Is Subsidized Housing in Sustainable Neighborhoods? Evidence from Chicago

E. Talen, J. Kochinsky

2010

Working Paper Number 15
Is Subsidized Housing in Sustainable Neighborhoods?
Evidence from Chicago

May 2010

Emily Talen, Ph.D.¹
Professor, School of Geographical Sciences and Urban Planning
Arizona State University
PO Box 875302
Tempe AZ 85287-5302
etalen@asu.edu

Julia Koschinsky, Ph.D.
Research Director
GeoDa Center for Geospatial Analysis and Computation
Arizona State University
PO Box 875302
Tempe AZ 85287-5302
julia.koschinsky@asu.edu

¹ Corresponding author
Is Subsidized Housing in Sustainable Neighborhoods?
Evidence from Chicago

May 2010
Acknowledgements

The authors gratefully acknowledge the technical expertise of Andrew Winslow and Luc Anselin, assistance with data files and questions from Daniel Block, Richard Block, Dan MacMillen and Rachel Weber, and financial support from the GeoDa Center for Geospatial Analysis and Computation at Arizona State University.

Abstract

This article explores the connection between subsidized housing and sustainable urban form. Given the general disconnect between new market-rate housing in sustainable, walkable neighborhoods and affordable housing opportunities, we expect affordable housing to be located in less sustainable locations in terms of proximity to amenities, walkability, street connectivity, density, and diversity of urban form.

A rich set of parcel and planning data for the city of Chicago was used to correlate sustainability indicators with the locations of both project- and tenant-based affordable housing programs. Difference-in-means tests and other descriptive statistical analysis suggest that project-based locations (with the exception of CHA family units) actually score above average, especially in terms of accessibility and walkability, albeit it at the cost of concentrated poverty, racial segregation, and crime. In contrast, vouchers are located in less sustainable locations when it comes to accessibility and walkability, although they are in neighborhoods with more diversity and less poverty—and, at lower voucher concentrations, with less segregation and crime—than project units.

Keywords:
Low-income Housing, Sustainability, Location, Neighborhood, Urban Planning
Is Subsidized Housing in Sustainable Neighborhoods?
Evidence from Chicago

Introduction

Neighborhood form can have a dramatic effect on urban quality of life. The consequences of density, land use, and other environmental characteristics were dramatically illustrated in Klinenberg’s (2002) account of the 1995 Chicago heat wave that killed over 700 people within one week. Residents of the Latino Little Village neighborhood, with its busy commercial corridors, lively public spaces, and dense population, had a much lower death rate than those in African-American North Lawndale with its abandoned buildings, population loss, and social isolation. The author detailed how a spatial context that isolated people, buildings and resources made residents more vulnerable to crisis than a neighborhood that facilitated connectivity, walkability, density and diversity.

The effects of neighborhood form may be especially pronounced for low-income residents who rely disproportionately more than high-income residents on neighborhood and community-based resources. Research over the past decades has confirmed that neighborhood form has a significant effect on physical health, accessibility, crime, safety, and social interaction, all of which are important aspects of neighborhood quality of life.

In recognition of the importance of neighborhood, housing policy has become increasingly oriented toward ensuring that residents live in what could be termed “sustainable” neighborhoods – not only low in poverty and low in crime, but walkable, transit-served, and accessible to a wide variety of services and facilities. Federal initiatives have specifically called for affordable housing in the context of sustainable communities, achieved by increasing opportunities to access amenities by foot or public transit, decreasing vehicle miles traveled (VMT) and other transportation and energy costs, promoting “natural” forms of community surveillance (“eyes on the street”), encouraging compact mixed income and mixed land use, and fostering a sense of place and social connectedness. Current federal examples include HUD’s new Office of Sustainable Housing and Communities, HUD-DOT’s new Sustainable Communities Initiative (including location-efficient mortgages and the housing and transportation affordability index), EPA’s Green Communities, the Federal Transit Administration’s Transit-Oriented Development Initiative, and HUD’s Choice and Promise Neighborhoods initiatives. In the words of HUD’s current Secretary Donovan, “sustainability
is about tying the quality and location of housing to broader opportunities such as access to good jobs, affordable transportation, quality schools, and safe streets.”

A key question is whether subsidized housing tends to be located in neighborhoods that could be defined as “sustainable.” Little research has investigated whether sustainable neighborhoods – i.e. neighborhoods with social and economic diversity, public transit, and pedestrian orientation – are likely to contain long-term affordable housing options. In fact the goal of sustainability and the goal of affordability can be in conflict: sustainability focuses on access, walkability and service, while affordability focuses on cost. Building housing in locations that are well serviced and walkable goes against the basic outlines of building affordable housing in affordable locations. In short, the goal of sustainability may be less about keeping costs down and more about increasing access to services and maintaining a walkable environment, both of which are likely to increase costs.

This article is an empirical investigation of the degree to which affordable housing is being developed in neighborhoods that would be defined as being “sustainable” by looking at the neighborhood characteristics of subsidized housing locations in the City of Chicago. Our motivation is to extend the notion of sustainability in affordable housing research to the neighborhood a property is located in – beyond the traditional emphasis on how sustainable the affordability of an individual property is, for example in research on expiring use restrictions, community land trust ownership, public or nonprofit housing ownership. This focus on the sustainability of a location that a building is located in also extends the more common notion of building sustainability as in green building standards, e.g. for HOPE VI projects.

We draw on recent literature to specify the parameters of what a sustainable neighborhood might be. Measures of neighborhood quality, often in sync with sustainability concepts, have advanced significantly to assess outcomes related to public health, sprawl, social diversity, and sense of community. The measures of neighborhood form used in these models are generally focused on issues like connectivity, density, mix, access and safety. Many of these measures are now contained in the U.S. Green Building Council’s Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND) rating system. The goal of these rating systems is to establish “standards for assessing and rewarding environmentally superior development practices” (LEED-ND).
How likely are the locations of affordable housing to coincide with sustainability criteria as measured by these standards? We analyze this question by comparing the location of different types of affordable housing, especially housing built and managed by public or nonprofit agencies (subsidized projects) versus apartments that tenants rent in the private market through a rent subsidy. The housing policy context for such an analysis is framed by a longstanding debate between arguments in favor of supply-side, place-based housing and community revitalization programs (often supported by planners) and those in favor of demand-side housing voucher programs (often supported by economists). The surrounding location of both supply-side and demand-side housing programs has played an increasingly important role in this debate and in related research (Crane and Manville, 2008).

As an example, over the past decade a new body of research has started to analyze the extent to which public housing facilitates the concentration of poverty in inner-city neighborhoods (e.g., Massey and Kanaiaupuni, 1993; Jargowsky 1997). More recent research found supportive evidence of positive “upgrading” effects on neighboring property values in lower-income neighborhoods that contained new subsidized housing (e.g., Ellen et al., 2001; Galster et al, 2003). While the concentration of poverty research has often been used to support the deconcentration of poverty through programs such as HOPE VI or vouchers, the neighborhood externalities research is frequently brought to bear in favor of continued support for place-based initiatives.

Another prominent example of the relevance of the location of assisted housing is the federal Moving to Opportunity program, which was based on the (as it turns out only partially realized) premise that education, employment, safety, housing, health and other outcomes of voucher holders would improve as a result of moving to low-poverty neighborhoods. Instead, one of the preliminary findings of the experimental program has been that many voucher holders reconcentrate in higher-poverty neighborhoods after an initial stay in lower-poverty areas (Orr et al. 2003). Critical research on public housing deconcentration programs points to the fact that residents’ social networks in a neighborhood are often ignored in these programs (Goetz 2003).

---

2 It should be noted, though, that since it is not uncommon for voucher holders to live in non-private apartments, the boundaries between the two housing types are often blurred.
Understanding the locational context of affordable housing is especially relevant given the past history of attempts to locate subsidized housing in low-poverty neighborhoods, especially in Chicago. A wealth of scholarship has focused on the inability of subsidized housing to be located in more affluent, better serviced areas, as well as the effect of planning policy and regulation more generally on the isolation of poor and minority groups (see, for example, Anderson’s *The Federal Bulldozer*, 1964; Frieden & Kaplan’s *The Politics of Neglect*, 1975; Kushner’s *Apartheid in America*, 1982; Keating’s *The Suburban Racial Dilemma*, 1994; and Thomas & Ritzdorf’s *Urban Planning and the African American Community*, 1997). Meyerson and Banfield’s (1955: p. 23) seminal study of the politics surrounding the “energetic and persistent opposition to public housing” in Chicago showed how the resistance to public housing was largely a matter of resistance to racial integration. Strong political opposition in the more suburban parts of Chicago meant that public housing was eventually located on vacant sites near the central core.

Without ignoring the lingering racial context of subsidized housing locations, our study focuses more specifically on building an understanding of the urban form characteristics of the locations surrounding affordable housing. This is relevant because it supplements the traditional focus on race, poverty rates and other socio-economic characteristics in affordable housing location research with an emphasis on sustainability factors: proximity to amenities, pedestrian orientation, street connectivity, density and diversity. While these elements are immediately relevant to tenants, they have not been systematically analyzed in the context of affordable housing.

Drawing from a number of sustainability indicators at the neighborhood level, we thus investigate the neighborhood contexts of several affordable housing programs managed by public and nonprofit agencies in Chicago, including community land trusts, housing developed by the Chicago Housing Authority (including HOPE VI projects,) Low-Income Housing Tax Credit properties, multi-family subsidized housing, and housing vouchers.

**Background**

Theoretical and empirical research on sustainable neighborhoods, particularly how they can be defined and measured, has advanced significantly over the past two decades (e.g.,
Mazmanian & Kraft, 1999; Wheeler, 2005; Jabareen, 2006; Farr, 2008; van der Ryn and Calthorpe, 2008). Jabareen reviewed the “typologies, models, and concepts” of sustainable urban forms and found distinctions between neotraditional development, compact cities, urban containment theories, and eco-cities, although the basic thrust of sustainable urbanism is fairly established. Using criteria such as density, level of compactness, and sustainable transportation, differences in emphasis appeared to result in varying levels of overall sustainability, but concepts overlapped significantly.

Relating sustainability to affordable housing may involve simultaneously promoting sustainable building practice and affordability through the use of cost-effective building materials and designs that reduce energy costs (Pettit, 2005; Asian Neighborhood Design, 2004). At the level of neighborhood, the question is how, and whether, affordability and sustainable urban form are mutually supportive. There are two ways in which this could occur: by incorporating smaller sized units in sustainable neighborhood contexts, and by reducing distance and increasing accessibility. For the former, the idea is that small lots and small housing units not only contribute to walkable neighborhoods and good urbanism – consistent with sustainability – but they are more affordable by definition. Options for smallness include apartments over stores, apartments over garages (granny flats), corner duplexes, walk-up apartments on side streets, residential mews on alleys, courtyard housing, and apartments and duplexes that look like single-family homes. Reducing size may require increasing density, reducing parking requirements, allowing multi-family units where they have been excluded, and eliminating minimum lot size and setback requirements. Changes may be needed to permit narrower road width and other ways of building more compactly, reductions that in turn are likely to lessen development costs.\(^3\)

The second approach involves designing communities with good access and lower transport costs. Walkable access to services then becomes an essential part of both the sustainability and the affordability equation because people living in well-serviced locations will have lower transport costs and lower VMT. The higher the access to opportunities like jobs and services, the lower the transport costs. This metric has been used to argue for “location-efficient” financing of mortgages, where residents are permitted to leverage
transport cost savings to access cheaper or larger loans (Brookings Institute, 2006; Center for Neighborhood Technology, 2008). The reduction of costs in a walkable neighborhood can be extended to other dimensions; for example, if the neighborhood is also able to incorporate green areas for local food production, this may constitute further savings for the household by way of providing cheaper food (Mouzon, 2006).

There is evidence that the principles of sustainable urban form and affordability are at odds. The main problem is that affordable housing in desirable locations goes against the basic principles of land economics in the U.S. If a neighborhood is walkable and amenity-rich (i.e., well serviced by stores, transit, and schools), demand for such places will quickly escalate housing costs. The sustainable city is one in which context is highly valued, which means that the source of increasing housing cost is land cost, not unit cost, and thus increasing the cost efficiency of individual units may not necessarily have a significant effect on affordability. One study of housing prices in New Urbanist development – a development form meant to be sustainable – found that most projects were priced at above-market rates (Eppli & Tu, 1999). Subsequent research supported the view that New Urbanist developers have been able to command a higher price in the market place (Tu and Eppli, 2001). Song and Knaap’s 2003 study of New Urbanist housing values found that a net 18% premium was paid for design amenities like pedestrian quality and walkable access, while another recent study funded by the U.S. Department of Transportation found that many New Urbanist developments – those located near transit stops – are becoming increasingly unaffordable (USDOT, 2008).

While the market may not be behaving as desired in terms of providing sustainability and affordability in the same place, how are the neighborhoods with subsidized affordable housing faring? Is publicly funded housing located in neighborhoods that could be viewed as “sustainable”, i.e., walkable, well serviced, compact, and pedestrian-oriented?

Defining and Measuring Sustainable Urban Form

Research on sustainable urban form has been active for two decades (Williams et al., 2000; Frey, 1999), and there is now concerted effort to develop quantified measures of what

---

3 A number of publications have summarized the ways in which local regulations of all kinds tend to undermine affordability (Downs, 1991), and the U.S. Department of Housing and Urban Development has its own
sustainable urban form actually means. Currently, the best-known measurement tool in the U.S. is LEED-ND, or “Leadership in Energy and Environmental Design – Neighborhood Development” (USGBC, 2009). LEED-ND measures draw from other types of research that have attempted to quantify neighborhood form. Four types of research are especially relevant, where neighborhood form has been linked to a) physical health (Moudon et al., 2006; Giles-Corti and Donovan, 2003); b) accessibility (Talen, 1998; Murray and Davis, 2001); c) sprawl (Galster et al., 2001); d) and social diversity (Nyden et al., 1998; Talen, 2008).

To define sustainable urban places for Chicago, we included the most widely used measures of sustainability and derived a set of quantified urban form characteristics, listed in Table 1.

We condensed the sustainability measures of neighborhood form into five areas: location, pedestrian orientation, street design, density and diversity. Each of these is backed by substantial research that links urban form to a variety of goals related to sustainable urban places - i.e., places that are diverse, health-promoting, socially active, well connected, safe, accessible, pedestrian-based, and not car-dependent. Notions of accessibility, connectivity, diversity and compactness link sustainability goals to specific urban forms. Table 1 lists the five types of measures and how they relate to these goals.

Accessibility is a particularly important aspect of neighborhood sustainability, and is a longstanding component of theories of good urban form (see in particular Jacobs, 1961; Lynch, 1981; Jacobs and Appleyard, 1987). Kevin Lynch (1981) argued that access could be used as a measure of “settlement performance”. Access to facilities, goods and services is also used to define spatial equity: who has access to a particular good or service and who does not, and whether there is any pattern to these varying levels of access. In addition, increasing access to needed facilities, goods and services among low-income populations is considered to be an essential part of social policy. Access to resources defines the “geography of opportunity”, where proximity to resources significantly impacts the ability of low-income residents to improve their lives (de Souza Briggs, 2005). It is also understood that for locally oriented populations – residents who rely on modes of transport other than the automobile (e.g., the elderly and the poor) – accessibility to urban services may be more important because distance is not elastic (Wekerle, 1985).

Elevating the role of spatial accessibility is closely tied to the view that settlement patterns should increase access between residents, their places of work and the services they require. In this regard, accessibility is not conceptualized as an issue of private mobility, but is generally approached as a community-wide, public problem. Equity in accessibility to resources is therefore tied to the principles of smart growth (Song and Knaap, 2004) and active living environments (Heath et al., 2006; Norman et al., 2006) in which pedestrian access to daily life needs is viewed as especially important.

When access is defined as a matter of proximity to urban resources (Knox, 1978; Lindsey et al., 2001), urban form variables are the basis of access measurement. A number of spatial approaches are used, for example by counting the number of facilities within a given spatial unit (a census tract, political district, or municipal boundary). A “minimum distance” approach measures access as the distance to the nearest facility – often used in research on access to health care services – whereas the “travel cost” approach calculates the distance (cost) between an origin and all included destinations (often the preferred method for calculating access to amenities such as parks within a city). In the gravity potential measure, facilities are weighted by their size (or other characteristic) and adjusted for the frictional effect of distance (Pacione, 1989). Measures of access have been used extensively in the past few years as part of an effort to evaluate the built environment for health effects (see, for example, Moudon and Lee, 2003; Greenwald and Boarnet, 2001).

Connectivity refers to the degree to which local environments offer points of connection and contact (to people and resources) at a variety of scales and for multiple purposes. This quality promotes sustainability in that higher connectivity leads to higher levels of interaction between residents and environment, society, and cultural and economic activity – all of which improves the ability of place to sustain itself in the long term. Urban form is believed to play a role in promoting or constraining connectivity.

The underlying mechanisms involved in the translation between form and connectivity have been investigated at a variety of scales, from micro-environmental factors and site layout to regional systems. Interaction at the neighborhood scale is often a pedestrian phenomenon (Michelson, 1977), and networks of “neighborly relations” are related to interconnected pedestrian streets and the internal neighborhood access those street networks engender (Grannis, 2003). The provision of public spaces for casual or spontaneous interaction does not
create deep social bonds, but instead promotes “weak” social ties, which are believed to be especially sensitive to environmental design (Skjaeveland and Garling, 1997). Users tend to utilize public space most often if they can walk to it, i.e., if it is within 3-5 minutes walking distance from their residence or workplace (Kaplan and Kaplan, 1989).

The importance of maximizing connectivity in urban space is a common theme in urban form studies (Hillier & Hanson, 1984; Alexander, 1965). The main focus is on maximizing opportunities for interaction and exchange, often by increasing the number of routes (streets, sidewalks, and other thoroughfares and pathways) through an area. Providing alternative routes and access points affects both the public space network and the corresponding patterns of movement (Salingaros, 1998). From an urban form point of view, increasing connectivity translates to gridded street networks, short blocks, streets that connect rather than dead-end, establishment of central places where multiple activities can coalesce, and providing well-located facilities that function as shared spaces. It is generally agreed that large-scale blocks, cul-de-sacs and dendritic (tree-like) street systems are less likely to provide good connectivity. Connecting all types of spaces is viewed as important – public and private, residential and non-residential, storefront and sidewalk.

Related to this, sustainable urban form is defined by the degree to which it supports the needs of pedestrian and bicyclists over car drivers. This has in part been motivated by a concern over the effect of the built environment on physical activity and human health. Streets that are pedestrian-oriented are believed to have an effect not only on quality of place but on the degree to which people are willing to walk. Researchers have argued that activity levels can be increased by implementing small-scale interventions in local neighborhood environments (Sallis, Bauman, and Pratt, 1998), and a whole catalog of design strategies are now used to make streets more pedestrian-oriented. Many of these strategies fall under the heading “traffic calming”, a relatively recent concept probably originating with the Dutch “woonerf” in the 1970s. The measures included here are primarily concerned with connectivity. An additional measure of parking lots and vacant land is used as an indicator of the quality of the pedestrian environment.

Another essential component of sustainable urban places is diversity. In particular, land use diversity is believed to foster a number of sustainable benefits – economic vitality, social exchange, accessibility, and walkable provision of the diverse services and facilities a
neighborhood requires. Socially diverse neighborhoods continue to be seen as essential for broader community well-being and social equity goals (for example, Turner and Berube, 2009; Popkin, Levy and Buron, 2009), but the connection to sustainability is also made—mixing incomes, races and ethnicities are believed to form the basis of “authentic”, sustainable communities (Congress for the New Urbanism, 1999; see also Talen, 2008). In addition to mixed housing, land uses that compliment each other to promote the active use of neighborhood space at different times of the day will create “complex pools of use” (Jacobs, 1961), a component of natural surveillance, which is also a sustainability goal. Mixed income neighborhoods

Studies of socially mixed neighborhoods consistently identify urban form as a key factor in sustaining diversity. Variation in housing type is particularly important. This includes different tenures (owner vs. renter occupied), the mix of different forms and sizes (single-family vs. multi-family), and the mix of housing ages—the retention of existing housing stock, integrated and blended with new housing stock (important for economic diversity because older units are often more affordable than new). In addition, some research has indicated that stable, diverse neighborhoods are strengthened by economic diversity (stores and restaurants) and the existence of “social seams” in the form of schools, parks, or a strip of neighborhood stores (Nyden, Maly, Lukehart, 1997; Nyden et al., 1998). A diversity of neighborhood uses can be thought of as places of shared space, where collective “ownership” of facilities and services contributes to a neighborhood that is more socially active and stable, providing a better chance for informal, voluntary control. Supporting this are findings that neighborhood public facilities play a role in reducing crime (Peterson et al., 2000).

Finally, compactness is an important dimension of sustainable urban form. There is some disagreement over the exact relationship between “compactness” and sustainability, particularly as it relates to social justice goals (Jenks et al, 1996; Burton, 2002). But most researchers agree that cities that are more dense and compact and less sprawling and land-consumptive are likely to be more sustainable, especially in environmental and economic terms. Among many other negative effects, identified in studies like Costs of Sprawl (Burchell et al., 1998, 2005), low density development has been linked to higher infrastructure costs (Speir and Stephenson, 2002), increased automobile dependence (Cervero and Wu, 1998), and air pollution (Stone Jr., 2008).
Data and Methodology

To generate the indicators of sustainable urban form, we drew on a technique applied in Talen (2005) that measures the conditions of urban form within each census unit as a separate layer and then combines these layer into a composite picture of urban form. We identified key indicators of LEED-ND that could be operationalized with existing data and replicated in other studies. Specialized software developed for this purpose at the GeoDa Center for Geospatial Analysis and Computation was used to compute the non-standard variables.

Table 1 summarizes the 18 indicators that were used in this analysis. As mentioned, they fall into five categories of urban form characteristics: 1) Proximity to amenities, services and facilities, 2) Pedestrian orientation, 3) street design, 4) density, and 5) diversity. Each of these categories affects dimensions of access, connectivity, safety, and/or diversity. To measure accessibility and pedestrian orientation, data on residential and commercial parcels and buildings, public transit, schools, parks, and streets were obtained from the Cook County Assessor’s office and the city and county planning offices. Grocery store data came from a private source.4

These data were supplemented by data on walkable distance to employment, unit and population density and socio-demographic and housing form-based diversity from the 2000 Census. The notes in Table 1 provide additional detail on how the variables were generated. To combine these variables into an index for the five urban form characteristics as well for sustainability overall, the values of the 18 indicators were sorted from low to high in terms of their sustainability (see Table 1 for the direction of sorting) and subsequently converted to quintiles. The quintile variables within each of the five categories were then summed to obtain a sustainability indicator for each category (access, walkability, connectivity, density and diversity) and for an overall sustainability indicator.

We confined our study area to the City of Chicago for several reasons. First, as of this writing GIS data on built environment measures, such as parcel boundaries, block shapes and building outlines, were only available for the city, rather than the county or region as a whole. Second, because we relied on significant numbers of affordable housing units maintained by

4 Daniel Block, Department of Geography, Chicago State University.
the Chicago Housing Authority (explained below), it made sense to limit our analysis to coincide with their jurisdiction. Third, confining our study to the city of Chicago was not a significant limitation in terms of urban form variability – the city contains many different types of blocks and neighborhoods that vary widely from low-density sprawl to high-density urbanism. While the city does not contain the quantities of low-density sprawl that surrounding counties do, it does contain enough variation to be able to meaningfully differentiate between high and low levels of sustainable urban form qualities (Chicago has neighborhoods ranging from less than 2,000 population per square mile to more than 48,000). However, it should be kept in mind that the sustainability index values in one tract are relative to the distribution of values in the study area. Hence, if the spatial extent of the study included the larger Chicago metro area with the outlying sprawl regions, city tracts that currently receive lower sustainability scores, e.g. near the Western city border, might then be classified in the middle of the sustainability score distribution.

To analyze the sustainability of affordable housing developments, we mapped the addresses of several kinds of developments: community land trust units, Chicago Housing Authority developments (both senior and family units, and including HOPE VI federal housing projects), Low-Income Housing Tax Credit Properties, and the locations of subsidized multi-family housing, many of which are project-based Section 8 units.

There is no single source that we are aware of that lists the locations of all subsidized housing in Chicago. We therefore relied on separate datasets to map the locations of subsidized housing in Chicago, listed in Table 2: community land trusts (0.2%), family and senior housing projects (20%), subsidized multifamily rental developments (49%; much of it developed by the Chicago Housing Authority and listed as “scattered site properties” on their website), Low-Income Housing Tax Credit developments (15%), and housing vouchers (16%). We made every attempt to avoid duplication of this data, although it should be noted that due to inconsistencies in project addresses, number of units, and project names, some overlap might have occurred. There were close to 99,000 subsidized units in the combined datasets, representing about 17% of the total housing stock in Chicago.

The data was obtained from four sources (see Table 2 for more details). First, we used data from the Chicago Housing Authority, which maintains a complete listing of properties on their website. This was cross referenced with data obtained from a second source, the Illinois
Assisted Housing Action Research Project (IHARP), a database of subsidized housing owned and managed by both private and non-profit developers. The IHARP was also the source for locations of Low-Income Housing Tax Credit (LIHTC) developments. Third, the locations of community land trust properties were obtained from the two land trusts operating in the City of Chicago: the West Humboldt Park Community Land Trust and the Chicago Community Land Trust. Finally, housing voucher data from the U.S Department of Housing and Urban Development’s online Picture of Subsidized Households database were used to supplement the above project-based data. Since the project data are available at the address level while the voucher data only exist at the Census tract level, we include block group-level analyses for projects and use tracts to compare project and voucher data.

While there are many community development corporations that develop low-income housing in Chicago, the majority of subsidized multifamily developments are owned and operated by The Chicago Housing Authority (CHA). CHA is a municipal not-for-profit corporation that was created in 1937 under FDR’s Public Works Administration. It owns about 16,500 units in the city, housing close to 50,000 individuals and families in four types of housing: mixed-income developments located throughout the city (HOPE VI); senior apartments; scattered site housing; and traditional developments. It is currently undergoing a “Plan for Transformation” in which all of its public housing is being redeveloped or rehabilitated, including the demolition of its notorious high-rise developments. According to CHA’s website, the “guiding principle” of the Plan is “the comprehensive integration of low-income families into the larger physical, social and economic fabric of the city.”

In order to test for differences in sustainability scores in areas with and without subsidized housing, we apply difference-in-means tests (t-tests) within each sustainable urban form category. The null hypothesis is that areas with subsidized units and areas without subsidized units come from the same population, and therefore have the same mean. A rejection of this hypothesis implies that differences in the average sustainability score between these areas are statistically significant, i.e. would normally not be expected. These tests are conducted at the block group level for all subsidized projects and at the tract level for these projects as well as for housing vouchers (since data for the latter were only available to the authors at the tract level).
Results

The relationship between sustainability and subsidized housing appears to be non-linear, i.e. higher sustainability scores characterize areas with few or no subsidized housing units as well as areas with larger concentrations of such housing. For instance, on the one hand, only about 10% of the most sustainable tracts have more than 2 units of subsidized projects located within them (13 out of 144, out of a total of 866 tracts). Nevertheless, at the same time, of the 98 out of 866 tracts with subsidized projects, the majority (64) is above the median in terms of sustainability. 78 out of 866 tracts have more than 5 subsidized project units; of those, 20 are in the top sustainability quartile.

Interestingly, the difference-in-means tests results (Table 4) suggest that, in general, the subsidized projects in this analysis are in neighborhoods that are more sustainable than those without subsidized projects.\(^5\) Neighborhoods (defined as either block groups or tracts) with subsidized projects are more accessible to amenities, more pedestrian-oriented, denser, and overall more sustainable (all indicators combined). However, subsidized projects are also in block groups with less street connectivity compared to block groups without subsidized projects – although this difference disappears at the tract scale. There is no difference in terms of diversity (of people, built form and land use) between block groups with and without subsidized projects and tracts with 140 or less units. This pattern is not true for larger (140+ units) concentrations of subsidized projects in a tract. In this case, such tracts are less diverse than those without subsidized projects.

These patterns contrast with those for housing vouchers in notable ways. While subsidized projects are in block groups and tracts that are more accessible, more pedestrian-oriented and more sustainable overall than those without subsidized projects, vouchers are in tracts that are less accessible and no more pedestrian-oriented or, for tracts with 1-10 vouchers, no more sustainable than non-voucher tracts. In fact, at higher concentrations of vouchers (> 10 units), tracts with vouchers become less sustainable than those without vouchers. Similar to tracts with subsidized projects, tracts with vouchers are either no different (at lower voucher concentrations) or less connected (at higher concentrations) than non-

\(^5\) Note that the baseline case of tracts without vouchers or projects differs – including their sustainability scores, which, for tracts without vouchers are higher than for tracts without projects.
voucher tracts. Like subsidized housing tracts, voucher tracts are also characterized by larger unit and population density. In contrast to subsidized project tracts however, which are either no different in terms of diversity or less diverse at larger unit concentrations, voucher tracts are more diverse at both unit concentrations (1-10 and >10 units).

To break this analysis down further by housing program type, Table 3 compares the dimensions of sustainable urban form by the five subsidized project groups (individually and combined) and for vouchers. The table presents the percentage of units that are located in tracts with low, medium or high sustainability scores (tertiles). As Table 2 showed, about half of all units in this study are in multi-family projects funded by local, state and federal sources, with another 15% each in LIHTC projects or in voucher-assisted apartments and about 10% each in Chicago Housing Authority senior or family housing. Less than 1% of units (0.2%) are part of community land trusts. How do the location of these different projects and vouchers compare in terms of sustainable urban form?

The higher average sustainability scores (other than for diversity) for subsidized projects vis-à-vis vouchers found in the difference-in-means analysis holds true across subsidized housing projects. Chicago Housing Authority family projects are the one exception: Units in these buildings score about as low overall as vouchers (18 vs. 19%) and notably lower on pedestrian orientation (20 vs. 27%), density (11 vs. 29%) and diversity (8 vs. 23%). The program types with the highest overall sustainability scores are Chicago Housing Authority’s high-rise senior projects (40% in high-score tracts), Low Income housing Tax Credits (38%), and then, slightly lower at 33%, multifamily projects. CHA senior projects have the highest scores in all categories (amenities, pedestrian orientation, street connectivity and density) except for diversity where they score lowest (8%) – similar to CHA family projects (10%). The average subsidized project fares best in terms of accessibility to amenities (schools, transit, grocery stores, businesses, employment and parks) – at 44%, this score is 27 percentage points higher than that for vouchers. More than a third of all subsidized projects (36-37%) scores high for pedestrian orientation and density and twice as high on street connectivity than vouchers (24% vs. 12%).

As also reflected in the difference-in-means results, the one sustainability component where vouchers locations are more sustainable than those of the average subsidized project is diversity. With 23% of all vouchers in the top third of diversity scores, vouchers score about
ten percentage points higher on diversity than the average subsidized project. A remarkable result in terms of diversity is that 82% of CHA family units are located in the lowest third of diversity scores, reflecting locations characterized by homogeneity in land use and housing form as well as people (related to high racial segregation).

Figures 1-5 add a geographic dimension to these results. Figure 1 shows block groups that include one or more subsidized project units. Block groups shaded in black are in the top quartile in terms of number of units. The locations are clustered linearly in a “T” pattern, extending in three directions: north, south and west. Figure 2 shows the block groups with subsidized projects together with the block groups that scored highest on total sustainability. Many of the most sustainable areas are located in the North and Northwest, and there is some overlap with the subsidized projects block groups. Figure 3 highlights those block groups that were both high on sustainability measures and had some subsidized projects. Transit lines and park space – two variables that factored into the sustainability scores – are also shown. As expected, there is some correspondence between the presence of public transit, public space, and the locations of subsidized block groups that scored highest on sustainability measures.

A final visual analysis of the block group-level results is shown in Figure 4: point locations of all subsidized project units and block groups that were the least sustainable. As expected, the least sustainable areas are located away from transit and in more suburban, less accessible locations. Subsidized housing projects appear to be mostly steering clear of these locations.

Figure 5 identifies four types of tract-based neighborhoods in Chicago for both housing projects and vouchers:

1) **High Sustainability-High Subsidy**: Tracts with high sustainable urban form (SUF) scores (> 60) and large numbers of affordable housing (> 140 project units and > 10 vouchers, respectively),

2) **High Sustainability-No Subsidy**: tracts with high SUF scores and no subsidized units,

3) **Low Sustainability-No Subsidy**: tracts with low SUF score (< 50) and no subsidized units, and,

4) **Low Sustainability-High Subsidy**: tracts with low SUF scores and large numbers of affordable units (same categories as in 1).
For both projects and vouchers, only 5% of all tracts have large numbers of subsidized units in tracts in the top tertile of sustainability scores. These are primarily concentrated in the Northeast of the city where the majority of tracts with high scores and no subsidized housing (17% for projects and 13% for vouchers) are also located. As Figure 4 showed, most areas with low sustainability scores and no subsidized projects are located in the periphery of the city. The percentage of tracts with large numbers of vouchers (> 10) in the lowest third of sustainability scores is almost three times higher for vouchers (14%) than projects (5%). This reflects a greater dispersal of vouchers in the Southside of Chicago.

With the exception of the diversity indicator (which includes a summary measure of socio-demographic diversity), the sustainability index only includes measures of urban form. Especially in a context such as Chicago’s, a pertinent question to address is how sustainability scores compare to social indicators such as poverty, racial segregation, and crime. To begin to address this question, Table 5 relates the overall sustainability scores to poverty rates, a proxy measure for racial segregation (percent African-American) and the number of all crimes (May 2009-2010) for three groups of projects and vouchers: Tracts 1) without subsidized units; 2) with lower unit counts; and 3) with higher unit counts.

Not surprisingly, tracts without projects and vouchers have lower poverty and segregation rates as well as lower crime levels than tracts with such affordable housing. And for both, projects and vouchers, poverty, segregation and crime increase in tracts with higher unit counts, which at least for poverty and segregation is likely to include an endogenous effect. However, voucher holders tend to live in tracts with lower poverty rates than residents in subsidized projects: For vouchers, the increase in poverty rates from 17-20% (1-10 units), which is not statistically significant, and from 17-29% (> 10 units) is lower than that for projects from 18-24% (1-140 units) and 18-33% (> 140 units). For tracts with lower subsidized unit concentrations, segregation and crime levels are lower for vouchers than projects – however, this pattern reverses at higher unit concentrations (more than 140 project or 10 voucher units) where vouchers are in areas with worse segregation and crime levels than projects.

Hence, on average, voucher holders fare better in terms of poverty, segregation and crime in tracts with smaller numbers of other voucher holders – both compared to areas with higher concentrations of vouchers and compared to tracts with projects of any concentration.
However, they do not benefit from more sustainable urban form in their neighborhood. Tracts with subsidized projects score higher on sustainable urban form than those without. In contrast, tracts with vouchers do not show any improvements (or any difference) regarding sustainable urban form overall compared to non-voucher tracts (and at higher voucher concentrations, have statistically significantly lower sustainability scores).

Discussion

The problem of concentrated poverty and racial segregation that has been associated with subsidized projects, especially in Chicago, has long been recognized. What has not been quantified systematically is the extent to which a more market-based mechanism for allocating housing resources (housing vouchers) might result in locations that are less sustainable in terms of accessibility, pedestrian orientation, connectivity or diversity. Given emerging evidence that market-rate housing in sustainable neighborhoods tends to be associated with fewer affordable housing options (Talen, 2009), it is interesting to note our finding that the more market-based voucher system is associated with less sustainable neighborhood characteristics than those associated with subsidized projects.

However, at least at lower concentrations, subsidized projects also tend to be located in tracts with higher poverty, segregation and crime levels and less diversity compared to vouchers, suggesting a possible trade-off between neighborhoods with higher sustainable urban form and higher concentrated poverty, segregation and crime levels for subsidized residents. That sustainable urban form and affordable housing or poverty might not be linearly related could mirror the fact that older housing and neighborhoods are often home to residents with lower incomes since higher-income homebuyers tend to prefer new construction – yet older neighborhoods and historic preservation districts are frequently also attractive to higher-income buyers. This non-linear relationship has several important policy implications. For instance, the use of poverty rates as the sole criterion for gauging the desirability of a location ignores the fact that areas that are attractive because of their low poverty rates can become unsustainable for low-income residents if they are not accessible, pedestrian oriented, etc. A prominent example of a poverty-rate-only criterion is the national *Moving To Opportunity* experiment where the criterion for choice neighborhoods for certain voucher holders was a
10% poverty threshold for a census tract. Another implication relates to an increased awareness and protection of existing high levels of sustainable urban form in some low-income neighborhoods (Talen 2005).

Further, high scores for sustainable urban form in census tracts with high poverty rates raise the question whether accessibility, pedestrian orientation, street connectivity, density and diversity indicators have the same value in lower and higher-income neighborhoods. This question is linked to the broader notion that sustainable urban form is relevant because of its mediating role in facilitating access to opportunities (such as education or employment) or social connectivity and health, as outlined in the beginning of this article. For instance, having 200 feet access to a school will result in the same high sustainability score independently of whether the school is of high or poor quality – hence, in a higher-income neighborhood with better schools, this indicator does provide a proxy for opportunity while it does not in a lower-income neighborhood with worse schools. In addition, in neighborhoods where crime is prevalent, additional connectivity through streets or parks could be a disamenity rather than an amenity (Cutts et al., 2009; Roman and Chalfin, 2008).

These concerns are related to the larger issue that the LEED-ND sustainable urban form indicators, which guide the selection of indicators in this article, are primarily based on the environmental dimension of the sustainability triangle. As the cursory analysis of social indicators illustrated, the fact that they do not capture the social and economic dimensions of sustainability as well represents a limitation of the methodology of this article. There is a need to bridge the disconnect between the environmental dimensions of sustainability as applied here and the socio-economic indicators that characterize research on the geography of opportunity (de Souza Briggs, 2005), which generally ignores urban form.

Finally, one result of particular policy concern is the concentration of vouchers in tracts with low sustainability rates (in this case in the Southside of Chicago) and the existence of 13-17% of tracts (especially in the wealthier Northeast of the city but also Northwest of the Loop) with highly sustainable tract scores but no affordable housing. As urban policy increasingly revolves around the need to consider the locational context of affordable housing, sustainability indicators will be an important tool to better identify and assess improvements in the accessibility, walkability, connectivity, density, and diversity of the locations that host low-income units and tenants.
Conclusion

As one of the most often studied cities in the world, social scientists have used Chicago since the early 20th century to explore the relationship between environmental context and social phenomena. Chicago is also the city where urban policy is continually manifested, at one time home to the largest concentration of public housing in the U.S. (Robert Taylor homes) and now, the location of a dramatic re-working of public housing policy under CHA’s Plan for Transformation. Chicago is thus the perfect place to study the relationship between the new goal of “sustainability” and the enduring struggle to house the nation’s poor.

The results of this study shed light on the connection between sustainability and public housing. One conclusion to be drawn is that the relationship between sustainability – in particular, the “sustainable neighborhood” – and the location of subsidized housing is likely to be complex. The expectation of a disconnect between affordable housing and sustainable neighborhood form was primarily true for housing vouchers (especially regarding accessibility and walkability), but not for project-based units. Many vouchers with lower sustainability scores are located on the Southside of Chicago. However, at lower unit concentrations, locations of project-based units have higher poverty, segregation, and crime levels than vouchers, while vouchers are in more diverse areas. Especially in the more affluent Northeast and Northwest of Chicago, there are many tracts with high sustainability scores and no affordable housing units.

Moving forward, it will be important to understand what aspects of sustainability are most important to subsidized housing residents. Affordable housing advocates and sustainability proponents can make progress toward reconciliation of their sometimes conflicting objectives by first understanding the degree to which their goals intersect. One window into that connection is to look at the neighborhood context of subsidized housing and whether these contexts are more or less sustainable.

More research is needed to analyze the robustness of different specifications of sustainable urban form indicators to alternative specifications. Without a better understanding of how different choices about which indicators to include and how to operationalize them, the extent to which sustainable urban form outcomes are driven by measurement and other methodological characteristics remains unclear.
A future research question, one not addressed here, is whether the qualities of sustainable neighborhoods have varying benefit depending on the income level of residents or the income level of the neighborhood. Normative theory of sustainable communities generally presumes that characteristics like walkability, denser street networks, access to amenities such as public transit, parks, schools and retail or mixed land use are desirable in all neighborhoods, regardless of the income-level of either residents or the neighborhood as a whole. A legitimate question is whether the value of sustainable urban form is mitigated in low-income neighborhoods where, e.g., access to nearby parks and transit stops might coincide with higher crime risks, where neighborhood schools and stores are not real assets because of poor quality, and where greater land use mix might represent a higher likelihood of living near a variety of undesirable land uses. The same indicators of sustainable urban form that are appreciated in higher-income neighborhoods do not necessarily have the same value in neighborhoods where crime, poor quality of amenities, and undesirable land uses are prevalent.

A crucial point to consider is whether the relationship between subsidized housing and sustainability is changing. One of the primary concerns of affordable housing advocates is that the availability of subsidized affordable housing is decreasing in the face of increasing need. This is occurring in Chicago because of a scaled-down approach to public housing on the part of the Chicago Housing Authority, the loss of assisted units due to the expiration of Section 8 contracts, and the affordability expirations of Low-income housing tax credit properties (University of Illinois at Chicago, 2006). An important implication that ties into the research presented here is whether this loss is occurring in the most sustainable neighborhoods. An important future research question will be the degree to which subsidized housing is being squeezed out of the more sustainable locations, and whether there are certain sustainability criteria that seem to hold better for subsidized housing.
References


Cutts, Bethany B., Kate J. Darby, Christoher G. Boone, and Alexandra Brewis. (2009). City Structure, Obesity, and Environmental Justice: An Integrated Analysis of Physical and


<table>
<thead>
<tr>
<th>Urban Form Characteristic</th>
<th>Dimensions Affected</th>
<th>Measurement Variables</th>
<th>More sustainable is:</th>
<th>Less sustainable is:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Location of Amenities, Services and Facilities</td>
<td>Access, Connectivity</td>
<td>Average distance (in feet) to nearest shopping area lower higher</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>nearest Metra or CTA stop lower higher</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>nearest school lower higher</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>nearest park lower higher</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>nearest grocery store (1) lower higher</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>% of workers (16+) within 1 mile of employment (Census) higher lower</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Pedestrian Orientation</td>
<td>Access, Connectivity</td>
<td>% of residential parcels within 400ft of shopping areas higher lower</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>within 1/4 mile of Metra or CTA stop higher lower</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Land not supportive of pedestrian activity - w/o buildings (2) lower higher</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- all land (3) lower higher</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Street Design</td>
<td>Connectivity, Safety</td>
<td>Sum of intersections/square mile higher lower</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Median distance between intersections lower higher</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total street length/square mile higher lower</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Density</td>
<td>Diversity, Connectivity, Safety</td>
<td>Units/area (Census) higher lower</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Population/area (Census) higher lower</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Diversity (3)</td>
<td>Access, Connectivity, Diversity</td>
<td>Land use diversity higher lower</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Diversity of people higher lower</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>of form higher</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 1 Notes:

(1) Source: Chicago State University Neighborhood Assistance Center, "Northeastern Illinois Community Food Security Assessment," Funded by the Searle Funds at the Chicago Community Trust.
(2) Industrial, institutional, commercial, vacant, expressways and streets MINUS all land devoted to buildings by BG.
(3) Vacant, industrial, or commercial incentive parcels as defined by the Cook Co. Assessor's office. Commercial incentive parcels are those slated for redevelopment.
(4) These measures use the Simpson diversity index to calculate diversity. "Land use diversity" was calculated using 4 categories of land use found in the Chicago parcel file (single-family, multi-family, mixed use, commercial). The other two measures were calculated using 2000 Census block group data. For "diversity of people", diversity was calculated using the following categories: race/ethnicity (White alone/Black alone/ Asian alone or Pacific alone/Hispanic/Other), Age (5 and under/6 to 18 years/19 to 34 years/35 to 64 years/65 and over); Family income (Under $20,000/$20,000 to $39,999/$40,000 to $74,999/$75,000 and over); and family type (Married, with children under 18/ Married, no children under 18/ Single, with children under 18/ Single, no children under 18/ Non-family household). For "diversity of form", diversity was calculated using the following categories: housing unit type (1 unit detached/1 unit attached/2 units/3 or 4 units/5-9 units/10-19 units/20-49 units/50+ units); housing tenure (Owner occupied/Renter occupied); year built (Built 1939 or earlier/Built 1940-1959/Built 1960-1979/Built 1980 or later); unit size (No bedroom/1 bedroom/2 bedrooms/3 bedrooms/4 bedrooms/5+ bedrooms); housing value (Less than $100,000/$100,000 to $174,999/$175,000 to $299,999/$300,000 and over); and monthly rent (Under $500/$500 to $799/$800 to $1,249/$1,250 and over).
<table>
<thead>
<tr>
<th>Type</th>
<th>Source</th>
<th>Units</th>
<th>% of All Units in Study</th>
<th>No. Projects/Locations</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Trusts</td>
<td>Chicago community land trusts (Department of Housing, City of Chicago)</td>
<td>195</td>
<td>0.2%</td>
<td>35</td>
<td>Includes data from 2 community land trusts operating in Chicago, Chicago Community Land Trust and W. Humboldt Park Community Land Trust; These are mostly small developments, many &lt;5 units</td>
</tr>
<tr>
<td>CHA Family</td>
<td>Chicago Housing Authority (CHA)</td>
<td>10,687</td>
<td>11%</td>
<td>56</td>
<td>Data is from CHA’s Moving to Work Annual Plan, 2009, Administrative Appendix, Yardi Database; Includes projects with mostly &gt; 200 units per site; many large projects, including 8 projects &gt; 500 units <a href="http://www.thecha.org/pages/plans__reports___policies/40.php">source</a></td>
</tr>
<tr>
<td>CHA Senior</td>
<td>Chicago Housing Authority (CHA)</td>
<td>9,187</td>
<td>9%</td>
<td>54</td>
<td>Data is from CHA’s Moving to Work Annual Plan, 2009, Administrative Appendix, Yardi Database; Most developments are 100-200 units; <a href="http://www.thecha.org/pages/plans__reports___policies/40.php">source</a></td>
</tr>
<tr>
<td>LIHTC</td>
<td>Illinois Assisted Housing Action Research Project (IHARP)</td>
<td>14,650</td>
<td>15%</td>
<td>207</td>
<td>Projects placed in service in Chicago between 1987 and 2006; Most developments &lt; 100 units; <a href="http://www.uic.edu/cuppa/voorheesctr/iharp_data.html">source</a></td>
</tr>
<tr>
<td>Multi-Family Subsidized</td>
<td>Illinois Assisted Housing Action Research Project (IHARP)</td>
<td>48,173</td>
<td>49%</td>
<td>565</td>
<td>Includes projects funded by various IHDA, DOH or HUD programs; Most developments &lt; 100 units; <a href="http://www.uic.edu/cuppa/voorheesctr/iharp_data.html">source</a></td>
</tr>
<tr>
<td>Housing Choice Vouchers</td>
<td>U.S. Department of Housing and Urban Development</td>
<td>15,776</td>
<td>16%</td>
<td>15,776</td>
<td>1998 Picture of Subsidized Households Database; data aggregated at Census tract level; <a href="http://www.huduser.org/datasets/assthsg/statedata98/">source</a></td>
</tr>
</tbody>
</table>

| Total                |                                                                       | 98,668|                         | 16,692                 |                                                                                                                                                                                                           |
TABLE 3. Percentages of units within high and low sustainability quantiles: Overall sustainability vs. individual components

Overall Sustainability

Amenity Accessibility

Pedestrian Orientation

Street Connectivity

Density

Diversity

Legend:
- Low
- Medium
- High
### TABLE 4. T-Tests on sustainability variables and block groups with/without affordable housing

<table>
<thead>
<tr>
<th></th>
<th>Subsidized Projects</th>
<th>Census Tract Level</th>
<th>Housing Choice Vouchers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Block Group Level</td>
<td>Census Tract Level</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Amenity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>without Aff Hsg</td>
<td>17.58</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>with Aff Hsg</td>
<td>19.92</td>
<td>0.19</td>
<td></td>
</tr>
<tr>
<td>Combined</td>
<td>18.00</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td><strong>Difference</strong></td>
<td>-2.34 ***</td>
<td>0.21</td>
<td></td>
</tr>
<tr>
<td><strong>Accessibility</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>without Aff Hsg</td>
<td>17.37</td>
<td>0.21</td>
<td>17.37</td>
</tr>
<tr>
<td>with Aff Hsg</td>
<td>18.86</td>
<td>0.34</td>
<td>19.27</td>
</tr>
<tr>
<td>Combined</td>
<td>17.70</td>
<td>0.18</td>
<td>18.71</td>
</tr>
<tr>
<td><strong>Difference</strong></td>
<td>-1.49 ***</td>
<td>0.40</td>
<td>-1.90 ***</td>
</tr>
<tr>
<td><strong>Pedestrian</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>without Aff Hsg</td>
<td>11.12</td>
<td>0.06</td>
<td>11.26</td>
</tr>
<tr>
<td>with Aff Hsg</td>
<td>11.64</td>
<td>0.14</td>
<td>12.03</td>
</tr>
<tr>
<td>Combined</td>
<td>11.22</td>
<td>0.06</td>
<td>11.43</td>
</tr>
<tr>
<td><strong>Difference</strong></td>
<td>-0.52 ***</td>
<td>0.15</td>
<td>-0.77 **</td>
</tr>
<tr>
<td><strong>Street</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>without Aff Hsg</td>
<td>9.08</td>
<td>0.06</td>
<td>8.97</td>
</tr>
<tr>
<td>with Aff Hsg</td>
<td>8.64</td>
<td>0.14</td>
<td>8.92</td>
</tr>
<tr>
<td>Combined</td>
<td>9.00</td>
<td>0.06</td>
<td>8.96</td>
</tr>
<tr>
<td><strong>Difference</strong></td>
<td>-0.44 **</td>
<td>0.16</td>
<td>-0.21</td>
</tr>
<tr>
<td><strong>Connectivity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>without Aff Hsg</td>
<td>5.80</td>
<td>0.06</td>
<td>5.58</td>
</tr>
<tr>
<td>with Aff Hsg</td>
<td>6.89</td>
<td>0.13</td>
<td>6.86</td>
</tr>
<tr>
<td>Combined</td>
<td>6.00</td>
<td>0.06</td>
<td>5.88</td>
</tr>
<tr>
<td><strong>Difference</strong></td>
<td>-1.08 ***</td>
<td>0.14</td>
<td>-0.97 **</td>
</tr>
<tr>
<td><strong>Diversity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>without Aff Hsg</td>
<td>8.54</td>
<td>0.07</td>
<td>8.98</td>
</tr>
<tr>
<td>with Aff Hsg</td>
<td>8.54</td>
<td>0.14</td>
<td>8.97</td>
</tr>
<tr>
<td>Combined</td>
<td>8.54</td>
<td>0.06</td>
<td>8.77</td>
</tr>
<tr>
<td><strong>Difference</strong></td>
<td>-0.49 **</td>
<td>0.28</td>
<td>-0.89 **</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>without Aff Hsg</td>
<td>52.12</td>
<td>0.23</td>
<td>52.16</td>
</tr>
<tr>
<td>with Aff Hsg</td>
<td>55.64</td>
<td>0.45</td>
<td>56.08</td>
</tr>
<tr>
<td>Combined</td>
<td>52.76</td>
<td>0.20</td>
<td>53.04</td>
</tr>
<tr>
<td><strong>Difference</strong></td>
<td>-3.51 ***</td>
<td>0.50</td>
<td>-3.92 ***</td>
</tr>
<tr>
<td><strong>Sustainability</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>without Aff Hsg</td>
<td>52.12</td>
<td>0.23</td>
<td>52.16</td>
</tr>
<tr>
<td>with Aff Hsg</td>
<td>55.64</td>
<td>0.45</td>
<td>56.08</td>
</tr>
<tr>
<td>Combined</td>
<td>52.76</td>
<td>0.20</td>
<td>53.04</td>
</tr>
<tr>
<td><strong>Difference</strong></td>
<td>-3.51 ***</td>
<td>0.50</td>
<td>-3.92 ***</td>
</tr>
</tbody>
</table>

p-value: ***0.001  **0.01  *0.05 (two-tailed test)
N: Block groups without subsidized projects (2,015), with subs. projects (447)
N: Tracts without subsidized project units (543), 1-140 units (156), > 140 units (166)
N: Tracts without vouchers (295), with 1-10 vouchers (275), with > 10 vouchers (295)
Table 5. Social Indicators & Sustainability, by Tract

<table>
<thead>
<tr>
<th></th>
<th>% Poverty (N = 854)</th>
<th>Segregation (% African-Am) (N = 854)</th>
<th># All Crimes (N = 865)</th>
<th>Sustainability (N = 865)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
<td>SE</td>
</tr>
<tr>
<td><strong>Subs. Projects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>18.0</td>
<td>0.65</td>
<td>35.1</td>
<td>1.84</td>
</tr>
<tr>
<td>1-140 Units</td>
<td>24.4</td>
<td>1.16 *</td>
<td>46.3</td>
<td>3.45 *</td>
</tr>
<tr>
<td>&gt; 140 Units</td>
<td>33.0</td>
<td>1.30 *</td>
<td>62.4</td>
<td>3.09 *</td>
</tr>
<tr>
<td><strong>Vouchers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>17.1</td>
<td>1.03</td>
<td>15.8</td>
<td>1.78</td>
</tr>
<tr>
<td>1-10 Units</td>
<td>20.0</td>
<td>0.93</td>
<td>31.7</td>
<td>2.43 *</td>
</tr>
<tr>
<td>&gt; 10 Units</td>
<td>28.9</td>
<td>0.78 *</td>
<td>78.0</td>
<td>1.86 *</td>
</tr>
</tbody>
</table>

*0.05 significance (tracts with subsidized housing compared to without)

Data sources: Poverty and race data (2000 Census Bureau, SF3). Sustainability index (see Table 1). Crime data: All crimes from May 3, 2009-May 3, 2010 (CLEARMAP Chicago Police Department).
Figure 1. Block groups with subsidized affordable projects, Chicago. Darker shades are block groups that have more units.

Figure 2. Block Groups with the highest sustainability scores (cross-hatched areas), and block groups with the most subsidized affordable projects.

Figure 3. Transit, parks, and block groups with high sustainability and subsidized projects.

Figure 4. Block groups with the lowest sustainability scores, and point locations of subsidized affordable projects.
FIGURE 5. Lowest and highest tertile of sustainability scores compared to two categories of subsidized project and voucher units

Sustainable Urban Form (SUF) scores for bottom and top tertiles <50 and >60 per tract
Affordable project (AH) and voucher (S8) top categories (see Table 4): >140 units and > 10 units per tract