The Importance of Place:

How Chicago's Subsidized Housing Programs Impact Elementary School Experiences

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Abstract

Students and parents rely on public schools to be catalysts of social mobility, but too often already disadvantaged students are served by the poorest-performing schools. This paper assesses how the spatial placement of subsidized housing in Chicago—including traditional public housing, privately owned subsidized rental units, and Housing Choice Vouchers—impacts the elementary educational experience of residents. A multivariate spatial analysis of subsidized housing and school quality reveals that some of the city's poorest-performing schools, as measured by standardized test scores in reading and math, serve some of the highest concentrations of subsidized housing residents. In addition, elementary schools attended by residents of subsidized housing have, on average, lower test scores, higher percentages of Black students, and higher percentages of students receiving free or reduced price lunch than the city average. Residents of traditional public housing fare the worst, while residents of privately owned subsidized housing and Housing Choice Voucher holders attend slightly higher-performing schools. Interviews with four parents of Chicago elementary students, including residents of both subsidized and market-rate housing, suggest that both school quality and a safe neighborhood environment are highly important to parents, but that affordable options near desirable schools are limited. The findings support a reevaluation of Chicago's housing programs to prioritize access to effective schools with new project-based developments, transfer resources to tenant-based subsidies with greater residential choice, provide relocation counseling to all residents who want it, and increase the supply of affordable housing in high-opportunity neighborhoods.

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Introduction

Children who grow up in Hyde Park can expect to make an average of $37,000 per year by age 35, according to the Census Bureau's Opportunity Atlas. Just a few miles west in parts of Englewood, that figure drops to $16,000. The discrepancy appears early: at the elementary school serving Hyde Park, the average student scores well above the 50th percentile nationwide in reading and math, while Englewood's public elementary students average the 6th and 14th percentile in those subjects, respectively. Most Americans agree that a child's chances for upward mobility should not depend on the zip code where they grow up, but this pattern is a stubbornly persistent feature of American society. Elementary school attendance zones can perpetuate a pernicious cycle of spatial stratification and intergenerational poverty by tying school composition to existing residential segregation. Neighborhood context and elementary school quality are both linked to children's long-term social, economic, and physical well-being (Breger, 2017; Card & Krueger, 1992; Ludwig et al., 2001).

The incredible power of early education would be inspiring rather than troublesome, were it not that quality varies widely across elementary schools, even within individual districts, and access to desired schools is largely determined by where a student lives. Tiebout's classic theory of local expenditures, which posits that public goods like education can be efficiently allocated at the local level through variation between many small jurisdictions, among which "consumer-voters" choose by deciding on a place of residence, suggests that people will sort themselves into districts and school catchment areas that align with their needs (Tiebout, 1956; Hachadoorian, 2011). Many critics have argued, however, that this sorting perpetuates socioeconomic and racial segregation, leaving disadvantaged households stuck in regions of concentrated poverty and poor government services (Greene, 2008; Shah, 2006). Indeed, while

many parents can choose their housing in order to maximize the quality of the school their child will attend, low-income families face significant cost barriers to residing in communities with highly effective public schools (Freeman & Botein, 2002; Jellison Holme, 2002). This is doubly true for recipients of public housing assistance, who by definition cannot exercise full choice over the location and nature of their housing (Nyden et al., 2003). Past research has shown that publicly subsidized housing is disproportionately located in disadvantaged neighborhoods, which often are served by underperforming schools (Edmunds, 2009; Gould Ellen & Horn, 2018; Jourdan et al., 2014; Talen & Koschinsky, 2014).

Much economic research has explored how school quality impacts the desirability of a community, as measured by its housing prices, and to what extent these findings validate Tiebout's theory (Bayer et al., 2004; Kane et al., 2006; Stein, 1987). It remains unclear, however, how families without the financial means to independently purchase or rent a home value local school quality in making housing decisions. The extent to which the restrictive nature of public housing subsidies violates Tiebout's assumption of low-cost mobility between jurisdictions, and how this impacts low-income families educational experience, is also unexplored. Additionally, a significant body of work aims to understand how neighborhood and home factors influence school quality and individual student achievement (Breger, 2017; Card & Krueger, 1992). Yet few researchers have established direct links between housing subsidy program design and the schools available to residents, despite the well-documented importance of the home and school environment to student outcomes.

In this study, I seek to understand how the placement of Chicago's publicly subsidized housing programs affects the elementary educational experience for young children. Specifically, I evaluate the degree of spatial clustering evident across Chicago's elementary schools on several

demographic and achievement metrics. I focus on areas where clusters of subsidized housing overlap with low-quality schools or appear to exacerbate between-school segregation by race and income. I also compare the characteristics of schools available to residents of different types of subsidized housing in order to evaluate the city's effort to "help low-income families increase their potential for long-term economic success" through educational attainment (Chicago Housing Authority). Finally, drawing on qualitative interviews with parents of elementary-aged children, I investigate how local school characteristics influence families' housing decisions and how their satisfaction with their school experiences varies by housing type.

Quantitative spatial analysis revealed that schools are highly clustered by demographic composition and average test scores. Patterns of school performance unsurprisingly mirror residential stratification across the city—high-achieving schools are clustered in the north and northwest areas of the city, while struggling schools are clustered in the near south and west sides. Subsidized housing is also concentrated around lower-achieving schools with high percentages of Black and low-income students in a way that may exacerbate school segregation by race and income. The near south side has several neighborhoods that fall in both the bottom quartile of test scores and the top quartile of subsidized housing density, while the west side has several similarly high subsidized housing density neighborhoods that also fall in the top quartile of Black students and students receiving free or reduced price lunch.

The degree of choice residents have over their housing matters, however. Public housing residents are served by public elementary schools with lower test scores, a higher percentage of Black students, a lower percentage of Hispanic students, and a higher percentage of students receiving free and reduced price lunch (FRPL) than other subsidized housing residents. Schools serving Section 8 listings are demographically similar, with slightly lower percentages of Black

and FRPL students and higher percentage of Hispanic students, but have significantly higher test scores. Schools serving privately owned subsidized housing developments have even slightly higher test scores, the highest percentages of Hispanic students, and the lowest percentages of Black and FRPL students. Qualitative interview data helped explain the lack of a clear positive relationship between residential choice and school performance.

Interviews with parents of Chicago elementary school students confirmed that school quality is an important determinant of housing choice, but also introduced other concerns. Parents balance community ties, neighborhood characteristics, and school options when choosing where to live. They fear violence and gang activity in their neighborhood and desire strong extracurricular programs for their children, especially as the children get older and develop their own academic needs and preferences. Their information about these characteristics came from word-of-mouth reputation among other parents, contact with their children's school, and published online data. Several parents described a desire to move to another, safer neighborhood or out of the city entirely, but were currently limited by the availability of affordable housing. Residents of subsidized housing reported moving into the first development that would accept them after long wait times on the Section 8 waiting list.

These findings, combined with past research on the effects of school quality and composition, suggest that urban housing authorities should consider the status of local schools when constructing or converting new subsidized developments. In the long-term, they should consider transferring resources toward more tenant-based subsidies like Section 8, which provide a greater degree of choice to the beneficiary, while providing informational counseling to help families find the neighborhoods that fit their needs. Most importantly, it is imperative to increase

the supply of affordable housing options near desirable schools in order to break the pernicious cycle of place-based educational deprivation.

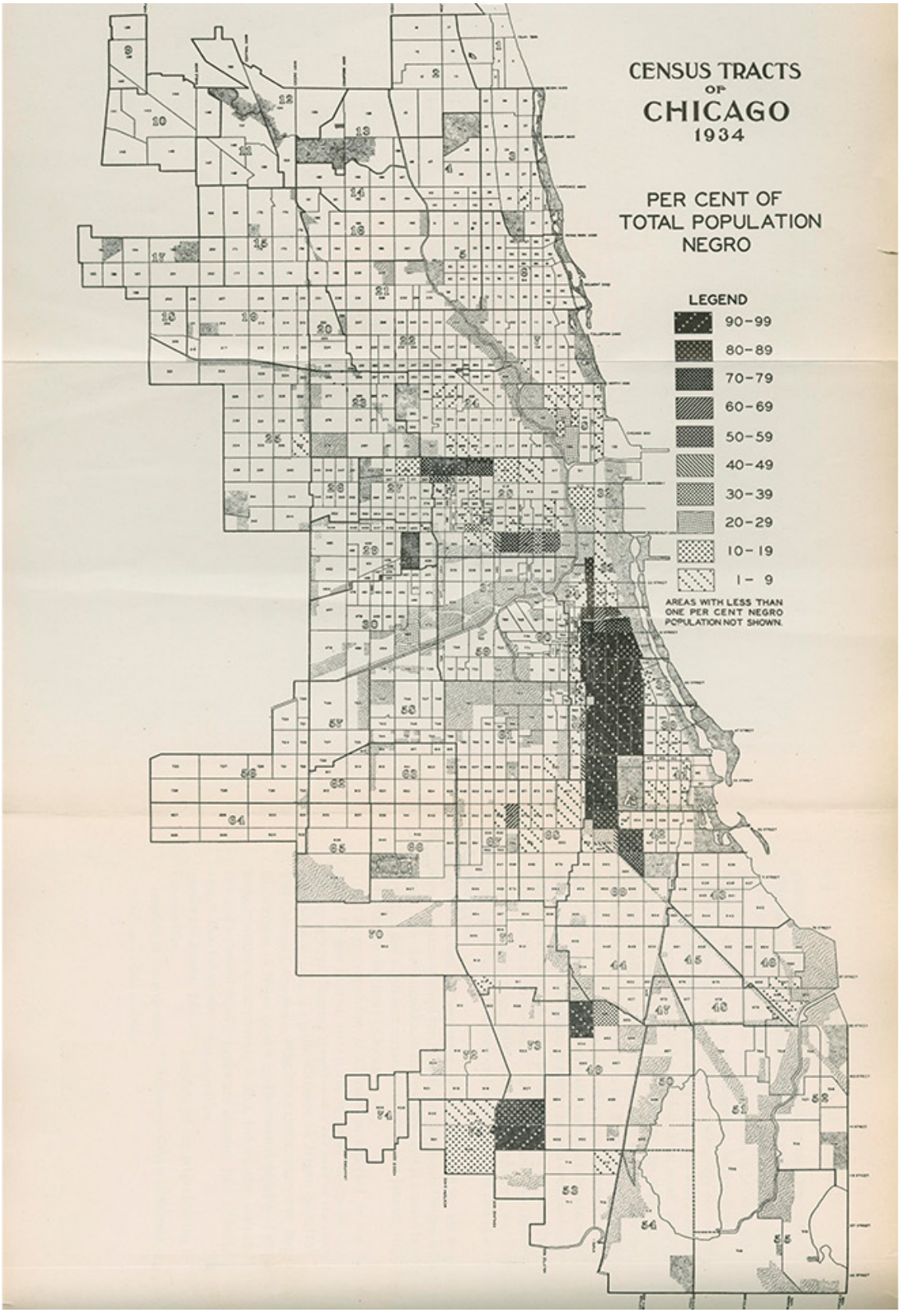
Literature Review

Context and Previous Research

The history of public housing.

Publicly subsidized housing in the United States has gone through many iterations as new programs have been introduced, studied, replicated, and often ultimately abandoned. Though new evidence has sometimes driven these changes, evolving social attitudes have also played a role (Stoloff, 2004). Beginning in the Great Depression era and continuing through World War II, public housing developments were mostly low-rise units intended as temporary residences for the working class (Stoloff, 2004). Post-war, the expansion of the suburbs opened up new home ownership opportunities for middle-class whites that were unavailable to minorities and the very poor (Gotham, 2000). Simultaneously, the Civil Rights Movement pressured housing authorities to integrate developments, which often led to an exodus of white residents. As a result, the resident population of public housing became lower-income and less white over time. This was a self-reinforcing process: the less "desirable" the public housing resident population, the stronger the resistance from local communities where new developments were proposed—even in poor neighborhoods (Banfield, 1955). In Chicago, the housing authority operated under the "neighborhood composition rule," which disallowed projects that disrupted the racial makeup of a neighborhood, through the 1960s (Hirsch, 1998). The Chicago City Council also routinely rejected proposals by the Chicago Housing Authority (CHA) that were politically unpopular, effectively limiting new construction to the "Black Belt" of the city's South and West sides (Schill & Wachter 1995).

Figure 1: The "Black Belt" as of 1934 (Local Community Factbook of Chicago 1949)



Segregationist policies and the biases that motivated them led public housing authorities to target developments in the poorest inner-city communities. Wilson (1987) termed these areas "truly disadvantaged," due to the concentration of poverty and minority households in areas with limited opportunities for employment or institutional support. In Chicago, the median income and proportion of Black residents in 1950 were strong predictors of whether a neighborhood would build a public housing development from 1950 to 1970 (Massey and Kanaiaupuni, 1993). Contemporary research has confirmed that this practice continues, though it relies on "affordability" and municipal veto power rather than explicit racial discrimination (Rabe Thomas 2019). Public housing can then exacerbate the concentrated disadvantage it is built within: developments in Cleveland, Detroit, Boston, and Philadelphia led to increases in the local poverty rate relative to other areas of the city (Carter et al., 1998).

Concerns about concentrated poverty, as well as increasing political favorability toward market-based solutions, led to a shift in policy during the 1980s. Rather than directing federal money toward high-rise projects, the Department of Housing and Urban Development (HUD) began to emphasize a more decentralized approach to subsidized housing (Erickson, 2004). Now, publicly subsidized housing is comprised of several major programs: traditional public housing developments, funded in part by HUD but administered by local housing authorities, affordable rental units built using the Low Income Housing Tax Credit (LIHTC), and Section 8 housing, which can be further broken down into new construction projects and Housing Choice Vouchers (HCV), which help tenants afford private rental housing (Kane-Willis, 2003). Since the Bush administration, the vast majority of federal housing subsidies have gone toward maintaining existing developments and providing voucher assistance.

Project-based subsidized housing.

Project-based housing includes any below-market housing financed by the local housing authority for occupancy by low-income individuals. It is characterized by immobility: the subsidy is tied to the units rather than the tenants that occupy them. The largest federally funded programs are HUD-assisted "traditional" public housing projects, LIHTC developments, and Section 8 new construction projects. Though public opinion turned against "the projects" in the late twentieth century, the evidence of their impacts on their communities is mixed.

Since Park (1936) introduced the ecological theory of sociological change, a concern over "white flight" has marked debates over the establishment of new subsidized housing developments. He posited that "invasion" of a neighborhood by a new social group leads to the "succession" of that neighborhood to dominance by that group as others migrate away. Researchers adopted this model to explain *de facto* racial stratification in the absence of *de jure* segregation, finding that sufficient in-migration of Black residents to a neighborhood in the mid-1900s—as might occur with the construction of public housing—led to an outflux of white residents and a decrease in average socioeconomic status (Massey & Mullan, 1984; Taeuber & Taeuber, 1965). Modern research tends to avoid the language of invasion-succession, yet continues to suggest that project-based public housing may have negative socioeconomic impacts on its surrounding neighborhoods. Studied impacts include concentration of poverty (Carter et al., 1998; Guhathakurta & Mushkatel, 2002; Massey & Kanaiaupuni, 1993; Newman & Schnare, 1997; Williamson et al., 2009), through both direct clustering of low-income individuals and negative effects on the local housing market (Holloway et al., 1998), racial isolation of Black residents (Goering et al., 1997), and violent crime (McNulty & Holloway, 2000; Roncek et al., 1981).

However, other research has found neutral or even positive impacts of project-based housing on the surrounding communities. Lee and Wood (1991) found that the likelihood of neighborhood succession decreased across five large metropolitan areas during the 1970s. A follow-up study of all metropolitan areas in the U.S. found no evidence of racial transition in response to new project-based housing of any type from 1980 to 1990 (Freeman & Rohe, 2000). Corroborating evidence comes from Briggs et al (1999) and MaRous (1996), who show that neither white flight nor home price depression resulted from the construction of new project-based housing developments throughout New York City and Chicago's suburbs. Some studies have found positive impacts of new developments on local home prices, though the conclusions are somewhat suspect; the research designs ignore the possibility that other factors may cause changes in a neighborhood over time or account for differences between neighborhoods (DeSalvo, 1974; Farley, 1982; Rabiega et al., 1984).

Given the contradictory effects reported in the literature, it is clear that the impacts of project-based housing on neighborhoods are complex and mediated by both the program design and the local environment. Owner-occupied housing subsidies seem to be particularly beneficial for local house prices (Ellen, 1998) and even local student test scores (Chellman et al., 2011). A study of Denver's subsidized rental developments suggests that they had positive impacts on the sales prices of nearby single family homes—unless the neighborhood was over 20 percent Black (Santiago et al., 2001). Several studies conclude that the effect differs by the program responsible for the housing development, alternatively suggesting that traditional public housing has more positive (Lee et al., 1999; Lyons & Loveridge, 1993) and more negative (Goetz et al., 1996) impacts on local housing prices than Section 8 and LIHTC properties. Nevertheless, negative

stereotypes about public housing projects persist, tied to their historical role in concentrating poverty and the racial composition of their residents.

Tenant-based subsidized housing.

Tenant-based housing refers to subsidy programs that provide individuals with vouchers that they can use to rent privately managed properties. The main mechanism for tenant-based subsidies in the U.S. and Chicago is the Housing Choice Voucher program, which was created by Section 8 of the Housing Act of 1974. HCVs cover the difference between eligible tenants' income and their rent, up to the "fair market rent" for their desired unit, which is determined by the local housing market and the number of bedrooms (FY 22 FMRs).

One motivation for providing greater mobility to residents of subsidized housing is the well-documented effects of neighborhood context on individuals. Contagion theory posits that negative behaviors can be acquired from peers and spread through a community. Case and Katz (1991) document that this is the case for children and adolescents in Boston: peers influence individual drug use, pregnancy, school attendance, and employment. Aggregate neighborhood characteristics have been associated with educational attainment, employment probability, and earnings (Datcher, 1982; Massey et al., 1991; Turner & Ellen, 1997). One study estimated that neighborhood effects can account for 40 percent of the interracial gap in educational attainment and earnings (Datcher, 1982). High neighborhood income is associated with higher academic achievement, while lower income and residential stability are associated with negative behavioral outcomes (Leventhal & Brooks-Gunn, 2000).

Several programs have leveraged the presumed positive effects of low-poverty neighborhoods on individuals by incentivizing residents of subsidized housing to move away

from areas of concentrated poverty and into areas of greater opportunity. I outline the evidence on each program below.

HOPE VI

In 1992, HUD established the Housing Opportunities for People Everywhere (HOPE VI) program, which provided grants to local public housing agencies to rehabilitate existing units and relocate displaced residents using voucher subsidies (About HOPE VI). Popkin et al. (2004) synthesize the findings from surveys and interviews with participants, suggesting that vouchers were able to help people improve their housing quality and neighborhood safety, but that most participants still lived in relatively poor and racially segregated neighborhoods. While over half either left subsidized housing or used their vouchers in new areas, 29 percent simply relocated to other public housing developments. The "hard to house" population that did not utilize the program was composed mostly of individuals with significant mental illness-related problems, physical disabilities, or very large families.

Gautreaux court-ordered relocations

In 1966, public housing resident Dorothy Gautreaux initiated a lawsuit against the CHA and HUD for unlawful segregation of Black tenants. The resulting 1976 court-ordered settlement established a voluntary relocation program (Varady & Walker, 2003). Two-thousand participants were randomly assigned to relocate to city locations (mostly poor and majority Black) or suburb locations with populations that were less than 30 percent Black. Three-hundred volunteers were screened out due to a limit on the number of children (four), debt owed, and "unacceptable housekeeping" (Varady & Walker, 2003), raising doubts about selection bias in the observed results. Still, movers saw significant benefits: surveys and interviews revealed that most were able to socially integrate into their new neighborhoods (Popkin & Rosenbaum, 1991) and

increase their sense of self-efficacy (Rosenbaum et al., 2002). Youth who moved to suburbs experienced better employment and higher educational achievement, on average (Rosenbaum, 2005).

Moving to Opportunity (MTO)

In 1994, HUD randomly assigned 4600 low-income families with children who were living in distressed public housing in Baltimore, Boston, Chicago, Los Angeles, and New York City to one of three groups:

1. An experimental group, which received housing choice vouchers that could only be used in low-poverty neighborhoods and counseling to help them relocate
2. A Section 8-only group, which received housing choice vouchers only
3. A control group (Orr et al., 2003).

The experimental group reduced the poverty rate of their neighborhood by about 8 percent on average, though the average neighborhood poverty rate remained above 30 percent (Sampson, 2008). Children in the experimental group scored, on average, one-quarter of a standard deviation higher in reading and math than their control group counterparts after several years (Ludwig et al., 2001). Positive effects on the mental health and risk-taking behaviors of girls are well-documented (Kling et al., 2007; Leventhal & Dupere, 2011), though effects on boys are disputed. Qualitative work revealed that both supply and demand forces combined to determine participants' housing trajectories over time: families generally prioritized reducing their exposure to crime and maintaining social ties, but options were limited by landlord refusal and program requirements for unit quality (Briggs et al., 2010).

Despite the successes of mobility pilot programs in improving neighborhood conditions for some individual families, many studies have criticized the Housing Choice Voucher program

for failing to meaningfully deconcentrate poverty. McClure (2008) points out that very few voucher holders live in neighborhoods with poverty rates below 10 percent. In fact, many voucher holders choose to locate in neighborhoods of concentrated poverty similar to those that contain most project-based subsidized housing (Guhathakurta & Mushkatel, 2002; Oakley & Burschfield, 2009; Wyly & DeFilippis, 2010). This may be because they do not value traditional metrics of neighborhood quality; there is only a weak correlation between subjective neighborhood quality ratings by HCV holders and census variables (Buron & Parabens, 2008). Program constraints like the calculation of fair market rent and quality inspections of units can also limit the supply of available units (Edin et al. 2012; McClure 2010). Finally, many housing markets simply have a lack of affordable units in "high quality" neighborhoods (Basolo & Nguyen, 2005; Comey et al., 2008). Vouchers provide a greater putative degree of choice to subsidized housing residents, who can leverage that choice to improve the context in which they raise their children, but issues of structural segregation and inequity remain.

Challenges to expanding subsidized housing.

It is easy to suggest that housing authorities should make more affordable units available in stable neighborhoods. However, there are several challenges that residents face in moving to areas of greater opportunity.

For one, there is a strong stigma in American culture surrounding residents of publicly subsidized housing. Katz (1986) coined the term "the undeserving poor" to describe how many people view beneficiaries of public welfare programs: lazy, uneducated, and prone to criminal activity. This idea is inextricably tied to racist conceptions of the welfare-dependent population (Quadagno, 1994). Williamson (1974) documented that the stigma against public housing

residents specifically (at least in the study's Boston-based sample) was stronger among higher-income participants.

It is unsurprising, then, that low-poverty neighborhoods are rarely welcoming to new publicly subsidized developments or their residents. Though there are documented cases of negative effects of subsidized housing on their neighbors (Carter et al., 1998; Galster, 2002; Galster et al., 1999; Guhathakurta & Mushkatel, 2002; Goetz et al., 1996; Holloway et al., 1998; Lee et al., 1999; Lyons & Loveridge, 1993; Massey & Kanaiaupuni, 1993; McNulty & Holloway, 2000; Roncek et al., 1981), this evidence is disputed and the effect of any specific development is difficult to predict *a priori* (Briggs et al., 1999; Freeman & Rohe, 2000; Lee & Wood, 1991; MaRous, 1996). Neighbors and landlords often believe there will be negative consequences to accepting voucher holders into the community. Landlord discrimination by tenant race, income source, and family composition is well-documented in both qualitative (Marr, 2005; Popkin & Cunningham, 1999; Popkin et al., 2004) and experimental (Turner et al., 2002; Yinger, 1995) research; landlords select against minorities, voucher holders, and families with many children.

Despite the challenges to providing an adequate supply of subsidized housing in low-poverty areas, the benefits to low-income households are clear. One of the most important mechanisms behind these benefits is school quality.

The importance of school placement.

Individual, family, peer, neighborhood, and school characteristics combine to affect the academic achievement and educational attainment of children. In turn, educational trajectories impact lifetime earnings, health, and happiness.

Much of the literature on education inputs focuses on contextual factors, and rightly so. From the Coleman Report (1966) onward, many studies have attempted to elucidate the mechanisms and effect sizes behind his statement that "a child's home environment, as well as the environment of other children in which he finds himself, is a very crucial influence on his performance in school." A meta-analysis of the link between socioeconomic status and student achievement from 1990 to 2000 concluded that there are strong positive effects of socioeconomic status on achievement (Sirin, 2005). Experimental results corroborate this finding; welfare programs that provide earnings supplements to parents have significant positive effects on young children's cognitive skills and performance in school (Clark-Kauffman et al., 2003). Research has also documented peer effects on achievement, delinquency, and educational planning (Davies & Kandel, 1981; Duncan et al., 2001; Hanushek et al., 1999). Neighborhood composition is both an important mechanism behind these peer effects (as students usually attend schools in their area) and an independent contributor to individual and school success (Andrews et al., 2003; Berger, 2017), leading to clustering of high and low performing schools according to patterns of residential stratification (Edmunds, 2009).

Schools can also vary in quality independently of their neighborhood, reflecting budgetary, pedagogical, and management differences. Card and Krueger's (1992) classic study of men born from 1920 to 1949 showed that men born in states with lower pupil-to-teacher ratios and higher teacher salaries completed more years of education and enjoyed higher earnings returns from each additional year. More recent and inclusive research confirms the importance of teacher, classroom, and school practices to student outcomes. Tennessee's Project STAR, which randomly assigned elementary school students to classes of different sizes, demonstrated that low-income children especially benefit from smaller class sizes (Krueger & Whitmore, 2001).

Students also tend to learn more from teachers who performed better in school (Ballou, 1996; Ehrenberg & Brewer, 1994; 1995; Ferguson, 1991; Ferguson and Ladd, 1996; Mosteller & Moynihan, 1972) and have more experience (Darling-Hammond, 2000; Murnane & Phillips, 1981; Rivkin et al., 1998). Jennings et al. (2015) found unexplained differences in college attendance across Texas schools after accounting for standardized test scores, family characteristics, and neighborhood differences, suggesting that school practices significantly influence college-going behavior.

The stakes for educational performance are high. Higher scores on standardized tests are associated with higher rates of college attendance, postsecondary degree completion, and post-graduate earnings (Deming et al., 2016). Completing each successive level of education, from obtaining a high school diploma to a graduate degree, leads to higher earnings, better health outcomes, and greater levels of self-reported happiness (Heckman et al., 2018, Nikolaev & Rusakov, 2015).

Given the importance of peer, neighborhood, and school factors for educational attainment and the knock-on effects of that attainment throughout the lifespan, accessing quality neighborhoods and schools is essential. A key way in which households choose quality schools is by choosing their place of residence.

Previous research linking housing and schools.

A large body of economic literature analyzes how property values vary across school boundary lines in order to assess the importance of local school quality to residents. Studies concur that school quality is an important determinant of housing prices (Black, 1999), though effect sizes range from twp (Bayer et al., 2004a) to ten percent (Kane et al., 2006) for one standard deviation difference in average test scores. Notably, the direct effect of school quality

(controlling for neighborhood characteristics) on both housing prices and stratification by income is only about one-fourth as large as the combined direct and indirect effect (Bayer et al., 2004a; Kane et al., 2006). This implies that initial differences in school quality precipitate changes to neighborhood composition that then reinforce stratification across the boundary, since people have preferences for housing types and neighbors in addition to schools.

This valuation effect suggests a lack of access to quality schools for low-income families and residents of subsidized housing, who cannot register their preferences for education by simply renting or purchasing property at a premium. Bayer et al. (2004b) model that an increase in earnings among upper-income households puts pressure on housing prices in desirable neighborhoods, squeezing out lower-income residents. This could be partially responsible for the 40 percent increase in between-school income segregation in large districts from 1991 to 2012 (Owens et al., 2016).

Comparatively little research has directly linked publicly subsidized housing to local school characteristics, despite the importance of school placement on children's development. Talen and Kochinsky (2014) note that there is often a tradeoff between access to services, which are more plentiful around traditional public housing developments in the urban core, and metrics of neighborhood desirability like crime and school quality, which are generally more favorable in outer ring and suburban locations where voucher holders cluster. Ellen and Horn (2018), however, offer the first and only direct comparison of school quality and demographics across different subsidized housing programs. With a national sample of housing locations, they show that residents of these programs have access to worse schools on average than other low-income renters, though they are relatively better for HCV holders and worse for public housing residents.

Theoretical framework

The spatial stratification I have described in the context of schools comports with Tiebout's classic theory of residential sorting (1956). He posits that greater fragmentation of public jurisdictions will lead to greater efficiency in the allocation of public goods, because citizens are able to "vote with their feet" and choose the jurisdiction that best matches their preferences. Overburdened governments providing inadequate services will lose their tax base and institute more efficient resource allocation, while over-resourced areas will attract more constituents until resources become strained. Tiebout's theory relies on several assumptions: mobility is cost-free, service bundles are exogenously determined and immutable, and citizens have full information about service bundles in different jurisdictions (Tiebout, 1956). Despite the rigidity of these assumptions, later research has confirmed the implications of Tiebout's theory: migration responds to changes in local government policy (Banzhaf & Walsh, 2008) and as a result citizen characteristics are discontinuous at jurisdictional boundaries (Hachadoorian, 2011). Some studies have also complicated the picture, however. Stein (1987) finds some homogenous sorting of residential populations, but only on the dimensions of race and education. Rhode and Strumpf (2003) note that as mobility costs have decreased over time—and therefore Tiebout predicts sorting should accelerate—heterogeneity of public service bundles has decreased. However, this may reflect greater information-sharing rather than an invalidation of Tiebout's core ideas.

Critics of Tiebout's theory note that race and income are more likely to determine residential location than pure preference, given that mobility and full information are assumed but not equally distributed among all citizens. Greene (2008) highlights zoning as a way that desirable neighborhoods prevent undesirable residents from entering, thus violating the

self-correcting efficiency mechanism behind Tiebout sorting. By comparing satisfaction with public services across consolidated and fragmented jurisdictions, Kelleher and Lowery (2002) argue that preferences are not as heterogeneous as access to housing markets; satisfaction is more varied, not uniformly higher, in the fragmented setting.

Sorting across school districts is a natural application of Tiebout sorting: there is considerable variation in quality and price (usually in the form of property taxes) and assignment is generally determined by residential placement. Several studies have used sorting across school districts to assess the validity of Tiebout's theory and found positive results. A greater number of districts leads to greater homogeneity of resident populations (Eberts & Gronberg, 1981) and a reduction in allocative inefficiencies by schools (Grosskopt et al., 1998). A greater degree of school choice also reduces private school attendance (Martinez-Vazquez & Seaman, 1985; Uriquola 2005), suggesting that more families are satisfied with their chosen public schools.

In addition to inter-district choice, I posit that Tiebout sorting mechanisms can operate within large urban districts as well, despite their reliance on a common tax base. School quality is known to affect property values within the school catchment area (Bayer et al., 2004a; Black, 1999; Kane et al., 2006), introducing a housing cost/school quality tradeoff that parents must consider when choosing a residence. There is ample evidence that Chicago's public schools differ significantly in terms of quality and that the neighborhoods they reside in are stratified by income, race, education, and other demographics (Breger, 2017). Combined, these facts imply that there is some level of school selection via residential placement occurring in Chicago.

For families living in subsidized housing, however, nearly all of Tiebout's assumptions are violated. Information about different neighborhoods and their resources is generally low (Edin et al., 2012; Marr, 2005) and mobility is extremely limited. Even Housing Choice Voucher

holders are constrained by program requirements like inspections and fair market rent, as well as landlord discrimination. Past evidence suggests these constraints may limit access to quality schools (Ellen & Horn, 2018), which can have significant and long-lasting consequences for children (Heckman et al., 2018; Nikolaev & Rusakov, 2016). Despite ample research on wealthy families (Bayer et al., 2004a; Black, 1999; Holme, 2009; Kane et al., 2006), it remains unclear how subsidized housing residents value school quality, how it factors into their residential decision-making, and how the placement process impacts their satisfaction with their local school. With this paper, I seek to remedy this gap in the literature by analyzing the spatial distribution of elementary schools and subsidized housing, comparing school characteristics across subsidy programs, and seeking the perspectives of residents themselves.

Data and Methods

In seeking to understand how the placement of Chicago's subsidized housing affects the educational experience of elementary students, this paper aims to answer a series of related questions:

1. How are quality schools and subsidized housing distributed throughout the city? How do the density of subsidized housing residents and the quality of available school options intersect with one another?
2. How do the public elementary schools serving children in different types of subsidized housing differ, both from each other and from other city elementary schools?
3. How are families' subjective experiences of elementary education impacted by their geographic location, housing situation, and/or involvement with subsidized housing programs?

The first two questions require geographic and quantitative data on Chicago's subsidized housing developments and public elementary schools. The third requires qualitative data about families' personal experiences.

Quantitative analysis

Data sources.

Elementary school quality ratings and demographic data for 2020-2021 school year come from the Chicago Public Schools website. To link these metrics with subsidized housing placements, I acquired data on Chicago's subsidized rental housing units and elementary school attendance boundaries from the Chicago Open Data Portal. The housing data set contains the development names, types, and locations of all completed privately owned, project-based subsidized housing in Chicago. Developments identified as Senior housing were removed to limit the analysis to units that are likely to contain school-aged children. Additionally, a web scraping tool pulled the locations of Chicago's traditional public housing developments from the Chicago Housing Authority's public website to add the names and addresses of the developments to the housing data set.

Housing Choice Vouchers present more of a challenge, as obtaining exact locations for the homes of individual voucher-holders would violate their privacy. However, the Chicago Housing Authority links to a website, AffordableHousing.com, to help voucher holders locate units that meet the program's affordability and quality standards. The addresses of 1000 listings marked "Experienced with Section 8" as of March 2022 were scraped from the website to build a data set. Though these locations do not reveal exactly where Chicago voucher holders are currently living, they provide an idea of 1) where Section 8 voucher holders have used their vouchers in the past and 2) where the CHA's HCV program is steering future voucher holders,

which is important for developing policy recommendations. In addition, prior research has indicated that steering can be highly influential with regards to housing choices, with both negative and positive effects (Briggs et al., 2010; Edin et al., 2012; McClure, 2010).

Spatial distribution of subsidized housing across elementary school boundaries.

The most basic question of spatial analysis deals with spatial autocorrelation: do like values tend to appear geographically close to each other? Past research indicates that subsidized housing developments are often built within close proximity to each other, and that the highest and lowest performing schools within large urban districts also tend to cluster together (Edmunds 2009).

To assess whether there is clustering of school quality and subsidized housing in Chicago, I calculated a value for each of Chicago elementary school catchment areas corresponding to the density of subsidized housing units, both privately and publicly owned. The HCV program was not included in this analysis as it is a tenant-based subsidy and thus units are not stably assigned to a local school. I computed this density using a count of the subsidized units in each elementary school catchment area, divided by the total number of housing units as recorded in the 2020 Census. Because elementary school boundaries are not always coterminous with Census blocks, housing units from each Census block were assigned to the school catchment area that contains the block's centroid, a commonly used approximation for combining spatial data across different scales (Gotway & Young, 2002).

The densities of subsidized housing in each elementary school zone, along with demographic and achievement metrics published by the Chicago Public Schools, comprised a lattice data set to which spatial autocorrelation statistics could be applied. First, I calculated a global value for Moran's I, which indicates whether positive spatial autocorrelation (clustering of

like values) is present across each metric. Then, I computed local values for Moran's I to detect the location of clusters, following the LISA method pioneered by Anselin (1995) and using conditional permutation to estimate p-values under a null hypothesis of spatial randomness. The significant clusters represent areas where schools similar on a particular metric are unusually geographically close, which indicates a regional pattern of inequality that future policies can address. For instance, schools serving unusually high proportions of students living in subsidized housing may need increased support, while neighborhoods with low proportions of students in subsidized housing may consider constructing additional affordable housing options.

Comparing the elementary schools attended by subsidized housing residents.

Past research at the national level has shown that there are significant differences in the schools attended by residents in different types of subsidized housing, but that the differences vary significantly across metropolitan areas (Gould-Ellen & Horn, 2018). To replicate this research with the latest data from Chicago, I assigned each subsidized housing development and HCV listing to its zoned public elementary school. Then, I calculated Tukey's Honest Significant Difference in means (Tukey 1949) between the three major types of subsidized housing—traditional public housing, privately owned subsidized rental units, and HCV-approved units—on a variety of school quality and demographic indicators. This empirically tests the prediction implied by Tiebout's theory that programs with greater mobility allow residents to select locations with more desirable public services, like education.

Qualitative analysis

Data collection.

Though quantitative data can reveal the characteristics of the elementary schools serving residents of Chicago's subsidized housing, they cannot measure the value families place on these

characteristics or the effect that they have on children's qualitative elementary educational experiences. Qualitative data is needed to contextualize and expand upon the quantitative findings so that the policy implications reflect the perspectives of the households who are served by Chicago's subsidized housing programs and elementary schools.

The qualitative data analyzed in this study come from 4 interviews with parents of children in Chicago public elementary schools. Two live in project-based subsidized housing—one in a privately owned subsidized apartment building and one in a mixed income complex receiving the low-income housing tax credit— and two live in market-rate housing. All perspectives are necessary to assess how the values and experiences of households in regards to education vary across different types of housing.

Interviews were conducted over Zoom video conferencing and lasted about 30 minutes. They were semi-structured in nature: a common set of broad questions about experiences and satisfaction with housing and schools guided each conversation, but participants were asked to expand upon their answers where appropriate (see Appendix C for the basic interview protocol). In exploring how subsidized housing residents with limited mobility make strategic, education-focused housing choices, I extend the work Holme's (2009) similar work with affluent households.

Interview content analysis.

I immediately recorded, transcribed, and de-identified each interview immediately following its conclusion. I retained only relevant demographic data for later analysis. This process began with post-interview memos, which I created directly following each interview to capture major themes. Then, I returned to each transcript to highlight interesting quotes and add notes on how they fit into the theoretical framework pursued in this study. After all interviews

were complete, quotes of interest were then marked with a common set of codes reflecting content heard across multiple interviews. Finally, I aggregated the sections grouped by each code and re-assessed them as a whole. The broad findings that emerged from this final stage structure the analysis that follows.

The interviews in this study qualify as *phenomenological* research in the framework of Creswell (2007); that is, they aim to deduce from multiple participants the fundamental processes underlying a common experience. The process of meaning-making from this qualitative data follows the *content analysis* procedure outlined by Denzin and Lincoln (2002) as suitable for quantitatively driven mixed-methods studies, where semi-structured interviews are used to gather discrete pieces of information from participants that can then be linked across the entire sample.

Findings

I set out to explore how the design and placement of Chicago's publicly subsidized housing programs affects the elementary educational experience for residents. This research question

Spatial analysis revealed that Chicago public elementary schools are clustered not only by achievement level and income, which comports with well-documented residential sorting by neighborhood, but also by the density of subsidized housing that they serve. Schools with catchment areas that include the highest densities of subsidized housing, both publicly and privately owned, tend to serve populations that are less white and lower-income than the city at large and to lie adjacent to similar schools.

Comparing the schools that serve residents of different types of Chicago housing also uncovered a troubling pattern. Residents of public housing attend schools that are lower in achievement and more racially homogenous than the city average. Residents of Section 8

properties fare similarly or attend even poorer schools. These results complicate Tiebout's (1956) prediction that greater residential agency allows households to choose a location that is optimal for their purposes, suggesting that resource and supply constraints are still significant challenges for Section 8 households.

The qualitative interview data supports this assertion. Families with children in CPS elementary schools reported considering the quality and environment of the local school when choosing where to live. They also reported their place of residence as a constraint on the schools they were willing to send their children to; some desirable options were simply too far for parents and/or students to commute. Top neighborhood concerns for all parents included safety and demographic makeup, though preferences regarding the latter were varied. School concerns included the academic offerings, the perceived academic rigor, and the openness of staff to parental involvement. Residents of subsidized housing and one resident of market-rate housing expressed dissatisfaction with their current neighborhoods, but cited a lack of affordable options in other neighborhoods as the main barrier to moving immediately. One resident of market-rate housing revealed a potential mechanism behind this shortage; they expressed distaste for the introduction of new public housing in their neighborhood, viewing it as a sign of deterioration.

Spatial distribution of subsidized housing across elementary school boundaries

Univariate clustering: elementary school quality and subsidized housing.

Chicago elementary schools are spatially sorted according to both demographic and achievement metrics. Univariate global Moran's I values, which measure the degree of spatial autocorrelation across the city's 356 elementary catchment areas, are significant for average reading and math percentile, school quality rating, percent free or reduced price lunch, percent Black and percent Hispanic at the 0.1 percent level under 99,999 conditional permutations. All

values reflect 8 nearest neighbor weights, but the results are robust across a variety of weights specifications (see Appendix A).

Table 1: Values of global Moran's I for elementary school characteristics, 8 nearest neighbor weights

Variable	Global Moran's I	Moran's z-score	Computational p-value on 99,999 permutations
Average NWEA MAP reading percentile, grades 3-8	0.45	17.65	0.00001***
Average NWEA MAP math percentile, grades 3-8	0.433	17.16	0.00001***
Average attendance percentage	0.102	4.17	0.00014***
Percent free or reduced price lunch	0.584	23.48	0.00001***
Percent Black	0.812	32.22	0.00001***
Percent Hispanic	0.775	30.75	0.00001***
Density of project-based subsidized housing	0.125	5.61	0.00061***

**** significant at 0.1% level // ** significant at 1% level // * significant at 5% level*

These values provide strong statistical evidence that Chicago's well-documented racial and economic residential sorting is reflected in its public elementary schools. Despite the limited choice parents have to send their children to schools outside of their neighborhood—by entering into charter school lotteries, for example—elementary schools are still highly stratified according to demographics. This makes sense given the ages of the students; parents reported reluctance to send young children to school alone and difficulty finding the time to make a long commute. A comparison of Moran's z-scores shows that the strongest stratification is by race, followed by

income (as measured by the percentage of students eligible for free or reduced price lunch) and standardized test scores. Attendance rates and the density of subsidized housing are also strongly spatially autocorrelated, though to a slightly lesser degree.

Cluster maps pinpoint where in Chicago this autocorrelation is strongest: where high values are surrounded by other high values and where low values are surrounded by other low value (High-High and Low-Low, respectively, on the map legends). In rare cases, they also show where high values are surrounded by low values and vice versa (High-Low and Low-High, respectively, on the map legends). High-achieving schools are clustered in the North and Northwest parts of the city, while clusters of low-achieving schools appear in the South and West. The patterns for reading and math are roughly the same:

Figure 2: Local Moran's I cluster map of NWEA reading percentile (8 nearest neighbor weights, 1% significance filter on 99,999 permutations)

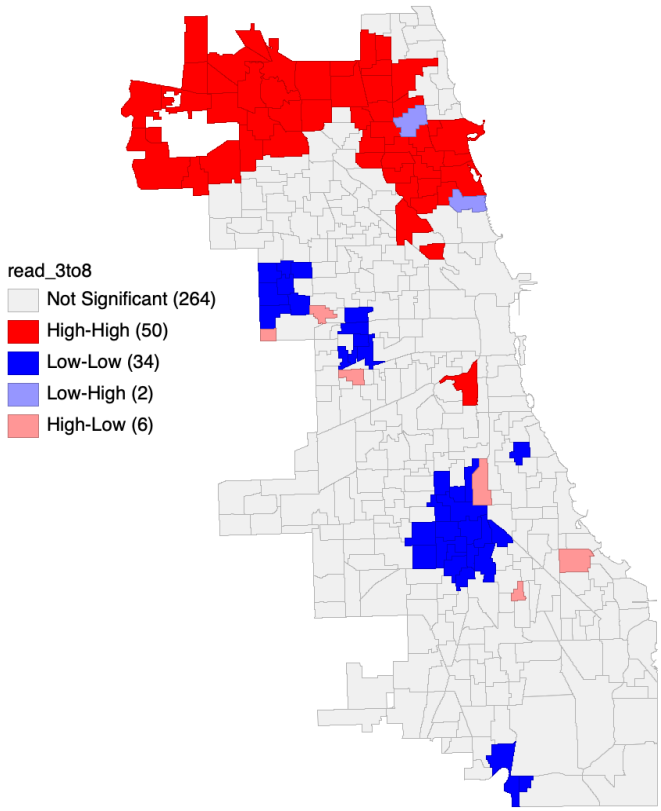
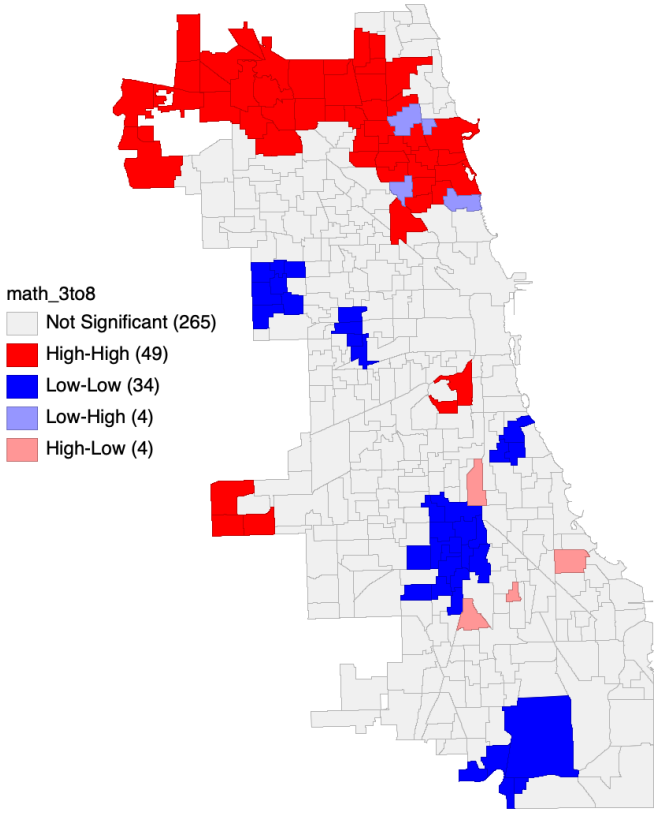
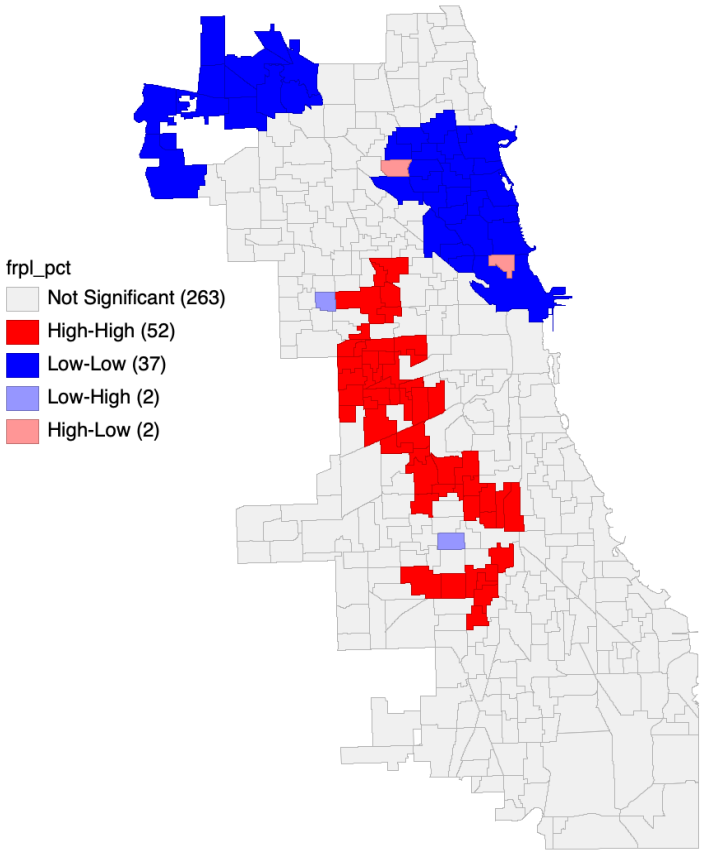


Figure 3: Local Moran's I cluster map of NWEA math percentile (8 nearest neighbor weights, 1% significance filter on 99,999 permutations)



Unsurprisingly, many of the same elementary schools with high standardized test scores serve a high percentage of students who receive free or reduced price lunch, a proxy for low-income status. While this relationship does not prove causality in either direction—student background influencing student scores or school quality influencing the type of families in the area—the mere fact of a correlation is troubling:

Figure 4: Local Moran's I cluster map of percentage free and reduced price lunch (8 nearest neighbor weights, 1% significance filter on 99,999 permutations)



Notably, there is a cluster of low-scoring schools on the Southside that do not classify as a cluster of schools with high percentages of FRPL students, as well as schools in the far North that are high-scoring but have some FRPL students. Nevertheless, the spatial stratification of both of these variables is concerning from a housing policy perspective, as any subsidy program that places a family in a particular neighborhood more than likely determines the quality of the elementary school that their children will attend. Additionally, there is significant overlap between segregation by income and by race:

Figure 5: Local Moran's I cluster map of percentage of Black students (8 nearest neighbor weights, 1% significance filter on 99,999 permutations)

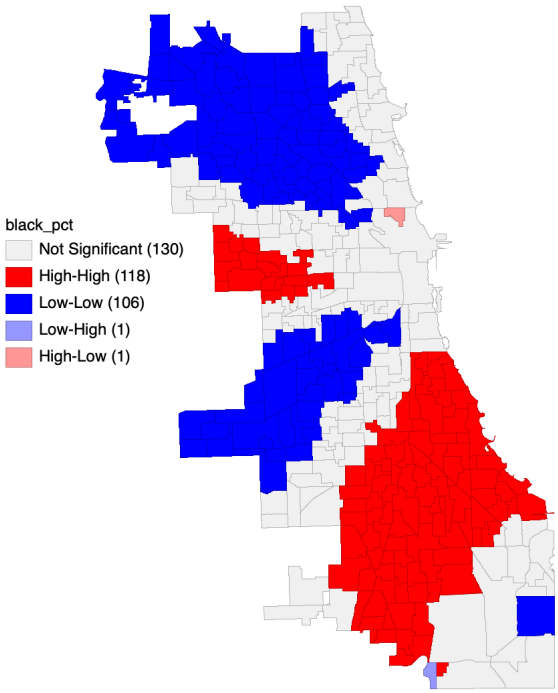
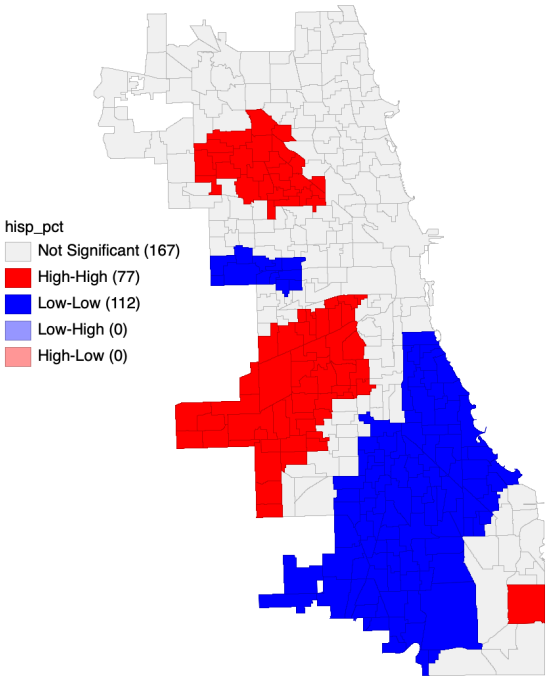
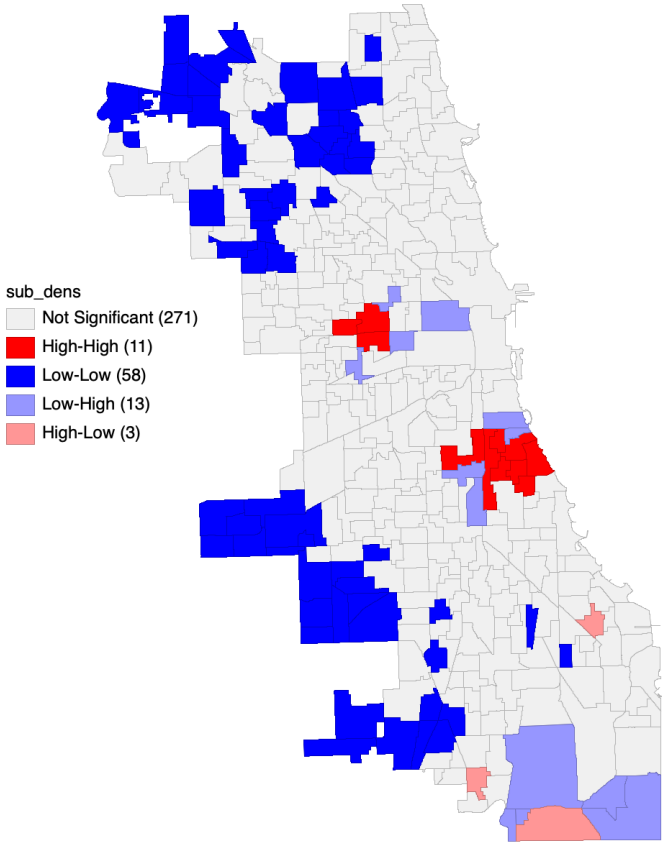


Figure 6: Local Moran's I cluster map of percentage of Hispanic students (8 nearest neighbor weights, 1% significance filter on 99,999 permutations)



The above maps are near mirror-images: schools heavily attended by Black students are nearly mutually exclusive with schools heavily attended by Hispanic students. Additionally, demographically similar schools tend to be located near each other, so that parents seeking a different type of school must commute long distances or physically move their residence. This sorting gives educational opportunity the appearance of a zero-sum game, where school quality is reserved for certain neighborhoods over others. Subsidized housing residents, who lack agency over their place of residence, disproportionately end up in the same schools on the South and West sides with poor standardized test scores and a high percentage of Black students. Meanwhile, the outskirts of the city have little to no subsidized developments:

Figure 7: Local Moran's I cluster map of project-based subsidized housing density (8 nearest neighbor weights, 5% significance filter on 99,999 permutations)



This clustering of schools by race, income, and achievement level is already troubling; past research has found significant negative effects of racial isolation on Black students' academic performance (Kainz & Pan 2014; Mickelson & Heath 1999) and of poverty concentration on school quality (Carnoy & García 2017). The relationship between these variables can be self-reinforcing, trapping schools in a cycle of low achievement and few resources. The question for housing policymakers, however, is whether the distribution of subsidized housing ameliorates or exacerbates this problem in Chicago.

Bivariate relationships.

School catchment areas where high densities of subsidized housing overlap with underperforming schools are of particular interest for policy intervention. If subsidized housing developments are clustered in the same regions that poor quality schools are clustered, then the location of the housing effectively sends children from low-income families to schools that are unlikely to set them up for economic mobility and success as adults. Similarly, if subsidized housing developments, whose residents are majority nonwhite, are clustered around racially isolated schools, then the distribution of subsidized housing is worsening school segregation in Chicago.

There are several areas in Chicago where this compounding effect appears possible. Figures 8-10 show that several of the school catchment areas in the top quartile of subsidized housing density (as measured by the number of subsidized units divided by total housing units) are served by elementary schools that fall in the bottom quartile of standardized test scores. Several also have percentages of Black students and students receiving free and reduced price lunch that fall in the top quartile.

Figure 8: Multivariate quantile LISA map of school catchment areas in the top quartile of subsidized housing density and the bottom quartile of NWEA reading and math percentiles (8 nearest neighbor weights)

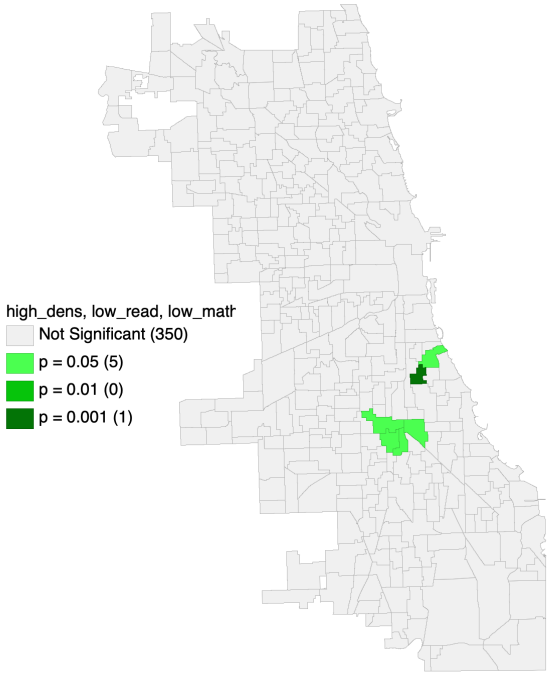


Figure 9: Multivariate quantile LISA map of school catchment areas in the top quartile of subsidized housing density and the top quartile of Black student population (8 nearest neighbor weights)

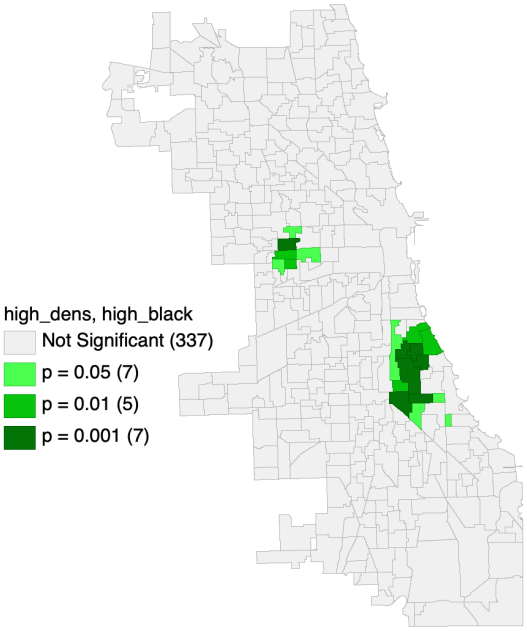
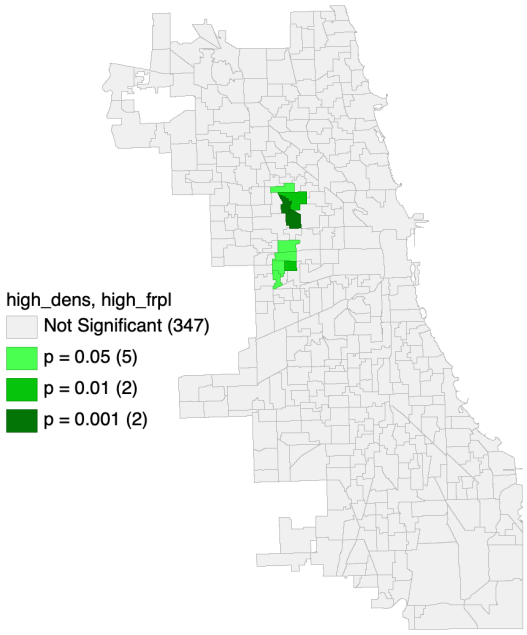


Figure 10: Multivariate quantile LISA map of school catchment areas in the top quartile of subsidized housing density and the top quartile of students receiving free or reduced price lunch (8 nearest neighbor weights)



The bivariate analysis pinpoints the areas where a concentration of subsidized housing may disadvantage both students and schools. Students who already face disadvantages relative to their peers from higher-income households end up disproportionately concentrated in schools that are unlikely to help them advance academically and economically. Schools already struggling to meet proficiency standards with limited resources are further strained by the addition of students who may require increased attention.

In Chicago, the near South and near Northwest regions of the city exhibit the greatest concentrations of disadvantage. Several elementary schools in Garfield Park that are in the top quartile of percentage of Black students and students receiving free and reduced price lunch also have some of the highest densities of subsidized housing. Several schools in Bronzeville,

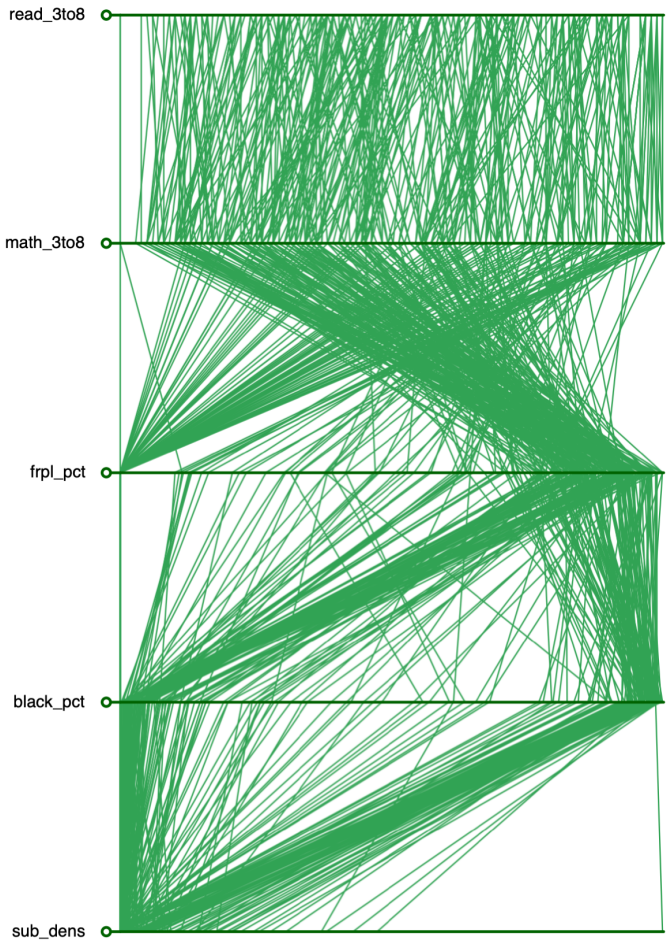
Washington Park, and Englewood in the bottom quartile of standardized test performance have similarly high densities of subsidized housing.

Multivariate clustering.

Multivariate cluster detection reveals where the relationship between several variables—in this case, school characteristics and subsidized housing density—is similar across several contiguous areal units, to a degree that is highly unlikely under a null hypothesis of spatial randomness. It goes beyond the overlap between the variables in individual school catchment areas to highlight regions where subsidized housing density follows or violates larger patterns in demographics and achievement levels. Clusters indicate areas where the density of subsidized housing may contribute to a self-perpetuating cycle of racial exclusion and academic success or segregation and underperformance.

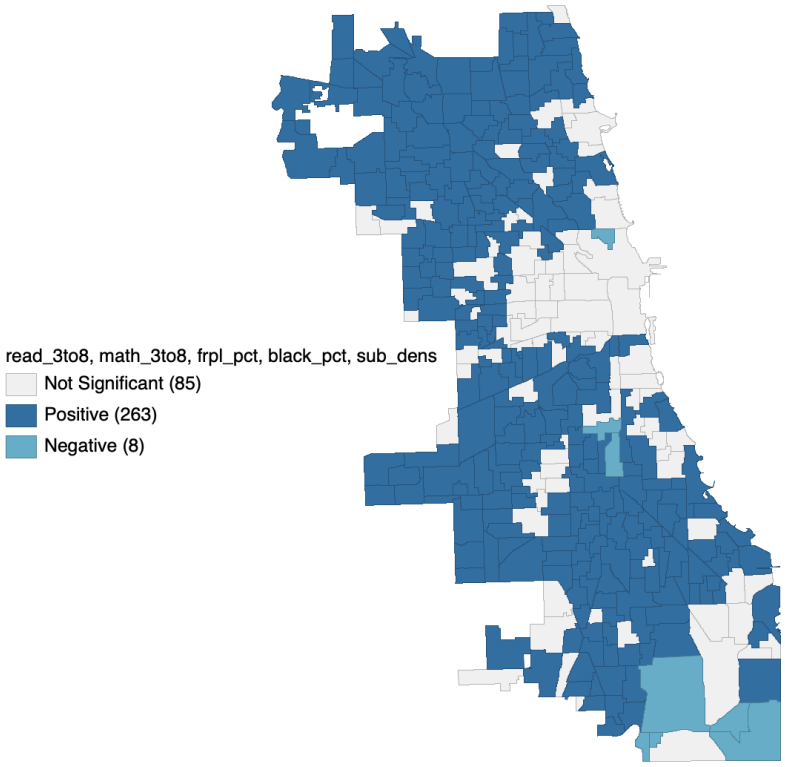
In Chicago, it is clear that subsidized housing density is intimately linked with the demographic makeup of neighborhoods and the pattern of school quality differences seen in the univariate analyses. Adjacent school catchment areas tend to exhibit a similar pattern across five variables: average NWEA reading percentile, average NWEA math percentile, percentage of Black students, percentage of students receiving free and reduced price lunch, and density of subsidized housing. Figures 11 and 12 showcase this clustering both with and without a geographic dimension.

Figure 11: Parallel coordinate plot of NWEA reading percentile, NWEA math percentile, percentage of students receiving free or reduced price lunch, percentage of Black students, and density of subsidized housing (in order, top to bottom)



As expected, reading and math percentiles are highly correlated. The percentage of students receiving free and reduced price lunch and the percentage of Black students are both bimodal, with most schools falling at either the low or high extreme. The density of subsidized housing is very right-skewed, since many catchment areas contain zero subsidized housing developments, but the areas with higher densities almost all have a high percentage of Black students and students receiving free or reduced price lunch. These schools also tend to have lower test scores, though the existence of disadvantaged schools with relatively high test scores is worth further investigation.

Figure 12: Multivariate local Geary cluster map of NWEA reading percentile, NWEA math percentile, percentage of Black students, percentage of students receiving free or reduced price lunch, and density of subsidized housing (8 nearest neighbors weights, 5% significance filter)



Adding the geographic dimension to the multivariate analysis reveals that significant positive spatial autocorrelation of the relationship between all five variables (Figure 11) exists across almost the entire city. This implies that schools that are close to one another also tend to have similar relationships between demographics, achievement, and housing. The wealthy, high-scoring, majority white schools are concentrated in the far north and northwest of the city, where the density of subsidized housing is very low. The South and West Sides have concentrations of majority Black schools with moderate to high densities of subsidized housing and moderate to low standardized test scores. Only the Near North Side exhibits no systematic pattern among its neighboring schools.

Comparing school characteristics across housing programs

The analysis so far has relied on an aggregation of all project-based subsidized housing in Chicago. However, there are important differences between the different subsidy programs in the characteristics of the schools they provide access to. Project-based subsidized housing, such as traditional public housing units and privately owned subsidized rentals, are stably assigned to a certain elementary school, which will serve most of the elementary-aged residents. Section 8 voucher holders, on the other hand, can choose to locate in any residence that meets the criteria of the program, namely an inspection and rent that falls within HUD's Fair Market Rent for the area. Though the Section 8 listings data does not reflect the exact residences of Chicago's current voucher holders, the availability of the "experience with Section 8" filter on the Chicago Housing Authority's affordable housing search engine provides a good indicator of where voucher holders have chosen to locate in the past. In addition, the search engine and filter represent one way the CHA influences residential choice by voucher holders, which makes the location of the listings an interesting area for inquiry in its own right.

If Tiebout's (1956) theory holds, voucher holders should be able to express their preferences regarding public services like education more easily than residents of project-based subsidized housing. For instance, families with young children would be expected to select housing that provides access to desired elementary schools. The choice of variables to analyze is purely theoretical: Tiebout is silent on which characteristics define a desired school. However, past literature and the qualitative interviews analyzed in the following section suggest that standardized test scores and racial makeup are relevant metrics that parents consider when evaluating elementary school options.

The elementary schools serving residents of Chicago's subsidized housing do differ from other schools in several measurable ways. Compared to the citywide average, schools serving residents of all types of subsidized housing have, on average, lower scores in reading and math, higher percentages of students receiving free or reduced price lunch, higher percentages of Black students, and lower percentages of Hispanic students. This comports with the expectation that the budgetary and statutory limitations imposed on residents of subsidized housing undermine their access to high-performing and racially diverse schools.

However, the distinctions between different subsidy programs are somewhat surprising. Privately owned subsidized housing, such as developments built using the low-income housing tax credit, are served by the highest-performing schools, though they still underperform the city average. Schools serving Section 8 listings are not significantly different in terms of performance, but tend to have a higher percentage of Black students and students receiving free or reduced price lunch. Schools serving traditional public housing developments perform at a significantly lower level in reading and math than those serving both private developments and Section 8 listings, and also have a significantly higher percentage of Black students and students receiving free and reduced price lunch than schools serving private developments.

Table 2: Average school characteristics across housing programs.

		Housing subsidy program		
School variable	**Citywide**	**Public housing**	**Privately owned subsidized housing**	**Section 8 listings**
Mean NWEA MAP reading percentile, grades 3-8	54.1	25.1	40.9	36.3
Mean NWEA MAP math percentile, grades 3-8	49.3	18.6	35.9	31.1
Mean attendance	94.6	93.8	94.7	94.6

Percent free or reduced price lunch	78.8	91.5	84.8	89.8
Percent Black	46.5	88.6	73.9	87.7
Percent Hispanic	37.9	6.5	17.7	10.0

See Appendix B for a table of schools missing data.

Figure 12: Comparing average school characteristics across housing subsidy programs.

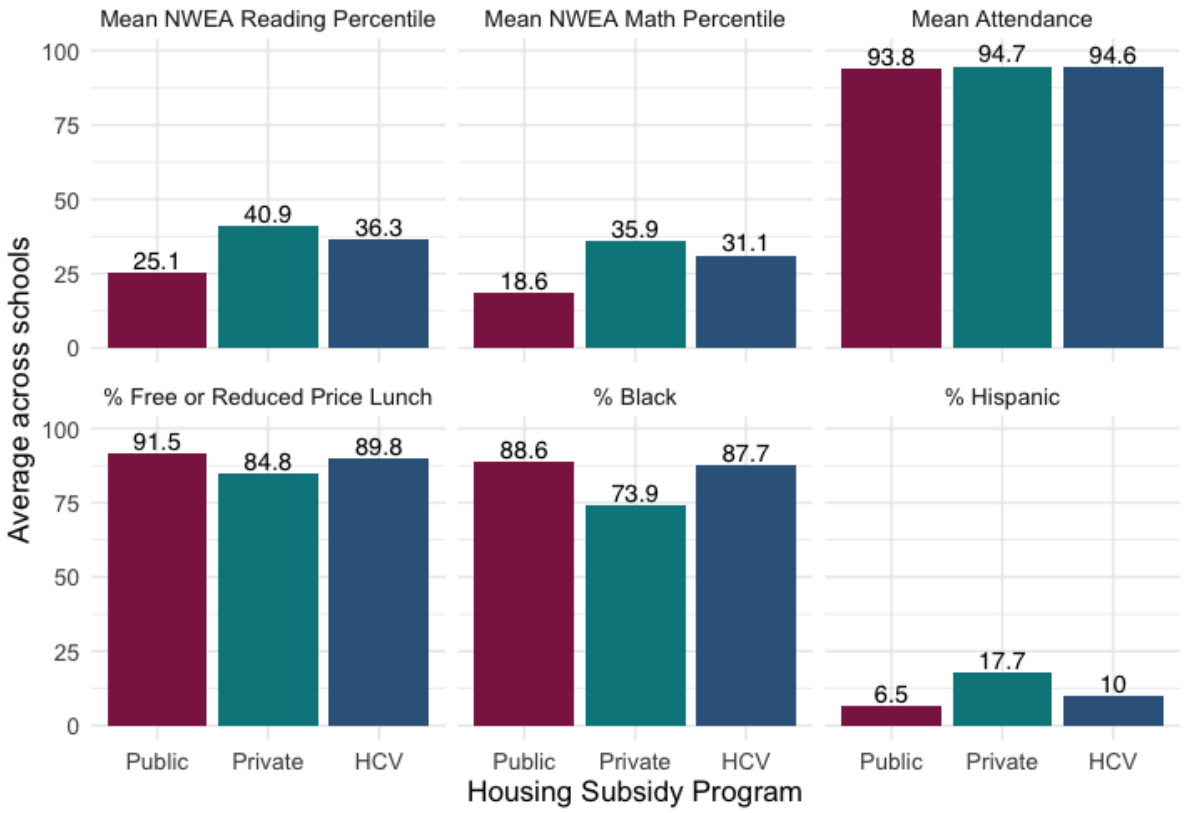


Table 3: Tukey's Honest Significant Difference (Tukey 1949) for multiple pairwise comparisons.

School variable	**Public - Private**	**Public - HCV**	**Private - HCV**
Average NWEA MAP reading percentile, grades 3-8	-15.8***	-11.2***	4.6***
Average NWEA MAP math percentile, grades 3-8	-17.3***	-12.6***	4.8***

Mean attendance	-0.94***	-0.76***	0.17*
Percent free or reduced price lunch	6.7**	1.7	-4.9***
Percent Black	14.7**	0.94	-13.7***
Percent Hispanic	-11.2**	-3.5	7.7***

** significant at the 10% level // ** 5% level // ***1% level. See Appendix B for a table of schools missing data.*

From Table 3, it becomes clear that the main distinction between subsidy programs is not simply project-based versus tenant-based strategies. Traditional public housing is indistinguishable from HCV listings in terms of school demographics and privately managed subsidized housing are slightly better than HCV listings in average student test performance. The residential choice provided by the Section 8 program does not uniformly improve the quality of residents' local elementary school. Rather, the Section 8 program appears to allow residents to selectively choose slightly better schools than they might access without a voucher while remaining in largely poor, racially isolated neighborhoods.

This pattern violates a pure interpretation of Tiebout's theory: an increase in mobility does not necessarily precipitate an increase in the quality of public services accessed. Voucher holders do not enroll in better schools than residents of scattered-site project-based housing, where location is predetermined. There are two potential explanations for this phenomenon. First, the Section 8 program may not provide true mobility; program requirements could restrict the number of available housing units enough that residents are effectively limited to the same neighborhoods where project-based subsidized housing is concentrated. Second, residents may have competing priorities aside from maximizing school quality or diversity when selecting housing. The interviews I conducted with Chicago residents suggest that both mechanisms play a role.

Resident perspectives

The quantitative results reveal patterns in the placement of Chicago's subsidized housing, but qualitative data is necessary to understand how these patterns affect the subjective experience of actual households. I conducted four interviews with parents of children in Chicago's public elementary schools to shed light on this context. Two were parents who live in subsidized housing, while two do not and were included for comparison. Their perspectives demonstrate the strengths and weaknesses of Chicago's subsidized housing programs and suggest points of focus for any future interventions.

In choosing a neighborhood, safety was a top priority for all residents. Cora, a single mom living temporarily in a market-rate apartment, put it simply: "I think [when considering] the best place to raise a child, of course it comes down to safety." Brenda, a single mom living in a subsidized rental unit, remarked "I don't want to move in[to] an area where I can't walk the street at night, or I'm ducking and dodging bullets. I don't want to live like that." She had marked out areas of the city where she would not consider living based on their reputation for violence, despite her limited options.

Despite their common concern, however, there was a sharp distinction between residents and non-residents of subsidized housing in terms of their satisfaction with the safety of their current neighborhood. Ann, a longtime resident of a market-rate house, said her kids feel comfortable in their neighborhood: "If they want to hang out with their friends outside, they can do that." She called the constant presence of other trusted adults "like an indirect Neighborhood Watch." On the other hand, Debbie, a resident of an LIHTC building, wished for a better environment for her children: "My kids are exposed to a lot of stuff, just like coming out [of] the building. Maybe somebody's drunk, maybe somebody's screaming … you just never know." Her

neighborhood, she said, is “predominantly known for violence” and “if I had another choice to move I’d go somewhere else safe, safe for my kid.”

Community came up as a related concern, again with a clear distinction based on housing situation. Ann expressed gratitude for her neighborhood’s community, noting “the saying goes, it takes a village to raise a child, and we're all [] trying to work together to raise many children.” When asked what she would change about her neighborhood given the opportunity, Brenda wished for a similar atmosphere: “I would hope people [would] be a little bit more [] welcoming and friendly…I would hope that the neighborhood can come together.” In the same answer, she pinpointed long-term housing as key factor in building community:

> When you live on a block that has more housing, you know, like homes and things, you tend to see neighbors be a little bit more friendly because that's where they live. That's where they're invested, right? Just having buildings, a bunch of buildings, you got people moving in and moving out … it's like a constant shift and change. So I think just a block with homes and things.

School quality was another main concern for parents, though how it was defined and its importance differed on an individual basis. Ann, Cora, and Brenda all expressed support for gifted programs, which they believed were taught at a much higher level than other classes. One parent especially valued caring teachers for her child, who has an Individualized Education Plan (IEP) for a learning disability. Brenda liked the career preparation provided by her child’s school, noting that the music, art, and drama programs mean that “if they wanted to pursue a career from leaving school, they can go directly into it as they leave the school.” Cora also valued diversity of programming, but acknowledged that there is sometimes a distinction between valuable academic opportunities and “looking good on paper.” Debbie preferred “word of mouth” to

looking for specific programs: “If I haven't heard anything [] about the school, bad reviews or parents talking like, yeah, why can't they go on here?”

Seeking these school characteristics involves tradeoffs, which are often untenable for subsidized housing residents. Though satisfaction with their child’s school did not map neatly to the housing situation of the interviewed parents—Ann and Debbie generally approved of their children’s schools, while Brenda and Cora had more complaints—the level of maneuvering required of the parent did vary by housing type. While Ann described continued involvement in her children’s local school, including personal relationships with teachers and the principal, Brenda and Debbie had to sacrifice involvement and proximity for quality. Brenda sent her daughter to live with her father, whose local school was preferable to hers. After trying for a while to commute with her daughter through “rough” areas, Debbie sent her to live with their grandparents during the week. In contrast, Cora found her neighborhood school acceptable enough to turn down seats at “better schools” because “they’re far away.”

For three of the parents, safety, community, and school concerns combined to incentivize moving away from their current neighborhood. Cora was planning to move of state to be with family, but school quality continued to be a motivating factor: “I know that they have better schools in the district that I'm interested in moving to just because they [] have smaller class size[s than] right now here at [my son’s school].” Debbie described her daughters’ desire to “move in[to] a house.”. For Brenda, safety was the overriding concern:

> I feel like it's time to go. Because now, [] you have a lot of [] all different races up here… and so now it's getting kind of tough with gangs trying to move in the area, shootings happening in the area. And it's just now I have two sons. So before with my daughter it

was fine, but now I have teenage sons that ha[ve] been approached by gang people. So that's not safe for me any longer.

Neither Debbie nor Brenda expected to be able to move, despite their wishes. Brenda described applying to Section 8 for the past 20 years with no luck; she has been on the waitlist since 2015. Debbie has been on the waitlist since 2010. However, both considered themselves lucky to have found their current subsidized units and described the process as relatively seamless. In this way, they both provide examples of the strengths and weaknesses of Chicago's housing subsidies suggested by the quantitative results; though privately owned units provide residents with better neighborhoods and educational opportunities than they might otherwise have been able to afford, residents still want the option to choose their housing to best fit their own individual needs.

As a whole, the interviewees shared a common set of core values—safety, community, and opportunities for their children—but differing circumstances. School quality played a role in their residential decision-making, but it was not the only factor they considered. Sometimes, social ties and access to neighborhood amenities took precedence. Subsidized housing residents found creative ways to reach desired schools, but it required sacrificing involvement and stability in their child's education. Residents of market-rate housing described similar goals and tradeoffs, but exhibited more satisfaction with their neighborhoods and agency over their children's academic trajectory.

Limitations

The main limitation of the quantitative analysis is the incompleteness of Chicago's subsidized housing data. Specifically, the CHA website lacks information about the number of units in some of its public housing developments. As a result the estimation of the density of subsidized housing in each school catchment area is somewhat imprecise; missing unit values

were imputed with the median number of units across all other properties. Still, the vast majority of subsidized housing in Chicago is privately owned, so the effect on overall trends should be small.

Additionally, the list of available properties that are suitable for Section 8 voucher holders is likely incomplete. There are almost certainly voucher holders currently living in properties that are not listed as having "experience with Section 8" on the search engine linked to by the CHA. They may be the first Section 8 tenants residing in the property or their landlord has chosen not to list their property on the website. Thus, the data on Section 8 locations should not be treated as a definitive list of where voucher holders reside. Rather, it is an indication of where (1) voucher holders have lived in the past and (2) where the CHA is steering voucher holders to seek apartments via their website.

On the qualitative side, the sample size presented here is very limited. The perspectives of the parents interviewed reflect only their own individual experiences with Chicago's housing programs and schools and many other perspectives exist. Therefore, their values, opinions, and desires should not be taken as generalizable principles, but rather information that can contextualize the quantitative findings with lived experience. It would be difficult, for instance, to understand why increased residential choice does not necessarily lead to improved school quality without speaking directly with parents of differing means. Each of the interviewees raised different concerns with neighborhoods and schools that add a more realistic depth to Tiebout's simplified model.

Other potential limitations are theoretical. One could argue that subsidized housing should be located where its beneficiaries are already concentrated: generally in high-poverty, racially isolated neighborhoods, which often are served by underperforming elementary schools.

This strategy minimizes relocation costs and preserves ties to community in the short-term, but at a potentially significant long-term cost. Past research on neighborhood effects (Datcher 1982; Leventhal and Brooks-Gunn 2000; Massey et al. 1991; Turner & Gould-Ellen 1997), the Gatreaux pilot in Chicago (Rosenbaum 1995; Rosenbaum et al. 1991; Rosenbaum et al. 2002; Rosenbaum & Zuberi 2010) and HUD's Moving to Opportunity program (Kling et al. 2007; Leventhal & Dupere 2011; Ludwig et al. 2001a; Ludwig et al. 2001b) affirms that moving to neighborhoods with lower poverty levels and higher performing schools raises academic achievement, decreases behavioral issues, improves mental health, and enhances employment opportunities for school-aged children. Though this paper does not provide a normative perspective on which school and neighborhood qualities a family should value, I contend that measures of school-level achievement and demographic makeup provide relevant information about the effectiveness and desirability of Chicago's elementary schools. This assertion is supported by qualitative interviews with parents, who expressed explicit preferences about the quality and composition of their children's schools.

Finally, the findings of this paper do not show that Chicago's subsidized housing is intentionally placed to concentrate children from low-income families in poor or racially segregated schools. Rather, it illustrates that the design of a subsidized housing program has significant implications for the lives of its residents. Program requirements like fair market rent limits and inspections, combined with implicit steering, individual preferences, and market forces reinforce Chicago's existing pattern of residential and school stratification by race and income that previous research has shown is detrimental to the well-being of Chicago's elementary-aged residents of subsidized housing. Countering this cycle requires intentional policy intervention.

Policy Implications

The above findings highlight areas where the CHA and other urban housing authorities can make improvements. Many subsidized housing developments and Section 8 voucher holders are concentrated in racially isolated neighborhoods where housing is cheaper. Residents face long wait times that lead them to accept the first housing that becomes available, regardless of whether it meets their educational needs. These residents then must either accept suboptimal education for their children, endure long daily commutes to alternate schools, or give up their housing subsidy by moving to another neighborhood.

Given that one of the goals of the CHA's housing subsidy programs is to "help low-income families increase their potential for long-term economic success" (Chicago Housing Authority), public elementary schools are a perfect mechanism: they are free for residents to access, require no additional support from the housing authority, and have significant effects on students' long-term economic prospects (Deming et al. 2016; Heckman et al. 2018, Nikolaev & Rusakov 2015). To help residents access quality elementary schools, there are several available strategies: prioritize school quality in housing subsidy program design, allocate future funding toward tenant-based subsidies with greater residential choice, provide proactive, comprehensive, and individualized information to residents in all housing programs, and increase the supply of subsidized housing in stable neighborhoods with quality schools.

Prioritize school quality in housing subsidy program design

The spatial analysis reveals that Chicago elementary schools are spatially clustered by average test scores, race, and income. Subsidized housing of all types is also clustered, with the greatest concentration in the South and West sides. This autocorrelation is unsurprising, given the well-documented residential stratification between Chicago neighborhoods. The issue, from a

program design perspective, is that some of the areas with the highest concentration of subsidized housing are served by some of the lowest performing schools in the city. This is a preventable problem; data on school quality and demographics are readily available. Several parents—residents of both market-rate and subsidized housing—indicated that both of these metrics matter to them. When asked what factors they consider as they evaluate school options for their children, one interviewee emphasized both quality and student population:

> "How it ranks academically. What programs are available so that their education can be [] challenged? … What kind of kids attend these kind of schools? …Are there more kids that are driven to do well, than kids who just have to go to school because it's mandatory?"

Another specifically mentioned the online data on school quality: "The first and foremost [way I judge a potential school] is based on online review and the ratings and the score."

Several metropolitan areas have demonstrated that tweaking program incentives and requirements can improve the quality of schools that residents attend. For the low-income housing tax credit, Gould-Ellen et al. (2015) found that states that explicitly prioritize opportunity neighborhoods (an aggregate measure that includes education, employment, and sociodemographic information) and deconcentrating subsidized developments build a higher share of LIHTC units in low-poverty neighborhoods. For voucher programs, local housing authorities in Baltimore, Buffalo, Columbus, Dallas, Houston, Minneapolis, and Westchester already consider educational opportunities when determining target neighborhoods for their mobility programs (Kurniawan et al. 2020). Chicago's mobility program, however, defines target neighborhoods according only to the levels of poverty and violent crime. Though all interviewees mentioned safety as a top concern when choosing neighborhoods, the quality of the

local school received equal attention and should factor into site selection for the mobility program. At the national level, HUD should make the proportion of families with children that use HCVs near high-performing schools a part of its periodic evaluations of local housing authorities, which determine whether they receive additional funding (Sard & Rice 2014).

A potential barrier to incorporating school quality into housing subsidy programs is local resistance to subsidized developments around high-performing schools. Many parents fear that an influx of low-income students will hurt the effectiveness or perceived quality of their child's school (Holme 2009). Ann indicated dissatisfaction with the construction of new public housing in her neighborhood because she associated it with crime and transience:

> "You hear stories. Well, you know, the police are over that building more. Why are they always there? And then you come to realize, okay, there's tenants there that are not acting appropriately and then you come to realize: Oh, it's a public housing building."

There is some basis for suspecting that subsidized housing can negatively impact local schools. Schwartz et al. (2014) showed that the construction of subsidized rental housing in New York City led to an increase in the cost of education at local schools. However, innovative school-based interventions can alleviate this burden. Massachusetts' 40S law, passed in 2006, provides extra state funding to school districts where new subsidized units are built. This has the double benefit of combating local resistance and helping schools support vulnerable students. Additionally, some parents see school diversity as a positive, as long as it does not seem to negatively impact their child. Several expressed appreciation for the diversity of their children's schools; Ann also remarked "It's so diverse. There's so many languages spoken about. …. And I just never heard of any discrimination or prejudice going on." Schools expecting an influx of residents of subsidized housing should proactively highlight increased racial and economic

diversity as a benefit of new construction, while assuring parents that they will not cut existing programs to accommodate new students. In Chicago as in most large urban districts, increased funding accompanies increased enrollment at an individual school; access to educational opportunity is not a zero-sum game.

Allocate future funding toward subsidies with greater residential choice

The quantitative comparison of neighborhood school characteristics by housing subsidy program and the qualitative interviews present mixed results. On one hand, schools serving privately managed subsidized housing exhibit the highest test scores and lowest concentrated poverty when compared to traditional public housing and Section 8 listings. On the other hand, both of the parents currently living in private subsidized housing remained on the waitlist for Section 8, even after acquiring their current apartments. Debbie cited the program's protections as the reason behind her preference:

> Me: Would you prefer to use a Section 8 voucher over your current housing?
>
> Debbie: Sure, yes.
>
> Me: And why is that?
>
> Debbie: Because here once you move in, it's like your rent is your rent. If you lose your job, you get sick, anything, you still have to pay that same exact rent, they don't go up and down. Versus Section 8, if you lose your job, [] you don't have to pay rent if you get sick or something …. I thought this was a subsidy, but it's [] no subsidy. I still don't understand what it is. But I understand who pays half about right.

It is impossible to draw conclusions about the opinions of all subsidized housing residents based on the perspective of just a few, but it follows that greater choice is desirable regardless of school quality differences. Parents' preferences are varied, while project-based housing programs must

paint with a broad brush. Should the placement of new developments prioritize school quality, or employment access, or something else? Should the housing authority work to maintain cultural communities or deconcentrate poverty? These goals are often in conflict; the easiest way to maximize resident satisfaction is to simply let residents choose for themselves where to use their subsidy.

What is clear is that schools surrounding traditional public housing are struggling, above and beyond the schools serving other subsidized residents. These developments suffer from a legacy of purposeful segregation and aldermanic privilege, which has restricted new developments to areas of already concentrated poverty (Hirsch 1998). Most urban housing authorities, including the CHA, no longer build new public housing developments, and this policy should continue. Political pressures have the potential to result in further concentration of poverty and racial segregation, as wealthier residents exercise their significant political capital to keep new developments out of their neighborhoods. It would be a mistake, however, to demolish existing developments, which would only decrease the supply of affordable housing and destabilize the families who call them home.

Provide proactive guidance to residents in all housing programs

Many studies have found that relocation counseling is effective at encouraging subsidized housing residents to move to areas of greater opportunity (Briggs et al. 2010; Edin et al. 2012; McClure 2010). When counseling targets education specifically, it can have significant impacts on the schools children attend: DeLuca and Rosenblatt (2011) found that one-on-one counseling comparing current schools to better options in Baltimore resulted in moves to schools with mean test scores that were 20 percentage points higher, on average. However, counseling has generally been limited to voucher holders, who have the greatest level of choice over their location.

The qualitative findings suggest that residents of all types of subsidized housing are concerned with local school quality. Brenda lacks the ability to move, given that her housing subsidy is tied to her current apartment, and found her neighborhood school wanting:

> "[The school] isn't really what I really thought it could have been, you know….Their curriculum, in my opinion, wasn't really challenging to my children, and they had a lot of older teachers. And so there were a lot of old ways; in my opinion, the school was just not very active."

However, she also described strategies she uses to enhance her child's educational experience: "I've always been the type of parent that wants to know the teachers, that will have meetings with the teachers, that will let my children know that the teacher and I are together so that we can help strengthen the child. So I've always been an active parent."

Nevertheless, residents of project-based subsidized housing like Brenda are served by schools that are, on average, lower-achieving than the city average. This is suboptimal, both because residents are sorted according to financial means rather than preferences, as in Tiebout's ideal framework, and because it is fundamentally inequitable. Securing a quality education for one's child should not be a privilege reserved for the wealthy.

Therefore, housing authorities should provide information about school quality to residents of project-based housing as well as voucher holders. Especially in Chicago, where parents can exercise school choice from kindergarten through 12th grade, counseling could steer subsidized housing residents toward effective schools, even if they cannot relocate. Brenda lamented that, when she was a young single mother, she did not know about differences between neighborhood schools or how to consider them:

> “I was 22 I think, when I finally moved. And I didn't even know to look into areas that you would live, to find out if this is a suitable area for your children to be, or schools to go to. I didn't know that until after I moved, and then I'm looking in the areas trying to figure out the schools. That's when I learned that you can't go to every school, that there's zip codes, and there are rules.”

To rectify this deficit of information, the counseling process should involve, at minimum, proactive sharing of publicly available school data via online communication and in-person presentations and reminders about school application deadlines. Periodic one-on-one meetings with case-specific residential counselors who can advise their assigned families based on their unique needs would be ideal, but also much more expensive to implement. Counseling is increasingly important as students get older, when parents said that they care more about school quality and children are able to travel further on their own.

Address supply-side constraints to subsidized housing in areas of opportunity

Many parents expressed frustration with the limited availability of affordable housing where they wanted to live. Brenda applied to the Section 8 program six years before she finally was selected to receive a voucher via lottery. Debbie applied in 2010 and is still on the waitlist. Cora similarly had to make compromises to acquire housing in a timely manner, even though she was not limited by a subsidy program: “[My] price range for two bedroom [] didn't leave me with a lot of choices. And this is one of the few that kind of satisfies all the categories that I consider to be important. So that's how I ended up settling in this apartment.” She described her son’s school as “not the best.”

The results corroborate previous research, which indicates that landlord refusal (Marr 2005; Popkin & Cunningham 1999; Popkin et al. 2004; Turner et al. 2002; Yinger 1995), quality

inspections (Briggs et al. 2010; McClure 2010), and a lack of affordable units that meet program price limits (Basolo & Nguyen 2005; Comey et al. 2008) are all significant supply-side barriers for low-income families looking to relocate to low-poverty areas.

At the local level, addressing these barriers should involve disallowing landlord discrimination against housing voucher holders. Incentives for landlords that do accept voucher holders may complement these policies; for instance, Seattle's pilot mobility program for voucher holders promises to repay landlords above and beyond the security deposit should beneficiaries damage the property (J-PAL 2018). In Chicago, landlord discrimination is already illegal, but enforcement is essential. Violations must be reported and then promptly and thoroughly investigated, which requires an accessible complaint process as well as adequate funding. To evaluate the effectiveness of anti-discrimination statutes, the housing authority should also partner with researchers to send rental applications to landlords that vary on characteristics of interest, such as source of income, race, and family composition. The findings from such controlled research can reliably identify problematic areas of the city, sources of discrimination, and (depending on the experimental design) individual landlords who are not in compliance with anti-discrimination laws.

At the federal level, raising the fair market rent allowed by the HCV program in each metropolitan area would increase the units available to voucher holders. Alternatively, providing housing subsidies as direct cash transfers rather than vouchers would ameliorate landlord discrimination by income source by removing the requirement that recipients explicitly identify themselves to prospective landlords. Past research on cash transfers has shown positive effects on food security (Doocy & Tappis, 2017), health, school attendance, and savings (Bastagli et al.

2016). It is reasonable to assume that they could be a similarly cost-effective way to increase housing quality, with the added benefit of increased accessibility and agency for beneficiaries. However, changing HUD rules to alter the design of the national Section 8 program represents a much larger scale of intervention than the analysis in this paper can justify.

Each of these policy recommendations are complementary. Prioritizing school quality in housing subsidy design entails a focus on scattered-site and tenant-based housing over traditional public developments and suggests a role for residential counseling to rectify information deficits about the school choice process. Additionally, none of these moves will be effective in reducing spatial stratification and educational inequity if the supply of affordable and subsidized housing in neighborhoods with quality schools remains extremely limited. Only an approach that integrates school data into housing policy design, centers the preferences of individual families, and provides them with the information and financial support that they need can successfully make Chicago's housing subsidies work for public school students.

Conclusion

This paper aimed to extend Tiebout's contention that greater residential mobility leads to greater satisfaction with public services in an understudied realm: the experiences of Chicago's subsidized housing residents with elementary schools. The quantitative results revealed that subsidized housing residents attend schools that are lower-achieving and more racially homogeneous than the city average. In addition, some of the city's lowest performing schools serve the highest densities of subsidized housing residents, as measured by the percentage of subsidized units in their catchment areas. This result comports with follow-up research on Tiebout's theory that suggests spatial sorting across jurisdictions occurs primarily by socioeconomic means rather than preferences, which are relatively homogenous.

However, the breakdown by subsidy program is somewhat surprising: Section 8 voucher holders (or, more accurately, the apartment listings designated as having housed voucher holders in the past) are the most spatially clustered, despite their freedom of movement. They are heavily concentrated on the city's South and West sides. While far less numerous, project-based housing developments are more dispersed throughout the city, though the highest density remains in the Near South Side. This pattern helps explain the comparison of school quality by housing program; Section 8 apartments are served by schools that are *worse,* on average, than privately owned project-based developments. They also tend to have a higher proportion of low-income and Black students.

What can explain this surprising result? Qualitative perspectives shed some light on the mechanisms behind the continued concentration of subsidized households around under-resourced schools, even when they are provided greater residential choice. For one, schools are not the only factor parents consider when choosing a home; neighborhood characteristics like safety and proximity to amenities matter as much or more, depending on the individual. Parents may also trade off living near family and friends with longer commute times to more desirable schools; residents and non-residents of subsidized housing alike expressed skepticism about attending "the neighborhood school" and reported seeking out desired academic programs for their children. Still, many were currently or have been "stuck" in undesirable schools for considerable periods of time, since better options were too far away. Almost universally, parents expressed a desire to move to a better, safer neighborhood in the future, though few thought that moving soon would be possible given their budget constraints.

From both the quantitative and qualitative results, it is clear that Chicago's subsidized housing programs are not providing all of their residents with access to quality neighborhoods

near quality schools. Even residents of market-rate housing cannot always secure educational opportunities that align with their preferences due to spatial stratification of schools by quality and demographics and budgetary constraints. This points to a way to expand educational opportunity: provide more subsidized housing options in high-opportunity areas. In the short-term, while Section 8 waiting lists remain years long and most tenants are served by poor schools, this should involve project-based developments that are not as dependent on federal funds, such as low-income housing tax credit construction near quality schools. In the long-term, it is imperative to transfer resources to tenant-based subsidies, loosen their restrictions in targeted opportunity areas, and enforce their acceptance by all landlords to decrease the amount of people on the waiting list while increasing the opportunities available to residents. A child's opportunity to attend a quality school should not depend on where they happen to grow up; but until that goal becomes a reality, housing subsidy programs must recognize the importance of place.

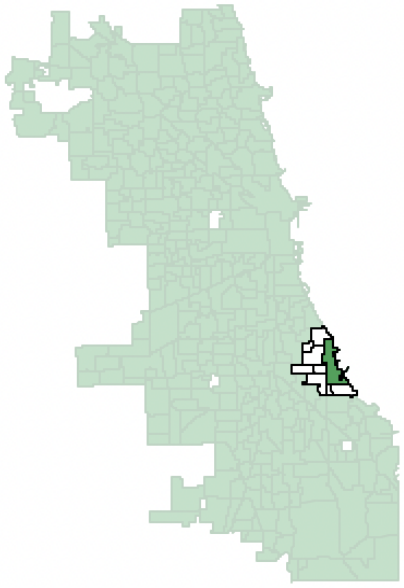
Appendix A: Sensitivity Analysis

Sensitivity of global spatial autocorrelation of 4 selected school variables to 3 different spatial weights specifications. All calculations are with 99,999 permutations.

Variable	**Weight**	**Min/Mean/Max Neighbors**	**% nonzero**	**Global Moran's I**	**z-score**	**P value**
Average NWEA MAP reading percentile, grades 3-8	8 nearest neighbors	8 / 8 / 8	2.27%	0.45	17.7	<0.001
Average NWEA MAP reading percentile, grades 3-8	Queen contiguity	2 / 5.6 / 11	1.60%	0.49	15.2	<0.001
Average NWEA MAP reading percentile, grades 3-8	Distance band 8000	1 / 11.4 / 24	3.24%	0.44	17.2	<0.001
Percent free or reduced price lunch	8 nearest neighbors	8 / 8 / 8	2.27%	0.58	23.5	<0.001
Percent free or reduced price lunch	Queen contiguity	2 / 5.6 / 11	1.60%	0.66	20.7	<0.001
Percent free or reduced price lunch	Distance band 8000	1 / 11.4 / 24	3.24%	0.62	24.6	<0.001
Percent Black	8 nearest neighbors	8 / 8 / 8	2.27%	0.81	32.2	<0.001
Percent Black	Queen contiguity	2 / 5.6 / 11	1.60%	0.83	25.8	<0.001
Percent Black	Distance band 8000	1 / 11.4 / 24	3.24%	0.79	30.7	<0.001
Density of project-based subsidized housing	8 nearest neighbors	8 / 8 / 8	2.27%	0.13	5.6	<0.001
Density of project-based subsidized housing	Queen contiguity	2 / 5.6 / 11	1.60%	0.15	5.4	0.0010

Density of project-based subsidized housing	Distance band 8000	1 / 11.4 / 24	3.24%	0.13	5.7	0.0013

Changes in weights specifications do not significantly alter the value of Global Moran's I nor its significance; highly significant positive global spatial autocorrelation appears across all four variables regardless of the weights used. Only subsidized housing density changes significance levels between weights specifications, but this is a product of the fact that the p-value is near the arbitrary 0.1% threshold rather than large changes in the Moran's z-score. I proceed with 8 nearest neighbors weights to pursue a middle ground between sparsity (as in the queen contiguity weights, where only 1.60% of all possible pairs are neighbors) and over-generalizing (as in the distance band weights, where 3.24% of pairs are neighbors). Under this specification, each school's characteristics are compared to those of the 8 nearest schools. The set of neighbors is determined using the distance between the centroids, or average points, of adjacent school catchment areas. For example, the following map shows the neighbors of the Hyde Park/Jackson Park school catchment area:



Appendix B: Data Quality

Schools missing data on each variable for the 2019-2020 school year

Variable	Number missing data	Schools	Reason
Mean NWEA MAP reading percentile, grades 3-8	3 out of 356	Ogden, Alcott, and Ortiz de Dominguez	Ortiz de Dominguez only serves grades K-2 (no testing). Alcott and Ogden unknown
Mean NWEA MAP math percentile, grades 3-8	3 out of 356	Ogden, Alcott, and Ortiz de Dominguez	
Mean attendance	2 out of 356	Ogden and Alcott	Unknown
Percent free or reduced price lunch	1 out of 356	Ogden	Unknown
Percent Black	1 out of 356	Ogden	Unknown
Percent Hispanic	1 out of 356	Ogden	Unknown
Density of project-based subsidized housing	0 out of 356*	None	Unknown

** to my knowledge at the time of writing, though this assumes the public and subsidized housing development lists provided by the Chicago Housing Authority and the Chicago Data Portal are complete. 226 catchment areas have a density of 0.*

Appendix C: Interview Guidelines

First, a few quick demographic questions:

1. How do you identify your gender and race?
2. What is your current housing situation?

Next I have some open-ended questions:

3. Can you tell me a little bit about your background and your family?
    a. How many children do you have, and what level of school are they in?
    b. Can you tell me about your educational background?
4. How did you find your current housing?

    Follow-up questions if not addressed:

    a. How many housing options did you consider before settling on this location?
    b. What factors did you consider in choosing the location?
    c. How was the process of finding housing? Did you run into any difficulties?
    d. Did moving to your current housing involve any significant changes from your previous housing?
5. How do you feel about your current neighborhood?

    Follow-up questions if not addressed:

    a. To what degree is it similar or different from your previous neighborhood[s], if you have lived elsewhere?
    b. How do you feel about your current neighborhood as a place to raise a child?
    c. How does your child feel about your neighborhood, if they have an opinion?
    d. Are there any characteristics of your neighborhood that you would change?
6. How do you feel about your child's elementary school?

Follow-up questions if not addressed:

a. Do you feel involved in the educational process?

b. What are the teachers like?

c. What are the other students like?

d. Do you feel like the school has high expectations for its students?

e. Do you feel the school is preparing your child for success?

f. How does your child feel about their school, if they have an opinion?

g. Are there any characteristics of your child's elementary school that you would change?

7. Is there anything you would like me to know that we haven't addressed?

Appendix D: Reproducibility

All files needed to reproduce the quantitative portion of the above analysis—including cleaned raw data files, R scripts, and data files created/joined specifically for this paper—can be found in a Box folder at this link:

https://uchicago.box.com/s/8d7lbgcuppauktsw5r655ciyqg42nmld

Creating a file of elementary school data

1. Combine school_race_data.xls, school_demo_data.xls, and school_ratings.xls (all from the Chicago Public Schools website) using create_school_dataset.R

Creating files of subsidized housing data

1. Use public_housing.R to scrape the Chicago Housing Authority's website for addresses of traditional public housing developments and use Google Maps API to add latitude and longitude coordinates
2. Use private_housing.R to clean the Chicago Data Portal's file, private_housing_raw.csv, into private_housing.csv. Combine public and private project-based housing into all_project_based.csv
3. Use section_8.R to clean the scraped addresses in section_8_addresses.xls and apply Google Maps API to add latitude and longitude coordinates, outputting section_8.csv. Combine all housing subsidy types into all_housing.csv

Calculating subsidized housing density

1. Use Geoda to create block_centroids.shp from chicago_blocks.shp, from the 2020 Census
2. Use Geoda to spatially assign each block centroid and its accompanying housing unit data from block_centroids.shp to the appropriate elementary school catchment area in WGS84_elemboundaries.shp

3. Use calc_housing_density.R and spatial_assign_schools.R to spatially assign each housing development in all_project_based.csv to the appropriate elementary school catchment area in WGS84_elemboundaries.shp and calculate an aggregated count of total subsidized units in each catchment area.
4. Calculate sub_dens variable by dividing subsidized units by total number of units.

Compare school characteristics across housing subsidy programs

1. Use spatial_assign_schools.R to spatially each housing unit in all_housing.csv to the appropriate school catchment area in WGS84_elemboundaries.shp
2. Use comparison_figures.R to generate visual and statistical comparisons in school characteristics between subsidy programs

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