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DAWN OF THE DEAD CITY: AN EXPLORATORY ANALYSIS OF VACANT ADDRESSES IN BUFFALO, NY 2008–2010

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ABSTRACT: *This article examines residential vacancy patterns in Buffalo, NY, using data from a unique data set. It includes variables from HUD Aggregate USPS Administrative Data on Address Vacancies, the American Community Survey (ACS) 5-year estimates for 2005–2009, housing choice voucher (HCV) records of local public housing agencies, and municipal* in rem *property records. Multiple regression is used to identify significant relationships between vacancy patterns, socioeconomic characteristics, and institutional factors. The findings from this analysis suggest that the percent of vacant residential properties increases in census tracts with elevated poverty rates, higher percentages of renters receiving rental assistance, and long-term vacancies. They also suggest that the percent of abandoned residential properties increases in census tracts with highly concentrated black populations, elevated poverty rates, long-term vacancies, and higher percentages of business addresses. We conclude that these relationships are unique to older core cities experiencing systemic population and job losses. These cities struggle with a distinct type of long-term vacant and abandoned structures, which we label zombie properties. They can be contrasted with vacant and abandoned properties in transitional or regenerating areas. We offer recommendations for further analysis of zombie properties in these urban settings.*

SHRINKING CITIES COME TO AMERICA

Oh, America. I wish I could tell you that this was still America, but I've come to realize that you can't have a country without people. And there are no people here. No, my friends. This is now the United States of Zombieland. (Fleischer, 2009)

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During the late 20th century Buffalo, NY, experienced a period of rapid depopulation and deindustrialization. It became the quintessential *rust belt* city, exhibiting many of the characteristics described by Bluestone and Harrison (1984). The 1970 U.S. Census reported that there were 52,851 manufacturing jobs in Buffalo. The number was estimated to have dropped to 10,801 in 2009 (www.census.gov/acs). Between 1970 and 2009 the city lost 42,050 manufacturing jobs, 79.6% of its manufacturing base. The city's population peaked in 1950 when it reached 580,132. By 2009 it was estimated that the city's population had plummeted to 273,335. In approximately 60 years Buffalo's population shrank by 52.9%.[1] Population loss was not restricted to the City of Buffalo. During this period it was a regional phenomenon. The Buffalo-Niagara Falls metropolitan statistical area (MSA) population peaked in 1970 when it reached 1,349,211. By 2009 the region's population was estimated at 1,128,813. In approximately 40 years the region's population declined by 16.3%.[2] When the city of Buffalo's population is subtracted from the MSA, the suburban population in the area peaked in 1970 at 886,443. In approximately 40 years the suburbs' population declined by 3.5%.[3] It is noteworthy that the Buffalo-Niagara Falls MSA experienced population losses in both its older core city and suburbs. This pattern has been observed in other older industrial cities in the United States such as Cleveland, Pittsburgh, and Detroit (Goodman, 2005b; Puentes & Orfield, 2002). This scenario can be contrasted with other metropolitan areas in the United States which have experienced what has been referred to as a "hollowing out" or "doughnut effect" where declining population in older core cities has been driven by robust growth in suburban communities (Pallagst, 2008).

From the 1970s forward, decline in Buffalo has been a regional phenomenon driven by demographics, accelerated out-migration, and deindustrialization. Unlike growing metropolitan areas in the United States, patterns of urban decline in Buffalo are similar to those identified with shrinking cities like Dresden and Leipzig in eastern Germany (Haase, Lautenbach, & Seppelt, 2010; Pallagst, 2008; Wiechmann, 2008). Studies of shrinking cities in the eastern German context, which have come to form a "German School" in this area of analysis, treat urban decline as a regional phenomenon driven by sustained population and industrial losses. The physical manifestation of this decline is an oversupply of residential units and chronic property abandonment. Because shrinking is viewed as an enduring change by the German School, it is argued that there is a need for a shift in planning practices away from paradigms focusing on growth and toward more appropriate strategies based on rightsizing. Among other elements, this shift entails advocacy for intensified residential property demolition and the rightsizing of the built environment to adjust to demographic and economic change.

Like many eastern German cities, the impact of job losses and population decline in Buffalo has had a number of ripple effects on the local tax base, public school enrollment, and the level and quality of public services and amenities. By 2004 the City's fiscal position was compromised to the point that the State of New York was compelled to create a public benefit corporation, known as the Buffalo Fiscal Stability Authority, to oversee its finances. The fiscal crisis was not restricted to the City; it was a regional problem. In 2005, the State of New York created another public benefit corporation, known as the Erie County Fiscal Stability Authority, to oversee the finances of the county in which Buffalo and its suburbs are located.

In addition to weakening public institutions, job losses and population decline have had negative impacts on the local economy and social institutions. This is reflected in Buffalo's poverty rate, which was estimated at 29.5% in 2009. At that time, Buffalo was the second most impoverished city in the United States with a population over 250,000. Detroit was the most impoverished city. Housing values have also been depressed in the city of Buffalo for decades. For example, Yin (2009) found that median housing sale prices per square foot across census blocks in Buffalo have been declining since 1980. The stagnation of Buffalo's housing market predated the 2007–2008 U.S. mortgage crisis by at least a decade. Property values did not increase in Buffalo during the

real estate bubble that preceded the mortgage crisis, and housing prices remained relatively flat in its aftermath (Feroleto, 2009; Mallach, 2010).

In essence, Buffalo's real estate market has been soft for decades. This has been attributed to a sustained decrease in the demand for housing driven by demographic and economic change. The processes affecting Buffalo's housing market mirror those identified by Goodman (2005a) in other U.S. central city housing markets negatively impacted by demographic shifts and declining demand for housing. One consequence of this change has been the growth in vacant and abandoned property in the city.

One of the ramifications of structural decline in employment and population is the chronic problem of vacant and abandoned property. Scholars (e.g., Accordino & Johnson, 2000) and groups like the National Vacant Properties Campaign (2005) have linked vacant and abandoned properties to a variety of economic and social ills including property crimes, drug trafficking, arson, declining property values, and the burden on public coffers associated with demolition and the management of vacant lots. The problem of abandoned residential property is also a central theme in the shrinking cities literature (Accordino & Johnson, 2000; Bernt, 2009; Bontje, 2004; Dettmar, 2005; Hasse 2008; Haase et al., 2010; Mallach, 2010; Pallagst, 2008; Shetty, 2009; Schilling & Logan, 2008; Wiechmann, 2008). This literature suggests that targeted demolition of abandoned residential structures is an important precursor to stabilizing housing markets in cities experiencing sustained decline. Addressing the problem of long-term abandonment involves both the identification of factors linked to it, and a paradigm shift among policymakers from an emphasis on growth (Molotch, 1976; Stone 1989) to rightsizing cities (Hollander, 2010; Schilling & Logan, 2008).

Attempts have been made in past research to identify factors linked to property abandonment. Hiller, Culhane, Smith, and Tomlin (2003) examined housing data in Philadelphia and found that several factors contributed to abandonment. Two of the strongest predictors of housing abandonment were elevated rates of vacancies and high numbers of City-owned properties[4] in neighborhoods. In another study, Mallach (2010) examined U.S. Census data and used the category "other" for vacant housing units to isolate properties suspected as being abandoned. Vacant units categorized as "other" in the U.S. Census are composed of units that are not being offered for rent, held for future occupancy, or limited to seasonal or occasional uses. In essence, this subset of vacant units served as a proxy for abandoned property in Mallach's (2010) analysis of older distressed cities in the United States. In cities like Buffalo, a large portion of vacant properties appear to be abandoned. For instance, in 2009 it was estimated that there were 27,879 vacant housing units in Buffalo (www.census.gov/acs), and 17,416 of those units fell into the category of "other" vacant units. This suggests that over 58% of vacant housing units in the city are abandoned.

However, estimates of vacant and abandoned properties fluctuate widely, making the employment of multiple measures necessary when examining this issue. For example, a 2008 report of the United States Conference of Mayors (2008) identified over 10,000 vacant and abandoned properties in Buffalo, and suggested that vacancies were a growing problem in the city despite efforts to enhance code enforcement and property demolition.[5] The report indicated that "Buffalo is among the top five U.S. cities in numbers of vacant properties and, at 7.7 vacant housing units per 100 residents, has the highest rate of vacant housing in New York State" (United States Conference of Mayors, 2008, p. 26). In the third quarter of 2010, the United States Postal Service (USPS) reported that there were 15,857 vacant addresses in Buffalo. Those addresses represented 11.5% of the 138,215 addresses the USPS identified in the city.

This vacancy rate was present despite the City of Buffalo's aggressive plan, coined the "5-in-5" plan, to demolish 5,000 structures in 5 years (City of Buffalo, 2007). The City's "5-in-5" plan projected that the total number of vacant structures would fall below 6,000 by 2010. When the

City's "5-in-5" demolition plan was announced, the official position of the City was that vacant property was at an epidemic scale. The publication announcing the demolition plan framed the issue in this manner:

> [O]ne of the most important issues facing our community [is] vacant structures. These blighted properties perpetuate a negative perception of Buffalo. The blight thwarts economic investment; it strains City finances; and, of prime importance, it compromises the safety of our residents who live adjacent to these structures and the courageous men and women of the Buffalo Fire and Police Departments who respond to the high rate of fires and crime in these structures.

Unfortunately, U.S. Census data, USPS data, and other sources suggest that the target of reducing the number of vacant structures in Buffalo to 6,000 was not reached in 2010. Instead, the vacancy epidemic continues to affect Buffalo. Despite the City's enhanced demolition efforts, the USPS identified a slight increase in the total number of vacancies ($n = 27$) between the first quarter of 2008 and the third quarter of 2010. More alarming, the number of vacancies remained relatively unchanged in Buffalo during that period, while the total number of residential addresses fell by 813 and the total number of business addresses fell by 66.

Zombie Properties: They're Not Your Father's Abandoned Buildings

Vacant and abandoned properties have emerged as the physical manifestation of the city of Buffalo's economic decline. Despite efforts to address the vacancy crisis, structural change continues to outpace efforts to cure the city's ills. Economic stagnation and population decline are projected to continue into Buffalo's foreseeable future, and the rate of property abandonment outpaces demolitions. These conditions make shrinking cities in declining regions unique. They have social and economic institutions that continue to stagnate while exhibiting few signs of recovery.

Buffalo represents a critical case of a shrinking city in a declining region. Its economy remains stalled in a landscape of vacant and decaying properties. For this reason, we argue that vacant and abandoned structures in Buffalo represent a new type, *zombie properties*. This type of vacancy is distinct from other types. Zombie properties are a specific type of abandoned structure. They are found in shrinking cities where demographic and economic decline make abandonment an enduring fixture of the urban milieu. These structures no longer have a raison d'être in the new urban milieu, but they persist as lifeless shells. Many zombie properties are boarded up, contain health hazards such as asbestos and lead, and have extensive structural damage.[6] In order for rightsizing to take place, there is a need to remove zombie properties from the urban landscape. Zombie properties can be contrasted with vacant properties in transitional or regenerating areas of vibrant regions. For instance, Greenberg, Popper, and West (1990) coined the term TOADS to describe *temporary obsolete abandoned derelict sites* in their analysis of vacant properties in U.S. cities.[7] Their analysis produced a number of recommendations for addressing the TOADS problem in cities. However, the temporary nature of TOADS makes many of the remedies forwarded to address this type of vacancy inadequate in places facing sustained decline.

The growing literature on shrinking cities is more germane to these places (Bernt, 2009; Bontje, 2004; Dettmar, 2005; Haase, 2008; Hollander, 2011; Reese, 2006; Rieniets, 2009; Ryan, 2008; Schilling and Logan, 2008). This body of literature focuses on a growing subset of cities in the United States and elsewhere confronting sustained decline and the challenges associated with mass abandonment and downsizing. It identifies instances of shrinking cities in a variety of places across Europe and the United States, establishing this phenomenon as a truly international

dilemma which transcends borders. Rieniets (2009) defines the scope of the shrinking cities problem in this manner:

> Between 1950 and 2000, more than 350 large cities experienced, at least temporarily, significant declines in population. In the 1990s, more than a quarter of the world's large cities shrank. Economic and demographic indicators, particularly in developed countries, suggest that shrinking cities will continue being a challenge for planners, decision makers, and inhabitants alike (Rieniets, 2009, p. 251).

Despite these ominous trends, shrinking cities are not dead cities. Many of their core functions remain intact, but on a smaller scale. Consequently, they must buttress the surviving cityscape against encroachment by the larger share of the built environment that is obsolete and in decay.

Zombie properties are an indicator of a city in sustained decline. We argue that these properties are analogous to fictional zombies that are the focal point in films like George A. Romero's *Dawn of the Dead* (1978). In the film, a handful of survivors find themselves surrounded by zombies. Despite their efforts to fend off and incapacitate the zombie horde, they are ultimately overwhelmed by exponential growth in the zombie population. At a deeper level, scholars like Bishop (2010) and May (2010) add to our understanding of this dilemma. These scholars develop a conceptual metaphor for urban decline and argue that zombie films offer a critique of the socioeconomic processes that have produced the contemporary city. This critique suggests that contemporary cities have shifted away from traditional productive and reproductive functions. From this perspective, cities no longer produce goods and services in a sustainable manner, their schools fail to replenish human capital, their labor forces are depleted as the population grays, they have weakened civic institutions, and they are devoid of cultural meaning. Cities like Buffalo embody this transformation.

Some scholars have picked up on these themes and argue that new urban regimes have emerged in declining industrial cities. For example, Rae (2006) argues that as deindustrialization has led to the decline of older cities in the United States and abroad, a new urban regime has emerged to replace older growth regimes composed of private industry, commercial interests, and public service unions. Rae's new urban regime consists of well-capitalized nonprofits and public sector institutions such as hospitals, colleges, and universities. In shrinking cities, new urban regimes have emerged as the core employment and economic development engines. Rae based his research on New Haven, CT, where Yale University emerged as a lead institution promoting university and medical expansion as a remedy for the city's decline. Buffalo, NY, has adopted a similar strategy, led by the University at Buffalo, which has pursued the development of its downtown medical campus as an economic development engine for the region (Carlson, 2009). Other private and public colleges, universities, and hospitals in Buffalo have joined the new urban regime.

The new urban regime has emerged in response to continued decline in the city and a power vacuum resulting from a weakened growth coalition. One of the foci of the new urban regime is to fortify neighborhoods adjacent to its member's hospitals, campuses, and other facilities. This approach to revitalization represents a shift from a growth orientation to an emphasis on rightsizing. In part, this shift has been in response to long-term population trends and the proliferation of vacant, idle, and decaying properties in the city. This emphasis has also emerged as efforts to mount large-scale demolition programs have fallen short of stabilizing many city neighborhoods. In hindsight, the demolition of hundreds, even thousands, of blighted properties seems futile in the wake of the city's wholesale abandonment. Despite the best efforts of public officials, the city seems unable to reverse its general decline and return to a traditional growth paradigm.

In this article we examine the characteristics of vacant and abandoned property in Buffalo with a focus on isolating factors distinct to zombie properties. As an exploratory analysis, we examine demographic and institutional dimensions of the vacant property phenomenon. Our goal is to generate a framework for analysis that is tailored to the needs of cities impacted by chronic abandonment and decline. An underlying assumption of this analysis is that zombie properties occupy terrain that is not a candidate for urban revitalization or regeneration. Instead, these properties occupy a no-man's-land in shrinking cities. Consequently, new containment and remediation strategies are needed to halt their spread and buffer what remains of old industrial cities from further decline.

DATA AND METHODS

This article is based on an analysis of data from four sources. First, HUD Aggregated USPS Administrative Data on Address Vacancies for 2008–2010 were used in the analysis. These data are compiled quarterly for the United States Department of Housing and Urban Development (HUD) by the United States Postal Service (USPS). These data are aggregated at the census tract level. At the census tract level, all addresses are identified by vacancy status and length of vacancy in a geographic area. Since 2008, the USPS reported address data by type, subdividing them as residential, business, and other.[8] We argue that there are many advantages in using USPS data to analyze vacancy patterns, instead of U.S. Census and other data sources. Among them are the benefits of having current data based on full counts of all addresses in an area, and the benefits of having vacancy data from a single source that subdivides properties by residential, business, and other types.

To supplement data from the USPS, data from the U.S. Census Bureau are used in this analysis. These data include variables from prior decennial censuses and 5-year estimates from the 2005–2009 American Community Survey (ACS).[9] We find the 5-year estimates from the ACS to be of particular value, because they are the most current estimates of population and housing characteristics that are available using the same census geography as the HUD Aggregated USPS Administrative Data on Address Vacancies.[10] These data were only released at the census tract level using 2000 tract boundaries.[11] In addition to these data sources, variables were included in the analysis measuring the distribution of *in rem* and Housing Choice Vouchers (HCV) properties in Buffalo. *In rem* properties include all residential and commercial tax foreclosure properties owned by the City of Buffalo in 2010. Of the *in rem* properties examined, 73.3% were residential properties. In order for the title of a property to be transferred to the City of Buffalo and obtain *in rem* status it must have delinquent taxes, user fees, and/or sewer and water charges for a number of years. If the City is unable to resolve outstanding debts after several attempts are made to notify the legal owner of a property, title is transferred to the City and attempts are made to sell the property at an annual auction. The process for a property to become *in rem* typically culminates after several years of abandonment and neglect by owners. Records of *in rem* properties were obtained from the City of Buffalo property files. HCVs are rental assistance vouchers issued by HUD and distributed through local public housing agencies (PHAs). The HCV program is the largest affordable housing program administered by the U.S. government. HCV properties in 2008 were identified using data from two local PHAs that were contracted to administer the HCV program in the city of Buffalo and its surrounding metropolitan area. Together these two PHAs distributed 8,835 HCVs in 2008; this constituted 98% of the total vouchers distributed in the city.

Variables from each of the data sources were merged into a single database to compare census tract characteristics in the City of Buffalo. There were a total of 89 census tracts in the city of Buffalo at the time of this analysis.[12] Selected variables were highlighted using geographical information system (GIS) software. Maps from this analysis are presented. Finally, multivariate models were developed using linear regression.[13]

RESULTS

The Socioeconomic Geography of Vacancy and New Urban Regimes

An analysis of descriptive statistics for variables measuring community demographics and the built environment in Buffalo adds to our understanding of vacancy patterns in shrinking cities. This analysis also enhances our understanding of the relationship between vacancy patterns and the spatial distribution of institutions that Rae (2006) identifies as comprising new urban regimes.

Figure 1 displays the geographic distribution of vacant addresses by census tract in Buffalo in 2010. This figure illustrates that much of the vacant property is concentrated on the east side and west side of the city. Historically, Main Street in the city of Buffalo has served as a dividing line (Patterson, 2011; Taylor, 2011). Neighborhoods in the geographic center of the city have been referred to as being part of the east side or west side depending on the side of Main Street where they were located. These areas contained a large portion of the city's industrial property during the 20th century and experienced the greatest impact of deindustrialization and subsequent population loss during the post-1950 era. They are also the areas of the city with the highest poverty rates and concentrations of minority residents (Yin, 2009). Buffalo has historically been a segregated city. For instance, CensusScope.org identified it as a highly segregated city. In 2000, Buffalo had a white/black dissimilarity index with a value of 0.74, which indicates that 74% of the blacks in the city would have to move in order to produce a completely integrated community.[14] This segregation was the product of historical patterns of redlining, blockbusting, steering, and other forms of housing discrimination and disinvestment.[15] Figure 1 suggests that the socioeconomic geography of vacancy in Buffalo exposes disenfranchised groups to greater negative externalities associated with the processes of urban decline. The census tracts with the highest concentrations of vacancy correspond with concentrations of poverty, HCV recipients, minority groups, and other indicators of distress (Patterson, 2011).

Figure 2 maps the locations of hospitals, colleges, and universities in Buffalo. These institutions form the core of the new urban regime that Rae (2006) identifies. What is striking about the locations of these institutions is that they tend to be found outside of areas where high levels of vacancies appear. These institutions are located in a variety of neighborhood contexts, and many are adjacent to poor neighborhoods. This is a reflection of their historical legacy, their ties to specific locations, and the relative immobility of larger institutions and organizations. The distinguishing feature is not the demographics of surrounding neighborhoods or land use characteristics. Rather it is the apparent ability of these institutions to influence patterns of public and private investment which discourage the proliferation of property vacancy and abandonment. Collectively, members of the new urban regime appear to fortify the built environment and stave off the proliferation of abandoned property and unwanted land uses. This can be contrasted with traditional public institutions that were part of old urban regimes such as: fire houses, police stations, libraries, and public schools. Figure 3 illustrates how institutions of the old urban regime are dispersed across the urban landscape. The new urban regime represents both a re-centering of the urban landscape and the establishment of a buffer zone between areas of the city that remain viable and those that have been systematically abandoned. The re-centering of the city by the new urban regime creates an institutional context in which zombie properties proliferate on the periphery.

Table 1 adds to our understanding of the socioeconomic geography of vacancy in Buffalo. The first grouping of data presented in Table 1 comes from the 2005–2009 ACS. These data estimate the city's population at 273,335 in 2009, indicating that the city experienced an estimated 6.6% decline in population during the last decade. White and minority populations were relatively equal in 2009, with an estimated 51.4% of the population white, 40.2% black, and 8.4% other races.

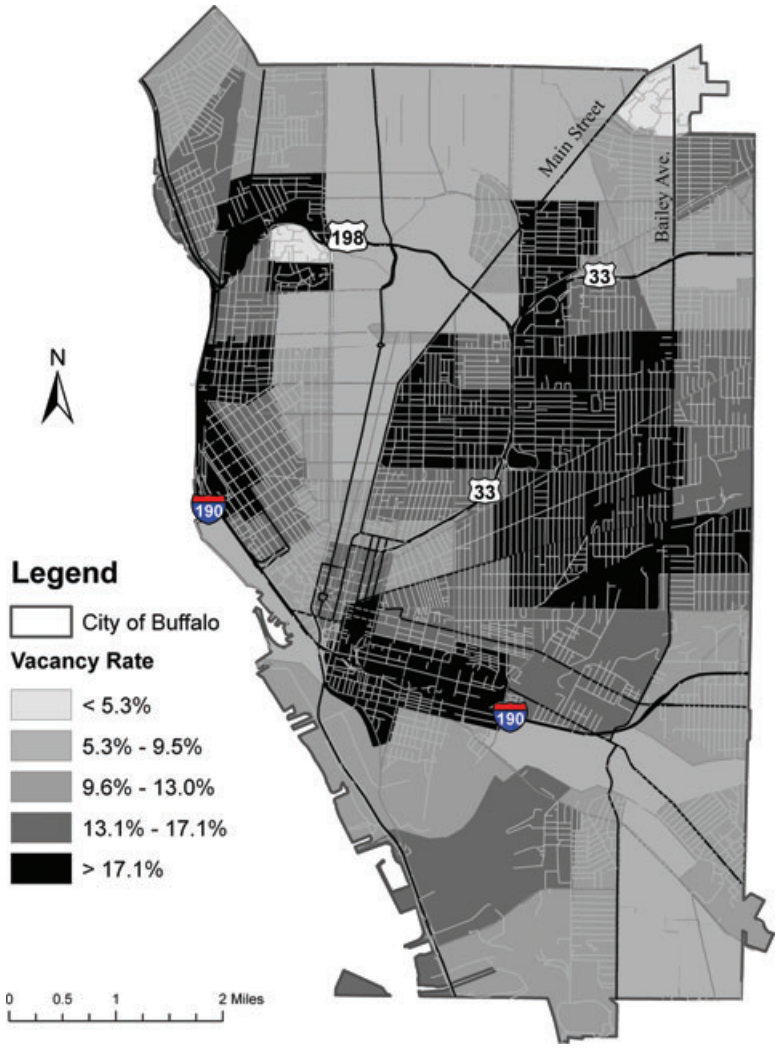

FIGURE 1

Percent of Addresses Vacant 2010

However, disparities in income and housing tenure were substantial between whites and blacks. Median household income was estimated to be 25% lower for blacks in 2009 and homeownership rates were estimated to be 22% lower. The 2005–2009 ACS also provides estimates of vacant housing units. There were an estimated 145,668 housing units in 2009, and an estimated 19.8% of all housing units in the city of Buffalo were vacant. It was also estimated that 58.6% of all vacant housing units in the city of Buffalo fell into the "other" vacant category. Housing units falling into the "other" vacant category include all units that are not: being offered for rent or sale, being held for future occupancy, or limited to seasonal or occasional use. In essence, the "other" category serves as a proxy for abandoned housing units.

The second grouping of data in Table 1 comes from HUD Aggregate USPS Administrative Data on Address Vacancies for 2008–2010. These data highlight the characteristics of all property

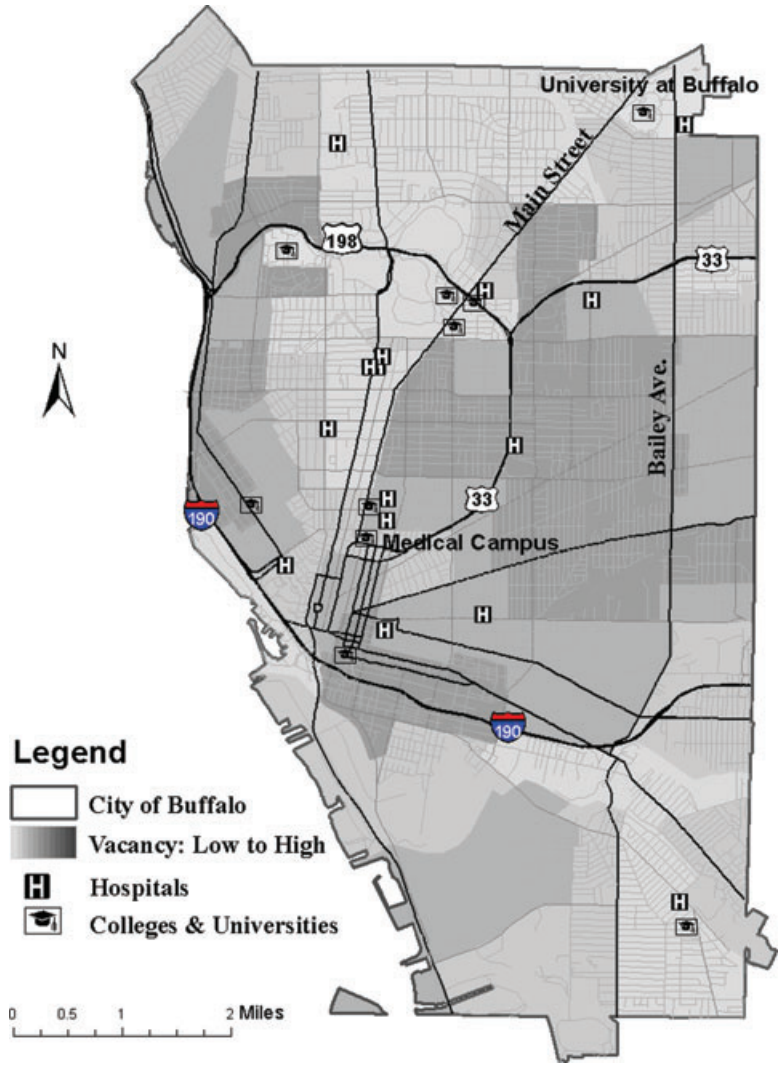

FIGURE 2

Hospitals, Colleges, Universities

addresses and their vacancy status in Buffalo. In 2010, 11.5% of all addresses identified by the USPS were vacant and it is estimated that 12.1% of those addresses were for *in rem* properties.[16] The vast majority of all addresses (87.8%) were residential. Of the residential addresses, 11.1% were vacant in 2010. The second largest group of addresses (8.0%) was composed of businesses. Of those addresses, 20.8% were vacant in 2010. It is noteworthy that the total numbers of residential and business addresses declined between 2008 and 2010, by 0.7% and 0.5%, respectively. In contrast, "other" addresses were the fastest growing, increasing by 47.5% as a group. These addresses, which constituted 4.2% of all addresses in 2010, included government, religious, and other nonprofit institutions, as well as mixed-use properties and other uses that the USPS was unable to classify as businesses or residential properties. The growth in other properties

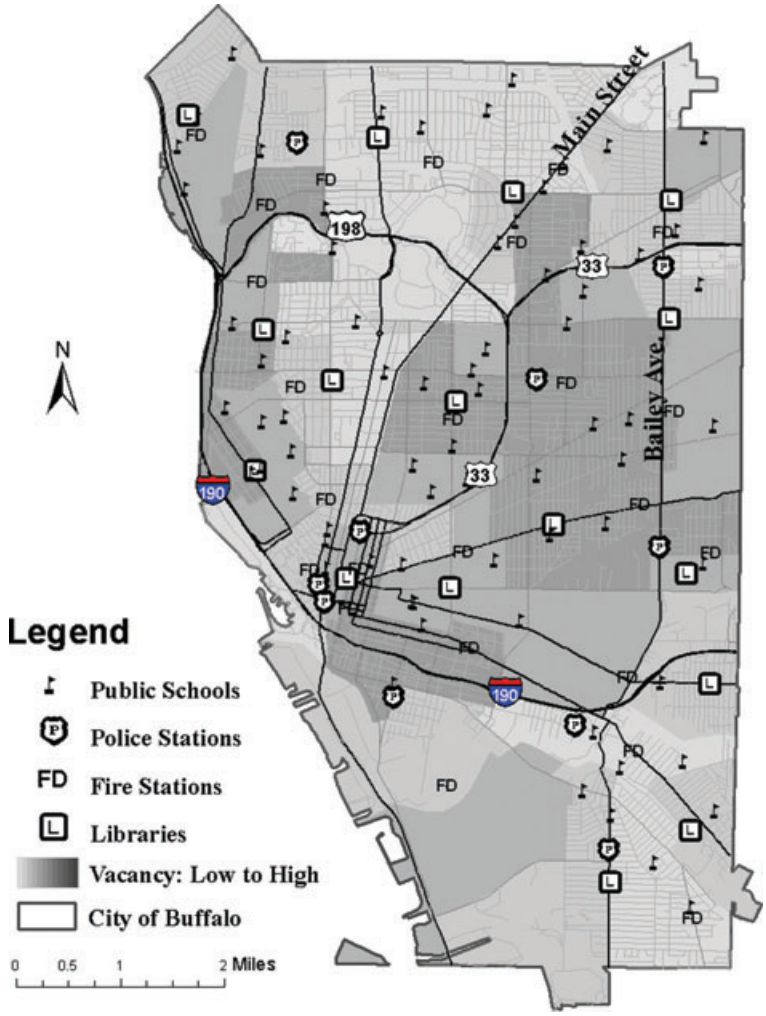

FIGURE 3

Other Public Institutions

suggests a growing presence of Rae's (2006) new urban regime in the urban landscape. The other distinguishing characteristic of other properties was their extremely low vacancy rates (0.03%).

Who's Stuck in Zombieland?

In order to understand the factors related to vacancy patterns in Buffalo, multivariate models using linear regression were developed. These models examined socioeconomic factors and characteristics of the institutional and built environment. The models focused on predicting vacancy and abandonment rates for residential properties by census tract. It was hypothesized that weakened socioeconomic conditions and change in the composition of the institutional and built environment would be associated with elevated vacancy and abandonment rates. The variables entered into the linear regression models are defined in Table 2.

TABLE 1

Summary of Census Tract Characteristics in Buffalo, NY (*N* = 89)

2005–09 American Community Survey (ACS)	
Total population, estimate 2009	273,335
Percent population change, estimate 2000–2009	−6.6
Percent Black, estimate 2009	40.2
Percent White, estimate 2009	51.4
Percent other, estimate 2009	8.4
Percent below poverty, estimate 2009	29.5
Median household income, estimate 2009	$30,946
Median household income (Black/ African American), estimate 2009	$25,916
Median household income (White), estimate 2009	$34,591
Total housing units, estimate 2009	145,668
Median year housing units built, estimate 2009	1941
Median value of all owner-occupied housing units, estimate 2009	$74,804
Percent of all occupied housing units renter-occupied, estimate 2009	56.5
Percent of Black/African American occupied housing units renter-occupied, estimate 2009	72.8
Percent of White occupied housing units renter-occupied, estimate 2009	50.8
Percent of renter-occupied housing units receiving housing choice vouchers (HCV) 2008	6.2
Percent of all housing units, vacant, estimate 2009	19.8
Percent of vacant housing units "other" (not being offered for rent or sale, being held for future occupancy, or limited to seasonal or occasional use), estimate 2009	58.6
HUD Aggregated USPS Administrative Data on Address Vacancies, 2008–2010	
Total number of addresses 2010	138,215
Percent of all addresses vacant 2010	11.5
Percent of vacant addresses *in rem*, estimate 2010	12.1
Total number of addresses residential in 2010	121,397
Percent change in total residential addresses 2008–2010	1.1
Percent of all addresses residential 2010	87.8
Percent of residential addresses vacant 2010	11.6
Average number of days residential addresses were vacant in 2010	757
Total number of addresses business in 2010	11,077
Percent change in total business addresses 2008–2010	0.01
Percent of all addresses business 2010	8
Percent of business addresses vacant 2010	20.8
Average number of days business addresses were vacant in 2010	986
Total number of addresses other in 2010	5,741
Percent change in total other addresses 2008–2010	160.5
Percent of all addresses other 2010	4.2
Percent of other addresses vacant 2010	0.03
Average number of days other addresses were vacant in 2010	7

Sources: U.S. Census Bureau, 2000 U.S. Census, U.S. Census Bureau 2005–09 American Community Survey (ACS); HUD Aggregated USPS Administrative Data on Address Vacancies, 2008–2010; City of Buffalo property files; and local PHA records.

Twelve variables from the 2000 Census, 2005–2009 ACS, HUD Aggregated USPS Administrative Data on Address Vacancies for 2008–2010, the City of Buffalo's *in rem* property records, and lists of HCV properties in Buffalo were used to predict vacancy rates.[17] These variables were selected after testing for multicolleanearity. The first four independent variables identified in Table 2 measured socioeconomic characteristics. The first is an estimate of population change between 2000 and 2009. The second two independent variables measure the estimated percent of the population that was black in 2009. Two partial slopes for the percent of the population in a

TABLE 2

Variables Used in Linear Regression Analysis

Variable Name	Variable Description
Dependent Variables	
Percent of housing units vacant, estimate 2009	Percent of all housing units vacant, 2009 estimate (Source: 2005–09 American Community Survey [ACS])
Percent of residential addresses vacant 2010	Percent of all residential addresses vacant in the third quarter of 2010 (Source: HUD Aggregated USPS Administrative Data on Address Vacancies)
Percent of vacant housing units "other", estimate 2009	Percent of vacant units not being offered for rent or sale, being held for future occupancy, or limited to seasonal or occasional use, 2009 estimate (Source: 2005–09 American Community Survey [ACS])
Percent of all addresses *in rem*, estimate 2010	Percent of addresses that were *in rem*, estimate 2010 (Source: HUD Aggregated USPS Administrative Data on Address Vacancies and City of Buffalo property files)
Independent Variables	
Percent population change, estimate 2000–2009	Estimated percent change in population (Sources: 2010 U.S. Census and 2005–09 American Community Survey [ACS])
Percent Black, estimate 2009	Percent of the population that was Black, estimate 2009 (Source: 2005–09 ACS)
Percent Black squared, estimate 2009	Percent of the population that was Black squared, estimate 2009 (Source: 2005–09 ACS)
Percent in poverty, estimate 2009	Percent of the population that was below the poverty line, estimate 2009 (Source: 2005–09 ACS)
Percent of occupied housing units with HCVs 2008	Percent of occupied residential addresses with housing choice vouchers (HCV) in 2008 (Source: HUD Aggregated USPS Administrative Data on Address Vacancies and local PHA records)
Median year residential structures built, estimate 2009	Median year structure built, estimate 2009 (Source: 2005–09 ACS)
Median housing value, estimate 2009	Median housing value, estimate 2009 (Source: 2005–09 ACS)
Average days residential addresses vacant	Average number of days residential addresses were vacant (Source: HUD Aggregated USPS Administrative Data on Address Vacancies)
Average days business addresses vacant	Average number of days business addresses were vacant (Source: HUD Aggregated USPS Administrative Data on Address Vacancies)
Average days other addresses vacant	Average number of days other addresses were vacant (Source: HUD Aggregated USPS Administrative Data on Address Vacancies)
Percent of total addresses that were business	Percent of total addresses that were business (Source: HUD Aggregated USPS Administrative Data on Address Vacancies)
Percent of total addresses that were other	Percent of total addresses that were other (Source: HUD Aggregated USPS Administrative Data on Address Vacancies)

Sources: U.S. Census Bureau, 2000 U.S. Census, U.S. Census Bureau 2005–09 American Community Survey (ACS); HUD Aggregated USPS Administrative Data on Address Vacancies, 2008–2010; City of Buffalo property files; and local PHA records.

census tract that was black were entered into the model (i.e. "percent black, estimate 2009" and "percent black squared, estimate 2009" appear in the regression models). This was done because a nonlinear relationship existed for this variable. The analysis indicated that an increase in the black population initially was associated with declining vacancy rates. However, when the black population began to rise above two-thirds of the total population in a census tract, vacancy rates increased. This suggests that filtering of the housing inventory was occurring in neighborhoods, with black households initially replacing nonminority households in areas experiencing turnover. However, as neighborhood decline accelerated, the volume of households exiting an area outpaced

the influx of black residents. What remained were depopulated areas with poorer, predominantly black residents. The fourth socioeconomic variable in the models captures a nuance of this phenomenon. It is an estimate of the percent of the population living below the poverty line in 2009.

The last eight independent variables identified in Table 2 measure different dimensions of the composition of the institutional and built environment. These variables examine institutional influences, housing characteristics, and contrast dimensions of residential, business, and other addresses. The emphasis is on the influence of local public policy, the age and cost of housing, the length of time property is vacant, and the mix of land uses in a census tract. These variables were designed to provide statistical controls for relative levels of stability in the institutional and built environment. The first independent variable in this group measures the percent of occupied residential addresses with HCVs in 2008. This variable was included in the analysis to control for the effects of subsidized housing on vacancies. There is a great deal of dispute in academic and policy circles on the impact that subsidized housing has on neighborhoods (Galster, Tatian, Santiago, Pettit, & Smith, 2003). The addition of this variable to the models allows for an analysis of the degree to which such policies have a stabilizing or destabilizing effect. The next two independent variables in this group provide measures of the age and cost of residential property. The first is an estimate of the median year that residential structures were built. The second is an estimate of median housing values. The next three variables in this group provide measures of how long property sits vacant. These variables are divided into three categories (residential, business, and other). Combined they allow for an analysis of the impact of the duration of vacancy by property type on neighborhood conditions. Finally, two variables measuring the composition of land uses are included in the models. These variables allow for the analysis of the relative effects of competing land uses on overall vacancy patterns.

The variables measuring socioeconomic characteristics and the composition of the institutional and built environment were first entered into separate linear regression models and then entered into fully specified models for each of the dependent variables identified in Table 2. Four dependent variables were examined in the analysis. The first two dependent variables represent two estimates of residential property vacancies in the city of Buffalo. Two variables were selected for this dimension of the analysis because each represents an approximation of vacant property. By examining both available measures, we were able to gain insights into nuances of residential vacancy and assess the strengths and weaknesses of two distinct data sources. The first dependent variable was extracted from the 2005–2009 ACS. It estimates the percent of all housing units that were vacant in 2009. The second dependent variable was extracted from the 2010 HUD aggregate USPS administrative data on address vacancies. It reports the percent of residential addresses that were vacant in the third quarter of 2010. There is a discrepancy in the percent of housing units and addresses identified as vacant between the two data sets because each employs a different methodology to identify properties.[18] Consequently, the use of multiple data sets is beneficial in order to account for these nuances. The second two variables serve as proxies for abandoned property. The first of these two variables was extracted from the 2005–2009 ACS. It estimates the percent of vacant housing units that were categorized as "other" in 2009. The second of these two variables was calculated using City of Buffalo property files and HUD Aggregate USPS Administrative Data on Address Vacancies. It estimates the percent of all addresses *in rem* in 2010. As noted earlier, these two variables have been used as proxies for housing abandonment in past research. We estimated two measures of property abandonment in order to capture nuances associated with the data sources.[19] The results for the fully specified linear regression models for each dependent variable are summarized in Table 3.

Table 3 summarizes the results from four fully specified linear regression models. The first model in the table shows the independent effects of factors associated with socioeconomic characteristics and the composition of the institutional and built environment on the estimated

TABLE 3

Linear Regression Models for the Effects of Independent Variables on Measures of Vacancy and Abandonment ($N = 89$)

Variable Name	Model 1 Estimated Percent Housing Units Vacant 2009 Coefficient/SE/(β)	Model 2 Percent Residential Addresses Vacant 2010 Coefficient/SE/(β)	Model 3 Estimated Percent Vacant Housing Units "Other" 2009 Coefficient/SE/(β)	Model 4 Estimated Percent All Addresses *In Rem* 2010 Coefficient/SE/(β)
Percent population change, estimate 2000–2009	−0.037/0.047/(−0.069)	−0.028/0.025/(−0.088)	0.203/0.120/(0.156)	−0.0002/0.008/(−0.002)
Percent Black, estimate 2009	0.007/0.152/(0.023)	0.077/0.082/(0.099)	−0.648/0.385/(−0.915)	0.046/0.027/(−0.830)
Percent Black squared, estimate 2009	0.001/0.001/(0.320)	0.00003/0.001/(0.021)	0.008/0.004/(1.119)*	−0.0002/0.0002/(−0.386)
Percent in poverty, estimate 2009	0.175/0.88/(0.216)*	0.155/0.047/(0.325)**	0.530/0.223/(0.272)*	−0.002/0.016/(−0.013)
Percent of occupied housing units with HCVs 2008	0.391/0.289/(0.147)	0.338/0.155/(−0.216)*	−0.862/0.735/(−0.135)	−0.008/0.052/(−0.015)
Median year residential structures built, estimate 2009	−0.391/0.185/(−0.244)*	−0.079/0.101/(0−.083)	−1.000/0.470/(−0.259)*	−0.062/0.034/(0.206)
Median housing value in $US, Estimate 2009	−0.00002/0.00002/(−0.151)	−0.00002/0.0001/(−0.238)*	−0.0001/0.0001/(−0.294)*	−0.000003/0.000004/(−0.087)
Average days residential addresses vacant	0.015/0.005/(0.308)*	0.007/0.003/(0.246)*	0.044/0.013/(0.371)***	0.003/0.001/(0.369)***
Average days business addresses vacant	−0.0007/0.004/(−0.015)	−0.002/0.002/(−0.082)	−0.020/0.011/(−0.194)	−0.001/0.001/(−0.168)
Average days other addresses vacant	0.004/0.037/(0.009)	0.004/0.009/(0.034)	0.179/0.094/(0.169)	0.002/0.003/(0.061)
Percent of total addresses that were business	0.127/0.143/(0.105)	0.040/0.076/(0.056)	0.923/0.364/(0.317)*	0.053/0.025/(0.236)*
Percent of total addresses that were other	−0.035/0.391/(−0.009)	−0.018/0.209/(−0.008)	−0.468/0.992/(−0.051)	−0.153/0.070/(−0.217)*
Constant	758.425*	154.603	1,980.760*	120.026
Adjusted R^2	0.482***	0.568***	0.425***	0.527***
Standard error of estimate	7.653	4.113	19.427	1.373

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Note: Fourth quarter 2009 data were used in Models 1 and 3, third quarter 2010 data were used in Models 2 and 3 for the following variables: average days residential addresses vacant, average days business addresses vacant, average days other addresses vacant, percent of total addresses that were business, and percent of total addresses that were other.

Sources: U.S. Census Bureau, 2000 U.S. Census, U.S. Census Bureau 2005–09 American Community Survey (ACS); HUD Aggregated USPS Administrative Data on Address Vacancies, 2008–2010; City of Buffalo property files; and local PHA records.

percent of vacant housing units in 2009. The results in Model 1 indicate that three variables were significantly correlated with elevated vacancy rates. A census tract's estimated poverty rate ($p < 0.05$), the median year residential structures were built ($p < 0.05$), and the average number of days residential structures were vacant ($p < 0.05$) were all significantly related to higher vacancy rates. This suggests that higher rates of residential vacancy are found in census tracts with poor residents, older housing, and long-term vacant properties. These findings seem to fit popular perceptions of why vacancy rates are elevated in some areas as opposed to others. It is noteworthy that other independent variables were not significantly related to higher vacancy rates, particularly those related to population change, race, housing subsidies, and the composition of land uses.[20] The adjusted R^2 indicated that 48.2% of the variance in vacancy rates was attributed to the variables used in Model 1.

Model 2 represents an alternative method for measuring the dependent effects of factors associated with socioeconomic characteristics and the composition of the institutional and built environment on residential property vacancy. This model examined the dependent variable measuring the percent of residential addresses vacant in 2010 from the HUD Aggregate USPS Administrative Data on Address Vacancies. The results in Model 2 indicate that four variables were significantly correlated with elevated vacancy rates. A census tract's estimated poverty rate ($p < 0.01$), the percent of occupied housing units with HCVs ($p < 0.05$), the estimated median housing value ($p < 0.05$), and the average number of days residential structures were vacant ($p < .05$) were all significantly related to higher vacancy rates. This suggests that higher rates of residential vacancy are found in census tracts with poor residents, government subsidized rental housing, less expensive housing, and long-term vacant properties. These findings also seem to fit popular perceptions of why vacancy rates are elevated in some areas as opposed to others. Again, it is noteworthy that other independent variables were not significantly related to higher vacancy rates, such as those related to population change, race, and the composition of land uses. The adjusted R^2 indicated that 56.8% of the variance in vacancy rates was attributed to the variables used in Model 2.

It is important to take note of the similarities and discrepancies between the two models used to predict residential vacancy rates. These distinctions provide insights into the degree to which the methods used by the U.S. Census and USPS to collect data influence their usefulness in analyzing vacancy patterns. Both models indicated that a census tract's estimated poverty rate and the average number of days residential structures were vacant were significantly related to higher vacancy rates. The agreement between two distinct measures of vacancy on these variables adds weight to their predictive power. With that said, it is not surprising that higher rates of residential vacancy are found in census tracts with poor residents and long-term vacant properties. On the other hand, discrepancies between the two models also add to our understanding of the nuances associated with residential vacancy patterns.

For instance, the percent of occupied housing units with HCVs was only found to be significantly related to residential vacancies in Model 2. This model focused on 2010 USPS data, which differ from U.S. Census vacancy data along one dimension that may have bearing. The USPS only reports residential address vacancies for addresses that received mail during the previous 5 years. The USPS maintains a separate count of "no-stat" addresses with no record of mail delivery for an extended period of time. These addresses have no postal status. No-stat addresses include those that are potentially abandoned, new construction that is not occupied, vacant lots, and nonvacant addresses where occupants receive mail at a post office box instead of through home delivery. It is not possible to differentiate among different types of no-stat address, but it is clear that some of the addresses excluded from the USPS data are similar to the "other" vacant category which is part of the total vacancy data reported in the U.S. Census. This is important since the percent of occupied housing units with HCVs was significant in Model 2, but not in Model 1. This

suggests that rent subsidies are correlated with vacant units available for occupancy, but not with abandoned property. This seems to be a sensible conclusion, given that HUD discourages the use of HCVs in impacted neighborhoods (those with poverty rates above 20%) and HUD does not subsidize rents for substandard housing. The discrepancy between Models 1 and 2 with respect to HCVs also tends to dispel perceptions that subsidized housing promotes neighborhood decline and property abandonment. On the contrary, these data lend some support to past research which argues that rent subsidies may have the opposite effect (Galster et al., 2003).

Model 3 shows the independent effects of factors associated with socioeconomic characteristics and the composition of the institutional and built environment on the estimated percent of "other" vacant housing units in 2009. As described earlier, this dependent variable serves as a proxy for abandoned residential property. The results in Model 3 indicate that six variables were significantly correlated with elevated rates of abandonment in a census tract: high concentrations of blacks ($p < 0.05$), the estimated poverty rate ($p < 0.05$), the age of housing units ($p < 0.05$), the estimated median housing value ($p < 0.05$), the average number of days residential structures were vacant ($p < 0.001$), and the percent of business addresses ($p < 0.05$). This suggests that higher rates of residential abandonment are found in census tracts that have segregated black populations, poor residents, older and less expensive housing, long-term vacant properties, and a mixture of commercial and residential land uses. The adjusted R^2 indicates that 42.5% of the variance in abandonment rates is attributed to the variables used in Model 3.

When contrasted with the results for residential vacancies in Models 1 and 2, these results highlight two additional attributes that may be associated with property abandonment. First, the significance of the squared term for the percent of the population black in Model 3 suggests that residential abandonment may take place at the latter stages of the housing filtering process. Black households appear to initially replace nonminority households in census tracts experiencing high levels of vacancy, but when blacks make up two-thirds of the total population in a census tract, property abandonment appears to accelerate. This suggests that there may be a racial component associated with property abandonment. For example, some whites may be more prone to abandon property when a neighborhood's black population reaches a two-thirds tipping point. It is also possible that blacks are more directly impacted by residential abandonment because they face more impediments to residential mobility and discrimination in regional housing markets. Patterson and Silverman (2011) found some evidence to support this in their analysis of impediments to fair housing in Buffalo's suburbs. As a result, neighborhoods with higher levels of black segregation also have higher rates of property abandonment.

In addition to the racial component, attributes associated with property abandonment were distinct from vacancy rates along a second dimension. The percent of addresses that were businesses was also significantly related to residential abandonment in Model 3. This suggests that abandoned property is more concentrated in places where mixed land uses and incompatible land uses are prevalent. This presents a number of potential challenges to cities facing abandonment, since areas facing abandonment may need to reconsider current land use policies.

Model 4 represents an alternative method for measuring the independent effects of factors associated with socioeconomic characteristics and the composition of the institutional and built environment on residential property abandonment. This model uses the estimated percent of *in rem* property in a census tract as the dependent variable. This dependent variable serves as a proxy for abandoned property. However, it should be noted that the variable measures both residential (73.3%) and nonresidential property (26.7%).[21] The results in Model 4 indicate that three variables were significantly correlated with elevated rates of abandonment in a census tract: the average number of days residential structures were vacant ($p < 0.001$), the percent of business addresses ($p < 0.05$), and the percent of other addresses ($p < 0.05$). This suggests that higher rates of residential abandonment are found in census tracts that have long-term vacant

properties, and land use patterns that entail relatively higher concentrations of business property and lower concentrations of other property. The adjusted R^2 indicated that 52.7% of the variance in abandonment rates was attributed to the variables used in Model 4.

In rem properties represent a subset of abandoned properties. These properties have amassed outstanding debt and the City of Buffalo has taken proactive steps to take possession of them. The results from Model 4 suggest that these tax foreclosed properties are found in places that fit a specific land use profile. They tend to be more prevalent in areas with higher percentages of business properties. It is possible that the visibility of abandoned properties in these areas increases the likelihood that local government will take proactive steps to initiate the tax foreclosure process. This can be contrasted with abandoned property that is relatively hidden in residential settings. The results from Model 4 also suggest a bias toward commercial interests with respect to *in rem* property, since local government may be more responsive to the interests of the local business community when addressing abandonment as opposed to the interests of residents. An examination of discrepancies between Models 3 and 4 highlight this point. When all abandoned properties are considered in Model 3, elevated rates of abandonment are associated with high concentrations of blacks, the estimated poverty rate, the age of housing units, the estimated median housing value, the average number of days residential structures were vacant, and the percent of business addresses. In contrast, only the average number of days residential structures were vacant and the relative percent of business and other addresses influenced the concentration of *in rem* property.

CONCLUSION

This study is exploratory in nature and many of the issues identified in it warrant more in-depth analysis. The findings from this study and some of the limitations of the data provide a foundation for future research on vacant and abandoned property. From a theoretical standpoint, there is support for adopting the conceptual framework we have applied to abandoned properties in shrinking cities. In particular, the operationalization of abandoned properties in regions experiencing population and employment stagnation as zombie properties appears beneficial. This distinction allows for a more focused analysis of abandonment in the context of declining cities and regions. Another theoretical contribution involves the relationship between shrinking cities and the emergence of new urban regimes consisting of well-capitalized nonprofits and public sector institutions such as hospitals, colleges, and universities. This analysis suggests that a dynamic exists between factors linked to the emergence of shrinking cities and new urban regimes. More focused research is needed to understand how these two phenomena interact and what are their implications for urban policy. Closely tied to this topic is the question of how the poor and minorities fare in the emerging urban milieu. Basic research is needed to understand how opportunity structures are affected by change in the built environment and decision-making structures. Equally important is the need for applied research aimed at empowering disenfranchised groups as changes unfold in the neighborhoods and communities where they reside.

In order to expand this area of research and praxis, several methodological issues should be addressed. One of the limitations of this exploratory research involved the availability of parcel level data. As a result, the analysis was primarily conducted using aggregate data at the census tract level. This data limitation curtailed the use of more advanced methods such as spatial statistics and agent-based modeling. Future analysis would benefit from the application of such methods to parcel level data. One corrective measure that could be taken to address this problem would be for HUD and the USPS to establish protocols for researchers to access disaggregated parcel level data.[22] In a similar vein, the manner in which data are collected by agencies like the U.S. Census Bureau and the USPS constrained analysis. One example of this involves how "no-stat" data are

coded by the USPS. The separation of no-stat addresses into distinct categories (e.g. abandoned structures, new construction, vacant lots, addresses where occupants receive mail at a post office box, etc.) would allow for more refined measures of vacancy and abandonment to be developed.

Finally, additional variables should be considered in the analysis of vacancy and abandonment. For quantitative analysis, data on demolitions and vacant property should be incorporated into future studies. Our understanding of the pace and scope of demolitions, as well as how abandoned property is adapted to the changing urban landscape, is limited. In addition to this void in research on vacancy and abandonment, there is a dearth of perception-based analysis and qualitative research on abandonment. Studies focusing on the perceptions of residents and policy-makers would enhance our understanding of the effects abandonment has on communities and how policies are formulated to mediate them. Qualitative analysis, especially if it applies participatory action research methods, could also serve as a vehicle to empower disenfranchised groups who are disproportionately affected by abandonment.

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ENDNOTES

1 At the time that this article was written, 2010 U.S. Census data were becoming available. For 2010, the U.S. Census reported that the total population in Buffalo was 261,301. This represented a 55.0% decline between 1950 and 2010. Correlations were calculated on the population counts by census tract comparing the 5-year estimates for 2005–2009 and full counts for 2010. The counts were highly correlated ($p = 0.96$). The 2010 full counts also fell within the margin of error reported for the five year 2005–2009 estimates.

2 For 2010, the U.S. Census reported that the total population in the Buffalo-Niagara Falls metropolitan statistical area was 1,135,599. This represented a 15.8% decline in population between 1970 and 2010.

3 For 2010, the U.S. Census reported that the total population in the suburbs of Buffalo was 874,199. This represented a 1.4% decline in population between 1970 and 2010.

4 City-owned properties are largely comprised of *in rem* properties. *In rem* properties include residential and commercial tax foreclosure properties owned by municipalities. These properties are often transferred to municipalities after prolonged periods of abandonment and neglect.

5 Estimates of vacant properties reported by the City of Buffalo have fluctuated in recent years. For instance, the City's Office of Strategic Planning identified over 23,000 vacant and uninhabitable structures in a prior report (United States Conference of Mayors, 2006). In contrast, the 2008 estimate was based on a survey submitted by the Mayor's Office. Because of inconsistent reporting on vacancies by the City of Buffalo, we consider U.S. Census data and HUD Aggregated USPS Administrative Data on Address Vacancies more reliable estimates of vacant property.

6 Structural damage is often the result of extended exposure to extreme weather conditions, insect and rodent infestations, a lack of regular building maintenance, mold, and/or damage due to looters stripping fixtures and scrap metal from buildings.

7 The term TOADS was introduced in reference to a variety of vacant and abandoned properties, including residential structures, commercial buildings, industrial sites, and vacant lots. Our focus is primarily on abandoned residential structures.

8 The "other" category is used when the USPS is unable to categorize an address as either business or residential. For example, these addresses might be occupied by government, religious, or other nonprofit institutions. They might also be mixed-use properties, functioning as both businesses and residential units.

9 The American Community Survey (ACS) is an annual survey of population and housing characteristics conducted by the U.S. Census Bureau. It is administered to 3 million households in the country each year. The ACS collects information previously collected in the long form of the decennial census. It is the largest survey, other than the decennial census, administered by the U.S. Census Bureau. The 2005–2009 ACS represents estimates based on a rolling average for five years of sampling. Because these data are based on a sample of the total population, the Census reports margins of error for individual variables in the ACS. Population counts reported in the 2010 Census were compared to the 2005–2009 ACS, and they fell within the margins of error reported.

10 At the time this research was conducted, a limited amount of 2010 U.S. Census data was available. These data were part of the summary file 1 (SF1) data release, which includes full count data for general population and housing characteristics. More detailed data for population and housing characteristics were subsequently released. These data are part of the survey component of the U.S. Census which is included in the ACS estimates; 2010 ACS estimates and 2006–2010 estimates were released using the 2010 census tract boundaries. After adjusting for changes in tract boundaries, a Pearson's correlation coefficient was calculated for Buffalo's 2005–2009 ACS estimates and 2010 census population counts at the tract level ($R = 0.0956$); 2005–2009 ACS estimates were used in the analysis for this paper, in part, because of their compatibility with other data used in this analysis. This issue is elaborated upon in footnote 11.

11 The necessity of using 2000 census tract boundaries represents a limitation of this study. HUD Aggregated USPS Administrative Data on Address Vacancies were only released at this level of analysis. Consequently, 5-year estimates for the 2005–2009 ACS were used in this analysis. However, there were some advantages to using these data. First, a number of census tracts in Buffalo were consolidated between 2000 and 2010. In addition, some census tracts were split in a manner that did not maintain the integrity of 2000 block groups. Using 2010 tract boundaries would have resulted in a loss of twelve census tracts, reducing the sample size from 89 to 77. The option of using block group data was also limited due to issues of suppression in the data released by the U.S. Census, and the inability to obtain block group or individual address data from the USPS.

12 The number of census tracts and census tract boundaries remained constant in the city of Buffalo for the 1990 decennial census, 2000 decennial census, and all ACS years through 2009. In 2010 the U.S. Census adjusted tract boundaries in the city of Buffalo. The total number of census tracts was reduced from 89 to 77. The adjustments were made in response to population decline in the city.

13 Linear regression was used in this analysis since the dependent variables were interval, continuous. Because of this characteristic, other methods, such as logistic regression and Poisson count models, were not applied to this analysis. Such analytic frameworks require dependent variables that are discrete and based on count data. Although this analysis was exploratory in nature, future studies should consider more sophisticated techniques that apply advanced models to such data. Ideally, such data would be reported at the address or parcel level and not aggregated at the census tract level. The availability of parcel level data would also enhance the use of methods focusing on spatial analysis and diagnostic tools designed to test for spatial autocorrelation. These techniques were not applied to this analysis and represent a limitation of the available data and research design.

14 One method commonly used to measure segregation is the calculation of a white/black dissimilarity index. This index identifies the percent of blacks who would have to relocate in order to produce a completely integrated community. Hyper-segregation is suspected when the white/black dissimilarity index is above a value of 0.70 and minorities remain concentrated in a core city area that has experienced general population decline for several decades.

15 Some may argue that segregation is, in part, driven by more benign forms of *racial sorting* and expressions of individual tastes and preferences. In this article, we emphasize the broader institutional factors that structure racial segregation in an inner-city context.

16 The estimate for the percent of properties *in rem* was calculated using the total number of vacant addresses reported in the USPS data. This value was used to calculate the estimate since *in rem* parcels are composed

of residential and nonresidential properties. It should be noted that the estimate for the percent of *in rem* properties is based on two point-in-time counts from different data sources.

17 This analysis examined correlations between the independent variables and the dependent variables examined in the linear regression models. Establishing direct causal relationships is beyond the scope of this analysis.

18 In addition to the distinction between housing units and addresses, each database approaches the identification of properties with different objectives. For instance, the U.S. Census has a tendency to overestimate the number of housing units since it is required to make an effort to collect decennial census data from all housing units regardless of their occupancy status. One consequence of the U.S. Census methodology is that its estimate of all vacant units includes "other" vacant units. Consequently, long-term abandoned properties are intermingled with census counts of vacancy. In contrast, the USPS only identifies addresses that received mail during the past five years in its count of properties. The USPS maintains a separate count of "no-stat" addresses which have no current postal status. In 2010 there were 3,593 residential addresses that fit into this category. However, it is not possible to differential among no-stat address. For example, no-stat addresses include those that are potentially abandoned, new construction that is not occupied, vacant lots, and non-vacant addresses where occupants receive mail at a post office box instead of through home delivery. Because there was no clear methodology to disentangle no-stat addresses, we followed HUD's general cautionary notes and excluded them from the analysis.

19 The most notable distinction between these two dependent variables is that the percent of "other" vacant housing units accounts for all properties that are not being offered for rent or sale, being held for future occupancy, or limited to seasonal or occasional use. In contrast, *in rem* properties are comprised of a subset of vacant and abandoned properties that have amassed outstanding debt and for which the City of Buffalo has taken proactive steps to take possession. These properties may be viewed as worst-case abandoned properties or those that the City has prioritized for demolition, revitalization, or other actions.

20 Population change was not significantly related to vacancy and abandonment in any of the models presented in Table 3, and multicolleniarity was not detected with this variable when regression diagnostics were run. In part, this is a reflection of population decline occurring citywide. We suspect this also reflects the degree to which other factors impacted neighborhoods differentially across the city, such as declining household sizes, gentrification, and demolitions. Further analysis at the micro level is necessary in the future to disentangle these effects.

21 Separate models were run using residential and nonresidential *in rem* properties as the dependent variable. Significant independent variables were only identified in the latter case. The estimated percent of the population in poverty was correlated with nonresidential *in rem* property. However, examining all *in rem* property revealed relationships between abandonment and characteristics of the built environment that were pertinent to this analysis.

22 Protocols of this nature exist for other data sets, like data compiled by the National Center for Education Statistics. HUD and the USPS should model protocols for restricted use of parcel level data after similar policies that are in place.

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