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Post-Disaster Fertility: Hurricane Katrina and the Changing Racial Composition of New Orleans

Nathan Seltzer[*] and
University of Wisconsin, Madison

Jenna Nobles
University of Wisconsin, Madison

Abstract

Large-scale climate events can have enduring effects on population size and composition. Natural disasters affect population fertility through multiple mechanisms, including displacement, demand for children, and reproductive care access. Fertility effects, in turn, influence the size and composition of new birth cohorts, extending the reach of climate events across generations. We study these processes in New Orleans during the decade spanning Hurricane Katrina. We combine census data, ACS data, and vital statistics data to describe fertility in New Orleans and seven comparison cities. Following Katrina, displacement contributed to a 30% decline in birth cohort size. Black fertility fell, and remained 4% below expected values through 2010. By contrast, white fertility increased by 5%. The largest share of births now occurs to white women. These fertility differences—beyond migration-driven population change—generate additional pressure on the renewal of New Orleans as a city in which the black population is substantially smaller in the disaster's wake.

INTRODUCTION

Large-scale climate events can have enduring effects on the size and structure of populations. During the last decade, natural disasters have killed over one million people and generated 1.5 trillion U.S. dollars in damage worldwide (IFRC 2015). Appropriately, the mortality, displacement, and infrastructure impact of climate events have received a great deal of consideration in the social sciences (Kahn 2005; Rofi et al. 2006; Ratnayake et al. 2009; Vos et al. 2010). Nevertheless this focus neglects an important pathway through which disasters shape populations—specifically, fertility and the production of the next generation.

Populations undergo a continual process of renewal. Even in the immediate aftermath of natural disasters, children are born, gestated, conceived, and considered. Disasters shape these outcomes through a number of mechanisms, including miscarriage, partnering, the availability of economic resources, and the accessibility of reproductive health services (Carballo et al. 2005; Evans et al. 2010; Hamoudi et al. 2012; Ellington et al. 2013). Such

[*](nseltzer@wisc.edu) University of Wisconsin, Madison. 8128 William H. Sewell Social Sciences Building, 1180 Observatory Drive, Madison Wisconsin, 53706.

fertility effects, in turn, have *intergenerational* implications for populations by shaping the size and composition of new birth cohorts.

We study this process in the New Orleans metropolitan area during the five-year period following Hurricane Katrina. In August 2005, the category 3 storm killed 1,836 people along the Gulf Coast and caused 40 billion dollars of damage to New Orleans' infrastructure and economy. The study of fertility in the wake of this event is warranted for several reasons. To date, much attention has been paid to the physical reconstruction of the city and its comprising neighborhoods (Kates et al. 2006; McCarthy et al. 2006; Green et al. 2007). We aim to contribute to scholarship on the rebuilding of the city's population. Several studies have provided important insight on two demographic sources of renewal—return migration and in-migration (Curtis et al. 2014; Fussell et al. 2014; Pais and Elliott 2008). We ask how effects on fertility amplified or dampened the effects of migration on population change.

Secondly, the disaster affected many of the phenomena widely-understood to be antecedents of childbearing. This includes changes that might have had offsetting effects, via damage to reproductive health care and contraceptive services and via destruction of family assets and reductions in employment opportunities. *A priori*, the effects of the disaster on aggregate fertility are ambiguous. Thirdly, an early study, using data from 2004–2006, indicated substantial post-disaster drops in birth counts that were concentrated among the city's communities of color (Hamilton et al. 2009). If these shifts were sustained, they would exacerbate the effects on population change generated by disproportionate, post-disaster out-migration from communities largely populated by black residents.

We link multiple data sources to document changes in birth cohort composition and population subgroup fertility rates in the New Orleans metropolitan area during the 2000–2010 decade. We then use a set of comparison metropolitan areas to generate a plausible counterfactual: that is, what might fertility in the New Orleans metropolitan area have looked like from 2006–2010 if the disaster had not occurred? We consider whether the findings are purely compositional; that is, whether changes in out-migration and shifts in the composition of the resulting adult female population can account for these changes. We then use the counterfactual birth rates to discuss the contribution of post-Katrina fertility change to the composition of New Orleans' youngest population members.

CLIMATE, NATURAL HAZARDS, AND POPULATION FERTILITY

Although research on the causal links from environmental conditions to population processes are dominated by the study of mortality and migration, the value of attention to the environmental antecedents of fertility has emerged in a few, critical lines of research. These include focus on environment-linked antecedents of fecundity, such as agricultural conditions (Galloway 1986), temperature variation (Lam and Miron 1996; Barreca, Deschenes, and Guldi 2015), and environmental pollutants (Louis et al. 2013; Joffe 2003), as well as environment-linked antecedents of desired family size and attendant family planning practices (Brauner-Otto 2014; Grace and Nagle 2015).

In recent years, scholarship has turned a spotlight on the fertility effects of natural hazards, specifically. This has arisen in part because of wider acknowledgement that disasters are not uncommon (over 6,000 events worldwide since 2004, IFRC 2015), and that their fertility effects may have negative implications for population welfare. For example, disaster-induced reductions in contraceptive access may align an increase in unintended births with unstable or resource-poor conditions (Ellington et al. 2013; Hapsari et al. 2009). Social scientists have pursued these questions in part because unexpected disasters may provide a tool through which to learn about fertility behavior more generally (Lin 2010) and because, as we argue here, fertility in the aftermath of mortality and out-migration is a fundamental part of the recovery process (Hill 2005).

Two studies of note have examined fluctuations in fertility following natural disasters in the United States. Tong et al. (2011) examine changes in birth rates and birth outcomes following the Red River flood in North Dakota in 1997. The authors calculate crude birth rates and adjusted fertility rates in the three years leading up to the disaster as well as the three years following the disaster. The scale of the disaster was extensive; the destructive effects of the flood were statewide and resulted in severe economic damage to individual residences and businesses alike. All 53 counties in the state were recipients of recovery assistance from FEMA. The researchers found a significant decrease in births statewide, with crude birth rates falling from 13.1 births per 1,000 in the three years leading up to the flood to 12.2 births per 1,000 in the 3 years following the flood. In contrast, Cohan and Cole's (2002) research on fertility change in the year following Hurricane Hugo in 1989 concluded that affected areas of South Carolina exhibited significant increases in birth rates, while the non-affected areas experienced birth rates that remained consistent with their pre-disaster trajectories. Similar in the extent of devastation caused by the Red River flood, Hurricane Hugo was a category 4 storm that resulted in significant property damage in South Carolina as well as more generally along the mid-Atlantic seaboard. As Cohan and Cole (2002) point out, the physical devastation wrought by the hurricane resulted in damage to forty percent of residential dwellings in the state.

Why might such effects occur? Fertility decline may occur in the short term via lost pregnancies, reduced coital frequency, and, following disasters that cause adult mortality, the loss of spouses, and the desire to repartner before having children (Evans et al. 2010; Hamoudi et al. 2012). Natural disasters accompanied by population out-migration may also exert downward pressure on fertility demand for individuals or couples who wish to delay fertility until they have established a more permanent residence, resumed employment, and rebuilt lost assets (Creel 2002; Carballo et al. 2005). Such delays may be followed be increases in period fertility, generating a temporal pattern of short-term fertility decline and medium term fertility increase. Though not empirically linked to stated desire for children, this pattern has been demonstrated after several events, including the 2003 Bam earthquake in Iran and the 2004 Andaman-Sumatra earthquake and tsunami (Hosseini-Chavoshi and Abbassi-Shavazi 2013, Nobles, Frankenberg and Thomas 2015).

An additional mechanism by which fertility rates might increase after a natural disaster is the decreased availability of contraceptives (Ellington et al. 2013). In a cross-sectional study of birth control access administered after Hurricane Ike in 2008, which made landfall along

Galveston, Texas, Leyser-Whalen et al. (2011) find decreased levels of access to contraceptives for women who had evacuated. The study also suggests differences in contraceptive access across racial groups – compared to non-Hispanic whites, non-Hispanic blacks were 2.25 times less likely, and Hispanic women were 44% less likely, to have the ability to access birth control following the hurricane. Likewise, Kissinger et al. (2007), interviewing a small cohort of women (N=55) who regularly visited a family planning clinic in New Orleans prior to the disaster studied here, Hurricane Katrina, followed up five to six months after the hurricane made landfall and found that 40% of the women had not used birth control during the post-Katrina wave of data collection. In comparison to their pre-Katrina access to reproductive healthcare, women in the study were significantly less likely to be using birth control after Katrina and were, moreover, significantly less likely to have visited a family planning clinic.

If these gaps in coverage were representative of the experience in the population at large, they did not translate into an increase in births during the Summer of 2006. Using birth certificate vital statistics data from 91 FEMA-designated counties in Louisiana, Mississippi, and Alabama for the 12 months prior to and following the hurricane, Hamilton et al. (2009) found a 30 percent decrease in birth counts in Louisiana and a 13 percent decrease in birth counts in Mississippi, but a 6 percent increase in birth counts in Alabama. The study found large variance in birth count decreases across racial groups, with white and Hispanic women experiencing minor decreases (9 and 11 percent, respectively), while Asian/Pacific Islander and black women experiencing larger decreases (26 percent and 36 percent, respectively). For the hardest hit parishes in Louisiana, the researchers found that while white women experienced only a 14 percent decrease in birth counts, black, Asian/Pacific Islander, and Hispanic women experienced birth count decreases of 51 percent, 34 percent, and 21 percent, respectively, in the twelve-month period following the disaster. These findings raised new concerns: that the disproportionate destruction in black communities might have a decidedly intergenerational effect. We pursue that question here. In so doing, we extend scholarship on the fertility effects of natural disaster by explicitly considering the implications of those effects for the renewal of the city’s populations through changes to cohort composition. Before turning to the methods in the study, we briefly characterize the study’s context.

NEW ORLEANS, BEFORE AND AFTER HURRICANE KATRINA

On August 29, 2005, Hurricane Katrina moved ashore in the Gulf Coast, making landfall approximately twenty miles east of Orleans Parish along the Louisiana and Mississippi border (Knabb et al. 2005). The event resulted in the immediate evacuation of about 1.5 million adult residents in three states along the Gulf Coast (Groen and Polivka 2008; Weber and Peek 2012). Approximately 80 percent of the pre-Katrina population returned to their county or Parish of residence by October of 2006, 14 months after the initial landfall (Groen and Polivka 2008). For Orleans Parish, which was severely affected by the hurricane in terms of property loss and housing damage (Gabe et al. 2005; Kates et al., 2006), only about half of the pre-Katrina population had returned one year later (Sastry 2008; Sastry and Gregory 2014).

Examining post-Katrina migratory patterns and flows using a county-to-county migration dataset from the Internal Revenue Service, Fussell et al. (2014) found that the recovery migration of New Orleans after Katrina was predominately determined by in-flows of migration from nearby counties along the Gulf Coast. The nearby counties with the highest post-Katrina in-migration, they assert, corresponded almost entirely with the highest pre-Katrina out-flows of population from Orleans parish, illustrating how the concentrated intraregional ties of migration systems can structure population recovery following natural disasters.

Residents who eventually returned to the city were more likely to have higher levels of socioeconomic status, more likely to be older, and less likely to have children than those who did not return (Frey, Singer, and Park 2007). The most striking pattern of differential return, however, occurred across racial lines. A consistent finding across multiple studies and data sources suggests that white evacuees returned to the city more rapidly and in larger proportion than black evacuees (Fussell et al. 2010; see also Groen and Polivka 2010 for a description of return to the larger coastal region). Indicators from the housing market also suggested changes in the racial composition of New Orleans. A report from the U.S. Census Bureau indicated that the racial characteristics of individuals living in renter-occupied residential units shifted from being majority black prior to Katrina in 2004 to majority white after Katrina in 2009, while owner-occupied residential units experienced no change in racial characteristics (Geaghan 2009).

More broadly, the change in racial demographics following Hurricane Katrina represented a swift change in the residential context of the city. Like most cities in the middle of the twentieth century, New Orleans increasingly became less racially heterogeneous and more concentrated along racial lines, a result largely of restrictive segregated housing laws and the flow of white residents into suburban developments in the surrounding area (Campanella 2014). Over the past-half century, New Orleans became a majority black city, surrounded by largely white suburbs. As such, an analysis of how fertility in New Orleans varies across racial groups, particularly between blacks and whites, builds on the historical and contemporary significance of racial demographics and the corresponding racialized residential settlement patterns within the New Orleans metropolitan area. Moreover, the local residential context is crucial for understanding how racially concentrated neighborhoods were, and are still, differentially exposed to environmental hazards. As is now well-documented, the spatial organization of black and white residents across the city corresponds closely to flooding risk (Logan 2006). Prior to Katrina, black residents were more likely to be living in the eastern portion of the city, at risk of flooding via proximity to waterways that connect to the Gulf of Mexico as well as via a lower elevation than the western portion of the city, where white residents were more likely to live (Campanella 2014).

In this study, we ask how disaster-induced shifts in fertility accompanied, augmented, or offset changes to the New Orleans population structured by differential out-migration, return migration, and new in-migration flows. In light of the historical significance of race in New Orleans, and the disaster's role in making race-associated divisions evident, we give particular attention to race-associated variation as well.

DATA AND METHODS

Our descriptive analysis addresses three questions. First, how did the size and racial composition of birth cohorts in New Orleans change following hurricane Katrina? Second, are the changes plausibly attributable to the disaster? And third, to what extent did these shifts operate through the size and composition of cohorts of reproductive-age women? That is: did the disaster shape the composition of New Orleans birth cohorts by changes to fertility behavior or by altering *who* lives in New Orleans?

To answer these questions, we draw on multiple data sources to build a county-level and metropolitan statistical area-level (MSA) data set with information on live births, population counts, and population characteristics from 2000–2010. Information on county- and MSA-level live births comes from restricted-use geocoded birth certificate data collected by the National Vital Statistics System at the National Center for Health Statistics (NCHS 2012). These data include sociodemographic information on mothers as well as the information about the county in which births occurred.

For population counts, we use data from the 2000 Census, the 2010 Census, and the 2000–2010 intercensal population estimates generated by the Census Bureau, which are calculated at county-level and stratified by five-year age categories, sex, and racial/ethnic identification (U.S. Census Bureau 2013).[1] Finally, we generate information on population characteristics using data from the 2000 Census and one-year estimates from the American Community Survey (ACS) from 2005–2010. Data from the 2000 and 2010 decennial Censuses and the 2005–2010 ACS were accessed through the IPUMS-USA database (Ruggles et al. 2015); the intercensal estimates were accessed directly from the Census Bureau's website (U.S. Census Bureau 2013).

Geographic Levels of Analysis

We analyze fertility at two geographic levels. First, we seek to examine how Hurricane Katrina influenced fertility in the city of New Orleans, which is coterminous with Orleans Parish, as well as its largest immediate outlaying suburbs, including Jefferson and St. Tammany Parish. Louisiana uses the term *parish* in place of county; from this point forward we will use the term *county* for clarity. The socio-historical importance of Hurricane Katrina is bound up with the city of New Orleans, though the disaster's economic and political effects spilled over into neighboring regions. In order to ascertain broader geographic trends, then, we examine fertility at the metropolitan statistical area-level (MSA), defined by the Office of Management and Budget.[2] The New Orleans MSA includes seven counties

[1]It is important to note that the Census Bureau's intercensal population estimates for Orleans Parish during 2006 are slightly higher than rapid population estimates generated by both the City of New Orleans Emergency Operations Center and the Rand Corporation (VanLandingham 2007). This might also be the case for other parishes that compose the New Orleans MSA, although no competing population estimates exist to the authors' knowledge. The revised intercensal population estimates for Orleans Parish in July 2006 were 230,172 (U.S. Census Bureau 2013), while the City of New Orleans Emergency Operations Center estimates were 181,400 at the end of January 2006 (Stone et al. 2007; Emergency Operations Center City of New Orleans 2006) and the Rand Corporation estimates were 198,019 in September 2006 (McCarthy et al. 2006). Our usage of the Census Bureau's intercensal population estimates for 2006 likely overestimates the population size of the New Orleans MSA for this year, which, consequently, probably decreases our total fertility rate estimates. However, the intercensal estimates are the only source of population estimates that enumerate the post-Katrina population across five-year age groups stratified by sex and racial/ethnic identification – a prerequisite for calculating race-specific total fertility rates.

(Orleans, Jefferson, Plaquemines, St. Tammany, St. Bernard, St. Charles, and St. John the Baptist). The MSA level of analysis also provides a straightforward geographic unit that can be comparatively analyzed. Comparisons of the New Orleans MSA to similarly composed MSAs (detailed further below) support a central part of our analysis: a counterfactual assessment of fertility during the 2000–2010 decade. We turn to a description of these methods.

Documenting Changes in Birth Cohorts and Trends in Fertility Rates

To document the relationship between climatic events and *population change*, the analysis begins with a description of the shifts in birth cohort size and composition in the New Orleans MSA and comprising counties between 2000–2010. Here, we are interested in changes to the flow of births that comprise the next generation of New Orleans' residents.

We then consider whether these shifts are indicative of fertility change or indicative of shifts in the size and age-composition of reproductive age women. We generate year-, race-, and county- specific total fertility rates (TFR) for the New Orleans MSA and its comprising counties using Eq. 1. Counts of births to women age x to x+5 in year t, county c, and race/ethnic category k (B^{xtck}) come from the vital statistics data. Counts of women age x to x+5 in year t, county c, and race/ethnic category k (N^{xtck}) come from the Census estimates (2000 and 2010) and the Census Bureau intercensal estimates (2001–2009). To calculate TFR for the New Orleans MSA and for a set of comparison MSAs, Eq. 1 is also used; births (B) are pooled at the MSA level and the counts of reproductive-age women are pooled at the MSA level.

The TFR allows us to capture *period* fertility change while adjusting for changes to the population size and age composition; it is a numeric summary of age-specific fertility rates between ages 15 and 49 for a population in a given year.[3]

$$\mathrm{TFR}_{tck}=5\times\sum_{x=15\ldots45}\frac{B^{xtck}}{N^{xtck}} \quad (1)$$

Attributing Fertility Change to Disaster

Following our descriptive analysis of trends, we then ask whether changes in the TFR are plausibly attributable to Hurricane Katrina. We conduct this analysis at the MSA level, because doing so supports the use of a comparison group to model period trends arising for reasons *other* than the disaster. We assess the disaster's effect on the total fertility rate by

[2]MSA coding describes coterminous counties that have an urbanized core population of 50,000+ and share economic, social, and cultural ties. We use 2013 OMB codes for the full period of study.

[3]The TFR also has a *synthetic cohort* interpretation: the average number of births per woman that would be observed if a cohort of women survived to age 49 and experienced the period age-specific fertility rates in each age interval between 15 and 49. Our focus is on period fertility, period birth cohort size, and how both are changed by the disruption of Katrina. It is less heuristically useful to conceptualize period TFR values as being relevant to particular cohorts of women in New Orleans. The short-run population implications for New Orleans are related to, but distinct, from the question of whether women's completed fertility by age 50 shifts. It may be, for example, that any period changes we observe between 2005–2010 are offset in the years following, resulting in unchanged completed fertility for women; the implications for New Orleans birth cohorts between 2005–2010 would be unchanged by such a process.

fitting a time trend to the data and testing for discontinuities beginning in 2006. Critically, the expected TFR values after 2005 might not have been a simple extension of the pre-disaster trend—for example, studies have documented fertility effects of the Great Recession (Cherlin et al. 2013, Percheski and Kimbro 2016). Therefore, we use period trends in the total fertility rate in other U.S. metropolitan statistical areas during 2000–2010 as a comparison. To provide an appropriate approximation of period trends arising for reasons other than disaster that may have also affected New Orleans, these MSAs would ideally share some population or sociohistorical characteristics with New Orleans. These MSAs must also have been minimally affected by the disaster. With these goals in mind, we selected 8 MSAs for possible comparison—Atlanta, Birmingham, Charleston, Charlotte, Jacksonville, Louisville, Memphis, and St. Louis—on the basis of (a) comparability in region of the country, (b) either comparability of population size, levels of poverty, racial composition, or residential segregation, (c) location outside the path of Hurricane Katrina (e.g., Mobile, AL was not selected) and, (d) the influx of New Orleans residents in the aftermath of the disaster did not exceed a few thousand residents (e.g., Baton Rouge, LA, Houston, TX, and Jackson, MS were not selected).

Table 1 contains descriptive estimates on the population size and composition of these 8 comparison MSAs in 2000. Each comparison MSA, while not matching the New Orleans MSA on every attribute, shares a number of socio-demographic commonalities. Most have comparable population sizes, measures of residential segregation (Entropy Score), and have a black population that comprises at least one-fifth of the overall MSA population. We then tested whether each city's MSA provided an appropriate comparison for possible period changes affecting all large, Southern cities by testing the race-specific parallel trends assumption (Wooldridge 2001). That is, in each of the MSAs, we assess whether TFR values from the pre-disaster period (2000–2004) moved in parallel with values in New Orleans during the same period (results available from authors). For the black, white, and Asian populations, each of the cities meets the parallel trends test. Fertility among Hispanic women in 5 of the 7 comparison cities was increasing prior to the disaster; the parallel trends estimates fail. Consequently, tests of Hispanic fertility rely on TFR trends only from the MSAs of St. Louis and Little Rock, which both moved in parallel to those in New Orleans prior to the disaster.

As a sensitivity test, we used two other groups of comparison cities: (a) MSAs comparable in population size to New Orleans[4] and (2) Southern, coastal MSAs not affected by Hurricane Katrina, primarily bordering the Atlantic Ocean.[5] Use of the alternative comparison groups generates similar estimates to the primary analysis (discussed in the next section).

We pool the TFR values for the comparison MSAs with those from the New Orleans MSA and estimate a fixed-effects regression model. These models test for a spatial-period difference-indifference: Eq. 2, in which m indexes metropolitan statistical area and t indexes

[4]Jacksonville, FL; Oklahoma City, OK; Memphis, TN, Louisville, KY; Raleigh, NC; Richmond, VA; Hartford, CT; Birmingham, AB; Buffalo, NY; Rochester, NY; Salt Lake City, UT; Grand Rapids, MI; Tuscon, AZ.
[5]Savannah, GA; Charleston, SC; Virginia Beach, VA; Tampa, FL, Jacksonville, FL, Myrtle Beach; Wilmington, NC.

year. Specifically, we regress the pooled TFR values (θ_{mt}) on a parameterization of time using a linear term (Y_t) discussed further below, and a dichotomous variable capturing the post-disaster period (2006–2010), a set of metropolitan-area fixed effects (M_m), which includes a fixed term for New Orleans, and interactions between the post-disaster period and the New Orleans fixed term. The estimate of interest, γ_3, tests whether the TFR values in the New Orleans MSA following the disaster deviate from the pre-disaster values, net of the period-specific deviation observed in other MSAs that were, for the most part, not affected by the hurricane or the resulting out-migration of New Orleans residents. The metropolitan-area fixed effects adjust for any variation across metropolitan area that is enduring over time, whether or not it can be observed (Allison 2009). The post-disaster estimate adjusts for any source of variation (observed or unobserved) across the pre-and-post disaster periods that is common to all metropolitan areas in the analysis.

$$\theta_{mt}=\alpha+\gamma_1 Y_t+\gamma_2 Post_t+\gamma_3 (NO \times Post)_{mt}+\delta' M_m+\varepsilon_{mt} \quad 2$$

We tested an interaction between the year trend and the New Orleans fixed term, given our previous parallel trends tests; the estimate on the additional term was small (<0.015 for white and Asian women; <0.002 for blacks) and did not improve the fit of the model. We also tested the inclusion of a nonlinear year trend; it did not change the estimate of interest, γ_3, for any of the groups studied and is omitted for parsimony.

The analysis uses TFR values for each year between 2000–2004 and 2006–2010. We omit 2005 from the analysis for two reasons. One, disaster-induced changes to fertility in 2005 would have been driven by a distinct mechanism: 2nd and 3rd trimester miscarriages. Two, more importantly, the 2005 estimate in this study will be artificially low given the construction of TFR values in Eq. 1. The denominator estimate approximates the mid-year population; in 2005, this is prior to out-migration. The resulting mismatch between the numerator and denominator for the September–December births will contribute to an underestimate of the 2005 value. Therefore, we exclude 2005 values from the analysis entirely.

Documenting Changes in the Composition of Reproductive-Age Women

We then turn to our third question. We ask whether the fertility effects of the disaster are plausibly attributable to sociodemographic variation in the composition of reproductive-age women before and after the disaster. With limited degrees of freedom, we cannot statistically adjust the regression estimates in Eq. 1 for a set of covariates. However, we can separately estimate similar difference-in-difference estimates using sociodemographic characteristics and use their direction and magnitude to provide contextual information with which to interpret the estimates generated by Eq. 1. That is, would observed TFR changes be expected given the changing parity and socioeconomic profile of New Orleans residents resulting from out-migration and in-migration?

We use 2000 Census data to generate average MSA-level covariates for 2000 and annual ACS data from 2006–2010 to generate MSA-level covariates for 2006–2010.[6] We generate these covariates separately by race/ethnicity and calculate them specifically for the MSA-level populations of reproductive age women 15–49. The covariates include: (1) the percent with any college education, (2) the percent living in households below the poverty line, (3) the average number of children under age 18 in coresidence, and (4) the average age of reproductive age women. We apply survey weights to properly adjust our estimates so they represent the MSA-level population. In our difference-indifference model, we average the pooled estimates of each individual comparison MSA for both the pre-Katrina period, 2000, and the post-Katrina period, 2006–2010.

Effect Magnitude: Disaster-Induced Fertility Change and Birth Cohort Composition

We conduct a final exercise to characterize the substantive importance of the effect sizes on fertility. We consider how the composition of birth cohorts—measured by mothers' race and ethnic identification—shifted between the pre- and post-disaster period for the New Orleans MSA. We then use a simple accounting decomposition to describe what proportion of the difference between the observed composition and the expected composition of 2006–2010 birth cohorts is attributable to (a) migration-related change in the size and race composition of the population of reproductive-age women and (b) changes in women's fertility rates.

This exercise relies on a set of counterfactual age-specific fertility rates (ASFR*). These are calculated using Eq. 3. For each race-specific 5-year age interval between 15–49, we calculate the pre-disaster difference (2000–2004) in ASFR values between New Orleans and the pooled comparison MSAs. In each year t during the post-disaster period (2006–2010), we add this difference to the ASFR value observed in the pooled comparison MSAs. This is done separately by race/ethnicity. Conceptually, this takes the pre-disaster ASFR values for New Orleans and projects them forward using a parallel time trend to that observed in the pooled comparison MSAs.

$$\mathrm{ASFR}*_{\text{New Orleans, } t} = \mathrm{ASFR}_{\text{New Orleans, } 2000-2004} - \mathrm{ASFR}_{\text{Comparison, } 2000-2004} + \mathrm{ASFR}_{\text{Comparison, } t} \quad (3)$$

For each race/ethnic category, we generate four estimates. (1) We begin by calculating the number of births that occurred between 2000–2004 in New Orleans. (2) We then calculate the number of births that would have been expected in New Orleans in 2006–2010, in the absence of the disaster. We do this by taking the pre-disaster population values N and applying the counterfactual ASFR*. (3) We then calculate the number of births that would have been expected had the reproductive age population observed after the disaster been subject to the counterfactual ASFR*; this estimate allows the disaster to affect the number

[6]The ACS micro-data support an analysis of birth probabilities in the previous year with the possibility of substantial adjustment for features of changing population composition but do so only for the *post-disaster* period, rendering such an approach of little value for this endeavor.

and composition of reproductive age women, but not their fertility rates. (4) Finally we compare each of these to the observed size and composition of the 2006–2010 birth cohorts.

The difference between the second and fourth estimates captures the disaster effect on birth cohort size and composition. The difference between the third and fourth estimates captures the proportion of the overall disaster effect that is attributable to changes in fertility rates. This simple exercise helps characterize the substantive importance of the fertility changes implied by Eq. 2 in relation to the changes to the population race composition of New Orleans generated through migration patterns.

RESULTS

New Orleans Births Cohorts, 2000–2010

Figure 1a displays trends in the size and racial composition of birth cohorts in the New Orleans metropolitan statistical area during the full period of analysis. Several patterns are readily notable. In 2004, the year prior to Hurricane Katrina, births to black women were at 9,050, while births to white women were at about 8,550. In 2006, the year after the hurricane, births to black women declined precipitously to 4,900; meanwhile, births to white women only fell to 7,400. In 2007, births to black women stabilized at about 6,400 a year – 71% of the pre-disaster count – while births to white women remained similar to the 2006 count, stabilizing at about 85% of the pre-disaster count. The differential decrease resulted in a striking pattern: following decades during which the majority of births in the New Orleans MSA occurred to black women, the majority of births in the New Orleans MSA now occur among white women.

A disaggregation by the comprising parishes of the New Orleans metro area in Figure 1b indicates that the majority of the reduction in births to black women occurred in Orleans Parish, which was unambiguously among the hardest hit counties by the disaster. While births to white women rebounded in 2007 to 73% of their pre-Katrina size in 2004, births to black women rebounded to only 53% by 2007. Even by 2010, five years after the hurricane made landfall, births to black women were still well below their pre-Katrina size, at 57% of its pre-disaster size. Meanwhile, births to white women had been practically regained, making up 91% of pre-Katrina births. In contrast to Orleans Parish, Jefferson Parish experienced only marginal losses in births for black and white women, and actually saw increases in births to Hispanic women. There were not any sizeable differences between pre- and post-Katrina births for women in St. Tammany parish, besides a small dip in births in 2006.

Figure 1a also reveals evidence consistent with work on new migration to New Orleans in the disaster's aftermath (Fussell 2009; Fussell and Diaz 2015): births to women identifying as Hispanic nearly doubled. These births were largely concentrated in Jefferson Parish and raised the proportion of Hispanic births in the total cohort from 5.2% in 2004 to 10.6% in 2010. As Figure 2 displays, the majority of births to women of Hispanic origin in the New Orleans metropolitan area following Katrina were to mothers classified as Central or South American. Prior to Katrina, women with Central or South American Hispanic origin had under 100 births to year; however, by 2007 and onwards, their births numbered between

1000 and 1100. Births to women of Mexican Hispanic origin nearly doubled from 200 per year in the period preceding Katrina to 400 per year in the period afterwards. Meanwhile, births to women of other Hispanic origin, including Puerto Rican and Cuban origin, decreased by nearly two-thirds, from a peak of 700 in 2004 to 230 in 2010.

We observe minimal change in the total count of births to women identifying as Asian. Though interpretation of an aggregate, pan-ethnic category pattern like this must be done with caution, the absence of a major shift could be consistent with VanLandingham and colleagues' findings of the resilience of Vietnamese population in New Orleans (the majority Asian population in New Orleans) despite limited financial resources and extensive flooding damage in Vietnamese communities (VanLandingham 2010; Vu and VanLandingham 2009, 2012; Sastry and VanLandingham 2009). Unfortunately, the birth data in Louisiana does not accurately record specific Asian ethnicities, and we are therefore unable to look at Asian births in more detail.

Fertility Change: Migration and the Composition of Reproductive-Age Women

Out-migration and in-migration may have shaped the patterns in Figures 1a and 1b through two mechanisms. The population of women living in New Orleans in 2006 was much smaller than the population living in New Orleans in 2005. According to point-estimates of reproductive aged women between the ages of 15–49 from the ACS, the New Orleans metro area saw a loss of 29% of women, from roughly 324,000 in 2005 to 230,000 in 2006. For Orleans Parish, the reproductive age female population decreased by 61% in the same time period, from roughly 123,000 in 2005 to 48,000 in 2006. Accordingly, we turn to a discussion of period fertility rates.

Figure 3 depicts the annual total fertility rate in the New Orleans metro area from 2000–2010, excluding 2005. In 2006, TFR remained lower than pre-disaster levels for black women, at about 2.0 for the metropolitan area (and down to 1.7 in Orleans Parish; Online Appendix A). By contrast, TFR had increased among white women and increased substantially among Hispanic women.

Generating an estimate of fertility change that is plausibly attributable to the disaster—and the attendant successes or failures of recovery initiatives—requires an approximation of what fertility in New Orleans might have been in the absence of the disaster. To that end, we rely on period trends in seven comparison cities. Table 2 displays the mean and standard deviations for the average racial and ethnic-specific TFR for the New Orleans MSA and the comparison MSAs for the period before (2000–2004) and after (2006–2010) Hurricane Katrina in 2005. For the pooled comparison MSAs, there is relatively little change in the TFR values for white, black, and Asian women in the period before and after Katrina. Hispanic TFR, on the other hand, increases by 0.15 points for the average of all comparison MSAs.

Eq. 2 formally tests whether the period trends in New Orleans differed from those in comparison cities. We estimate Eq. 2 separately for black women, white women, Hispanic women, and Asian women. We present the results in Table 3. We observe that among black women, fertility in the post-disaster period fell below expected values by roughly 0.1 births per woman per year (column 1). By contrast fertility exceeded expected values by 0.077 births per woman per year for white women (column 2). The effect sizes are modest, they represent a 4% decrease (0.1/2.1) in the black TFR and a 5% increase (0.077/1.8) in the white TFR. Both estimates are statistically significant. For Hispanic women, the total fertility rate increased by 1.0 over the expected value in the post-Katrina period (column 3). This is a substantial increase of 55% in the pre-disaster TFR. Among Asian women, we observe a modest decrease of 0.067; this estimate is not statistically significant (column 4).

To ensure that these estimates are not driven by something anomalous about the comparison population, we estimated Eq. 2 substituting two other groups of comparison MSAs for the seven shown in Table 3: (1) MSAs comparable in population size to New Orleans and (2) Southern, coastal MSAs not affected by Hurricane Katrina. The estimates for black and white women are statistically equivalent to that shown in Table 3. For black women, the interaction term estimate (γ_3 from Eq. 2) which describes the fertility effect attributable to Katrina, is −0.124 and −0.06 using the first and second alternative comparison groups, respectively (full tables shown in Online Appendix C). The estimates for white women using the alternative comparison groups are 0.073 and 0.064; both are statistically significant. The estimates for Hispanic women, 0.92 and 0.64, attenuate some, indicating some sensitivity to the choice of comparison population, but are still sizeable (and statistically significant). The estimates for Asian women remain small, 0.02 and −0.01, and are not statistically significant.

Hurricane Katrina may have shifted the fertility rate through two types of mechanisms: by shifting the socioeconomic and demographic composition of the population and/or by changing fertility-related behaviors. To shed some light on this distinction, we tested for evidence that the New Orleans population changed in composition after the disaster in a way that was distinct from population composition change in the comparison cities. We estimate four population-level characteristics of reproductive age women (15–49) for each racial/ethnic group in the periods prior to and after Hurricane Katrina (Table 4). For each of these measures, we compare the pre-disaster values to the post-disaster values in New Orleans and in the comparison MSAs. We then calculate the difference between the pre-post comparison in New Orleans relative to that observed in comparison cities. In large part, the results of these difference-in-difference estimates are small, with none being statistically meaningful for any racial/ethnic group. In magnitude, however, some of these estimates may be meaningful for interpreting the findings in Table 3. White reproductive-age women living in New Orleans after Katrina were, on average, slightly younger and had fewer children than the pre-disaster population – both changes would be consistent with a small increase in the white fertility rate after the disaster. By contrast, black reproductive-age women in New Orleans following Hurricane Katrina were slightly older than those in the pre-disaster population, consistent with a small decrease in fertility. The average age of reproductive-age Hispanic women decreased by 1.34 years; though not a sizeable enough change to explain a TFR increase of 1.0, the pattern suggests that at least some of the fertility rate change observed in the Hispanic population was due to changes in the characteristics of the MSAs Hispanic population. This is to some degree expected given the sizeable inflow of Hispanic persons into the New Orleans MSA in the years following Hurricane Katrina.

The Effects of Fertility on Birth Cohort Composition

The demonstrated fertility effects are small; nevertheless, they appear to exacerbate the shifting racial composition of New Orleans generated by out-migration and in-migration. That is, New Orleans' black residents disproportionately migrated out of the metropolitan area and were less likely to return in the year following the hurricane (Fussell, Sastry, and VanLandingham 2010). Following the disaster, black fertility fell and white fertility increased, contributing to a declining share of births to black mothers in the 2006–2010 birth cohorts. To quantify the contribution of disaster-associated fertility change to the changing composition of the of New Orleans birth cohorts, we display four birth cohort estimates for each race and ethnic category in Figure 4.

The first estimate is the observed count of births in 2000–2004. The second estimate uses the counterfactual ASFR values from Eq. 3 and applies them to the pre-Katrina population of reproductive age women, generating the count of births expected in the absence of the disaster—that is, had the population been unaffected by changes from in- and out-migration rates and had fertility rates followed the period trends observed in comparison cities. These differ negligibly from pre-disaster rates, demonstrating a <1% increase in births to black women and a <1% decrease in births to white women. The third estimate applies the ASFR values to the observed counts of reproductive age women, generating an estimate of the birth cohort size and composition had the disaster shifted in- and out-migration but not fertility rates. The final estimate is the observed 2006–2010 birth cohorts; this captures disaster effects on the composition of reproductive age women and on their fertility rates.

The largest difference is that between estimate 2 and 4. The share of births to black women falls from 48% of the cohort to 40% of the cohort. Births to white mothers numerically dominate the cohort. The share of births to Hispanic mothers increases from 4% to 10%. What proportion of this is attributable to change in fertility *rates*? Comparing the second and third estimates: births to black mothers fall in part because of the reduction in the size of the reproductive-age black female population. This change represents about 57% of the difference observed between the second and fourth estimate; 43% of the reduction in the share of birth cohorts born to black women is attributable to changes in fertility rates.

The increase in the share of the cohort born to Hispanic mothers is also driven by changes the population of reproductive age women in New Orleans; but this explains only about a third of the increase. The remainder results from an increase to fertility rates observed among Hispanic women. We conclude then that shifts in fertility rates for black and white women were modest in size but had a meaningful impact on the relative share of the cohorts born to these women during the 2006–2010 period. Shifts in the fertility rates observed by Hispanic women magnified the impact of post-Katrina Hispanic in-migration on the composition of New Orleans' birth cohorts. Importantly, birth is only one way for children to enter a population. Whether the changes in Figure 4 have lasting impact on the population of New Orleans youth depends in large part on whether children born elsewhere in the disaster's aftermath ultimately move back with their parents. We consider this issue in more detail below.

DISCUSSION

In the eleven years since Hurricane Katrina made landfall, significant scholarly and public attention has questioned how the disaster—and the policy responses to it—reshaped the ethnic and racial composition of the Gulf Coast, and New Orleans in particular. The focal point of past research has considered whether differential access to financial resources diminished the ability of lower and working class black residents to return at the rates equivalent to whites (Sastry and Gregory, 2014; Cutter et al. 2006; Finch et al. 2010) and the extent to which the hurricane affected black residents more than whites, primarily in regards to flood damage (Campanella 2014; Masozera et al. 2007). Our analysis builds on the study of geographic out-migration and in-migration to examine fertility, a linked demographic process with implications for the city's recovery.

This study documents a shift in population renewal in the New Orleans metropolitan area. For several decades the largest share of birth cohorts were infants born to black women; the largest share of birth cohorts are now infants born to white women.[7] Even in Orleans Parish, the proportion of births to black mothers has yet to return to its pre-Katrina level. This is a marked difference from births to white women, which returned to nearly pre-Katrina levels in 2010.

These differences are not simply a reflection of population changes induced by race variation in out-migration and in-migration. We find evidence that the disaster affected fertility *rates*. The TFR among white women exceeded expected values for the 2006–2010 period, whereas the TFR among black women fell below expected values for the same period. These race differences in changes to the fertility rate exacerbate the changes in racial composition resulting from migration. A smaller population of reproductive-age black women multiplied by a lower fertility rate further reduces the number births to black women after the disaster. Although the effects are modest in size, they contributed to a 18% reduction)[8] in the share of New Orleans births to black women.

Whether these changes have long-run implications for the racial composition of New Orleans' population depends in large part on how long fertility differences are sustained and whether these are offset by future changes in migration. If the reductions in the black TFR were driven by an interest of women to delay additional childbearing (versus forgo additional childbearing) until after the economy recovered, TFR values would be expected to demonstrate an offsetting increase during the period after that considered in this study.

It is also essential to consider how in-migration has changed in the years since Katrina (Fussell 2015). Initial findings in the year immediately following the hurricane suggested that households with children were less likely to return than those without children (Plyer et al. 2009). By 2010, comparisons between the decennial censuses of 2000 and 2010 showed that the proportion of children living in the New Orleans metropolitan area had decreased

[7]The most recent release of birth records indicates that this pattern has not reversed in the years since 2010. In 2014, 45% of births in the New Orleans MSA were to white women and 38% of births were to black women (authors' calculation, Louisiana Department of Health 2017).

[8](48.7% – 39.8%)/48.7%

from 27% of the population to only 23% (Plyer and Ortiz 2011). Moreover, by 2013, data from the 2013 ACS indicated that the percentage of households with children had decreased from 34% in 2000 to 26% in 2013 (Shrinath et al. 2014). In total, these findings suggest that, although in-migration might have increased in the years since Katrina, it is unlikely to have substantially changed the size of child cohorts.

In-migration may have shifted the racial composition of cohorts. The black population in New Orleans and the greater metropolitan area have experienced steady increases since 2010 (Shrinath et al. 2014); the white population has as well. According to 1-year estimates from the ACS, the black population of the metropolitan area increased by 41,717 residents between 2010 and 2015, while the white population increased by 48,993 (Online Appendix B). In proportional terms, the black population increased by nearly a percentage point during this period (34.0% of the total population in 2010, 34.9% in 2015), while the white population declined by about 0.2 percentage points (58.3% in 2010, 58.1% in 2015). To be sure, in-migration still accounts for a substantial portion of the change in racial and ethnic demographics.

Though useful for the study of population change, an examination of aggregate fertility trends has drawbacks. We cannot, for example, study fertility at the micro-level, which would facilitate a clearer distinction between behavioral and compositional effects on fertility. Nor can we engage in a richer analysis of the mechanisms driving these effects. To the best of our knowledge, longitudinal, micro-data of this kind that describe the entire New Orleans MSA pre-disaster do not exist. Some progress may be possible in the future using linked administrative data (see the Census Longitudinal Infrastructure Project; Census Bureau 2016).

As in all studies of population trends, the estimates here are subject to the quality of the denominator estimates. We use the Census Bureau intercensal estimates, widely considered to be the most reliable estimates of sub-population county-level characteristics. We also used values from the IPUMS 2000 and 2010 Census estimates and the IPUMS ACS estimates from 2005–2010 to test for significant variation with the estimates shown here and found none.

Two other aspects of the research design are critical to discuss. An analysis of population renewal processes must be attentive to mobility across categories between parental characteristics and child characteristics (Mare 1997; Preston and Campbell 1993; Maralani 2013). This includes race. Not all births to mothers identifying as one racial/ethnic category will be children who identify as the same racial/ethnic category. Future research that extends this analysis would benefit from the use of a companion analysis of household survey data (should it exist) that facilitates the study of intergenerational mobility across race categories, or other relevant subgroup analysis under consideration.

Secondly, the social scientific scholarship on race and ethnicity underscores that both concepts are socially imposed classifications (Hummer 1996; American Anthropological Association 1998; Brubaker 2006). For the practical purpose of engaging with the literature on differential fertility among racial and ethnic groups, however, there is still utility in using racial categories such as black, white, Hispanic, and Asian that differentiate meaningful fertility disparities (Kaufman and Cooper 2001)— particularly following an event that so clearly displayed long-term race-associated disparities in living conditions (Forman and Lewis 2006). Nevertheless, the practice of demarcating group boundaries as units of analysis in social scientific research leaves open the possibility of reifying socially constructed racial categories (Bourdieu 1993; Brubaker 2006).

More broadly, the findings illustrate how the fertility outcomes of environmental disasters pertain to local social contexts. The racial composition of New Orleans has been a persistent social and residential dividing line (Campanella 2014), but since Katrina made landfall, the topic of racial composition *change* has become a contentious political issue. The issue came to the fore when Ray Nagin, the mayor of New Orleans at the time that Katrina made landfall, used the phrase “chocolate New Orleans” to indicate his intention of ensuring that the racial demographics that existed prior to the disaster would remain unchanged in the aftermath (Lay 2009). Mayor Nagin’s comments were a rebuke to those advocating that the city decrease its footprint by transforming some of the most severely damaged neighborhoods into “open space” which would “be designed to detain and attenuate stormwater flows, mitigate the impacts of floods, and provide water quality treatment” (Urban Land Institute 2005). The endorsement of this proposal by prominent officials in city government was met with suspicion by many black residents who regarded the proposal as an attempt to turn New Orleans into a whiter city by codifying reconstruction policies which would exclude poor and working class back residents from returning and rebuilding their communities (Hirsch and Levert 2009). Tension over the future racial demographics of the city was further agitated by racially-coded rhetoric from lawmakers (Falk et al. 2006) and media narratives that connoted the “criminality” of black disaster evacuees (Lacy and Haspel 2011; Dynes and Rodriguez 2007; Berger 2009).

The disaster has disproportionately affected the city’s black communities through a series of detrimental social and economic forces amplified by local policy decisions about housing, land use, and environmental protection (Ehrenfeucht and Nelson 2012; Parekh 2015; Lovet 2013; Deitz and Barber 2015; Johnson 2015). These differences were manifested in differential out-migration, destruction of homes, and an ability to return and rebuild. Our findings suggest differential effects on fertility that have also contributed to the reduction in the relative size of New Orleans’ black population. Whether these too are indicative of the city’s unequal structure remains an avenue for future research.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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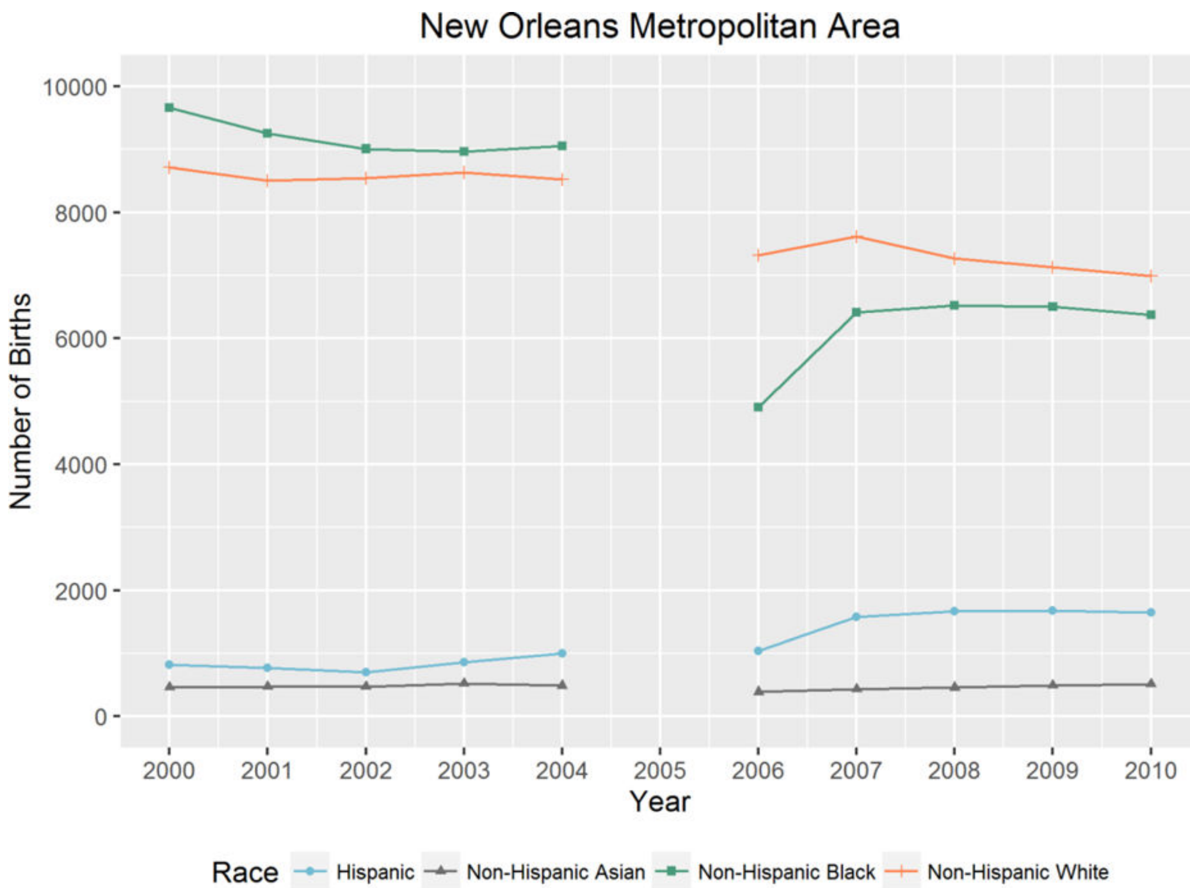
New Orleans Metropolitan Area
Number of Births
10000
8000
6000
4000
2000
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Year
Race
Hispanic
Non-Hispanic Asian
Non-Hispanic Black
Non-Hispanic White

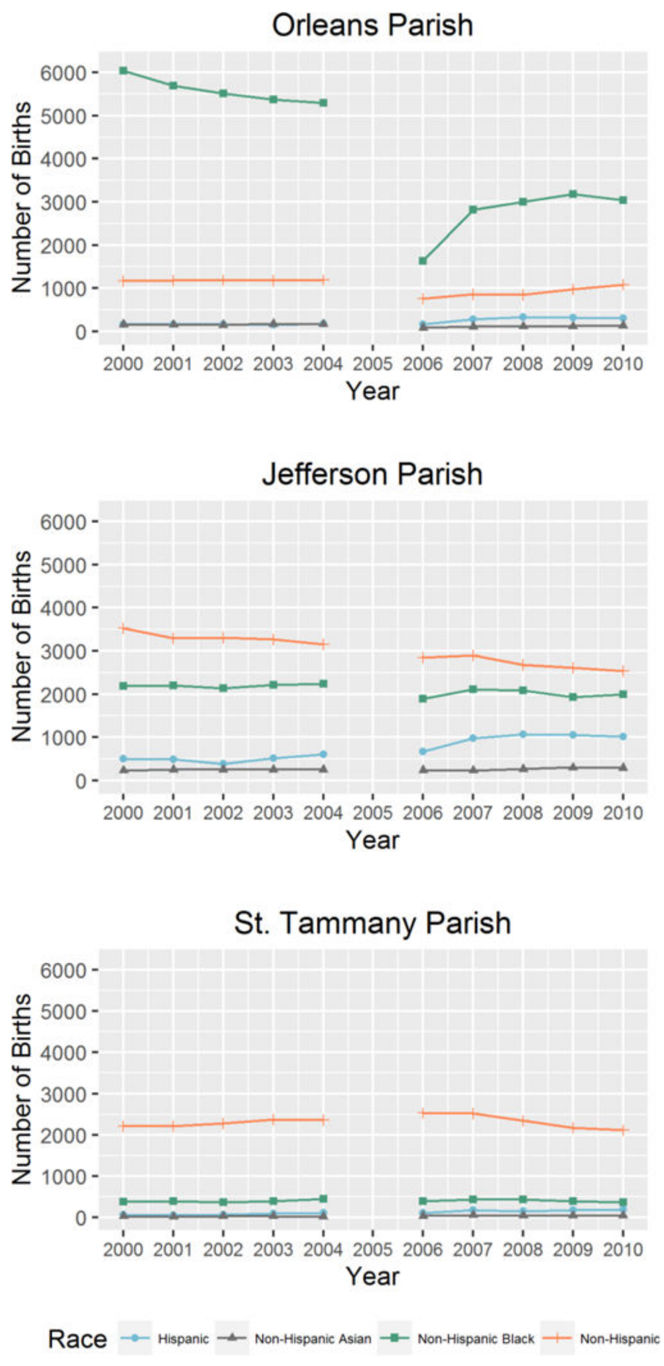

Figure 1.

Birth Cohort Size by Mothers' Racial and Ethnic Categorization for New Orleans Metro Area and Major Comprising Parishes, 2000–2010

A. New Orleans Metro Area

Source: Geocoded birth certificate records, National Center for Health Statistics.

Note: The New Orleans metro area is composed of seven parishes. Two of the seven, Orleans and Jefferson, accounted for 70% of the metro-area population during the 2000 Census.

B. Three Most Populous New Orleans Metro Parishes

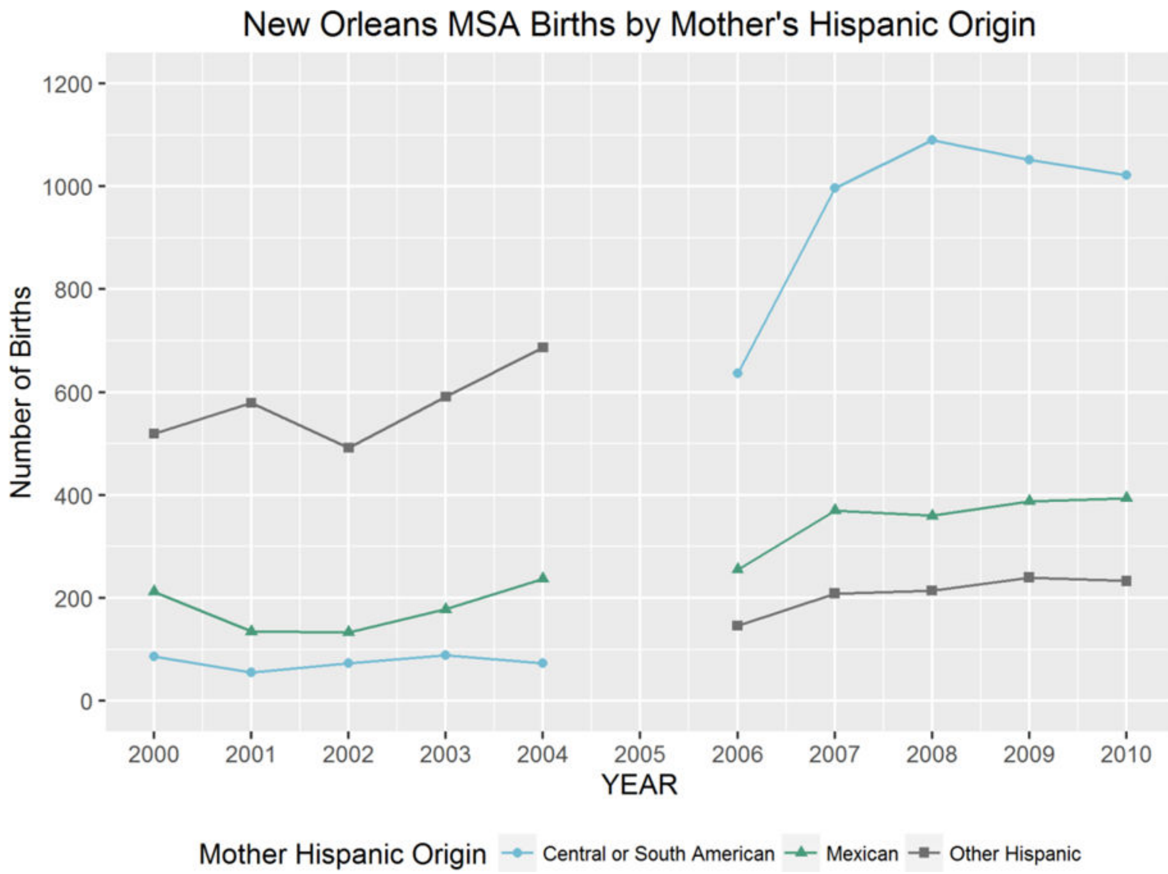

Figure 2.
Birth Cohort Size by Mother's Hispanic Origin for New Orleans Metro Area 2000–2010

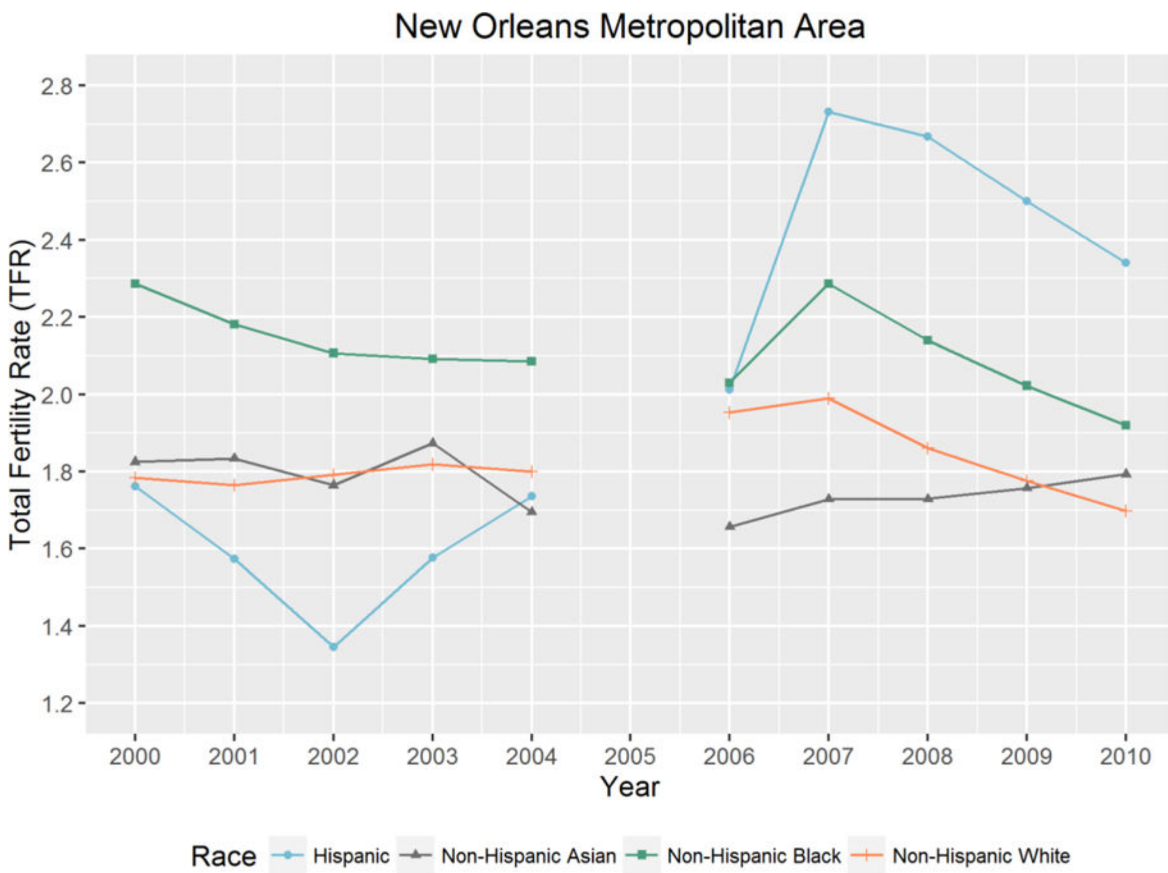

Figure 3.

Total Fertility Rate by Racial Categorization for New Orleans Metro Area and Major Comprising Parishes, 2000–2010

Note: TFR calculated using birth records from geocoded birth certificate records, National Center for Health Statistics, and intercensal population estimates from the U.S. Census Bureau.

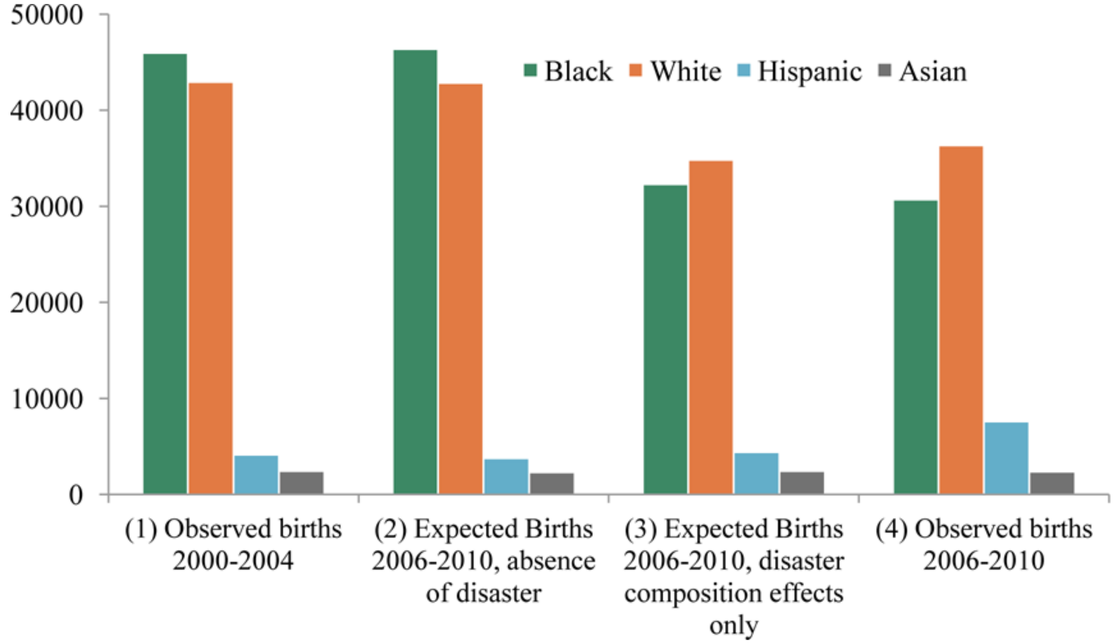

Figure 4.

Composition of Birth Cohorts by Mother's Race and Ethnicity, New Orleans Metropolitan Area

Source: NCHS vital statistics data and U.S. Census Bureau intercensal population estimates.

Notes: Estimates use counterfactual age specific fertility rates (ASFR), given in Eq. 3, or the fertility rates that would have been expected had fertility in New Orleans experienced the same period trends observed in comparison populations. (2) Estimates expected in the absence of the disaster are generated with New Orleans' pre-disaster population of reproductive-age women subject to counterfactual ASFR. (3) Estimates for disaster composition effects only are generated with New Orleans' post-disaster population of reproductive-age women subject to counterfactual ASFR values. (4) The observed births 2006–2010 are those observed in the vital statistics data; these reveal the disaster effects on both the composition of reproductive-age women and on the ASFR schedule.

Table 1

New Orleans Metropolitan Statistical Area and Comparison Metropolitan Statistical Area Characteristics in 2000

Metropolitan Statistical Area	Total Population[a]	Population Black (%)[a]	Child Poverty (%)[a]	Adult Poverty (%)[a]	Entropy Score[b]
Atlanta	4,112,198	28.9	12.1	8.2	63.2
Birmingham	921,106	30.1	17.6	11.4	47.6
Charleston	549,033	30.8	19.0	12.2	53.9
Charlotte	1,499,293	20.5	12.1	8.1	54.7
Little Rock	583,845	21.9	16.9	10.5	45.9
Louisville	1,025,598	13.9	15.9	9.4	36.8
Memphis	1,135,614	43.4	22.0	12.5	55.9
New Orleans	1,337,726	37.6	26.2	15.8	61.4
St. Louis	2,603,607	18.3	14.1	8.6	42.5

Sources:

[a] U.S. Census Bureau;

[b] American Communities Project, Spatial Structures in the Social Sciences, John R. Logan

Table 2

Racial/Ethnic-Specific Total Fertility Rates (TFR) for Metropolitan Areas in 2000–2004 and 2006–2010

	Hispanic		White		Black		Asian	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
2000–2004								
New Orleans	1.6	(0.17)	1.79	(0.02)	2.15	(0.08)	1.8	(0.07)
All Comparison MSAs	3.36	(0.61)	1.9	(0.06)	2.08	(0.12)	1.98	(0.27)
Atlanta	3.96	(0.27)	1.96	(0.03)	2.02	(0.06)	1.9	(0.04)
Birmingham	3.6	(0.33)	1.91	(0.03)	1.98	(0.08)	1.55	(0.17)
Charleston	3.09	(0.46)	1.78	(0.02)	2.11	(0.07)	1.84	(0.18)
Charlotte	3.93	(0.17)	1.94	(0.03)	1.97	(0.08)	2.15	(0.21)
Little Rock	2.94	(0.24)	1.91	(0.04)	2.04	(0.08)	2.2	(0.12)
Memphis	3.61	(0.38)	1.94	(0.05)	2.23	(0.10)	2.27	(0.14)
St. Louis	2.38	(0.11)	1.89	(0.02)	2.21	(0.05)	1.97	(0.08)
2006–2010								
New Orleans	2.45	(0.29)	1.86	(0.12)	2.08	(0.14)	1.73	(0.05)
All Comparison MSAs	3.51	(0.70)	1.89	(0.08)	2.11	(0.13)	1.98	(0.18)
Atlanta	3.83	(0.47)	1.88	(0.13)	2.02	(0.12)	1.82	(0.07)
Birmingham	3.97	(0.61)	1.95	(0.06)	2.01	(0.08)	1.8	(0.10)
Charleston	3.59	(0.62)	1.79	(0.04)	2.15	(0.13)	2.12	(0.14)
Charlotte	3.53	(0.62)	1.91	(0.07)	2.05	(0.10)	2.11	(0.05)
Little Rock	3.12	(0.24)	1.93	(0.04)	2.06	(0.06)	1.94	(0.22)
Memphis	4.02	(0.67)	1.91	(0.09)	2.23	(0.09)	2.15	(0.14)
St. Louis	2.49	(0.26)	1.88	(0.05)	2.24	(0.13)	1.93	(0.07)

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Table 3

Total Fertility Rate in New Orleans and Seven Comparison Cities, 2000–2010 Among women aged 15–49, by race and ethnic identification.

	(1) Hispanic	(2) White	(3) Black	(4) Asian
New Orleans x 2006–2010	−0.100 * [0.038]	0.077 * [0.037]	1.000 ** [0.248]	−0.067 [0.104]
2006–2010	0.315 ** [0.030]	0.099 * [0.029]	0.261 [0.287]	0.056 [0.082]
Year	−0.048 ** [0.004]	−0.019 ** [0.004]	−0.068 [0.041]	−0.009 [0.012]
Atlanta	−0.145 ** [0.031]	0.133 ** [0.031]	–	0.065 [0.086]
Birmingham	−0.171 ** [0.031]	0.145 ** [0.031]	–	−0.128 [0.086]
Charleston	−0.033 [0.031]	−0.003 [0.031]	–	0.182 * [0.086]
Charlotte	−0.158 ** [0.031]	0.138 ** [0.031]	2.206 ** [0.190]	0.332 ** [0.086]
Little Rock	−0.117 ** [0.031]	0.139 ** [0.031]	–	0.271 ** [0.086]
Memphis	0.066 * [0.031]	0.141 ** [0.031]	–	0.409 ** [0.086]
New Orleans (omitted)	–	–	–	–
St. Louis	0.061 [0.031]	0.100 ** [0.031]	0.908 ** [0.190]	0.148 [0.086]
Constant	2.246 ** [0.026]	1.829 ** [0.026]	1.736 ** [0.166]	1.817 ** [0.073]
R^2	0.83	0.59	0.88	0.59
N	80	80	30	80

* $p<0.05$

** $p<0.01$

Notes: Regression coefficients with standard errors in brackets. 10 observations (2000–4, 2006–2010) of up to 8 metropolitan statistical areas (MSAs). The specification in column 3 excludes five cities with pre-disaster TFR values that did not pass parallel trends tests. Columns 1, 2, and 4 are limited to women who identified as non-Hispanic.

Source: Author estimates of TFR from geocoded vital statistics data and aggregated intercensal county population estimates.

Table 4

Weighted Descriptive Statistics of Characteristics for New Orleans Metropolitan Area and Pooled Comparison Metropolitan Areas by Racial/Ethnic Group and Year(s).

	New Orleans MSA					Pooled Comparison MSAs						
	2000		2006–2010			2000		2006–2010				
	Mean	**S.E.**	**Mean**	**S.E.**	**Difference**	**Mean**	**S.E.**	**Mean**	**S.E.**	**Difference**	**Difference in Difference**	**S.E.**
Black												
% Any College	0.35	.	0.40	(0.02)	0.04	0.39	(0.02)	0.46	(0.01)	0.07	−0.02	(0.06)
% Below Poverty	0.35	.	0.29	(0.02)	−0.06	0.25	(0.02)	0.28	(0.01)	0.03	−0.09	(0.06)
# of Children	1.12	.	0.92	(0.04)	−0.20	1.07	(0.02)	0.98	(0.01)	−0.09	−0.11	(0.08)
Mean Age	31.54	.	31.54	(0.08)	0.00	31.93	(0.15)	31.80	(0.06)	−0.13	0.13	(0.45)
White												
% Any College	0.49	.	0.55	(0.01)	0.05	0.52	(0.01)	0.58	(0.01)	0.06	0.00	(0.04)
% Below Poverty	0.11	.	0.12	(0.01)	0.01	0.09	(0.01)	0.12	(0.00)	0.03	−0.02	(0.03)
# of Children	0.92	.	0.84	(0.02)	−0.08	0.95	(0.02)	0.91	(0.01)	−0.03	−0.05	(0.06)
Mean Age	33.25	.	32.96	(0.09)	−0.28	33.17	(0.10)	33.07	(0.06)	−0.10	−0.18	(0.43)
Hispanic												
% Any College	0.40	.	0.43	(0.03)	0.03	0.32	(0.03)	0.30	(0.01)	−0.02	0.05	(0.10)
% Below Poverty	0.19	.	0.24	(0.02)	0.04	0.22	(0.01)	0.28	(0.01)	0.06	−0.01	(0.10)
# of Children	1.03	.	0.83	(0.02)	−0.19	1.06	(0.03)	1.11	(0.03)	0.05	−0.24	(0.02)
Mean Age	31.85	.	31.89	(0.21)	0.04	29.75	(0.18)	31.13	(0.16)	1.38	−1.34	(1.06)
Asian												
% Any College	0.49	.	0.52	(0.04)	0.03	0.60	(0.03)	0.67	(0.02)	0.07	−0.03	(0.11)
% Below Poverty	0.21	.	0.19	(0.03)	−0.02	0.13	(0.01)	0.13	(0.01)	−0.01	−0.01	(0.08)
# of Children	1.13	.	0.94	(0.07)	−0.19	0.91	(0.04)	0.94	(0.02)	0.03	−0.22	(0.16)
Mean Age	32.01	.	32.36	(0.56)	0.35	32.65	(0.31)	33.28	(0.20)	0.63	−0.28	(1.43)

* $p<0.05$

** $p<0.01$

Source: American Community Survey (2000, 2006, 2007, 2008, 2009, 2010)