to reopen. However, by the time DNORPS was fielded, all of New Orleans had been reopened for residents to return and rebuild.[3]

The effect on return rates of damage to an individual's own dwelling may also reflect the fact that the dwelling was located in a neighborhood with widespread flooding. This may have resulted in major destruction of physical infrastructure and social networks, making these neighborhoods far less attractive places to which to return. For instance, flooded neighborhoods were likely to have longer delays in the reopening of schools and health facilities, and the restoration of public services. The absence of returned neighbors also meant that many community institutions were not functioning well or at all and problems related to crime and safety might be more severe than in neighborhoods with more residents.

Our analysis has several limitations due to its small sample size and the short observation period for return migration. However, our main conclusion that the racial and socioeconomic differential in the rate of return migration occurred in large measure because of differences in housing damage is unlikely to be affected by these limitations. Despite its small sample size the pilot study was successful in drawing and interviewing a representative sample of pre-Katrina residents of New Orleans. The comparison of respondent characteristics to corresponding data from the 2005 ACS suggests that the sample is not significantly biased in a way that would affect our results. Nevertheless the modest sample size precluded our ability to relax and test the assumption of proportional hazards in our piecewise hazards model. In addition, our analysis is limited by the relatively basic set of covariates and covariate categories that we used. Finally, our analysis focuses on return migration over a relatively short period of 14 months following the hurricane. The return migration process is likely to have continued in the subsequent months and years. We speculate, based on the findings from our analysis, that continued return migration among non-blacks and the highly educated was unlikely to be substantial. In contrast, there was a higher likelihood of additional return migration among blacks and individuals of low socioeconomic status. These residents may have been able to return as FEMA trailers became available, repairs to their homes were completed, or affordable rental housing became available. These developments

[3] The measure of housing damage from DNORPS provides a much better indicator of individuals' ability to move back to New Orleans than does information on when neighborhoods reopened or flood depth of the local area. This is because housing damage could vary greatly by housing characteristics (such as whether the dwelling had a raised rather than a slab foundation) within areas with similar flood depths.

were likely to have occurred slowly, although they have the important potential of reducing disparities in return rates by race and socioeconomic status.

These limitations have been addressed in a new survey—the Displaced New Orleans Residents Survey (DNORS)—being fielded in 2009–2010 and that builds on the DNORPS experiences. This full-scale survey of displaced New Orleans residents is being fielded approximately 4 years after Hurricane Katrina and will provide a picture of return migration among a larger group of displaced residents over a substantially longer period. It also includes a richer set of measures to analyze the effects of factors such as housing reconstruction and neighborhood recovery on return migration. By duplicating and expanding the analysis presented in this article with the new data, we will be better able to determine how race and socioeconomic disparities in return migration have shaped the repopulation of New Orleans in the aftermath of Hurricane Katrina and whether blacks and non-college educated pre-Katrina residents simply experienced a delay in return migration, or have in fact not returned at all.

The repopulation of New Orleans has been difficult to observe and even harder to analyze. DNORS may be the only data source to measure the medium-term return migration of displaced New Orleans residents because the 2010 U.S. Census form will not include the question asked in previous censuses regarding place of residence 5 years prior to the census date, which would have been about 5 months before Hurricane Katrina. Instead the 2010 Census will provide only a cross-sectional snapshot of New Orleans's population which mixes returned pre-Katrina residents with new post-Katrina residents, making it difficult to gauge the extent of selective return migration of pre-Katrina residents. DNORS will allow us to assess the extent to which later return migration by blacks and those with less than college education have brought the city closer to its pre-Katrina racial and socioeconomic composition.

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