Florida's 2004 Hurricane Season: Demographic Response and Recovery

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Paper presented at the annual meeting of the
Southern Demographic Association
Durham, NC
November 2-4, 2006

ABSTRACT

The 2004 hurricane season was the worst in Florida's history, with four hurricanes striking the state and directly causing at least 47 deaths and some $45 billion in damages. In order to collect information on the demographic impact of those hurricanes, the Bureau of Economic and Business Research at the University of Florida surveyed approximately 1,900 households at the state level and more than 11,500 households in the 13 counties sustaining the greatest damage. Interviewers collected data on population movements and housing damages caused by the hurricanes and the recovery efforts that followed the hurricanes. Using these data, we estimated that 1.7 million people were forced to move out of their homes at least temporarily and that 2.6 million homes sustained at least minor damage. In some counties, more than 30% of the residents were forced to move out of their homes and more than 80% of the housing units were damaged. For many residents, the post-hurricane recovery has been very slow.

In this study, we describe an approach that can be used to estimate the demographic impact of hurricanes and other natural disasters, provide a detailed assessment of the 2004 hurricane season in Florida, compare the 2004 hurricanes with Hurricanes Andrew (1992) and Katrina (2005), and draw several conclusions regarding the likely impact of hurricanes and other natural disasters on future population growth. This study provides the most comprehensive assessment yet of the 2004 hurricane season in Florida and adds to the small but growing literature on the demographic effects of natural disasters.

INTRODUCTION

By most measures, the 2004 hurricane season was the worst in Florida's history. Four hurricanes blasted through the state between August 13 and September 25, with Charley making landfall on the southwest coast near Punta Gorda, Frances on the southeast coast near Stuart, Ivan in the panhandle near Pensacola, and Jeanne nearly retracing the route followed by Frances (see Figure 1). This was the first time in recorded history that four hurricanes had struck Florida in a single year. Most parts of the state were hit by at least one hurricane and some were hit by two or even three. Overall, the storms were directly responsible for at least 47 deaths (National Hurricane Center, 2005) and caused approximately $45 billion in total damages (Blake, Jarrell, and Rappaport, 2006).

(Figure 1 about here)

Unfortunately, there are no readily available data sources capable of providing comprehensive information on the demographic impact of hurricanes and other natural disasters (e.g., Rossi, Wright, Wright, and Webber-Burdin, 1981; Smith, 1996). To remedy this problem, we conducted a series of sample surveys in Florida and the local areas most heavily affected by the 2004 hurricanes. We summarize the results in the present study. We have four primary objectives: 1) To provide a comprehensive assessment of the demographic effects of the 2004 hurricane season in Florida, 2) To suggest techniques that might be used to develop similar estimates in other areas, 3) To compare the impact of the 2004 hurricanes with that of two other major hurricanes, and 4) To draw several conclusions regarding the impact of hurricanes on population growth.

This study provides the most comprehensive assessment yet of the demographic impact of the 2004 hurricane season in Florida and adds to the small but growing literature on the

demographic effects of natural disasters. We define "demographic effects" broadly to include both housing damage and population mobility. We believe that documenting such effects for as many places and natural disasters as possible is essential for analyzing changes in those effects over time and for developing plans to deal effectively with the impact of future disasters.

DATA

The Bureau of Economic and Business Research (BEBR) at the University of Florida conducts a regular monthly survey of approximately 500 households in Florida, collecting information on consumer attitudes, buying behavior, and a variety of socioeconomic and demographic characteristics. To gather information on the demographic impact of the 2004 hurricanes at the state level, BEBR added a series of questions regarding evacuations, housing damage, population displacement, reconstruction, and recovery. These surveys were conducted between February and May, 2005.

In addition to state-level surveys, BEBR also conducted surveys in the local areas sustaining the greatest hurricane damage. Using data from the Federal Emergency Management Agency (FEMA), we selected the 13 counties with the highest proportion of housing units sustaining major damage. Samples were drawn at the county level in three counties and at the subcounty level in 10 counties, with a target sample size of approximately 400 in each of the 29 places surveyed. These surveys were conducted between March and June, 2005.

The samples in the 29 local areas were based on list-assisted random-digit dialing. Using a database maintained by the Marketing Systems Group/GENESYS of Ft. Washington, Pennsylvania, we identified working telephone banks with at least one residential number (a bank consists of the area code, prefix, and first digit of the suffix). The database excluded banks that had not been assigned or that had been assigned exclusively to commercial or government

entities. It also excluded banks associated with cell phone numbers because cell phones typically represent individuals rather than households. Excluding cell phone numbers had little impact on the representativeness of the sample because most households (including those with cell phone users) have a landline telephone. A recent survey found that households with a cell phone but no landline telephone accounted for less than 4% of all households in the United States in 2003 (Blumberg, Luke, & Cynamon, 2005).

Random digits were added to the partial numbers in the banks and the resulting telephone numbers were called. Numbers were called up to ten times before being dropped from the sample. The household member aged 18 or older who most recently had a birthday was selected to be the survey respondent. Only those who reported that they were permanent residents living in Florida when the first of the hurricanes struck in August, 2004 were included in the sample. This process led to interviews with 1,881 respondents at the state level and 11,559 at the local level. For the 10 counties in which surveys were conducted at the subcounty level, we analyzed the results separately for each individual area and after aggregating the results to the county level using proportional adjustment factors; in this study, we report only the latter. All findings have a margin of error of less than 3% at the state level, 5% for individual counties, and 1% for the 13-county area as a whole.

MOVES CAUSED BY HURRICANES

The hurricanes wreaked havoc from one end of the state to the other. For the state as a whole, almost one in ten survey respondents reported that they were forced to move out of their homes after at least one of the hurricanes (Table 1). Applied to Florida's 2004 mid-year population estimate of 17.6 million, this implies that 1,672,000 people were forced out of their

homes. For the 13-county region, more than 21% of the survey respondents were forced to move out of their homes; in several counties, almost one-third moved out at least once.

(Table 1 about here)

For the state as a whole, most people left their homes because of the loss of electricity, water, gas, or telephone service rather than because of structural damage to their housing unit (Table 2). Including multiple moves, more than 72% left because of a loss of utilities, 14% because of structural damage, and 14% for some other reason. Not surprisingly, the proportion moving because of structural damage was much higher for the 13-county area than for the state as a whole (37% compared to 14%). In some counties, almost half of the moves were due to structural damage.

(Table 2 about here)

For the state as a whole, 73% of those leaving their homes moved in with family or friends; 14% went to a hotel or motel; 3% rented a house or apartment; 3% stayed on the same property in a tent, RV, or some other type of temporary housing; 3% went to a public shelter; and 5% made other types of lodging arrangement (Table 3). For the 13-county region, 56% moved in with family or friends; 12% stayed in hotels and motels; 8% rented a house or apartment; and 7% stayed in temporary quarters on their pre-hurricane property. Less than 2% stayed in a public shelter. Large proportions staying with family and friends is a common finding in the disaster literature (e.g., Drabek, 1986; Smith and McCarty, 1996).

(Table 3 about here)

For the state as a whole, 88% of those forced to move had returned to their pre-hurricane homes by the spring of 2005 (Table 4). For the 13-county region, only 82% had returned to their pre-hurricane homes, reflecting the greater severity of damages in the region. Among counties,

the proportions returning ranged from 76% to 93%. These proportions were generally highest in counties with the least damage and lowest in the counties with the most damage.

(Table 4 about here)

For the state as a whole, 82% of those who had returned to their pre-hurricane homes were away for less than two weeks, 7% for two to four weeks, 6% for one to three months, and 5% for more than three months (Table 5). For the 13-county region, time away from home was substantially longer: 59% were away for less than two weeks, 16% for two to four weeks, 8% for one to three months, and 17% for three months or more. For individual counties, the proportion away for less than two weeks varied from 29% to 88% and the proportion away for more than three months varied from 4% to 32%. Not surprisingly, the length of time away from home was generally greatest in counties with the most damage and lowest in counties with the least.

(Table 5 about here)

We addressed several additional issues using cross tabulations of data for the 13-county region. First, we tabulated length of stay by type of lodging in the initial move (Table 6). Fifty-nine percent of those moving in with family or friends stayed for less than two weeks, 78% stayed for less than a month, and only 3% stayed for more than six months. Those moving to hotels or motels spent even less time in temporary quarters. Clearly, these two types of lodging are used primarily for short-term stays. On the other hand, almost half of those establishing temporary quarters on their pre-hurricane property stayed for three months or more. Persons moving into public shelters were bi-modally distributed: three-quarters were there for less than two weeks but one in six was there for three months or more.

(Table 6 about here)

Second, we looked at the type of lodging chosen for the second post-hurricane move (Table 7). Of those who initially moved in with family or friends, almost 80% moved into their current home on their second move. The same was true for those initially going to hotels or motels. It appears that most people moving into these types of lodging stay only for a short time and then return directly to their pre-hurricane homes. For all other groups, the proportions moving directly to their current homes were substantially lower. Of those who initially stayed in temporary quarters on their pre-hurricane property, 27% moved into some type of trailer on the same property. Of those who initially went to a public shelter, 30% moved in with family or friends and 15% moved into a trailer that was not on the same property. We speculate that many of these trailers were provided by FEMA.

(Table 7 about here)

AN ALTERNATIVE ESTIMATE OF MOVERS

One potential problem with the results reported above is that the sample included only people who were living in Florida in the spring of 2005, some 6-9 months after the hurricanes passed through the state. It did *not* include people who were living in the state when the hurricanes struck but had since moved away. If persons forced from their homes constituted a higher proportion of those leaving the state than of those remaining in Florida, the results reported above may have under-estimated the number of people forced from their homes.

We dealt with this problem by using network (or multiplicity) sampling (e.g., Kalton and Anderson, 1986; Sirken, 1970). Under this approach, information on persons outside the sample is collected from survey respondents who have some personal connection to them. Network sampling has been used to estimate emigration from the United States (Woodrow-Lafield, 1996), the incidence of rape and homelessness (Killworth, McCarty, Bernard, Shelley, and Johnsen,

1998), population movements caused by Hurricane Andrew (Smith and McCarty, 1996), and a number of other rare or difficult-to-estimate events.

We identified a network of neighbors, defined as persons living to the immediate right and immediate left of the survey respondents at the time of the hurricanes. At the state level, approximately 95% of the respondents reported that they knew whether or not their neighbors moved out of their homes as a result of the hurricanes. Of those whose neighbors moved, 98% reported that they knew whether or not they had returned to their pre-hurricane homes.

We used this information to develop an alternative estimate of hurricane-related moves. Survey respondents reported that 6.9% of their neighbors moved out of their homes because of the hurricanes. This is lower than the 9.5% reported for the survey respondents themselves (see Table 1) and implies 1,214,400 movers, compared to the 1,672,000 reported above. We believe the estimate based on data for neighbors is lower because many moves were for a short period of time and some survey respondents may have been unaware that their neighbors had been away. Consequently, the estimate based on the respondents themselves is probably more accurate than the estimate based on data for neighbors. At any rate, these results do *not* imply that the results reported above under-estimated the number of people forced from their homes by the hurricanes.

Survey respondents reported that 16.2% of their neighbors had not returned to their pre-hurricane homes by the time the surveys were conducted. This proportion is higher than the 11.9% reported for the respondents themselves (see Table 4). This finding is consistent with our hypothesis that many moves for neighbors went unnoticed by the survey respondents: If neither the move nor the return was noticed, the number of movers was under-estimated and the proportion failing to return was over-estimated.

Although survey respondents may not have noticed all the short-term moves made by neighbors, they most likely had accurate information regarding whether or not neighbors who moved had returned. By multiplying the number of movers by the proportion returning, we were able to develop two estimates of the number of people who moved following the hurricanes and had not returned by the time the survey was conducted, one based on data for neighbors and one based on data for the respondents themselves:

1) Neighbors: 1,214,400 x .162 = 196,733
2) Respondents: 1,672,000 x .119 = 198,968

The two estimates are virtually identical. Both show that almost 200,000 people moved out of their homes following the hurricanes and had not returned 6-9 months later. We believe the similarity of the two estimates strengthens their credibility.

Of those respondents whose neighbors moved, 84% reported that they knew where their neighbors went. We can use this information to develop estimates of the destination of movers who did not return to their pre-hurricane homes. According to the survey respondents, 73.4% of neighbors who moved went to another location within the same county, 8.7% went to another county in Florida, and 17.9% left the state. Applying these proportions to the number of movers who had not returned, we estimated that 144,402 were living in the same county as before the hurricanes, 17,116 were living in a different county in Florida, and 35,215 had left the state. To put the last figure in perspective, some 300,000-400,000 people move out of Florida each year.

In summary, almost 1.7 million Floridians were forced out of their homes by the 2004 hurricanes but most of the moves were temporary and covered only a short distance. Although they packed a ferocious punch, the hurricanes had relatively little impact on the number of people residing in Florida 6-9 months later. The same was true for most counties. In a few

counties, however, the hurricanes had a substantial impact. We return to this point later in the paper.

HOUSING DAMAGE CAUSED BY HURRICANES

Extent of Damage

Almost one in three Floridians reported at least some damage to their homes as a result of the hurricanes (Table 8). Only 0.4% reported that their homes were completely destroyed, but 8% reported major damage and 24% reported minor damage. These proportions were based on households, or housing units occupied by permanent residents of Florida. Assuming that the distribution of damages for all housing units was proportional to that of units occupied by permanent residents, we estimated that 2.6 million of Florida's 8.1 million housing units were damaged by the storms, with 35,000 destroyed, 649,000 sustaining major damage, and 1,917,000 sustaining minor damage.

(Table 8 about here)

Damages were proportionately much greater in the 13-county region than for the state as a whole. Just over 2% reported that their homes were completely destroyed, 33% reported major damage, and 39% reported minor damage. Only 26% reported no damage at all.

Approximately half the respondents in DeSoto, Charlotte, and Hardee counties suffered either major damage or the complete destruction of their homes. All three of these counties are located on or near the Gulf coast, directly in the path of Hurricane Charley. By this measure, it appears that Charley was responsible for more damage than any of the other hurricanes.

How did damages vary according to the type of housing unit? To answer this question, we analyzed damages separately for single family, multi-family, and mobile home units in the 13-county region (Table 9). Not surprisingly, mobile homes were far more vulnerable to

hurricane damage than other types of housing. More than 10% of mobile home residents reported that their homes were completely destroyed by the hurricanes and another 38% reported major damage. Only one in six reported that they sustained no damage at all. In contrast, only 1% of residents of single family and multi-family units reported the total destruction of their homes and more than one in four reported no damage at all.

(Table 9 about here)

It should be noted that recent changes in construction and installation standards appear to have had a substantial impact on mobile home damage rates. In 1994, amendments to federal housing regulations prompted several design changes that significantly raised the ability of mobile homes to withstand hurricane-force winds. In addition, changes in the Florida Administrative Code implemented in 1999 strengthened foundation and anchoring standards. A recent survey of almost 30,000 mobile homes in areas affected by one or more of the 2004 hurricanes found that whereas 14.2% of the mobile homes built under pre-1994 standards were destroyed or damaged beyond repair, none of those built under post-1994 standards were so severely damaged (Grosskopf, 2005).

It is also noteworthy that a higher proportion of single family residents than multi-family residents reported major damage (33% compared to 22%) and that 43% of multi-family residents reported no damage at all, compared to only 26% of single family residents. This may be due to one or more of several factors. First, large multi-unit structures may be built according to more exacting standards than single family units, leading to lower damage rates (e.g., Federal Emergency Management Agency, 2006). Second, some units in a particular multi-family structure may have sustained damage while others did not; consequently, some residents may have reported no damage even if other parts of the structure were damaged. Finally, the

geographic distribution of single family units within the 13-county region may have differed from the distribution of multi-family units, leading to different damage rates. Further research is needed before we can draw clear conclusions on this point.

Value of Damage

Almost 80% of survey respondents in Florida reported that they knew the dollar value of damage to their housing units. Of these, 29% reported damage of less than $1,000, 28% reported $1,000 to $4,999, 31% reported $5,000 to $24,999, and 11% reported $25,000 or more. The average estimate was $10,300 (not shown here).

The value of damage was much higher in the 13-county area, with a median value of $11,000 compared to $4,000 for the state as a whole (Table 10). The counties with the highest estimates were Charlotte ($30,000) and DeSoto ($20,000), the counties hardest hit by Hurricane Charley. Other counties where hurricanes made landfall reported lower median damages. Hurricane Ivan made landfall just west of Escambia ($13,000), while Hurricanes Jeanne and Frances made landfall near the border between Martin ($10,000) and St. Lucie ($10,000). Charley was a Category 4 storm when it made landfall, Frances was Category 2, and Ivan and Jeanne were Category 3. It is not surprising that the highest value of damage was found in the counties hit by the strongest hurricane.

(Table 10 about here)

Compensation for Damages

The 2004 hurricanes caused approximately $45 billion in total damages in Florida (Blake, Jarrell, and Rappaport, 2006). According to the Florida Office of Insurance Regulation (2006), more than $23 billion in insurance payments were paid as compensation for those damages. This

is consistent with the rule-of-thumb that insured losses are typically about half the value of total losses (National Weather Service, 2006, p. 1).

In order to collect information regarding compensation for damages, we asked a series of questions regarding insurance coverage and insurance payments; these questions were included only in the surveys conducted at the state level during April and May. Of the 936 respondents living in Florida when the hurricanes struck, 87% of those sustaining damage reported that their home was insured prior to the hurricanes. This is somewhat higher than the approximately 80% reported in several previous studies (e.g., Drabek, 1986; Rossi, Wright, Weber-Burdin, and Pereira, 1983; Smith and McCarty, 1996). Of the respondents who did not have insurance, over half (56%) lived in apartments or mobile homes.

Given that many homes sustained only minor damage, not all respondents filed a claim with their insurance company. Of those with insurance coverage who sustained housing damage, only 53% filed a claim; this represents 14% of all respondents. Applying this proportion to all households implies that 976,000 Florida households filed a claim related to housing damages. Assuming that the distribution of claims for all housing units (including unoccupied units and those used seasonally or on an occasional basis) is proportional to that of households, we estimate that approximately 1,169,000 claims related to housing damages were filed in Florida.

The Florida Office of Insurance Regulation reported 1,156,000 homeowner claims related to the 2004 hurricanes (Florida Office of Insurance Regulation, 2006). This number is very close to the estimate derived from the survey.

Of the survey respondents filing claims for housing damage, 88% received a payment and another 3% were still waiting for their claim to be settled at the time of the survey. Respondents

receiving payment reported that an average of 69% of the damage to their homes was covered by insurance payments and that the average pay-out was $16,100.

Slightly less than 5% of survey respondents filed insurance claims for damage to personal property (including automobiles). Of those, 91% received a payment and 2% were still waiting for their claim to be settled at the time of the survey. Respondents reported that about 44% of the damage to their personal property was covered by insurance payments and that the average pay-out was $7,800.

Of all the respondents filing insurance claims, 68% claimed housing damage only, 10% claimed personal property damage only, and 22% claimed both housing and personal property damage. Counting all three types, the average insurance payment to Florida households was $14,700. Combining this with the estimated number of households receiving a payment implies that the total insurance pay-out to households in Florida was $19.4 billion. This is similar to the pay-out of $19.1 billion to non-commercial enterprises reported by the Florida Office of Insurance Regulation (2006). Although there is some uncertainty regarding the proportion of non-commercial insurance payments going to households, the survey results were once again consistent with information coming from an external data source.

RESPONSE AND RECOVERY

The huge number of damaged units in Florida—combined with shortages of labor and building materials and delays in collecting insurance payments—made it difficult for many Floridians to carry out housing repairs. By May, 2005, about 8% of survey respondents with hurricane damage were not planning to make any repairs, 13% were planning to make repairs but had not yet started, 27% had repairs underway, and 52% had completed all repairs (Table 11). These proportions imply that—approximately 6-9 months after the hurricanes hit—there were

almost 696,000 housing units in Florida for which repairs had been started but not completed and another 348,000 for which they had not even been started.

(Table 11 about here)

For the 13-county region, repairs had been completed for only 35% of damaged units by May, 2005. Nearly 44% reported having some type of repair underway, 16% were planning to make repairs but had not yet started, and 5% were not planning to make any repairs. The proportion of respondents not planning to make any repairs was highest in Brevard and Polk, reflecting the relatively low levels of damage in those two counties. The proportion of respondents who had completed their repairs was lowest in Charlotte and DeSoto, two of the counties with the greatest damage.

In addition to repairing or rebuilding their houses, Floridians responded to the hurricanes in a variety of ways. At the state level, almost 10% made structural modifications, 8% cut down or trimmed trees, 4% bought a generator, 1% moved to a safer housing unit, and 3% made some other type of change. Altogether, about 18% of survey respondents reported that they had made some type of change in their housing or living arrangements.

Many plan to make further changes. Approximately 13% of survey respondents planned to make modifications to their housing unit, 13% planned to cut down or trim trees, 11% planned to buy a generator, 5% planned to move to a safer housing unit, 5% planned to make other types of changes, and 2% planned to leave Florida. Whether people actually carry out their plans remains to be seen, of course, but these numbers indicate that many Floridians were attempting to minimize the potentially negative effects of future hurricanes.

DISCUSSION

Comparison to Hurricane Andrew

Hurricane Andrew ripped through the southern tip of Florida on August 24, 1992 with winds reaching 175 miles per hour. Before exiting the state, it claimed at least 25 lives and caused some $44 billion in property damage in 2005 dollars (Blake et al., 2006). It destroyed approximately 23,000 housing units, caused major damage to 121,000 units and minor damage to 285,000 units, and forced more than 353,000 people to leave their homes at least temporarily (Smith and McCarty, 1996). The vast majority of the damage occurred in Miami-Dade County.

By most measures, the 2004 hurricane season was more destructive than Hurricane Andrew. Taken as a whole, Charley, Frances, Ivan, and Jeanne caused more deaths, damaged more housing units, and forced more people from their homes than Andrew. The geographic area affected by these storms was vastly greater as well. Only in terms of the dollar value of damages does it appear that Andrew was about equal to the 2004 hurricane season. Although Andrew remains the single most costly hurricane ever to strike Florida, its overall impact was substantially smaller than the 2004 hurricane season as a whole.

It should be noted that previous Florida hurricanes took far more lives than either Andrew or the 2004 hurricanes. The 1928 hurricane striking South Florida took some 2,500 lives and several other storms killed hundreds of people each (Blake et al., 2006). Although recent hurricanes have caused the most damage to housing and other property in Florida, they have not been nearly as costly as earlier hurricanes in terms of human life.

Comparison to Hurricane Katrina

Hurricane Katrina struck the Gulf Coast near the mouth of the Mississippi River on August 29, 2005, ravaging the coastal areas of Louisiana, Mississippi, and Alabama. It was the most costly hurricane ever to strike the United States (National Weather Service, 2006). There

are similarities between the effects of Katrina and the effects of the hurricanes hitting Florida in 2004, but the differences are more dramatic:

1) Katrina was much more destructive. Preliminary estimates indicated that it rendered as many as 622,000 housing units at least temporarily uninhabitable (Swanson, 2005), whereas the 2004 Florida hurricanes made around 105,000 housing units uninhabitable. Katrina was directly responsible for the loss of at least 1,300 lives and caused damages in excess of $80 billion (National Weather Service, 2006), whereas the 2004 Florida hurricanes took 47 lives and caused around $45 billion in damages.

2) People forced out of their homes by Katrina moved further and stayed away longer. Although the 2004 hurricanes caused 1.7 million Floridians to leave their homes, most left due to the loss of utilities rather than because of structural damage. They typically moved into nearby places and were away from home for only a few days or weeks. Preliminary estimates indicated that Katrina may have displaced as many as 1.4 million people, at least temporarily (Swanson, 2005). Many moved hundreds or even thousands of miles away and did not return for many months. Four months after the hurricane struck, the populations of the hardest hit counties were still substantially lower than they had been prior to the hurricane: Hodges (2006) estimated a decline of 382,000 and Frey and Singer (2006) estimated a decline of 452,000.

3) In New Orleans, most of the damage was caused by flooding rather than by wind or storm surge. Flooding is not covered by private insurance policies and most people do not purchase federal flood insurance; consequently, many of Katrina's victims suffered significant financial losses. Except for some areas affected by Hurricane Ivan, Florida did not experience major flooding in 2004 and 89% of those with damages were insured. Although many suffered financial losses, their losses were not as great as those suffered by Katrina's victims.

4) The 2004 hurricanes did not destroy a large number of jobs in Florida. Even if people lost their homes, most still had jobs to go to and paychecks coming in. Katrina, on the other hand, destroyed jobs as well as homes. The Congressional Budget Office estimated that Hurricanes Katrina and Rita caused some 570,000 workers to lose their jobs at least temporarily; most of these losses were caused by Katrina (Congressional Budget Office, 2006). Also, the Florida hurricanes had little impact on the national economy, whereas Katrina and Rita had a substantial impact, reducing the national economic growth rate by roughly half a percentage point during the second half of 2005 (Ibid).

5) The 2004 Florida hurricanes received a great deal of national publicity, but were generally viewed simply as natural disasters. Those storms and Hurricane Andrew in 1992 led to changes in building codes and increases in insurance rates, but did not lead to a national discussion of broader issues. Katrina, on the other hand, put the spotlight squarely on many of the nation's most serious social, economic, political, and environmental problems. The political fallout began almost immediately and Katrina has prompted a national dialogue on issues of race, inequality, wetlands restoration, building codes, coastal development, property insurance, urban design, and the proper role of government in disaster preparation and mitigation, including the payment of subsidies for flood protection and insurance. Many of these issues are far from being resolved. The rebuilding of New Orleans has proven to be particularly contentious.

Implications for Future Population Growth

Impact of 2004 Hurricanes. What impact will the 2004 hurricanes have on future population growth in Florida? Will they cause significant numbers of people to leave the state and prevent others from moving in? We doubt that the hurricanes will have much of an impact, for two reasons. First, hurricanes are not new to Florida. People have long been aware that

Florida has hurricanes, just as California has earthquakes, Kansas has tornados, and Arizona has wildfires. But, Florida also has warm winters, sandy beaches, low taxes, and rapid job growth. As is true for all states, Florida has a mix of positive and negative attributes. People make their choices about where to live based on the entire bundle of attributes and how the attributes of one place compare to those of another. Despite its summertime heat, humidity, and hurricanes, Florida continues to have an attractive bundle of attributes.

Second, history does not show hurricanes to reduce long-term population growth in hurricane-prone areas. Many hurricanes have struck coastal areas over the years, yet coastal areas continue to grow rapidly. Hurricane Andrew had a substantial short-term impact on population growth in Miami-Dade County, but no long-term impact; in fact, the county had a larger population increase during the 1990s than the 1980s (Bureau of Economic and Business Research, 2006). Florida City and Homestead were the cities most directly affected by Hurricane Andrew, with each losing approximately one-third of its population directly as a result of the hurricane (Smith, 1996). Both cities returned to their pre-hurricane population sizes within five or six years and have continued to grow since that time. Several studies have concluded that natural disasters have no significant long-range effects on the population growth trends that were occurring prior to the occurrence of the disaster (e.g., Friesema et al., 1979; Rossi, et al., 1981).

We expect the same to be true for the 2004 hurricane season. At the state level, Florida's population grew by more than 400,000 each year between 2004 and 2006, two of the largest annual increases ever recorded (Bureau of Economic and Business Research, 2006, 2007). At the local level, a number of cities and counties experienced population losses between 2004 and 2005, but most had returned to or exceeded their 2004 levels by 2006 (Ibid). We do not believe

the 2004 hurricanes will have any significant long-term impact on population growth in Florida, at either the state or local level.

The impact of hurricanes on Florida's population growth could change, however, if there were several consecutive years with high hurricane activity. Yezer and Rubin (1987) hypothesized that the effect of natural disasters depends on prior expectations. If disasters occur with the expected frequency, they will have no significant impact on economic activity (including labor migration). If they occur more frequently than expected, they will induce the out-migration of both labor and capital. Consequently, if Florida were to experience several highly destructive hurricane seasons in a row, the number of people moving into the state might decline and the number moving out might increase. Given the evidence that global warming is raising the intensity if not the frequency of hurricanes (e.g., Trenberth, 2005; Webster, Holland, Curry, and Chang, 2005), this is a possibility that should not be overlooked. Higher housing costs created by more stringent construction requirements and rising insurance rates could lead to slower population growth as well.

Impact of Hurricane Katrina. What impact will Hurricane Katrina have on future population growth in the Gulf Coast region? Before answering this question, it is important to note that there were two Katrinas:

Katrina 1: the storm that blasted coastal areas from Louisiana to Florida with high winds and a tremendous storm surge.

Katrina 2: the storm that devastated New Orleans through floods and the ensuing social, economic, and political breakdown.

These two storms differed substantially from each other in terms of their damages; we believe they will differ in terms of their impact on future population growth as well. The coastal

area battered by Katrina 1 will most likely follow the Florida model. Short-term population losses will be substantial in many areas, but areas that had been growing will begin growing again. It may take a number of years, but the populations of those areas will eventually reach or exceed their pre-hurricane levels. Some residents displaced by the storm will never return, but they will be replaced by new residents. Places that had been stagnant or declining, however, will probably not experience much (if any) growth. For those places, Katrina will have a lingering negative impact on population growth.

Katrina 2 is a different story. We doubt that New Orleans will follow the Florida model. Much of the city lies below sea level and relies on a system of levees and pumps for its survival. Rebuilding the levees and restoring the infrastructure is an expensive, time-consuming, and politically charged process. Many thousands of homes were so badly damaged that they will have to be destroyed. Some areas may be declared completely off-limits for reconstruction and others may see substantial changes in building codes and environmental regulations.

Katrina 2 may also change the demographic make-up of the New Orleans population. Prior to the hurricane, many residents were unemployed or underemployed, had low incomes, and were renters rather than homeowners. Many lost their jobs and homes as a result of the hurricane; many moved away and may be priced out of the future housing market. Indeed, recent estimates show that the mean household income in the New Orleans metropolitan area increased in the months following Katrina, while the proportion of renters and the poverty rate declined (Frey and Singer, 2006). The proportion black declined from 36% to 21% (Ibid). These changes were the result of the population movements caused by the hurricane.

Family and cultural ties to New Orleans are very strong and will bring many people back to the area. In addition, New Orleans' unique history and culture, its tourism industry, and its

strategic importance as a port will continue to attract newcomers. However, many people displaced by the hurricane will find new jobs, put their children into new schools, and start putting down roots in new locations. Many are likely to remain where they are. The New Orleans metropolitan area has grown very slowly in recent decades and the city's population has been declining since 1960. We believe New Orleans' recovery will be much slower than the rest of the Gulf Coast region and it may never again reach its pre-hurricane population size.

CONCLUSION

The major problem with evaluating the demographic impact of a hurricane or any other natural disaster is the lack of relevant data. The traditional indicators of population change—building permits, electric customers, school enrollments, Medicare enrollees, income tax records, and the like—become available only after a substantial lag time and do not provide the information needed to perform a detailed analysis of housing damage and population movement. How can this problem be dealt with?

Partial information on housing damage and population mobility can be collected from a variety of sources. The American Red Cross collects data on damaged or destroyed units in the weeks immediately following a natural disaster (e.g., Federal Emergency Management Agency, 2006). Insurance claims paid under homeowner and renter policies report the value of losses as well as the number of claims (e.g., Florida Office of Insurance Regulation, 2006). Local administrative records such as property appraiser files sometimes provide useful information on damaged units (e.g., Metropolitan Dade County Planning Department, 1993). Change-of-address data from the U.S. Postal Service can be used to adjust population estimates based on traditional methods (U.S. Census Bureau, 2006a). All these data sources provide potentially

valuable information regarding the demographic impact of natural disasters, but none provide detailed information on housing damages and population movements.

One potentially useful data source is the American Community Survey (ACS), a survey that reaches some three million households each year and is expected to replace the long form of the decennial census in 2010 (U.S. Census Bureau, 2006b). The ACS has been used in conjunction with special population estimates produced by the U.S. Census Bureau to estimate the demographic characteristics of 117 counties struck by Hurricanes Katrina and Rita in 2005 (Frey and Singer, 2006). However—although the ACS provides a great deal of useful information regarding demographic changes in areas affected by natural disasters—it cannot provide information directly related to housing damages and population movements because such questions are not included on the ACS questionnaire.

We believe that detailed information on the demographic effects of hurricanes and other natural disasters can be collected only through sample surveys designed specifically for those purposes. This paper has described one such survey and has presented a summary of the major results. Internal consistency checks and comparisons with other data sources and the findings of previous research have confirmed the general validity of these results. Similar surveys can be conducted following other natural disasters and will provide valuable information regarding the effects of those disasters. This information will be useful not only for measuring the demographic effects of natural disasters, but also for analyzing changes in those effects over time and for developing plans to minimize the negative effects of future disasters. We believe that comprehensive data collection is the essential first step toward developing a full understanding of the demographic effects of hurricanes and other natural disasters.

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Figure 1. Paths Followed by the 2004 Florida Hurricanes.

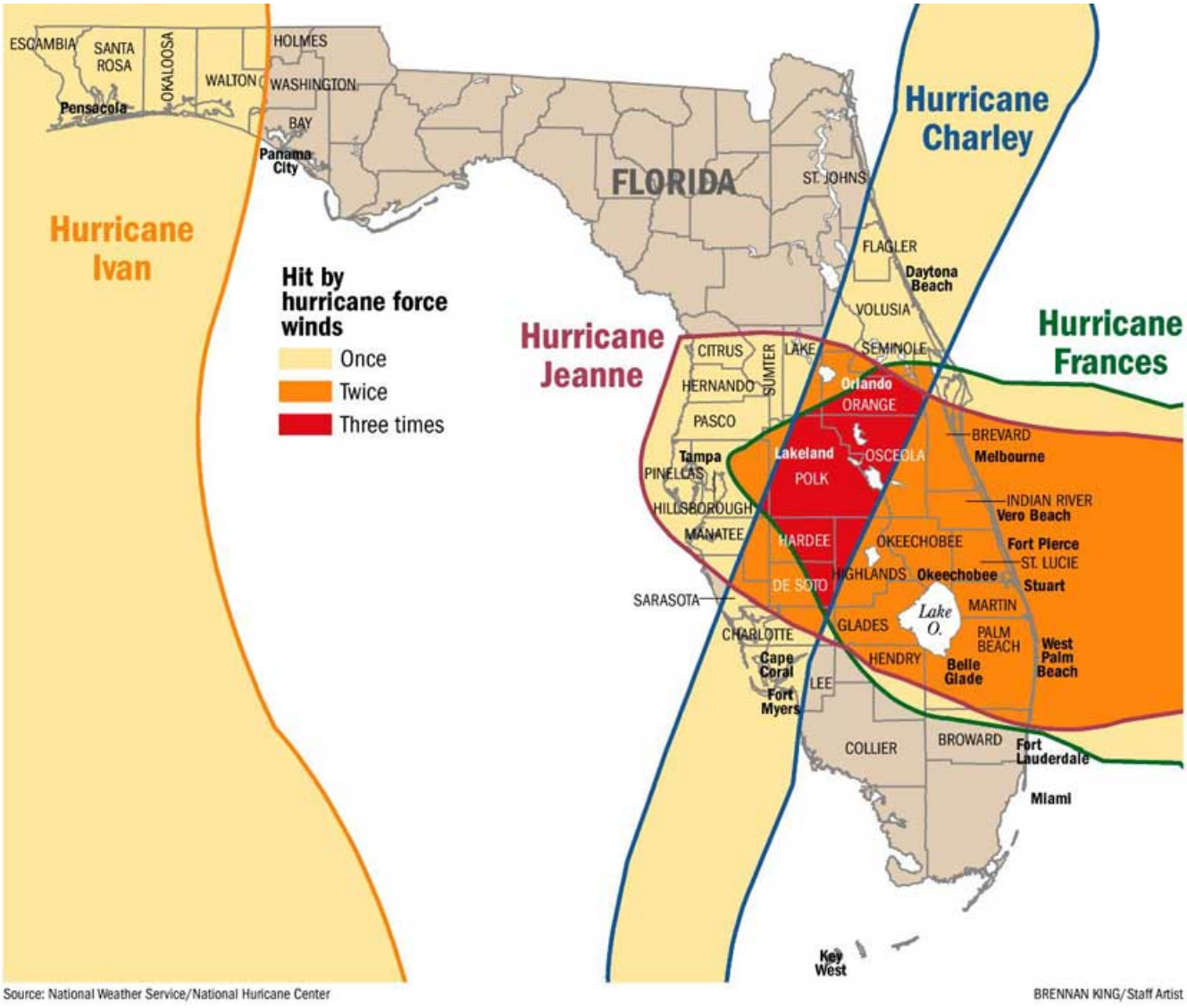

Table 1. Percent of Respondents Forced to Move Out of Home by at Least One Hurricane

PLACE	FORCED TO MOVE	NOT FORCED TO MOVE
BREVARD	16.5	83.5
CHARLOTTE	32.2	67.8
DE SOTO	32.9	67.1
ESCAMBIA	25.3	74.7
HARDEE	32.3	67.7
HIGHLANDS	22.4	77.6
INDIAN RIVER	24.6	75.4
MARTIN	17.5	82.5
OKEECHOBEE	25.8	74.2
OSCEOLA	20.8	79.2
POLK	17.0	83.0
ST. LUCIE	22.2	77.8
SANTA ROSA	23.5	76.5
REGION	21.2	78.8
FLORIDA	9.5	90.5

Table 2. Primary Reason for Moving out of Home after Hurricanes (Percent Distribution)

PLACE	STRUCTURAL DAMAGE	LOSS OF UTILITIES	OTHER
BREVARD	19.3	63.2	17.5
CHARLOTTE	43.0	43.8	13.2
DE SOTO	42.9	45.1	12.0
ESCAMBIA	45.9	41.6	12.5
HARDEE	48.5	38.6	12.9
HIGHLANDS	22.4	70.9	6.7
INDIAN RIVER	33.1	52.0	14.9
MARTIN	23.7	58.5	17.8
OKEECHOBEE	27.5	65.6	6.9
OSCEOLA	23.6	68.1	8.3
POLK	20.7	67.2	12.1
ST. LUCIE	36.3	53.4	10.3
SANTA ROSA	44.3	37.6	18.1
REGION	37.2	50.2	12.6
FLORIDA	13.7	72.3	14.0

Table 3. Type of Lodging Immediately after Moving Out of Home (Percent Distribution)

PLACE	FAMILY/ FRIENDS	HOTEL/ MOTEL	RENTAL	SAME PROPERTY	PUBLIC SHELTER	OTHER
BREVARD	60.7	25.0	1.8	3.6	0.0	8.9
CHARLOTTE	55.4	12.5	12.1	3.5	0.9	15.6
DE SOTO	61.6	6.7	3.6	11.1	0.5	16.5
ESCAMBIA	57.0	8.8	7.5	11.4	1.8	13.5
HARDEE	59.8	7.6	2.5	11.4	2.3	16.4
HIGHLANDS	68.0	10.3	6.9	4.3	1.2	9.3
INDIAN RIVER	48.5	20.0	7.3	4.7	0.9	18.6
MARTIN	60.8	8.7	5.5	4.0	2.0	18.1
OKEECHOBEE	53.1	15.7	4.5	8.6	0.9	17.2
OSCEOLA	47.2	33.3	8.4	1.4	2.8	6.9
POLK	63.8	17.2	0.0	6.9	1.7	10.4
ST. LUCIE	57.7	12.8	9.9	3.8	2.9	12.9
SANTA ROSA	54.2	4.7	11.3	16.5	0.8	12.5
REGION	56.3	12.1	8.0	7.0	1.6	15.0
FLORIDA	72.7	14.0	3.0	3.0	2.6	4.8

Table 4. Percent of Respondents Who Have Returned to Their Pre-hurricane Homes

PLACE	RETURNED	HAVE NOT RETURNED
BREVARD	87.7	12.3
CHARLOTTE	76.2	23.8
DE SOTO	76.7	23.3
ESCAMBIA	83.4	16.6
HARDEE	76.5	23.5
HIGHLANDS	87.8	12.2
INDIAN RIVER	86.6	13.4
MARTIN	93.0	7.0
OKEECHOBEE	87.9	12.1
OSCEOLA	86.1	13.9
POLK	89.7	10.3
ST. LUCIE	81.0	19.0
SANTA ROSA	82.5	17.5
REGION	82.0	18.0
FLORIDA	88.1	11.9

Table 5. Duration of Hurricane-induced Move for People Who have Returned to their Pre-Hurricane Homes (Percent Distribution)

PLACE	<2 WEEKS	2 - 4 WEEKS	1 - 3 MONTHS	3 - 6 MONTHS	> 6 MONTHS
BREVARD	69.6	19.0	7.6	1.3	2.5
CHARLOTTE	29.3	26.1	12.6	21.4	10.6
DE SOTO	42.0	24.2	15.7	8.5	9.6
ESCAMBIA	51.6	18.3	7.6	11.9	10.6
HARDEE	47.7	15.3	14.6	10.6	11.8
HIGHLANDS	81.6	5.1	4.8	3.0	5.5
INDIAN RIVER	65.4	17.1	3.1	5.2	9.2
MARTIN	77.9	8.4	1.4	8.2	4.1
OKEECHOBEE	62.9	19.4	6.0	3.0	8.7
OSCEOLA	88.0	5.4	1.1	4.4	1.1
POLK	82.2	6.7	4.4	2.2	4.5
ST. LUCIE	59.8	15.1	8.0	11.7	5.4
SANTA ROSA	44.0	17.6	8.9	10.4	19.1
REGION	59.2	16.0	8.1	9.0	7.7
FLORIDA	81.7	7.2	5.5	2.1	3.4

Table 6. Length of Stay by Type of Lodging (Percent Distribution): 13-County Region

TYPE OF LODGING	< 2 WEEKS	2-4 WEEKS	1-3 MONTHS	3-6 MONTHS	> 6 MONTHS
SAME PROPERTY	30.1	8.6	11.9	17.5	31.9
FAMILY/FRIEND	59.0	19.2	10.4	8.6	2.8
HOTEL/MOTEL	80.3	9.3	7.2	1.7	1.5
PUBLIC SHELTER	75.7	1.4	6.4	16.5	0.0
OTHER	26.0	11.0	12.8	18.8	31.4

Table 7. Type of Lodging in First Move by Type of Lodging in Second Move: 13-County Region

	LODGING IN SECOND MOVE				
LODGING IN FIRST MOVE	**CURRENT HOUSE**	**FAMILY/ FRIEND**	**TRAILER ON CURRENT PROPERTY**	**TRAILER NOT ON CURRENT PROPERTY**	**OTHER**
SAME PROPERTY	50.4	2.6	26.8	0.0	20.2
FAMILY/FRIEND	79.5	7.4	2.0	1.0	10.1
HOTEL/MOTEL	80.0	7.9	1.6	0.2	10.3
PUBLIC SHELTER	38.7	30.0	0.0	14.9	16.4
OTHER	56.1	6.7	6.3	2.6	28.3

Table 8. Extent of Hurricane Damage to Housing Unit (Percent Distribution)

PLACE	COMPLETELY DESTROYED	MAJOR DAMAGE	MINOR DAMAGE	NO DAMAGE
BREVARD	0.6	21.4	38.3	39.7
CHARLOTTE	6.0	43.0	32.6	18.4
DE SOTO	6.5	45.2	37.8	10.5
ESCAMBIA	1.7	40.7	39.1	18.5
HARDEE	8.1	40.3	38.7	12.9
HIGHLANDS	1.4	24.5	44.3	29.8
INDIAN RIVER	2.8	38.4	43.1	15.7
MARTIN	0.6	23.4	43.8	32.2
OKEECHOBEE	5.1	33.1	39.5	22.3
OSCEOLA	0.6	28.0	43.4	28.0
POLK	1.2	22.1	40.1	36.6
ST. LUCIE	1.8	36.4	40.4	21.4
SANTA ROSA	2.6	34.1	38.4	24.9
REGION	2.2	32.7	39.0	26.1
FLORIDA	0.4	8.1	23.8	67.8

Table 9. Extent of Damage by Housing Type: 13-County Region

HOUSING TYPE	COMPLETELY DESTROYED	MAJOR DAMAGE	MINOR DAMAGE	NO DAMAGE
SINGLE FAMILY	1.2	33.4	39.8	25.6
MULTI-FAMILY	0.8	21.8	34.2	43.2
MOBILE HOME	10.3	37.8	35.5	16.4
TOTAL	2.2	32.7	39.0	26.1

Table 10. Median Value of Housing Damage

PLACE	MEDIAN VALUE ($)
BREVARD	6,000
CHARLOTTE	30,000
DE SOTO	20,000
ESCAMBIA	13,000
HARDEE	14,000
HIGHLANDS	5,000
INDIAN RIVER	18,000
MARTIN	10,000
OKEECHOBEE	9,000
OSCEOLA	7,000
POLK	5,000
ST. LUCIE	10,000
SANTA ROSA	15,000
REGION	11,000
FLORIDA	4,000

Table 11. Status of Repairs to Housing Unit, May 2005 (Percent Distribution)

PLACE	NONE PLANNED	NOT STARTED	UNDERWAY	COMPLETED
BREVARD	12.5	20.7	30.4	36.4
CHARLOTTE	6.5	10.5	58.5	24.5
DE SOTO	6.8	12.4	51.3	29.5
ESCAMBIA	4.9	15.8	47.2	32.1
HARDEE	7.6	10.7	41.7	40.0
HIGHLANDS	4.7	20.1	29.9	45.3
INDIAN RIVER	2.8	14.8	50.5	31.9
MARTIN	4.8	20.3	37.9	37.0
OKEECHOBEE	7.2	19.0	39.1	34.7
OSCEOLA	8.2	11.5	38.9	41.4
POLK	13.9	16.7	36.1	33.3
ST. LUCIE	3.7	14.8	44.8	36.7
SANTA ROSA	4.3	15.0	50.0	30.7
REGION	5.5	15.8	43.9	34.8
FLORIDA	7.7	13.4	26.8	52.1