Will My Neighbors Rebuild? Rebuilding Outcomes and Remaining Damage Following Hurricanes Katrina and Rita

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Abstract

This article describes the rebuilding outcomes of hurricane-damaged properties in Louisiana and Mississippi using direct measures of remaining damage collected using onsite observation of properties' exterior conditions. The empirical analysis presents representative estimates of the rebuilding outcomes of owner-occupied properties and renter-occupied properties in early 2010, which is between 4 and 5 years after the 2005 hurricanes. The article then examines the extent to which damaged structures were clustered in concentrated pockets of remaining damage.

Introduction

Hurricanes Katrina and Rita created unprecedented damage to the housing stock in communities along the Gulf Coast. In Louisiana and Mississippi, in particular, the scale of the damage led policymakers to reconsider their approach to rebuilding assistance for residential housing recovery. This article provides representative estimates of the rebuilding outcomes of owner-occupied properties and renter-occupied properties in early 2010—between 4 and 5 years after the 2005 hurricanes. It then examines the extent to which properties with remaining damage were clustered in concentrated pockets or distributed among properties where other property owners had invested in rebuilding.

This information provides valuable insight into the rebuilding patterns of owner-occupied and renter-occupied properties following a natural disaster. Although the immediate goal of hurricane-recovery efforts should be to rebuild an adequate supply of habitable housing units, the design of housing recovery programs must also consider the longer term rebuilding outcomes of damaged properties and neighborhoods. In particular, properties that contain visible repair needs for sustained periods of time may reduce the property values and rebuilding outcomes of surrounding properties. Such externality effects represent social costs that are frequently used to justify the allocation of public funds to the rehabilitation or demolition of blighted structures. Documenting the extent and concentration of sustained damage therefore helps to inform the tradeoffs policymakers face when allocating limited funds between rebuilding assistance and blight remediation programs and when determining whether to incentivize property owners to rebuild in place or relocate to other areas.

An emerging literature reviews the process that the city of New Orleans used to develop a revised city plan (Nelson, Ehrenfeucht, and Laska, 2007; Olshansky, 2006; Olshansky et al., 2008). These discussions involved difficult decisions about how to define the future footprint of the city, thus charting the course for public investments in infrastructure, schools, and neighborhood-level rebuilding efforts. Lowe (2012) presented a similar discussion of the policy development and planning process in Mississippi, describing the political influences that shaped the design of housing recovery programs. Subsequent studies have also conducted detailed assessments of the Road Home program administered by the State of Louisiana, examining its calculation rules (Green and Olshansky, 2012; Spader and Turnham, 2014), implementation experience (GAO, 2010), distributional consequences (Gotham, 2014), and impact on households' locational and resettlement decisions (Gregory, 2012). Less evidence exists, however, regarding property owners' rebuilding activities and the longer term reconstruction of hurricane-damaged properties.

This article contributes to this literature by examining the patterns of rebuilding activity and sustained damage that were present following Hurricanes Katrina and Rita. First, it provides representative estimates of rebuilding outcomes for hurricane-damaged properties on significantly affected blocks and documents the presence of sustained damage. The results show that a substantial percentage of hurricane-damaged properties continued to show visible repair needs more than 4 years after the storms. Second, it examines the extent of spatial clustering among properties with sustained damage. The descriptive results show that damaged and uninhabitable properties were not isolated on a few abandoned blocks, but rather were distributed across blocks where other owners had invested in rebuilding. The analyses then estimate a census block-level fixed effects model that examines the extent of within-block clustering of damaged and uninhabitable structures on neighboring properties. The results show that the rebuilding outcomes of renter-occupied properties are significantly associated with the rebuilding outcomes of their neighboring properties, but that the extent of within-block clustering is weaker and not statistically significant among owner-occupied properties. Although these estimates are consistent with the presence of externality effects, the estimation strategy cannot rule out the potential for unobservable sources of within-block variation in rebuilding outcomes. Instead, the article uses these estimates to measure the extent to which damaged and uninhabitable structures were clustered in pockets of remaining damage.

Reconstruction of Damaged Properties Following Hurricanes Katrina and Rita

The nature of housing reconstruction following natural disasters is not well understood (National Research Council, 2006). Reviewing the literature on housing recovery following natural disasters, Peacock, Dash, and Zhang (2007) argued that insurance payouts, rebuilding assistance, and other sources of rebuilding funds play a central role in determining whether properties are rebuilt. Little empirical evidence exists, however, to document the rebuilding decisions of property owners or the reconstruction outcomes of damaged properties following natural disasters.

Zhang and Peacock (2010) analyzed the housing recovery process following Hurricane Andrew, describing changes in home sales, tax appraisals, and vacant parcels in Miami-Dade County. Their analysis found that the tax-appraised values of hurricane-damaged homes remained below their prestorm levels for many years after the storm. The authors also showed that housing recovery occurred unevenly across property types and neighborhoods, with rebuilding outcomes lagging among renter-occupied properties and properties in neighborhoods with greater shares of minority residents. Other case studies of previous natural disasters suggest that low-income and minority households suffered disproportionately high levels of damage and faced greater gaps in their access to sources of rebuilding assistance.[1] The literature unfortunately is less developed regarding the reconstruction outcomes of the permanent housing stock.

Empirical evidence is needed to document the extents and patterns of rebuilding activity on hurricane-damaged properties. Beyond the implications for individual property owners, the presence of sustained damage may negatively impact housing recovery outcomes at the neighborhood level. No existing studies examine the extent of spatial clustering in rebuilding outcomes or the presence of externalities from sustained damage. Instead, the most recent evidence on externality effects resulting from property conditions comes from the literature on the spillover effects of foreclosures (Campbell, Giglio, and Pathak, 2011; Fisher, Lambie-Hanson, and Willen, 2012; Frame, 2010; Gerardi et al., 2012; Goodstein et al., 2011; Harding, Rosenblatt, and Yao, 2009; Hartley, 2011; Immergluck and Smith, 2006; Lee, 2008; Leonard and Murdoch, 2009; Lin, Rosenblatt, and Yao, 2009; Mikelbank, 2008; Schuetz, Been, and Ellen, 2008; Whitaker and Fitzpatrick, 2011). Although these studies cannot isolate the contribution of deferred maintenance and visual blight apart from other potential mechanisms, they highlight the potential for property values to capitalize the presence of nearby disamenities.

In the case of Hurricanes Katrina and Rita, both the initial damage and the subsequent policy response were unique in scale relative to previous disasters in the United States. The rebuilding outcomes of hurricane-damaged properties must therefore be understood within the context of both the initial storms and the associated disaster recovery effort. Following the hurricanes, the largest source of rebuilding funds for most property owners came from insurance payouts—including any flood insurance from the National Flood Insurance Program. Aside from property owners'

[1] See Peacock, Dash, and Zhang (2007) for a literature review of housing recovery after natural disasters. See also Comerio (1998) and Wu and Lindell (2004) for case studies of the housing recovery response after other natural disasters in the United States.

insurance policies, the next largest source of rebuilding funds came from federal Community Development Block Grants (CDBGs) to the five states (Alabama, Florida, Louisiana, Mississippi, and Texas) along the Gulf Coast (Turnham et al., 2011). Although other sources of assistance existed, the percentage of households that received rebuilding funds from the Federal Emergency Management Agency's (FEMA's) Individual Assistance (IA) program, Small Business Administration (SBA) loans, or other sources is much smaller than the coverage of the CDBG assistance programs.[2]

The scale of the CDBG rebuilding assistance programs meant that these programs played a central role in determining the rebuilding funds available to property owners and the incentives associated with repairing damaged structures. The remainder of this section therefore provides a brief overview of the CDBG rebuilding assistance programs available to owner-occupants and rental property owners in Louisiana and Mississippi. For owner-occupants, the CDBG assistance programs provided grants directly to owners whose insurance payments and other sources of assistance did not fully cover the estimated cost to rebuild. In each state, the grant amount was defined to approximate the estimated cost to rebuild minus any insurance payouts and FEMA IA awards for structural repairs, with a maximum grant amount of $150,000.[3] The amount of any outstanding SBA loan was also deducted from the grant amount in order to pay off the SBA loan—that is, the CDBG grants replaced SBA loans with grant funds.

For owners of one- to four-unit rental properties, the CDBG assistance programs were substantially smaller than the programs available to owner-occupants, both in the number of grants distributed and in their coverage of damaged properties (Turnham et al., 2010). Using the Road Home Small Rental Property Program in Louisiana and Mississippi's Small Rental Property Assistance Program, owners of one- to four-unit rental properties could receive a rebuilding grant that required the owner to rebuild the damaged housing units and rent the rebuilt units to low- and moderate-income tenants.[4] In March 2010, only 4,449 rental properties in Louisiana and 2,149 properties in Mississippi had received grants from the small rental property programs. By contrast, the grant programs for owner-occupants distributed 124,516 grants in Louisiana and 25,086 in Mississippi during the same period.

These grant award outcomes highlight the extent to which policymakers in both Louisiana and Mississippi allocated larger amounts of funding to support rebuilding assistance for owner-occupants than for rental property owners. Accounting for the broader set of federal assistance programs, the Government Accountability Office (GAO, 2010: summary page) concluded that, "when the estimated number of assisted units is compared to the estimated number of damaged units,

[2] In the immediate aftermath of the hurricanes, FEMA's IA program included support for temporary housing needs and limited funding for structural repairs. SBA loans were also available to support property owners' rebuilding activities. A small number of property owners also used assistance from churches, charities, friends, relatives, state and local government programs, and other sources to support rebuilding activities (Turnham et al., 2011).

[3] Program guidelines—including the precise calculation rules—are available at the program websites, http://www.Road2LA.org and http://www.MSDisasterRecovery.com.

[4] These programs also had more restrictive eligibility rules—and more complex calculations for determining the grant amount—than the programs for owner-occupants.

62 percent of damaged homeowner units and 18 percent of damaged rental units were assisted."[5] Among owner-occupants, some variation existed in the extent to which the CDBG grants covered the full cost of rebuilding. In particular, the prestorm value rule in Louisiana reduced the grant amount below the full estimated cost to rebuild for many owner-occupants (Green and Olshansky, 2012; Spader and Turnham, 2014). Nonetheless, the coverage estimates suggest that CDBG grants helped to reduce the extent of resource constraints for many owner-occupants.

Although these programs delivered billions of dollars in rebuilding assistance to owner-occupied and renter-occupied properties, they did not guarantee investment in all hurricane-damaged properties (Spader and Turnham, 2014). The programs for owner-occupants in both states included options for owners who chose not to rebuild their damaged property. In Louisiana, the Road Home Homeowner Program provided 100 percent of the potential grant amount to owner-occupants who chose to relocate to another property within the state and 60 percent of the potential grant amount to owner-occupants who chose to relocate to another state. Owner-occupants who exercised these options transferred their damaged properties to the Louisiana Land Trust (LLT) for sale, rehabilitation, or demolition by the state. In Mississippi, the Homeowner Assistance Program compensated owner-occupants for their loss and did not require recipients to rebuild. For renter-occupied properties, the CDBG program rules required grant recipients to invest in the hurricane-damaged property, but the size of these programs meant that only a small percentage of rental property owners received CDBG funds.

The analysis in the remainder of this article contributes to the literature on housing recovery by documenting the extent to which hurricane-damaged properties continued to show visible repair needs for many years following Hurricanes Katrina and Rita. The objective of this analysis is to determine the extent of housing recovery among hurricane-damaged properties, providing representative estimates of sustained damage and examining the patterns of spatial clustering among properties with remaining repair needs. Although the CDBG assistance programs played an important role in supporting housing recovery, evaluation of the impact of CDBG assistance is beyond the scope of this article.[6] Instead, the rebuilding outcomes described in this article should be interpreted as the cumulative result of initial hurricane damage, access to CDBG and other sources of rebuilding assistance, and all other factors that shaped the housing recovery process following Hurricanes Katrina and Rita.

Data and Methods

The empirical analysis examines the patterns of rebuilding activity and remaining damage following the 2005 hurricanes. The analysis dataset draws on two sources of information. First, FEMA's initial damage assessments were used to provide baseline information on property damage and serve as the basis for the sampling approach. Second, updated information on property conditions was collected using onsite observation of each property's exterior conditions in early 2010.

[5] Spader and Turnham (2014) provided similar estimates specific to the CDBG program's coverage of owner-occupied properties and renter-occupied properties with major or severe damage on significantly affected blocks. They estimated that 58 percent of owner-occupied properties in the most severely affected neighborhoods of Louisiana and Mississippi received rebuilding grants compared with 10 percent of renter-occupied properties.

[6] Spader and Turnham (2014) provided a more detailed analysis of the CDBG housing recovery programs, including analysis of the grants' coverage and adequacy and estimates of rebuilding outcomes for grant recipients who chose each of the programs' grant options.

The FEMA data include all residential housing units that received a FEMA damage assessment in the wake of the 2005 hurricanes. These data are not exhaustive of all properties that experienced hurricane damage; however, they provide the most comprehensive source of information on damaged units (Richardson and Renner, 2007).[7] The FEMA inspections classify housing units into four levels of damage.

1. Severe damage: The damage estimate is more than 50 percent of the value.
2. Major damage: The damage estimate is more than $5,200 but not more than 50 percent of the value.
3. Minor damage: The damage estimate is less than $5,200.
4. No damage: The unit did not sustain hurricane damage.

The analysis sample includes hurricane-damaged properties on a stratified sample of significantly affected blocks. A significantly affected block is defined as a census block on which three or more housing units received FEMA assessments of major or severe damage. For the empirical analysis in this article, the unit of analysis is the property—defined as a residential structure. Properties that contain multiple housing units are classified according to the most severely damaged unit, and the onsite property observations document the exterior condition of the structure as a whole. The initial sample from the FEMA data includes all properties with major or severe damage on a stratified sample of significantly affected blocks in Louisiana and Mississippi (Turnham et al., 2010). The analysis sample for this article is limited to properties with FEMA assessments of major or severe damage on blocks with at least four properties with major or severe damage.[8]

The analysis sample includes 2,393 properties on 160 blocks in Louisiana and Mississippi. Of the 160 blocks, 11 (7 percent) contain the minimum of 4 properties with major or severe damage. The remaining blocks vary widely in the number of observed properties. 82 percent contain 6 or more properties and 57 percent contain 10 or more properties.

The second source of data comes from windshield observations of exterior property conditions in January and February 2010. For each of the 2,393 properties in the analysis sample, trained observers assessed the exterior condition of each property from the street or sidewalk using a structured observation guide. The observations document housing repair needs, signs of occupancy, and signs of ongoing repair activity. Turnham et al. (2010) provided detailed documentation of the observation instrument and data collection methodology. They also defined a measure—substantial repair needs—that aggregates the information about housing repair needs into a single measure

[7] HUD estimates suggest that properties that received a FEMA damage estimate constitute between 50 and 95 percent of all housing units in the areas covered by the sample. The estimates of coverage range from 53 percent of housing units in Jefferson Parish to 90 percent of housing units in Cameron Parish. Estimates for the New Orleans Planning Districts range from 61 percent in Uptown to 99 percent in New Orleans East.

[8] The requirement of at least four properties is necessary to conduct the analysis of clustering defined by Equation 1, where each property is compared with two neighboring properties (not necessarily adjacent) and at least one more distant property on the same block.

that reflects the extent of property damage visible to the observer. According to this definition, a property exhibits substantial repair needs if the exterior of the structure has one or more observable repair needs and the overall condition is fair or poor.[9]

The windshield observations were used to construct four measures of rebuilding outcomes.

1. Cleared lot: A property is assessed as a cleared lot if it contains an empty lot or a foundation with no standing residential structure. Because the sample is drawn from the population of properties with assessed damage to a housing unit, we infer that residential structures have been cleared from these properties.
2. Damaged structure: A property is assessed as a damaged structure if it contains a residential structure that shows substantial repair needs using the definition in Turnham et al. (2010).
3. Uninhabitable structure: A property is assessed as an uninhabitable structure if it contains a residential structure in which any housing unit does not meet the census definition of habitability. According to this definition, housing units are habitable if they are closed to the elements with intact roof, windows, and doors and no positive evidence—such as a sign on the house or block—that the unit is to be demolished or condemned. All uninhabitable structures also meet the definition of damaged structures, so these properties are a subset of the damaged structures.
4. Rebuilt structure: A property is assessed as a rebuilt structure if it contains a residential structure that does not meet the definition of a damaged structure. Thus, the measures of cleared lots, damaged structures, and rebuilt structures are mutually exclusive and exhaustive.

Because the property observations were made in January and February 2010, the observers could not determine whether the observed damage was caused by the 2005 hurricanes, deferred maintenance by the owner, or some other cause. Although the structured observation guide focused on repair needs associated with hurricane damage—such as missing shingles, observable flood lines, and so on—it is possible that some of the observed damage was not the result of the hurricanes. The measure of damaged structures may be particularly susceptible to this issue, so all the analyses are replicated using the measure of uninhabitable structures, which provides a more conservative measure that reflects severe damage to the property's exterior.

The first component of the analysis uses these property observations to produce representative information about properties' rebuilding outcomes. The analysis sample is representative of the population of properties that had major or severe damage assessments on significantly affected blocks in Louisiana and Mississippi with at least four hurricane-damaged properties. All analyses use probability weights to account for the sampling design.[10]

[9] Properties in fair or poor condition exhibit one or more repair needs and show major signs of deterioration, such as cracked or broken windows, missing roof materials, rotted porches, or large areas of peeling paint. See Turnham et al. (2010) for additional documentation regarding how this measure was constructed.

[10] The strata for sampling reflect counties in Mississippi and parishes in Louisiana. The sampling design oversampled blocks in strata with relatively fewer significantly affected blocks (Turnham et al., 2010).

The second component of the analysis examines the extent to which damaged and uninhabitable structures are clustered in concentrated pockets of remaining damage. The objective of these analyses is to examine the extent to which property owners' rebuilding decisions left blocks or sections of blocks with clusters of damaged or uninhabitable structures. The analysis first describes the distribution of remaining damage across blocks. It then examines the extent to which damaged and uninhabitable structures are clustered next to one another within blocks.

To measure the extent of spatial clustering, the analysis defines a variable that reflects the presence of damaged or uninhabitable structures on neighboring properties N_{pb}. Neighboring properties are defined as the two closest properties with major or severe initial hurricane damage.[11] Because the sample is limited to properties with major or severe damage, it excludes properties that either were not assessed by FEMA or that suffered minor or no damage from the 2005 hurricanes. As a result, the neighboring properties are not always the properties directly adjacent to the property. Instead, they are the two closest properties with FEMA assessments of major or severe damage. When properties are plotted to point locations in a Geographic Information System, or GIS, the centroid-to-centroid distances to the two closest properties are, on average, 17 and 33 meters, respectively. By comparison, the average centroid-to-centroid distance to the most distant nonneighboring property on the block is 139 meters. The measure of neighboring properties' rebuilding outcomes N_{pb} reflects the average value for the two neighbors. For example, the measure of remaining damage on neighboring properties would be equal to 0.5 if one of the properties contains a damaged structure and equal to 1 if both neighboring properties contain damaged structures.

The empirical model tests whether a property is more likely to contain a damaged structure if the neighboring properties also have remaining damage. A general form for the estimation model can be defined by—

$$D_{pb} = N_{pb}\beta_1 + X_{pb}\beta_2 + B_b + \varepsilon_{pb}\ , \qquad (1)$$

where p indexes the property and b indexes the census block. The outcome measure D_{pb} is an indicator variable for whether the property contains a damaged or uninhabitable structure. The set of baseline property characteristics X_{pb} includes measures that reflect the assessed level of initial hurricane damage and the ownership status of the property—owner-occupied property versus renter-occupied property. The census block-level fixed effects B_b isolate within-block variation, comparing the rebuilding outcome of each property with the rebuilding outcomes of other properties on the same block.

The coefficient β_1 therefore identifies whether a property is more or less likely—relative to the average rebuilding outcomes of nonneighboring properties on the same block—to contain a damaged or uninhabitable structure if the neighboring properties contain damaged or uninhabitable structures. If the within-block clustering of unobservables is minimal and the baseline property characteristics X_{pb} account for any within-block clustering of factors associated with rebuilding, the coefficient β_1 will measure the externality effect of neighboring damage. Because the set of baseline characteristics X_{pb} is limited, however, this interpretation requires an assumption about the absence

[11] An alternative is to define neighbors as the nearest observed property in either direction. This alternative selects the same set of neighboring properties for more than 80 percent of the analysis sample.

of within-block clustering of unobservables. The discussion therefore interprets this coefficient as a measure of the extent to which damaged and uninhabitable structures are clustered in pockets of remaining damage within blocks.

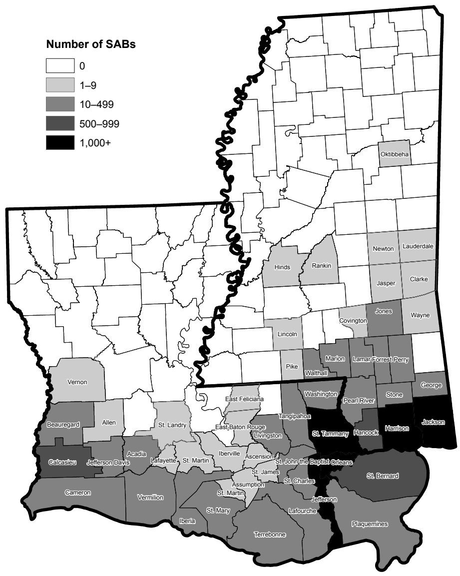
Equation 1 is estimated as a linear probability model using ordinary least squares (OLS).[12] To estimate this model with the analysis dataset, the analysis sample is separated into an estimation sample and the set of neighboring properties, which are omitted from the estimation sample. For each block, the process randomly selects an initial property as a sample property. It then identifies the neighboring properties and works in each direction to categorize properties as sample or neighboring properties. Continuing this process around each block produces an estimation sample of 948 properties, with 1,445 properties identified as neighboring properties.[13]

Estimates of Remaining Damage

Exhibit 1 shows the distribution of significantly affected blocks across parishes and counties in Louisiana and Mississippi—the states that experienced the most extensive hurricane damage. The shading

Exhibit 1

Distribution of Significantly Affected Blocks Across Parishes and Counties



SAB = significantly affected block.

Note: An SAB is a census block with at least three housing units that received Federal Emergency Management Agency assessments of major or severe damage after Hurricanes Katrina and Rita in 2005.

[12] Estimation with OLS is preferred because of limitations with the fixed-effect logit model, most notably the loss of sample on blocks with no variation in the outcome variable.

[13] Neighboring properties can be a neighbor to more than one property in the estimation sample. The number of neighboring properties is not a perfect multiple of the estimation sample because many blocks in the sample have an odd number of properties, a nonstandard shape, or both.

in exhibit 1 highlights the concentration of significantly affected blocks in a handful of parishes and counties. Although 20 Louisiana parishes contained 10 or more significantly affected blocks, 3 parishes—Orleans, Jefferson, and St. Tammany—contained more than 1,000 significantly affected blocks. Similarly, although 12 Mississippi counties contained 10 or more significantly affected blocks, 2 counties—Harrison and Jackson—contained more than 1,000 significantly affected blocks.

The analysis sample described in the previous section produces representative estimates of the rebuilding outcomes of properties that have major or severe hurricane damage on significantly affected blocks with at least four damaged properties. Before the hurricanes, 70 percent of such properties were owner-occupied properties and 30 percent were renter-occupied properties. The FEMA assessments for these properties indicate that 60 percent of properties received assessments of severe damage—59 percent among owner-occupied properties and 63 percent among renter-occupied properties—and 40 percent received assessments of major damage.

Exhibit 2 describes the estimated rebuilding outcomes, showing the percentage of properties in the analysis sample that contained rebuilt structures, cleared lots, damaged structures, and uninhabitable structures in early 2010. An initial finding from these estimates is that a substantial percentage of the properties contained damaged and uninhabitable structures 4 to 5 years after the initial hurricane damage. Although 70 percent of properties contained rebuilt structures, more than 17 percent of properties contained a residential structure with remaining damage that could be

Exhibit 2

Percent of Properties With Remaining Damage in Early 2010, by Geography

		Rebuilt Structures		Cleared Lots		Damaged Structures		Uninhabitable Structures	
	N	%	SE	%	SE	%	SE	%	SE
All	2,393	69.9	(0.025)	13.1	(0.028)	17.1	(0.020)	8.1	(0.012)
Louisiana	1,748	69.1	(0.027)	10.9	(0.032)	20.0	(0.027)	9.9	(0.015)
Jefferson Parish	199	96.0	(0.015)	1.0	(0.007)	3.0	(0.013)	1.5	(0.011)
Orleans Parish	1,177	64.5	(0.032)	7.3	(0.012)	28.2	(0.031)	14.4	(0.020)
MidCity Planning District	156	42.3	(0.079)	3.8	(0.014)	53.8	(0.083)	19.2	(0.055)
Lakeview Planning District	145	74.5	(0.059)	14.5	(0.046)	11.0	(0.047)	4.8	(0.021)
Gentilly Planning District	176	76.7	(0.050)	5.7	(0.035)	17.6	(0.049)	11.4	(0.053)
ByWater Planning District	165	50.9	(0.056)	8.5	(0.039)	40.6	(0.052)	25.5	(0.051)
Lower Ninth Ward Planning District	156	48.1	(0.077)	28.8	(0.093)	23.1	(0.040)	21.8	(0.038)
New Orleans East Planning District	192	82.3	(0.056)	2.1	(0.010)	15.6	(0.055)	7.8	(0.036)
Uptown Planning District	118	72.0	(0.098)	3.4	(0.031)	24.6	(0.087)	14.4	(0.049)
St. Bernard Parish	271	61.3	(0.069)	32.1	(0.080)	6.6	(0.052)	1.1	(0.006)
Mississippi	645	72.9	(0.062)	21.8	(0.065)	5.2	(0.011)	1.2	(0.005)
Harrison County	183	61.5	(0.055)	27.9	(0.065)	10.6	(0.025)	3.0	(0.012)
Biloxi	89	48.2	(0.078)	40.0	(0.110)	11.8	(0.049)	1.2	(0.011)
Jackson County	328	81.3	(0.099)	17.2	(0.103)	1.5	(0.010)	0.0	(0.000)
Pascagoula	219	89.0	(0.054)	11.0	(0.054)	0.0	(0.000)	0.0	(0.000)

SE = standard error.

observed from the street. Approximately one-half of these properties—8 percent of all properties in the sample—contained structures that did not meet the standard for habitability. The remaining 13 percent of properties contained cleared lots.

These rebuilding outcomes vary substantially between Louisiana and Mississippi. Although the proportion of previously damaged properties with rebuilt structures in both states is near 70 percent, Mississippi properties are more likely than Louisiana properties to be cleared of any remaining damaged structure. Of the Louisiana properties, 11 percent contained cleared lots and 20 percent contained damaged structures. By contrast, 22 percent of Mississippi properties contained cleared lots and only 5 percent contained damaged structures.

The variation in rebuilding outcomes across parishes, counties, and the other subgeographies shown in exhibit 2 is even larger than the differences between the state-level outcomes for Louisiana and Mississippi.[14] Although 70 percent of all properties contained rebuilt structures, the proportion of properties with rebuilt structures ranges from 96 percent in Jefferson Parish to 42 percent in the Mid-City Planning District of New Orleans. Similarly, the percentage of uninhabitable structures ranges from 0 percent in Pascagoula to 26 percent in the ByWater Planning District of New Orleans.

Exhibit 3 presents separate estimates for owner-occupied properties and renter-occupied properties. These estimates reveal much greater levels of remaining damage among the renter-occupied properties than among owner-occupied properties. Nearly 74 percent of owner-occupied properties were rebuilt compared with 60 percent of renter-occupied properties. This difference is entirely accounted for by the greater proportion of damaged structures among renter-occupied properties. Of owner-occupied properties, 13 percent contained damaged structures compared with nearly 28 percent of renter-occupied properties. With limited exceptions, the presence of remaining damage is greater among renter-occupied properties than owner-occupied properties in each state, county, and parish in exhibit 3.

The greater incidence of damaged and uninhabitable structures among renter-occupied properties is only partially explained by differences in initial hurricane damage and the geography of owner-occupied properties and renter-occupied properties. Exhibit 4 shows the results of regressions that test whether the differences in rebuilding outcomes between owner-occupied properties and renter-occupied properties are statistically significant after controlling for the initial damage assessment and for geography using census block-level fixed effects. Panel 1 presents the results from OLS regressions where the dependent variable indicates whether a property contained a damaged structure. Panel 2 presents similar estimates for uninhabitable structures.[15]

[14] Estimates for parishes, counties, and subgeographies are reported if the geography contains a minimum of 25 owner-occupied properties and 25 renter-occupied properties.

[15] Estimation with OLS is preferred because of the fixed-effect logit model's loss of sample from blocks that do not have any within-block variation in the outcome measure. The estimated differences between renter-occupied properties and owner-occupied properties are robust in sign, significance, and approximate magnitude when the models are replicated using fixed-effects logistic regression on the subsample of properties on blocks with variation.

Exhibit 3

Percent of Properties With Remaining Damage in Early 2010, by Tenure Status

	Owner-Occupied Properties		Renter-Occupied Properties		Owner-Occupied Properties		Renter-Occupied Properties	
	%	SE	%	SE	%	SE	%	SE
Panel 1	**Rebuilt Structures**				**Cleared Lots**			
All	73.9	(0.028)	60.3	(0.036)	13.5	(0.034)	12.0	(0.020)
Louisiana	73.1	(0.031)	60.5	(0.040)	11.9	(0.041)	8.6	(0.017)
Jefferson Parish	97.6	(0.012)	93.2	(0.038)	1.6	(0.010)	0.0	(0.000)
Orleans Parish	70.1	(0.032)	55.0	(0.042)	7.3	(0.013)	7.4	(0.015)
St. Bernard Parish	64.4	(0.075)	40.0	(0.076)	31.8	(0.083)	34.3	(0.107)
Mississippi	76.6	(0.061)	58.7	(0.077)	18.9	(0.063)	33.2	(0.083)
Harrison County	70.9	(0.046)	43.9	(0.073)	21.6	(0.044)	39.8	(0.109)
Jackson County	82.5	(0.090)	75.5	(0.144)	15.7	(0.096)	24.5	(0.144)
Panel 2	**Damaged Structures**				**Uninhabitable Structures**			
All	12.6	(0.018)	27.7	(0.030)	6.2	(0.010)	12.6	(0.022)
Louisiana	15.0	(0.025)	30.9	(0.036)	7.8	(0.014)	14.3	(0.025)
Jefferson Parish	0.8	(0.008)	6.8	(0.038)	0.0	(0.000)	4.1	(0.034)
Orleans Parish	22.6	(0.031)	37.7	(0.039)	12.2	(0.020)	18.1	(0.031)
St. Bernard Parish	3.8	(0.024)	25.7	(0.151)	0.8	(0.005)	2.9	(0.033)
Mississippi	4.5	(0.011)	8.1	(0.028)	0.9	(0.005)	2.3	(0.010)
Harrison County	7.5	(0.027)	16.3	(0.058)	1.7	(0.016)	5.4	(0.021)
Jackson County	1.9	(0.012)	0.0	(0.000)	0.0	(0.000)	0.0	(0.000)

SE = standard error.

The results in exhibit 4 show that controlling for properties' initial damage assessment and geography does not eliminate the differences in rebuilding outcomes between owner-occupied and renter-occupied properties. In Louisiana, the coefficients in Panels 1 and 2 show that the percentage of damaged and uninhabitable structures are 16 and 7 percentage points greater among renter-occupied properties than among owner-occupied properties. In Mississippi, these differences are 4 and 2 percentage points, respectively. In both states, these estimates closely mirror the differences between renter-occupied properties and owner-occupied properties in the descriptive statistics for damaged and uninhabitable structures shown in exhibit 3.

Controlling for geography with the census block-level fixed effects reduces but does not eliminate these differences. In Louisiana, the percentage of damaged and uninhabitable structures are, on average, 7 and 5 percentage points greater among renter-occupied properties than among owner-occupied properties on the same block. In Mississippi, these differences are 2 and 1 percent, respectively. The differences in Mississippi are small and not statistically significant, an outcome that appears to reflect the more frequent presence of cleared lots in Mississippi. The descriptive statistics in exhibit 3 show that—in addition to reducing the overall number of damaged structures in Mississippi—cleared lots appeared more frequently among renter-occupied properties than owner-occupied properties.

In Louisiana, the finding that small renter-occupied properties showed greater levels of sustained damage than owner-occupied properties in early 2010 is consistent with previous literature,

Exhibit 4

OLS Regressions of Differences in Rebuilding Among Owner-Occupied and Renter-Occupied Properties

	Louisiana		Mississippi	
	Coefficient (SE)	**Coefficient (SE)**	**Coefficient (SE)**	**Coefficient (SE)**
Panel 1: Outcome—Damaged Structure				
Renter-occupied property	0.161**	0.066**	0.040	0.021
	(0.034)	(0.025)	(0.031)	(0.026)
Severe damage	0.067***	– 0.020	– 0.029	– 0.005
	(0.035)	(0.029)	(0.025)	(0.062)
Block fixed effects	No	Yes	No	Yes
N	1,748	1,748	645	645
Panel 2: Outcome—Uninhabitable Structure				
Renter-occupied property	0.067**	0.051**	0.015	0.012
	(0.024)	(0.022)	(0.011)	(0.010)
Severe damage	0.038	0.002	– 0.009	– 0.020
	(0.024)	(0.020)	(0.008)	(0.030)
Block fixed effects	No	Yes	No	Yes
N	1,748	1,748	645	645

OLS = ordinary least squares. SE = standard error.
***p < .001. ***p < .10.*

suggesting that housing recovery takes more time for renter-occupied properties than owner-occupied properties (Peacock, Dash, and Zhang, 2007; Zhang and Peacock, 2010). Differences in insurance payouts, resource constraints, local rental requirements, and the other incentives facing owner-occupants versus rental property owners may each contribute to the slower pace of housing recovery among rental properties. The smaller size of the CDBG small-rental assistance programs described in the initial sections of this article may also contribute to the differences in rebuilding outcomes between owner-occupied properties and renter-occupied properties.

A final finding from exhibit 4 is that the severity of a property's initial hurricane damage is not a significant predictor of whether the property contained a damaged or uninhabitable structure. Although the measure of initial damage severity may not capture the full extent of variation in initial hurricane damage, the results in exhibit 4 do not provide any evidence that damaged or uninhabitable structures were more frequent among properties that suffered more severe levels of initial hurricane damage.

Taken together, the rebuilding outcomes described in this section document the potential for damaged and uninhabitable structures to remain unrepaired for many years. More than 4 years after Hurricanes Katrina and Rita, 17 percent of hurricane-damaged properties on significantly affected blocks continued to show repair needs that were visible from the street. This outcome highlights the need for disaster recovery efforts to anticipate the presence of sustained damage and to plan for blight remediation options that prevent unrepaired damage from becoming long-term sources of blight for neighboring residents.

Spatial Clustering of Remaining Damage

This section explores the patterns of rebuilding activity, examining the extent to which damaged and uninhabitable structures were clustered together in concentrated pockets of sustained damage. The analysis seeks to answer three questions about the spatial patterns of rebuilding activity and remaining damage. First: Were properties with damaged and uninhabitable structures concentrated on a few abandoned blocks or were they distributed across blocks where other property owners invested in rebuilding? Second: Were properties more likely to contain a damaged or uninhabitable structure if their neighboring properties contained damaged or uninhabitable structures? Third: To what extent were properties with sustained damage concentrated in neighborhoods with more vulnerable populations?

The first question—whether properties with damaged and uninhabitable structures were concentrated on a few abandoned blocks with no rebuilding activity—is straightforward to answer. It is not the case. Less than 3 percent of significantly affected blocks contained only damaged structures and cleared lots.[16] Instead, damaged and uninhabitable structures were primarily on blocks where other property owners returned to rebuild their hurricane-damaged properties. Of the significantly affected blocks, 57 percent contained both damaged structures and rebuilt structures. To the extent that damaged and uninhabitable structures create negative externalities for neighboring properties, this finding raises concerns about the potential for sustained damage to become a long-term disamenity for neighborhood residents. The remaining 40 percent of significantly affected blocks contained only rebuilt structures and cleared lots.

The second question explores the extent to which damaged or uninhabitable structures were clustered next to one another within blocks. Exhibit 5 presents descriptive statistics that show the percent of properties whose neighboring properties contained damaged or uninhabitable structures. The column for rebuilt properties suggests that many property owners who invested in rebuilding their properties continued to face visual blight from neighboring properties in early 2010. The figures for rebuilt properties show that 15 percent of rebuilt owner-occupied properties and 19 percent of rebuilt renter-occupied properties had at least one neighboring property with a damaged structure. Similarly, 8 percent of rebuilt owner-occupied properties and 10 percent of rebuilt renter-occupied properties had at least one neighboring property with an uninhabitable structure.

The figures for damaged and uninhabitable structures in exhibit 5 highlight the extent of clustering among properties with remaining damage. The figures for damaged structures show that 60 percent of damaged owner-occupied properties and 76 percent of damaged renter-occupied properties had at least one neighboring property with a damaged structure. Similarly, 43 percent of uninhabitable owner-occupied properties and 58 percent of uninhabitable renter-occupied properties had at least one neighboring property with an uninhabitable structure. These figures are substantially greater than the figures for rebuilt properties, reflecting the presence of clustering among damaged and uninhabitable structures.

[16] The estimates for block-level rebuilding outcomes use probability weights to account for the stratified sampling design. The resulting estimates are representative of the population of significantly affected blocks that contain four or more properties that received FEMA assessments of major or severe damage.

Exhibit 5

Clustering of Sustained Damage on Neighboring Properties

	Rebuilt Properties				Damaged Structures			
	Owner-Occupied Properties		Renter-Occupied Properties		Owner-Occupied Properties		Renter-Occupied Properties	
	%	SE	%	SE	%	SE	%	SE
Percent of properties where at least one neighboring property contains a damaged structure								
All	14.9	(0.022)	18.7	(0.027)	60.1	(0.048)	76.1	(0.038)
Louisiana	17.4	(0.029)	20.6	(0.031)	63.9	(0.048)	77.7	(0.038)
Mississippi	6.7	(0.027)	6.9	(0.031)	17.3	(0.091)	39.9	(0.205)
Percent of properties where at least one neighboring property contains an uninhabitable structure								
All	7.6	(0.014)	9.7	(0.020)	43.1	(0.059)	57.5	(0.073)
Louisiana	9.6	(0.019)	11.0	(0.024)	44.5	(0.059)	58.9	(0.074)
Mississippi	1.2	(0.007)	1.0	(0.010)	0.0	(0.000)	0.0	(0.000)

SE = standard error.

Notes: N = 1,188 rebuilt properties, 352 damaged structures, and 185 uninhabitable structures in Louisiana. N = 481 rebuilt properties, 35 damaged structures, and 8 uninhabitable structures in Mississippi.

Exhibit 6 measures the extent to which this clustering is explained by differences in properties' initial hurricane damage, tenure status, and the overall level of rebuilding on the block. The first column shows OLS coefficients for the estimation of equation (1) on all properties in the estimation sample.[17] The second and third columns present OLS estimates when the sample is separated into owner-occupied and renter-occupied properties. In each model, the coefficient of interest is the measure of neighboring damaged structures, which identifies the association between properties' rebuilding outcomes and the presence of damaged structures on neighboring properties. The covariate measures of damage and ownership reflect the baseline attributes of properties from the FEMA damage assessment.

The estimates in Panel 1 suggest that damaged structures are significantly clustered next to one another within blocks, even after controlling for initial damage and tenure status. Among all properties, the coefficient of 0.26 implies that the proportion of damaged structures is 26 percentage points greater when both of the neighboring properties contain damaged structures—or 13 percentage points greater when one of the neighboring properties contains a damaged structure. The second and third columns show that this clustering results primarily from the rebuilding patterns of renter-occupied properties. Among owner-occupied properties, the coefficient shrinks to 0.12 and is not statistically significant. By contrast, the proportion of damaged structures on renter-occupied properties is 44 percentage points greater when both neighboring properties contain damaged structures—or 22 percentage points greater when one neighboring property contains a damaged structure.

Panel 2 replicates these estimates for the more restrictive measure of blight—uninhabitable structures. The results show that neighboring uninhabitable structures are associated with a

[17] Estimation with OLS is preferred because of the fixed-effect logit model's loss of sample from blocks that do not have any within-block variation in the outcome measure. The substantive conclusions are similar when the estimates are replicated using fixed-effects logistic regression on the subsample of properties on blocks with variation.

Exhibit 6

OLS Estimates of Spatial Clustering in Rebuilding Outcomes

	All Properties		Owner-Occupied Properties		Renter-Occupied Properties	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Panel 1: Outcome—Damaged Structure						
Neighbors: Damaged structure	0.257**	(0.065)	0.121	(0.093)	0.442**	(0.093)
Neighbors: Cleared lot	0.052	(0.045)	0.029	(0.043)	0.136	(0.159)
Severe damage	– 0.010	(0.039)	0.055	(0.057)	– 0.077	(0.070)
Owner occupied	– 0.051***	(0.028)				
Panel 2: Outcome—Uninhabitable Structure						
Neighbors: Uninhabitable structure	0.121	(0.084)	0.038	(0.104)	0.354*	(0.159)
Neighbors: Cleared lot	0.046	(0.037)	0.046	(0.035)	0.043	(0.145)
Severe damage	– 0.022	(0.030)	0.001	(0.038)	– 0.006	(0.072)
Owner occupied	– 0.042***	(0.024)				

OLS = ordinary least squares. SE = standard error.

Note: N = 948 properties on 160 blocks (626 owner-occupied and 322 renter-occupied properties).

*p < .05. **p < .001. ***p < .10

35-percentage-point increase in the proportion of uninhabitable structures among renter-occupied properties. Among owner-occupied properties, the coefficient shrinks to 0.04 and is not statistically significant. These estimates are consistent with the findings for damaged structures.

These findings imply that renter-occupied properties are significantly more likely to contain damaged structures if their neighboring properties contain damaged structures—even after controlling for initial hurricane damage and the block fixed effects. Only six of the neighboring properties in the analysis sample are owned by the same property owner, so these patterns are not due to a single property owner making a coordinated decision about neighboring properties. Instead, these findings confirm the presence of clustering in the rebuilding outcomes of renter-occupied properties. To the extent that within-block clustering of unobservables is minimal, this finding is consistent with the presence of externality effects, suggesting that neighboring damage may influence the rebuilding decisions of rental property owners.

By contrast, the rebuilding outcomes of owner-occupied properties are less sensitive to the presence of neighboring damage. Although the estimated coefficients for owner-occupied properties are positive in both panels of exhibit 6, the magnitude of these estimates is much smaller than the estimates for renter-occupied properties and do not reach statistical significance. As a result, these estimates fail to confirm that clustering is present among owner-occupied properties.

One possible explanation for this finding is that greater levels of rebuilding assistance among owner-occupied properties enabled owner-occupants to rebuild in place when it was their preferred option, reducing their sensitivity to the presence of neighboring damage. Alternatively, the findings in exhibit 6 may reflect differences in the future incentives facing owner-occupants versus rental property owners. For example, because rental property owners have to anticipate the expected rent and occupancy rate of any rebuilt unit(s), the presence of neighboring damage may carry more immediate financial consequences for rental property owners than for owner-occupants. The analyses unfortunately are not able to distinguish between these possible explanations for the observed patterns of clustering.

The covariates in exhibit 6 provide insight into the determinants of properties' rebuilding outcomes and the potential for bias due to within-block clustering of unobservables. First, the FEMA initial damage assessment is not associated with the presence of a damaged or uninhabitable structure on the property in any of the models. These estimates suggest either that the FEMA assessment is a weak measure of damage or that rebuilding activity is not strongly predicted by the initial level of property damage. Second, the measure of properties' ownership status shows differences in the overall rates of rebuilding among owner-occupied properties and renter-occupied properties. Consistent with the estimates in exhibit 3, owner-occupied properties contained fewer damaged and uninhabitable structures than renter-occupied properties.

Lastly, the covariates in exhibit 6 report the estimated coefficients for neighboring cleared lots—testing the extent to which damaged structures and cleared lots cluster together. This measure provides an empirical test of whether initial hurricane damage or other unobserved factors contribute to the estimated coefficient for spatial clustering. Because cleared lots may be a preferable option for properties with intensive damage, significant clustering between cleared lots and damaged structures would suggest that unobserved initial damage may be responsible for the clustering of damaged structures—that is, the FEMA assessment inadequately controls for bias from unobserved clustering of initial damage. The estimates do not suggest that this scenario is the case. Instead, the results in exhibit 6 suggest that the distribution of damaged structures is not correlated with the relative presence of neighboring cleared lots versus rebuilt structures.[18]

To further examine the potential for bias due to within-block clustering of unobservable factors, a second empirical test is to replicate the estimates in exhibit 6 using only the subsample of properties that experienced severe initial hurricane damage. For the estimates shown in exhibit 6, the research design acts as the primary precaution against bias, limiting identification to within-block variation across properties with major or severe hurricane damage. Because each property in the sample suffered major or severe damage, the outcome measures should capture variation in rebuilding activities rather than initial hurricane damage or longer term deferred maintenance. As a further precaution, the sample can be tightened to include only those properties that suffered severe damage—limiting the sample to residential properties that were more than 50 percent damaged. The coefficients in exhibit 6 are robust in sign, significance, and magnitude when the models are replicated on the sample of properties with severe damage. Although the analyses cannot rule out the potential for unobservable sources of within-block variation, these results do not provide any evidence that the estimates in exhibit 6 reflect bias due to such factors.

The remainder of this section focuses on the third question, describing the attributes of the neighborhoods that contain unrepaired damage and clusters of damage. Because damaged and

[18] One possible explanation is that damaged structures and cleared lots largely appear on different blocks. The overlap appears sufficient, however, to identify clustering between damaged structures and cleared lots if it existed. Of the cleared lots, 62 percent are on blocks with at least one damaged structure, and 41 percent of damaged structures are on blocks with at least one cleared lot. The coefficients in exhibit 6 are robust in sign, significance, and magnitude when the models are replicated for the sample of properties on blocks that contain both damaged structures and cleared lots.

uninhabitable structures are likely to create disamenities for neighborhood residents, these attributes describe the extent to which the consequences of sustained damage primarily affect less advantaged neighborhoods. Exhibit 7 provides descriptive information from the 2000 census defined at the block-group level to describe mean neighborhood characteristics. Panel 1 describes the neighborhood-level characteristics of blocks that contain at least one property with the specified rebuilding outcome. The second, third, and fourth columns describe the set of blocks that contain cleared lots, damaged structures, and uninhabitable structures. Because many blocks contain properties with more than one type of rebuilding outcome, the blocks described by each column are not mutually exclusive. The initial column provides similar information for the 36 blocks (23 percent) that contain only rebuilt structures.

Exhibit 7

Neighborhood Characteristics of Blocks With Remaining Damage and Clusters of Damage

Block Contents	All Rebuilt	Cleared Lot	Damaged Structure	Uninhabitable Structure
Neighborhood attributes by presence of at least one cleared lot or damaged structure				
Severe damage (%)	19	62	61	69
Owner occupied (%)	72	65	58	58
Occupied (%)	93	88	89	88
Median home value ($)	128,980	81,341	74,710	73,010
Median household income ($)	45,639	32,355	28,486	28,061
Households with income below 150% of the poverty threshold (%)	19	32	36	38
White (%)	69	54	34	26
Black (%)	21	40	60	68
Hispanic (%)	4	3	3	3
Other race/ethnicity (%)	5	4	3	3
N	36	78	94	64
Block Contents	**No Clusters**	**Cleared Lots**	**Damaged Structures**	**Uninhabitable Structures**
Neighborhood attributes by presence of at least one cluster of cleared lots or damaged structures				
Severe damage (%)	32	69	75	83
Owner occupied (%)	69	68	50	46
Occupied (%)	92	86	87	87
Median home value ($)	103,448	81,570	70,894	69,649
Median household income ($)	38,447	35,107	25,400	23,949
Households with income below 150% of the poverty threshold (%)	25	30	41	44
White (%)	61	59	16	7
Black (%)	30	35	80	89
Hispanic (%)	4	2	2	2
Other race/ethnicity (%)	5	5	3	2
N	82	39	51	27

The census attributes in exhibit 7 show striking differences in the characteristics of blocks where cleared lots and damaged structures appear. The first row shows that cleared lots, damaged structures, and uninhabitable structures each appear more frequently on blocks with greater proportions of severe damage. The census characteristics then show that damaged and uninhabitable structures are more likely to appear in neighborhoods with more vulnerable populations. This contrast is particularly sharp regarding the median income of residents in the block group, the percent of residents in poverty, and the percent of Black residents.

Panel 2 presents similar figures for the set of blocks that contain clusters of each rebuilding outcome. The second column describes the set of blocks that contain a cluster of cleared lots, defined as two consecutive cleared lots—that is, a cleared lot with at least one neighboring cleared lot. Similarly, the third and fourth columns identify the set of blocks that contain clusters of damaged structures and uninhabitable structures. The first column describes the set of blocks that do not contain any of the defined clusters. These figures show that the differences in Panel 1 are magnified by the patterns of clustering. Blocks with clusters of cleared lots closely resemble the 82 blocks with none of the defined clusters, whereas blocks with clusters of damaged structures are concentrated in lower income neighborhoods and neighborhoods with high proportions of Black residents. These results suggest that any disamenities created by sustained damage were concentrated in low-income and predominately Black neighborhoods.

Conclusions

This article contributes to the literature on housing recovery by documenting the rebuilding outcomes of hurricane-damaged properties following Hurricanes Katrina and Rita and examining the patterns of spatial clustering among properties with sustained damage. The analysis first presents representative estimates of the rebuilding outcomes of hurricane-damaged properties in early 2010—between 4 and 5 years after Hurricanes Katrina and Rita. This information provides unique insight into the potential for property damage to remain unrepaired following a natural disaster. Among properties that received FEMA assessments of major or severe hurricane damage and that were on significantly affected blocks, 17 percent contained a damaged structure in early 2010—with 8 percent containing a structure that did not meet the census definition of a habitable housing unit.

These damaged and uninhabitable structures were distributed widely across a large number of neighborhoods. Less than 3 percent of significantly affected blocks had been largely abandoned, containing only cleared lots and damaged structures. Instead, most damaged and uninhabitable structures were on the 57 percent of significantly affected blocks that contained both damaged structures and rebuilt structures. Within these blocks, the evidence of clustering among properties with sustained damage is mixed. Where the rebuilding outcomes of renter-occupied properties are significantly associated with the rebuilding outcomes of their neighboring properties, the estimates for owner-occupied properties are weaker and do not reach statistical significance.

Taken together, these rebuilding outcomes highlight both the extent of sustained damage and the widespread presence of damaged and uninhabitable structures in many neighborhoods. Although these properties frequently appeared in clusters of two or more neighboring properties with sustained damage, the clusters were not geographically isolated in pockets of intensive damage. Instead, they were predominately located in proximity to other properties whose owners had invested in rebuilding.

These patterns of rebuilding outcomes suggest that disaster recovery efforts should anticipate the presence of sustained damage and consider potential strategies for preventing damaged properties from becoming long-term disamenities for neighboring property owners. For example, Options 2 and 3 of Louisiana's Road Home program provide examples of program design that both allows for relocation and addresses the presence of damage on the abandoned properties. Using Options 2 and 3, owner-occupants could receive a CDBG grant to support their relocation to a different property, transferring their hurricane-damaged property to the Louisiana Land Trust for sale, rehabilitation, or demolition by the state. The slow speed of blight removal among LLT properties has been a limitation in practice.[19] However, this approach illustrates a program design that attempts to mitigate the potential for sustained damage on program-eligible properties. Each state might have alternatively set aside some portion of its initial CDBG funds for programs focused exclusively on longer term blight remediation among the broader population of hurricane-damaged properties.

The caveat to these recommendations is that additional research is necessary to determine the relative cost-effectiveness of such strategies. Specifically, determining the socially optimal allocation of funding between rebuilding assistance and blight remediation efforts requires a more detailed understanding of the extent to which sustained damage—and clusters of damage—impose externality costs on neighboring property owners. For example, if the presence of sustained damage imposes only minimal externality costs on other residents, then remediation efforts may not be necessary and rebuilding assistance grants are likely to be the most cost-efficient mechanism for supporting the reconstruction of hurricane-damaged properties. This question is empirical and additional research that measures the presence and size of such externality costs is critically needed.

In the interim, the estimates in this article provide evidence regarding the extent of sustained damage—and concentrated pockets of sustained damage—more than 4 years after Hurricanes Katrina and Rita occurred. This evidence provides initial insight into the patterns of longer term reconstruction among damaged residential properties following a major natural disaster.

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[19] See, for example, *Times-Picayune* editorial board (2012).

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