Risking House and Home:
Disasters, Cities, Public Policy

John M. Quigley and Larry A. Rosenthal
Editors

Contents

Socioeconomic Differences in   10
Household Automobile Ownership Rates: Implications for Evacuation Policy

Alan Berube
The Brookings Institution

Elizabeth Deakin
Steven Raphael
University of California, Berkeley

In the areas affected by Hurricane Katrina, households lacking automobiles were most likely to be left behind during emergency evacuation efforts in advance of the storm. In New Orleans, there were numerous such residents, and they were overwhelmingly black and poor. In this chapter, we document differences in car-ownership rates between racial and socioeconomic groups. We present patterns for the nation as a whole, as well as for the pre-Katrina New Orleans metropolitan area, using data from the 2000 five-percent Public Use Microdata Sample (PUMS) of the US Census of Population and Housing. We also estimate the number residing in a household without access to an automobile. Finally, we explore the relationship among African Americans between residential housing segregation and spatial proximity to other households without access to automobiles.

Introduction

The devastation wrought by Hurricane Katrina has laid bare many of the disparities that continue to separate Americans by race and class. One disparity that was immediately apparent in Katrina's aftermath concerned the size and composition of the area's population lacking access to an automobile. These households, largely dependent on the limited emergency public transportation available to evacuate the city in advance of the storm, were those most likely to be left behind. In New Orleans, this population seemed quite large in size—and overwhelmingly black and poor.

In retrospect, the size and demography of the population stranded by Katrina is not particularly surprising. Nationwide, household access to automobiles is quite low for African Americans, especially if they are poor. The auto-

mobile-access disparity relative to white households is somewhat smaller than, yet comparable in magnitude to, the racial disparity in homeownership rates. Moreover, New Orleans was a predominantly black city, with an overall poverty rate far exceeding that of the nation. The evacuation failure in New Orleans was compounded by the racial segregation of the surrounding metropolitan area. Given that most black households resided in predominantly black areas, black households without cars were physically surrounded by neighbors without cars, rendering an evacuation strategy based on private transportation particularly ineffective.

We note that the outcome observed in New Orleans could well be reproduced elsewhere, should such a catastrophe hit another major American metropolitan area. New Orleans was a midsized American city with a population that happened to be disproportionately African American. In many larger US cities, the black population is comparable in magnitude, highly residentially segregated, disproportionately poor, and has low car-ownership rates—the precise traits that rendered blacks in New Orleans particularly vulnerable.

In this chapter, we document differences in car-ownership rates between racial and socioeconomic groups. We present patterns for the nation as a whole, as well as for the pre-Katrina New Orleans metropolitan area, using data from the five-percent Public Use Microdata Sample (PUMS-5%) of the US Census of Population and Housing (2000). We also present estimates for all US metropolitan areas of those residing in a household without access to an automobile. Finally, we explore relationships among African Americans between residential housing segregation and spatial proximity to other households without access to automobiles.

Our results suggest there are sizable populations without access to household automobiles in most US metropolitan areas. Similar to New Orleans, the members of these households are disproportionately poor and minority. Moreover, we show that low car-ownership rates among black households, coupled with racial housing segregation, renders evacuation plans based on private transportation ineffective for predominantly minority communities. The results suggest that cities facing evacuation risk cannot depend on decentralized private evacuation strategies alone.

Was New Orleans Unique? Basic Cross-City Differences in Household Access to Automobiles

Nationwide, roughly eight percent of the US population resides in a household with no access to an automobile. As we will soon see, there are great disparities across racial and ethnic groups, income classes, and other demographic characteristics such as age. Before turning to these comparisons, however, we first present some basic estimates of the population with no access to a car for specific metropolitan areas and cities. We assess whether access to private transportation in New Orleans prior to Katrina was particularly weak. In addition, we

seek to provide estimates for policymakers and planners of the size of their region's population that does not have access to a car.

Table 10.1 presents proportion and population estimates for the ten US metropolitan areas having the most people in households with no car.[1] Not surprisingly, the New York Consolidated Metropolitan Statistical Area has the largest population of individuals in households without access to a single automobile (forty-two percent of the population, accounting for almost four million people). Moreover, among the nation's top ten are some of the largest metropolitan areas in the country, such as Los Angeles-Long Beach, the San Francisco Bay Area, and Chicago.

The New Orleans metropolitan area ranked at the top of this distribution. As Table 10.1 indicates, New Orleans had the fourth highest rate of individuals with no access to a household auto among the nearly three hundred metropolitan areas in the country. As we will soon see, this fact is driven largely by the internal demographic composition of the metropolitan area. Figure 10.1 summarizes the relative position of New Orleans among all metropolitan regions in the country. In the lion's share of cases, the percent of individuals in households with no cars lies below eight percent, with a large share of metropolitan areas below four percent.

Table 10.2 reproduces these tabulations for the ten US central cities with the highest proportions carless as identified in the PUMS-5% data. Again, the table presents the percentage of the population with no auto access, as well as the corresponding estimate of the absolute population with access to a car. The percentages without access to a car are clearly higher for the nation's central cities relative to the comparable figures for metropolitan areas. This fact reflects the relative poverty of central city populations, the higher costs associated with owning and maintaining a car in more urban settings, and the wider availability of public transit in and around major American cities.

The percent of residents without access to a car in New Orleans before the storm was similarly high enough to place the city among the top ten. The remaining nine cities are all on the east coast, with Washington, Boston, and Baltimore being added to the list. In nearly all of these top ten cities, the absolute size of the population with no access to a car is either comparable in magnitude or exceeds the estimate for New Orleans. Figure 10.2 summarizes the distribution of these percentages across all central cities in the nation. Again, New Orleans was in the tail with a carless-resident percentage far above the average for other central cities.

As a final set of tabulations, Table 10.3 presents comparable city-specific estimates (again for the top ten cities) of the percent with no car access specifically for the poor (elderly and not). In the aftermath of Hurricane Katrina, it become evident that most of those stranded by the hurricane were poor, and many were

---

[1] Complete tabulations for all US metropolitan areas and cities on items reported in some tables can be downloaded via http://urbanpolicy.berkeley.edu/pdf/raphael.pdf.

Alan Berube, Elizabeth Deakin, and Steven Raphael

Table 10.1. Percent and Number of Residents in Households Without Access to an Automobile, Top Ten Metropolitan Areas, 2000

Top ten metropolitan areas	Percent with no auto access	Population with no auto access
New York-Northeastern NJ	42%	3,949,939
Jersey City, NJ	30%	182,252
Waterbury, CT	16%	17,731
New Orleans, LA	14%	175,289
Philadelphia, PA	13%	646,269
Baltimore, MD	12%	290,809
Newark, NJ	12%	243,673
San Francisco-Oakland-Vallejo, CA	12%	201,303
Chicago-Gary-Lake, IL	11%	877,429
Los Angeles-Long Beach, CA	11%	1,036,738

Source: 2000 PUMS-5%.

Table 10.2. Percent and Number of Residents in Households Without Access to an Automobile, Top Ten U.S. Central Cities, 2000

Top ten cities	Percent with no auto access	Population with no auto access
New York, NY	48%	3,815,980
Newark, NJ	38%	101,835
Jersey City, NJ	34%	83,610
Baltimore, MD	32%	205,544
Hartford, CT	32%	38,975
Washington, DC	32%	182,927
Philadelphia, PA	30%	460,331
Boston, MA	28%	163,340
New Orleans, LA	26%	123,084
Buffalo, NY	26%	75,563

Source: 2000 PUMS-5%.

Figure 10.1. Frequency of US Metropolitan Areas by the Percent of the Resident Population Without Access to a Household Automobile
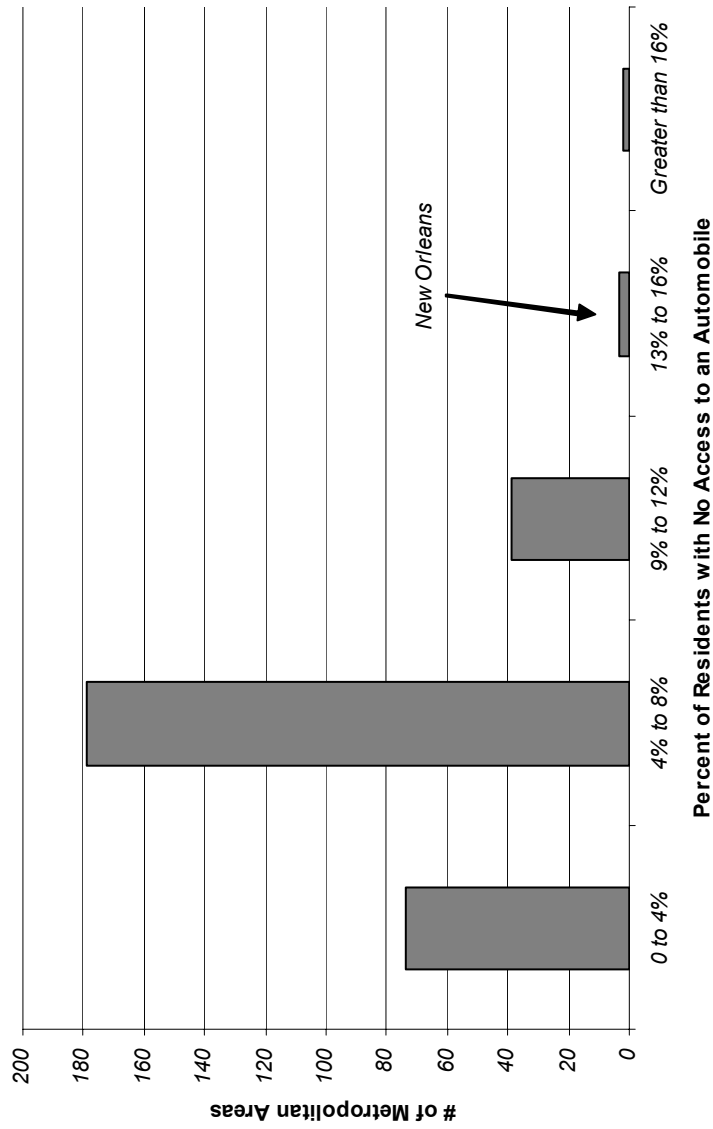
Figure 10.2. Frequency of US Cities by the Percent of the Resident Population Without Access to a Household Automobile

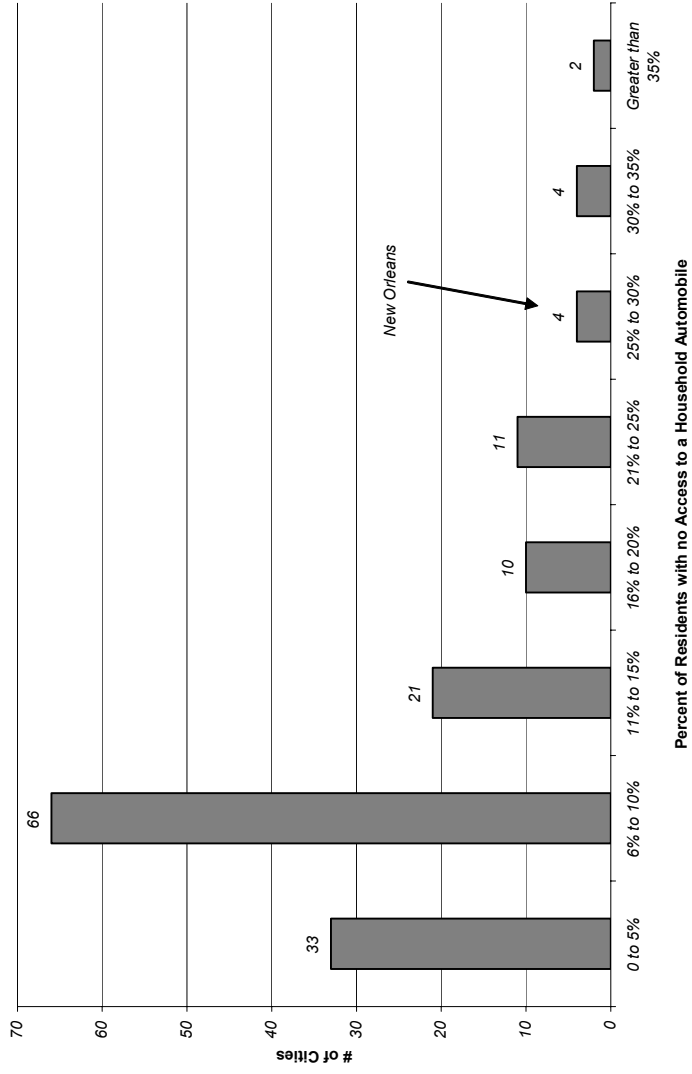Percent of Residents with no Access to a Household Automobile

Table 10.3. Percent of Non-Elderly and Elderly Poor in Households without Access to a Car, Top Ten U.S. Central Cities, 2000

Top ten cities	Percent of nonelderly poor in households with no car	Percent of elderly poor in households with no car
New York, NY	68%	64%
Newark, NJ	58%	52%
Jersey City, NJ	54%	52%
Baltimore, MD	53%	53%
Hartford, CT	53%	42%
Washington, DC	50%	49%
Philadelphia, PA	48%	47%
Boston, MA	47%	36%
New Orleans, LA	47%	44%
Buffalo, NY	44%	50%

Source: 2000 PUMS-5%.

elderly. Here we present figures for central cities only. The percentages in households with no cars are discretely higher for those residing in poverty. Averaging across all central cities, nearly forty-seven percent of the urban poor reside in households without a single automobile (with little difference between the elderly and nonelderly). This figure exceeds by far the percent without a car among the poor nationwide. Again, New Orleans ranked near the top along this dimension, as do the same set of east coast cities appearing in each of the two prior tables.

The Demographic Correlates of Car-Ownership

That African Americans have low car-ownership rates follows directly from sharp racial differences in household income and poverty. Low-income households are often unable to generate the resources needed for down-payments on expensive consumer durables that cannot be fully financed. Moreover, the cost of capital faced by poor households is likely to be higher on average, due to such factors as poor credit histories and perhaps even discriminatory treatment in capital markets. In 2004, roughly 24.7 percent of African Americans lived below the federal poverty line, compared with 8.6 percent of non-Hispanic whites. Me-

dian household income in 2004 for black households stood at $30,134 per year, only sixty-two percent of the median household income for whites.

The racial disparity in durable asset ownership that has perhaps received the most attention is housing. As of the fourth quarter of 2005, forty-eight percent of households headed by an African American owned their residence, as compared with seventy-six percent of non-Hispanic white residents and fifty percent of Hispanic residents. This racial disparity in homeownership rates has received much attention, as homeownership is one of main avenues of wealth accumulation for US residents. A house, in contrast to an automobile, generally appreciates in value over time. Moreover, borrowing against home equity is often considerably cheaper relative to the cost of capital for unsecured debt.

Racial disparities in car ownership rates have received far less attention. Nonetheless, substantial car-ownership disparities exist which may be linked to racial disparities in labor market outcomes (see, e.g., Raphael and Stoll [2001] and Raphael and Rice [2002]), time endowments, and, as has become evident post-Katrina, other important outcomes affecting the welfare of poor households. In this section, we document racial and ethnic differences in car ownership rates along with how car access differs by household income relative to the poverty line.

Table 10.4 presents 2000 PUMS-5% tabulations of the proportion residing in households without access to a single automobile. For all US residents, residents of the New Orleans metropolitan area, and residents of the city of New Orleans, the table presents estimates of the percent without cars by race and ethnicity (non-Hispanic white, non-Hispanic black, other non-Hispanic, and Hispanic) and income (those with incomes below one hundred percent of the poverty line [the poor], those with incomes between one hundred and two hundred percent of the poverty line [the near poor], and everyone else). Beginning with the results for all US residents, African Americans have the lowest car-ownership rates of all racial/ethnic groups. In particular, nineteen percent of blacks reside in households without a single car, compared to 4.6 percent of whites, 13.7 percent of Hispanics, and 9.6 percent of others. These racial disparities are particularly large among the poor, suggesting an interaction effect between race and poverty upon the likelihood of owning a car. For example, the black-white difference in car-ownership rates among the poor is over twenty-one percentage points (thirty-three percent of poor blacks, as compared with twelve percent of poor whites), compared with an overall racial disparity of roughly fourteen percentage points. This disparity narrows somewhat among the near poor but is still quite large (on the order of twelve percentage points).

Within the New Orleans metropolitan area, and in particular within the city of New Orleans, car ownership rates were very low. For example, the overall percentage of residents with no access to a car was fourteen percent in the metropolitan area and approximately twenty-six percent for the city, compared with eight percent for the nation as a whole. Among the poor, thirty-six percent of the poor in the metropolitan area and nearly forty-seven percent of poor residents of the city did not have access to a single automobile, compared with twenty percent of the

Table 10.4. Percentage of Residents Without Household Access to Automobile by Race and Ethnicity: The Nation, the New Orleans Metropolitan Area, and the City of New Orleans

Panel A: All U.S. Residents

	All Residents	**White, non-Hispanic**	**Black, non-Hispanic**	**Other, non-Hispanic**	**Hispanic**
All	7.8%	4.6%	19.0%	9.6%	13.7%
Poor[a]	20.4%	12.1%	33.4%	20.9%	25.0%
Near Poor[b]	12.4%	9.0%	21.4%	14.6%	14.0%
Non Poor[c]	4.0%	2.7%	9.9%	5.5%	7.8%

Panel B: The New Orleans Metropolitan Area

	All Residents	**White, non-Hispanic**	**Black, non-Hispanic**	**Other, non-Hispanic**	**Hispanic**
All	14.1%	4.7%	27.3%	6.8%	10.2%
Poor[a]	35.8%	13.3%	46.7%	17.8%	22.1%
Near Poor[b]	18.9%	10.5%	27.2%	7.5%	8.5%
Non Poor[c]	4.9%	2.5%	10.7%	2.7%	7.1%

Panel C: The City of New Orleans

	All Residents	**White, non-Hispanic**	**Black, non-Hispanic**	**Other, non-Hispanic**	**Hispanic**
All	25.5%	9.7%	32.7%	9.1%	20.9%
Poor[a]	46.7%	17.4%	52.4%	22.1%	40.2%
Near Poor[b]	30.2%	22.1%	33.4%	3.5%	21.0%
Not Poor[c]	10.0%	5.9%	13.2%	4.9%	11.5%

Source: 2000 PUMS-5%.

[a] Individuals in households with incomes under 100 percent of the federal poverty line.

[b] Individuals in households with incomes between 100 and 200 percent of the federal poverty line.

[c] Individuals in households with incomes greater than 200 percent of the federal poverty line.

poor nationwide. Interestingly, most of the differences between New Orleans and the nation are driven by particularly high figures for African Americans and, more specifically, the African-American poor.

Roughly half of African Americans residing in poverty in New Orleans (using either the city or metropolitan area definition) had no access to a car, compared with thirty-three percent of poor blacks nationwide.

In addition to these high percentages with no access to a car for specific racial and income groups, New Orleans's racial composition coupled with its unusually high poverty rate further contributed to the overall size of the population at risk of being stranded. Table 10.5 presents tabulations of average socioeconomic and demographic characteristics for all residents of the US, residents of the New Orleans metropolitan area and residents of the city alone. The table presents figures for all residents, residents in a household with access to at least one car, and residents in households with no cars.

A simple comparison of the figures in the first column of Table 10.5 reveals much about why those stranded by Katrina were disproportionately poor and black. While African Americans comprised 12.5 percent of the US population in 2000, blacks accounted for forty percent of the population of the New Orleans metropolitan area, and sixty-seven percent of the city population. Moreover, while the national poverty rate stood at 14.6 percent in 2000, the poverty rate for the New Orleans metropolitan area was six percentage points greater (20.8 percent), while the poverty rate for the city of New Orleans (30.5 percent) was more than double the national rate.

To be sure, it is unlikely that those left behind in the New Orleans Superdome or Convention Center were a random sample of the city's residents. While such a random sample would surely select a population that was disproportionately black and poor, the figures in the second two columns of Table 10.5 suggest that differential access to autos within New Orleans between racial and income groups was an important contributor. For example, within the metropolitan area, African Americans constituted thirty-four percent of residents residing in a household with access to at least one car, while at the same time accounting for seventy-seven percent of residents in households without access to a single automobile. Within the central city, blacks constituted sixty-one percent of residents in households with cars and eighty-six percent of residents of households without cars.

Similar patterns are observed in the proportional representation of the poor. Those residing in poverty accounted for sixteen percent of those in households with access to at least one automobile, but fifty-three percent of those in households with no cars. For the city of New Orleans, the comparable figures are twenty-one percent and fifty-six percent, respectively.

Thus, both nationwide and in the New Orleans metropolitan area, there are large racial and income disparities in car ownership rates, with unusually low car ownership rates within defined groups for New Orleans. The relative poverty and racial composition of those who did not evacuate certainly reflects in part the racial and income composition of the city of New Orleans pre-Katrina. However,

Table 10.5. Basic Demographic and Socioeconomic Characteristics of Residents in Households With and Without Access to Automobiles in 2000: The Nation, the New Orleans Metropolitan Area, and the City of New Orleans

	All Residents	Households with a Car	Households with No Car
Panel A: All U.S. Residents			
White, non-Hisp.	69.1%	71.5%	40.6%
Black, non-Hisp.	12.5%	11.0%	30.5%
Other, non-Hisp.	4.6%	4.5%	5.7%
Hispanic	12.5%	11.7%	22.0%
17 and Under	25.6%	25.7%	24.8%
65 and Over	11.8%	11.1%	19.9%
Homeowners	67.3%	70.6%	28.2%
Poor[a]	14.6%	12.6%	38.4%
Near poor[b]	16.9%	16.0%	26.7%
Panel B: The New Orleans Metropolitan Area			
White, non-Hisp.	52.2%	57.9%	17.8%
Black, non-Hisp.	39.6%	33.5%	76.9%
Other, non-Hisp.	2.8%	3.0%	1.3%
Hispanic	4.7%	4.9%	3.5%
17 and Under	26.6%	25.5%	33.2%
65 and Over	10.8%	10.2%	14.7%
Homeowners	63.0%	69.2%	25.0%
Poor[a]	20.8%	15.5%	53.0%
Near poor[b]	19.3%	18.2%	26.0%
Panel C: The City of New Orleans			
White, non-Hisp.	26.9%	32.6%	10.2%
Black, non-Hisp.	67.0%	60.5%	86.1%
Other, non-Hisp.	2.4%	3.0%	0.9%
Hispanic	3.1%	3.3%	2.6%
17 and Under	26.8%	24.1%	34.5%
65 and Over	11.1%	10.6%	12.8%
Homeowners	47.6%	56.8%	20.6%
Poor[a]	30.5%	21.8%	55.9%
Near poor[b]	21.5%	20.1%	25.4%

Source: 2000 PUMS-5%.

[a] Individuals in households with incomes less than 100 percent of the federal poverty line.

[b] Individuals in households with incomes between 100 and 200 percent of the federal poverty line.

these sharp differences in auto-access rates likely diminished the probability of evacuating before the flooding for the city's poor and African-American residents.

Racial Housing Segregation and
Neighborhood Access to Private Automobiles

Thus far we have demonstrated two general facts: (1) in nearly all metropolitan areas there are numerically large populations of individuals residing in households with no auto access, and (2) these populations are disproportionately poor and minority. We have also shown that in pre-Katrina New Orleans auto-access among poor and minority communities was particularly low.

Clearly, one would expect a relationship between the ease of evacuation in response to a crisis and access to a private household auto, and the lower household auto-ownership rates of African Americans would clearly put them at a disadvantage. This disadvantage may be offset, however, if African-American households have neighbors with cars who could help in the event of a disaster. Interestingly, the stock of privately owned automobiles in the New Orleans metropolitan area was more than sufficient to evacuate the entire population had those with cars extended help to neighbors lacking them. Tabulations from the 2000 Census indicate there were 2.3 persons for each automobile in New Orleans, slightly higher than the 2.2 persons per car figure for the nation as a whole. Assuming an average carrying capacity of three persons per auto, there should have been sufficient private capacity to evacuate all residents of the metropolitan area.

In practice, however, the racial housing segregation that is common in most US metropolitan areas is likely to have compounded African Americans' lower access to autos in New Orleans. Simply put, given that African Americans have low car-access rates and are quite likely to live in disproportionately African-American neighborhoods, such households with no access to a car are likely to be physically surrounded by other households without access to a car. Thus, racial segregation mechanically limits the potential for neighborly behavior to offset the consequences of racial disparities in car ownership.

In this section, we explore the relationship between racial segregation in housing and various measures of the degree of auto access among one's neighbors. To do so, we analyze tract-level[2] data from the 2000 Census Summary Tape Files 3 (STF3) for the entire nation and use these data to characterize auto-access rates within the neighborhoods of the average white and black residents in all US metropolitan areas.

---

[2] Census tracts are small subcounty geographic units that are meant to capture relatively homogenous areas within cities that may be thought to approximate neighborhoods. In the 2000 Census, the average population of a tract is approximately 4,000 persons.

Characterizing Modern-Day Segregation and Effects on Neighborhood Auto Access

Before discussing specific racial differences in auto access, we first depict the degree of racial housing segregation in US metropolitan areas as of the last census. While there are many ways to numerically characterize such segregation, a standard and easily interpretable measure is the "dissimilarity" index. The dissimilarity index provides a single number that depicts the degree of racial housing segregation in a given metropolitan area. The index describes the degree of dissimilarity between the spatial distribution of two population groups (for example, whites and blacks) across the neighborhoods of a given metropolitan area. The index varies from 0 to 1, with a value corresponding to the proportion of either of the metropolitan area's subpopulations that would have to be relocated to achieve perfect balance.[3] For example, our tabulations yield a black-white dissimilarity score for New Orleans of 0.687, indicating that about sixty-nine percent of blacks (or whites) would have had to move in 2000 to achieve perfect integration.

Figure 10.3 summarizes the degree of racial housing segregation between blacks and whites as of the 2000 Census. We construct the figure as follows. First, we tabulate the dissimilarity score between blacks and whites for each metropolitan area in the country. Next, we place metropolitan areas into segregation groups based on five-percentage-point intervals. Finally, we allot African Americans across these groups according to the size of the black population in each metropolitan area. Thus, the figure presents the distribution of segregation scores across metropolitan areas, weighted by the relative size of the black population in each region.

The degree of black-white segregation varies considerably from a low of roughly 0.25 to a high of 0.83. However, most African Americans live in fairly segregated metropolitan areas. The median black resident in US metropolitan areas resides in an area with a segregation score of 0.645 (that is to say, where about sixty-five percent of blacks would have to relocate to desegregate the region). While this represents a substantial improvement relative to the degree of segregation in 1990, the median level of segregation experienced by blacks remained high

---

[3] The dissimilarity index is fairly simple to calculate. Define the variable *black* as the total black population in a given metropolitan area, *white* as the total white population in a given metropolitan area, $black_i$ as the black population of neighborhood *i,* and $white_i$ as the white population of neighborhood *i.* The dissimilarity index *D* for the metropolitan area is calculated by the expression $D = \frac{1}{2} \sum_{i=1}^{I} \left| \frac{Black_i}{Black} - \frac{White_i}{White} \right|$.

Figure 10.3. Distribution of US Black Residents across Metropolitan Areas by Scores of the Black-White Dissimilarity Index, 2000
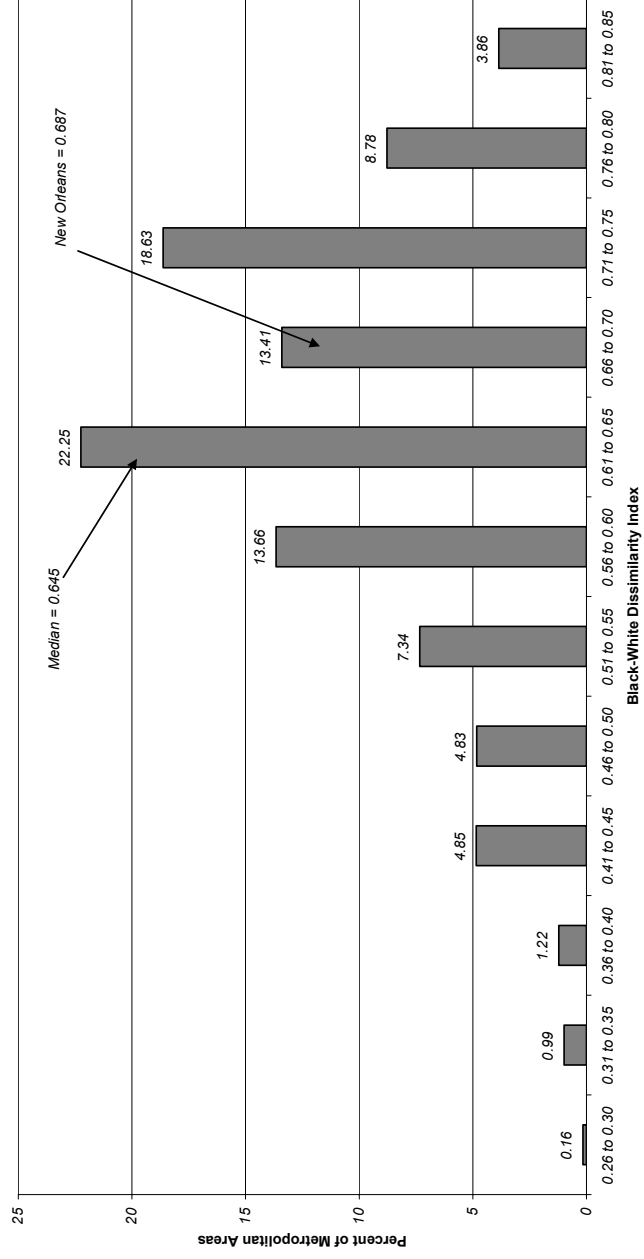
at the end of the century.[4] The degree of segregation experienced by black residents of New Orleans (a dissimilarity score of 0.687) was slightly above the national median.

To assess the extent to which racial housing segregation translates into lower neighborhood car-access rates in the respective neighborhoods of blacks and whites, we perform a series of simple tabulations using the STF3 data. First, for each census tract in the country, we calculate the proportion of households without access to a car as well as the number of persons per car in the census tract. Next, we tabulate the average values for these two neighborhood-level auto-access measures using various alternative populations as weights. We utilize total census-tract population levels as weights, yielding estimates of automobile access in the neighborhood of the average American. Next, we use census-tract white and black population measures separately as weightings, generating means that can be interpreted as the car-access rates for the average white and black Americans, respectively. To the extent that racial segregation concentrates black households in neighborhoods with low car-ownership rates, the fraction without a car and the number of persons per car should be higher in the typical black neighborhood relative to the typical white neighborhood.

Figures 10.4 and 10.5 graphically depict these tabulations for the nation as a whole and for the New Orleans metropolitan area. Starting with Figure 10.4, the average US resident resides in a census tract where roughly ten percent of households have no access to a car. The comparable figure for New Orleans is substantially higher (15.4 percent), likely reflecting the higher poverty and black population proportions there. For the average white US resident, eight percent of neighboring households do not have a single automobile, compared with approximately twenty percent for the neighborhood of the average African American. In New Orleans, both figures were higher (nine percent for white and twenty-six percent for blacks), especially for African Americans.

Figure 10.5 presents comparable tabulations for the ratio of neighborhood residents to cars. Nationwide as in New Orleans, there are slightly more than two persons per car in the neighborhood of the average US resident. However, there are notable racial disparities. For the nation and New Orleans, the ratio of people to cars in the typical white neighborhood is under two. In black neighborhoods, the ratio of people to cars ranges from 3.3 (New Orleans) to 3.5 (nationwide).

Racial Segregation and Neighborhood
Auto Access in New Orleans

The tabulations in Figures 10.4 and 10.5 provide a nice summary of typical neighborhood access to autos and how such access varies by race. A simpler

---

[4] See Raphael and Stoll (2002) for a discussion of how racial segregation and racial disparities in geographic job access changed between 1990 and 2000.

Figure 10.4. Proportion of Households Without a Car in the Typical Neighborhood of All Residents, White Residents, and Black Residents for the Entire US and for New Orleans, 2000

Legend:
- National Average
- New Orleans CMSA

Values:
- All: National Average 0.101, New Orleans CMSA 0.154
- White: National Average 0.078, New Orleans CMSA 0.087
- Black: National Average 0.197, New Orleans CMSA 0.26

Y-axis: Proportion of neighbors with no car (0, 0.05, 0.1, 0.15, 0.2, 0.25, 0.3)

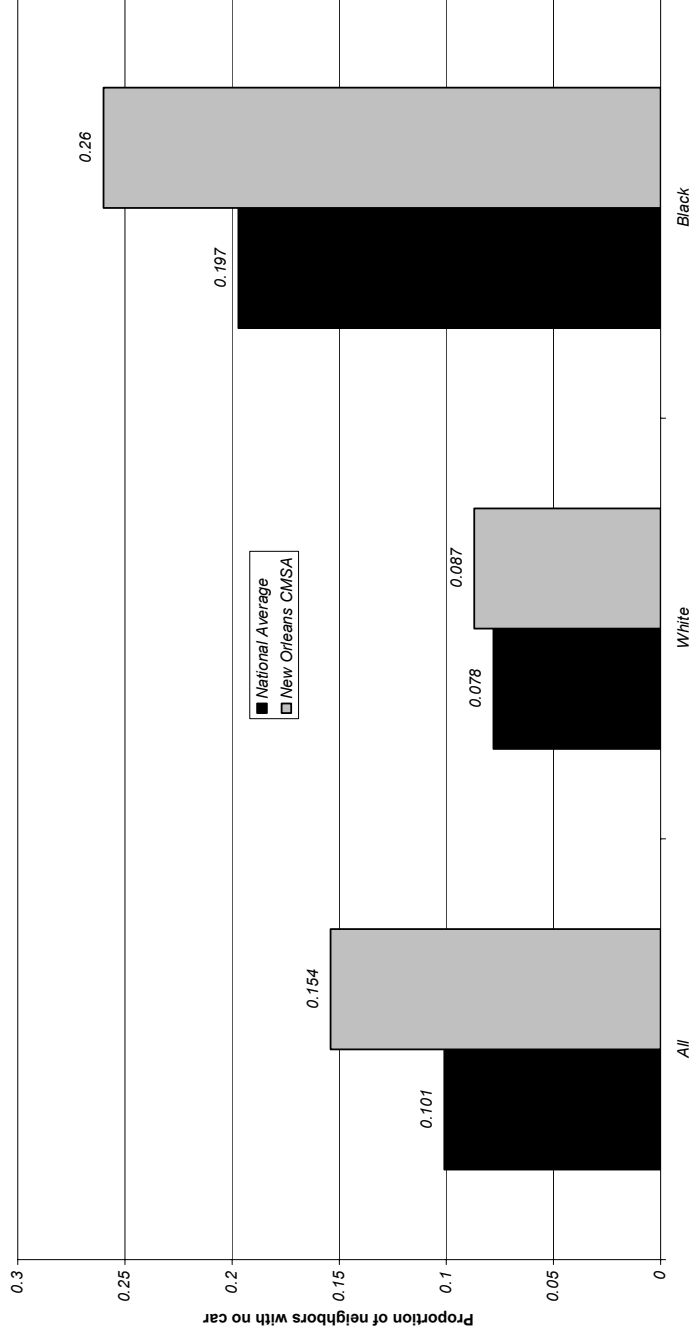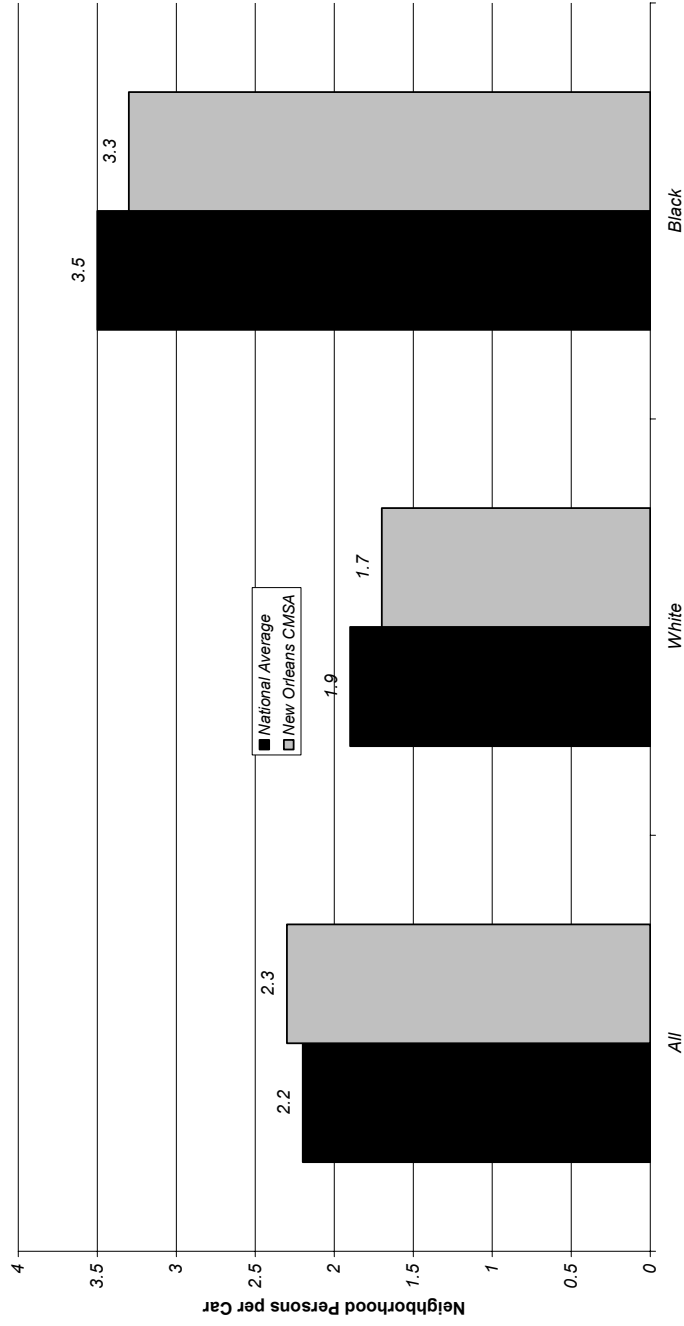**Figure 10.5. Average Number of Persons per Neighborhood Car for All Residents, White Residents, and Black Residents for the Entire US and for New Orleans, 2000**

Legend:
- ■ National Average
- ▨ New Orleans CMSA

All: National Average 2.2, New Orleans CMSA 2.3
White: National Average 1.9, New Orleans CMSA 1.7
Black: National Average 3.5, New Orleans CMSA 3.3

Y-axis: Neighborhood Persons per Car (0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4)

way to reinforce this point is to analyze maps of specific regions, to assess the visual correlation between racial housing segregation, on the one hand, and the spatial concentration of households with no autos, on the other.

Figures 10.6 and 10.7 present such an analysis for the city of New Orleans pre-Katrina. Figure 10.6 presents the fraction of each census tract's residents that were African American. As is readily apparent, the black community was visibly concentrated in a handful of neighborhoods, including New Orleans East, the lower ninth ward, and the seventh ward. Figure 10.7 graphically depicts two variables: the proportion of households without access to an automobile (reflected in the different shadings of the geographic subunits of the city) and the number of households without an auto (each dot representing twenty households). A comparison of Figures 10.6 and 10.7 reveals that households without access to automobiles were not randomly distributed. There is a notable visual correlation between the proportion of households that were black and the proportion of households without cars. In particular, predominantly African-American neighborhoods such as the Lower Ninth Ward and Holy Cross, the Seventh Ward, and Tremé, all inundated with flood waters, show large concentrations of carless households, in comparison to the mostly white, also-inundated Lakeview district.

Is the Proportion of Carless in Black Neighborhoods Higher in More Segregated Cities?

Thus far, we have shown that neighborhood access to autos is lower for African Americans (nationwide as well as in New Orleans) and, within New Orleans, is negatively correlated with the proportion of neighborhood residents that are black. An interesting implication of these patterns concerns whether blacks in less segregated cities have better access to neighbors with cars than blacks in more segregated cities. Figure 10.3 (above) reveals considerable variation in racial segregation across metropolitan areas, although most blacks reside in fairly segregated conditions. Here, we briefly explore how segregation and neighborhood auto access vary across metropolitan areas.

Figure 10.8 presents a scatterplot of the proportion of households with no access to a car in the neighborhood of the average black resident against the black-white dissimilarity index. Each data point represents one of the approximately 280 metropolitan areas in the country. There is an observable, positive relationship between the proportion of neighbors without a car in black neighborhoods and the degree of segregation between blacks and whites. This is precisely what one would expect given the relatively low car ownership rates of black households.

To ascertain whether the correlation depicted in Figure 10.8 is driven by some underlying characteristic that varies across metropolitan areas and that affects car-ownership rates for both blacks and whites, Figure 10.9 presents a comparable scatterplot where the variable on the vertical axis is the difference in the proportion of households without a car between the typical black and white neighbor-

**Figure 10.6. Percent Black by Census Tract,
City of New Orleans, 2000**
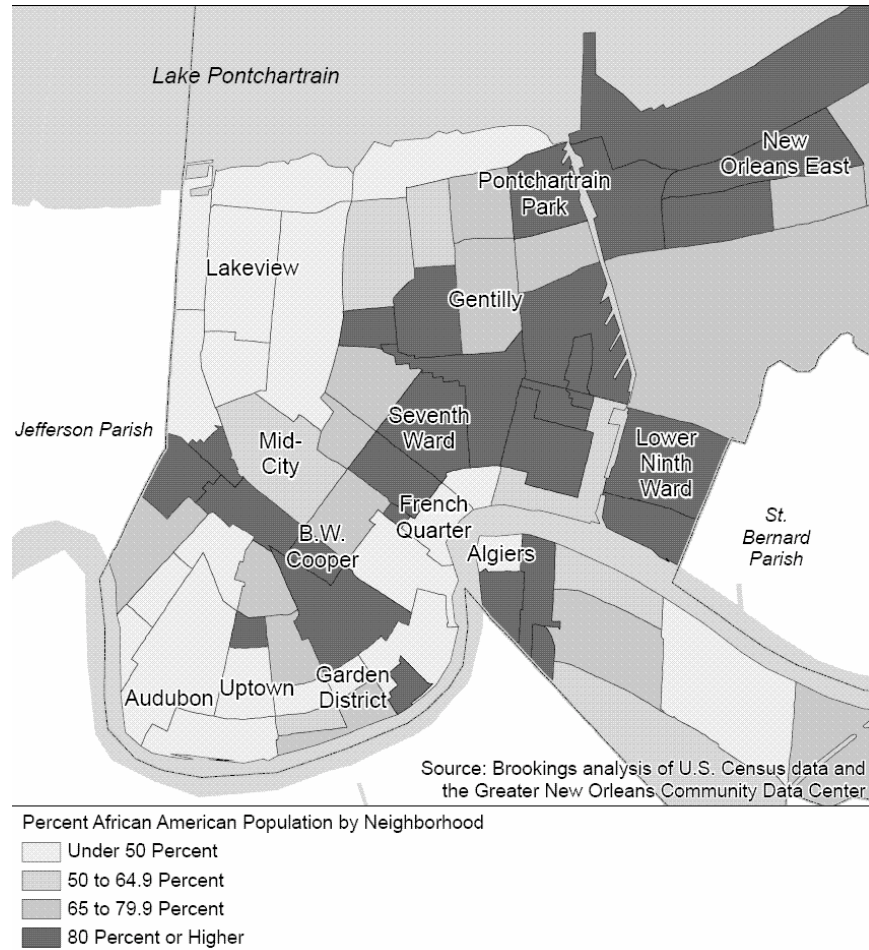
hoods of the city. By calculating the difference relative to white neighborhoods, the figure nets out any unobserved area characteristics influencing overall car access rates. Again, there is a strong positive correlation between the relative proportion of households without cars in black neighborhoods and the degree to which blacks are segregated from whites.

Figure 10.7. Households Without Access to a Vehicle by Block Group in Orleans Parish, 2000
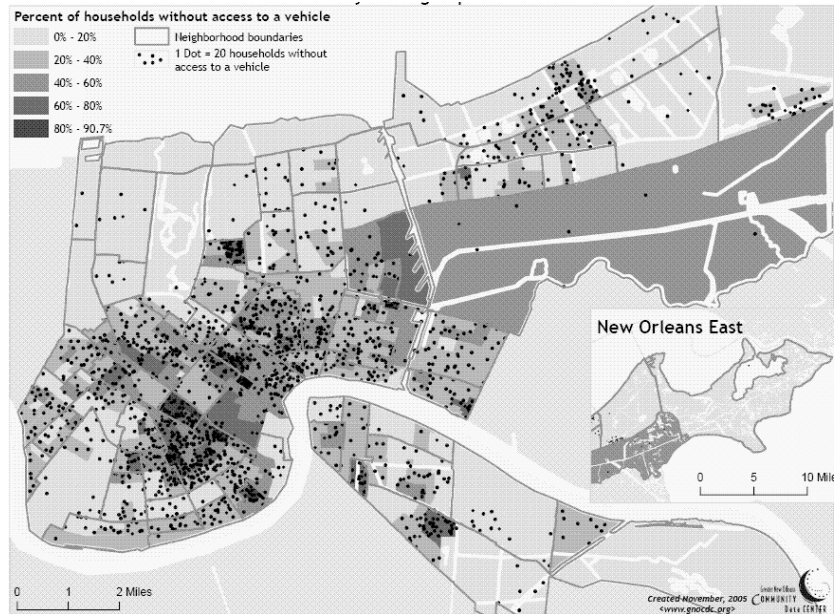

Conclusion

Several clear patterns are documented in this paper. First, we show that in most metropolitan areas there are sizable populations of households without access to automobiles. Individuals in these households are more likely to be poor and minority and are perhaps the most likely to be left behind in the event of an emergency evacuation. Second, there are quite large disparities in car-ownership rates between black and white households. These disparities certainly reflect average differences in income as well as differential costs of owning a car. Nonetheless, even among the poor, black households are considerably less likely than white households to have access to an auto. Finally, there is a compounding effect of racial segregation on access to automobiles via the fact that low black car-ownership rates coupled with racial housing segregation concentrates poor minorities in neighborhoods where many households lack automobile access.

These findings raise several questions regarding how federal, state, and local policymakers should plan for the evacuation of a region's most vulnerable residents. Given low car-ownership rates among certain subgroups, one might ask

Figure 10.8. Scatter Plot of the Proportion of Households with No Car in the Census Tract of the Average Black Resident Against the Degree of Black-White Segregation by Metropolitan Area, 2000

$$y = 0.5447x^2 - 0.2701x + 0.1201$$
$$R^2 = 0.4709$$
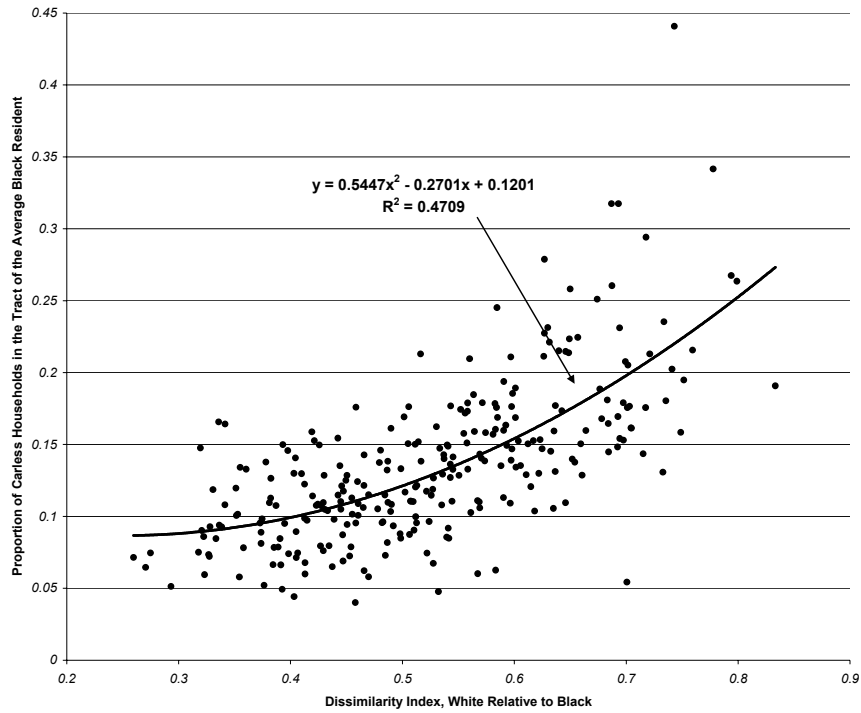
whether a city's existing public transit infrastructure can be adequately mobilized to fill the gaps left by a private-transport evacuation. Moreover, given many of the difficulties experienced in the evacuation of Houston soon after the Katrina disaster, one might further inquire whether higher car-ownership rates would appreciably help.

In the case of Katrina, the preexisting public transit evacuation plan failed miserably. New Orleans had an emergency plan to evacuate one to two hundred thousand people by bus in the event of an emergency. As the hurricane approached, the city established ten pickup points to take people to emergency shelters. Drivers were to take their own families to safety on the first loaded bus runs and then continue to evacuate others. However, the plan failed completely when only a few drivers reported to work during the evacuation period. Residents then were directed to the Superdome and the Convention Center despite the lack of adequate water, food, or security there.

Figure 10.9. Difference in the Proportion of Households with No Car in the Tracts of the Average Black and White Metropolitan Residents Against the Black-White Dissimilarity Index, 2000

$$y = 0.4907x^2 - 0.2293x + 0.0457$$
$$R^2 = 0.5595$$

Difference in the Proportion of Households Carless, Black-White

Dissimilarity Index, White Relative to Black
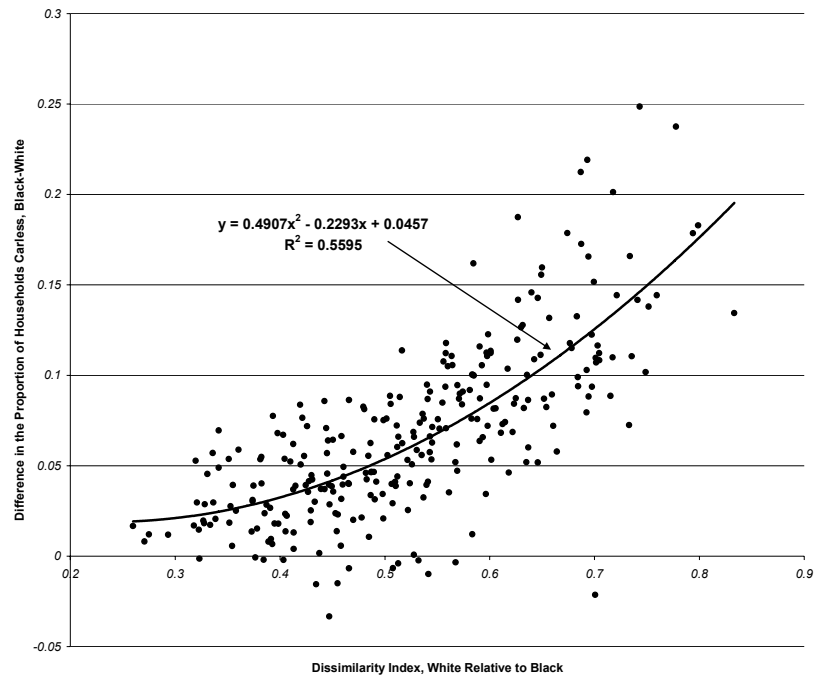
Even had the bus drivers done their jobs, the plan was not likely to succeed. A few simple calculations demonstrate the enormity of the task of evacuating those without private transportation and the limited ability of transit to rise to the occasion. Optimistically, five hundred buses[5] could have evacuated perhaps forty persons per vehicle or twenty thousand persons per set of outbound trips. A fifty-mile trip to shelters[6] outside likely high-damage areas would at minimum take one hour, assuming orderly loading and unloading, minimal time for driver relief, and little or no traffic congestion. Another hour would be consumed as the bus unloaded and then returned for the next run. If drivers had been willing to work sixteen-hour days, 160,000 persons could have been evacuated in a day under

---

[5] In the New Orleans Regional Transit Authority's February 2004 report to the National Transit Database, the agency reported 364 buses and 40 demand-response vehicles conceivably available for maximum service. Elsewhere, the school bus fleet has been estimated to be about one hundred vehicles (Litman, 2005).

[6] Note that Baton Rouge is about 80 miles away, so evacuations of up to 50 miles are conservative for these purposes.

ideal circumstances, i.e., assuming drivers could be found for all runs, fuel was available for rapid refueling, no breakdowns occurred, and no traffic backups or other incidents slowed the trips.

A more realistic plan would assume that speeds on freeways would be no more than twenty miles per hour during an evacuation, and perhaps as low as ten miles per hour. At these speeds a one hundred mile round trip would take five to six hours (assuming the inbound trip would be at posted speeds) and no more than two runs a day could be accomplished. This would have cut the New Orleans bus-evacuation rate to only forty thousand per sixteen-hour workday.

Thus, with the benefit of hindsight, it is not too surprising that the existing transit evacuation strategy failed. The system capacity was small relative to the population without automobiles, and serious implementation problems (e.g., high driver-absence rates) hampered the effectiveness of the effort.

To be sure, the results from this one disaster do not indicate that public transit cannot partially or even completely fill the gap left by less than universal access to private transportation. In other disasters, transit has played a significant role in both evacuation and postdisaster recovery. For example, transit was the principal means of evacuating hundreds of thousands of people from lower Manhattan after the 9/11 attacks on the World Trade Center. Transit also was used in New York to bring emergency aid into the area. Likewise, in Washington, DC, the city's Metro system evacuated several hundred thousand people after the attack on the Pentagon.

Nonetheless, the difficulties encountered in the wake of Katrina suggest that more comprehensive (and perhaps creative) planning is needed to avoid such catastrophes in the future. For example, while the initial plan was to evacuate New Orleans residents from the city, an alternative was to move those without cars and those with nowhere to go only as far as the nearest "safe" location within the storm zone. The Superdome and Convention Center were intended to be such sites. While the Superdome proved to be a severely flawed destination, identifying a more suitable location within, say, ten to twelve miles would have greatly reduced bus travel distance and may have permitted moving everyone to shelter in a day.

Alternatively, reports indicate that Amtrak had some equipment available for evacuation and such assets could have greatly increased New Orleans' overall evacuation capacity. A single train car can carry two buses worth of evacuees. Moreover, the exclusive right-of-way for rail means fewer congestion problems. However, communications broke down and this option was not used. Similarly, buses were not brought in from other jurisdictions to help with the evacuation. Perhaps tapping such alternative sources would have provided a substantial boost toward transit evacuation capacity.

The limitations facing transit-based evacuation strategies raise the question of whether higher car-ownership rates would increase the swiftness and coverage of a general evacuation. Clearly, low car-ownership rates among poor and vulnerable populations will continue in nearly all American cities. Even the smallest metropolitan areas have thousands of residents without cars. Moreover, a significant

proportion of such households also have mobility limitations or other physical or mental disabilities that might prevent them from driving.

Access to a car, however, does not guarantee an easy evacuation. In New Orleans when Katrina hit, some poor families with cars chose to remain in their homes because they did not know anyone outside the city that could provide shelter and did not have the money to stay in a hotel. Others stayed because they did not want to leave pets, for whom evacuation plans had made no provisions. Lack of information regarding the availability of shelters further discouraged departure. A study done two years before Katrina showed that there would not be enough roadway capacity to evacuate everyone by car in any case. With only sixty percent of the affected population evacuating by car, roads were predicted to be jammed with speeds lowered to five to ten miles per hour (Wolshon, 2002).

Other cities' experiences also underscore the limitations of auto-based evacuations. Following 9/11, many Washington, D.C. workers left their cars in the city and evacuated by transit due to standstill traffic. Average speeds on both local streets and freeways dropped to less than ten miles an hour and some travel lanes were blocked by cars abandoned after crashes, breakdowns, or simply running out of gas.

The Houston experience, a few weeks after Katrina, shows that even a reasonably well orchestrated, car-focused evacuation strategy can fail. As Hurricane Rita bore down on the Houston-Galveston area, officials called for early evacuation and planned to reverse freeway directions to increase capacity northbound, away from the coast. Plans assumed that as many as 1.2 million people would flee for points north. However, early notices recommended that everyone leave the metropolitan area, and some 2.5 million, about half the region's population, apparently attempted to do so. This led to massive traffic jams on all the freeways, with average speeds under five miles an hour on many routes. [7]

Given the limitations of transit-based as well as private transportation evacuation strategies, what should localities do in planning for future catastrophes? We have shown that thousands of people in every metropolitan area of the US lack cars to help them evacuate in the case of disaster. Many of them live in areas where transit could serve as a good alternative, but the New Orleans experience shows that transit can fail badly and that even a sizeable transit capacity may not suffice in a major disaster. Moreover, many of the nation's metropolitan areas do

---

[7] According to personal interviews conducted by the authors in November 2005, cars in Houston overheated and broke down or ran out of fuel, blocking roads and cutting capacity further. Gas stations ran dry and others were closed for lack of staff as their operators joined the evacuation. Plans to reverse freeway lanes to increase outbound capacity were abandoned; officials stated publicly that the lanes were needed to get emergency vehicles and supplies into the danger zone, but privately they admitted that a bigger reason was that the equipment and staff were not available to reverse direction of the lanes, a process that requires intervention at every on-ramp. In addition, they discovered that many motorists needed to travel south to pick up family members before evacuating, and closures caused considerable motorist confusion and consternation.

not have extensive transit systems, so there is no realistic possibility of relying on transit alone in those areas.

Cars can evacuate thousands or even millions, but in a mass evacuation, cars can be caught in multi-hour traffic jams, with vehicle breakdowns, fuel shortages, and in the worst cases, road blockages that constrict movement in or out of the affected area, exacerbating the extent of the disaster. Cars fall short if roads out have collapsed or are blocked, if fuel cannot be found, or if the vehicles are damaged in the disaster. Cars may not be fast enough if everyone is evacuating at the same time.

Tapping alternative sources of transit capacity is clearly an avenue worth exploring. Areas that face comparable yet imperfectly correlated risks (such as cities on the gulf coast) may benefit from pre-arranged sharing agreements whereby inter-locality cooperation can expand the capacity of a city's transit system when needed.

Sharing rides may also provide an alternative way to move more people out more quickly. To be sure, many drivers fill their cars with family members, pets and valuables; empty seats may be scarce. However, hardly any area has organized to provide ridesharing in a disaster. We cannot be sure what it would take to make such an effort successful. Future thinking and research in this area is needed.

Other options need to be coordinated better than they were in New Orleans. Trains could have evacuated thousands but were left idle. In the San Francisco Bay Area, ferries helped evacuate people in 1906; the Bay Area Regional Transit System kept operating after the 1989 Loma Prieta earthquake. But the next quake could block or damage ferry access or damage the BART tube or tracks. It is hard to know in advance which assets will be accessible, so all likely scenarios should be evaluated and workable response plans prepared.