

# The Effects of Gentrification on Neighborhood Public Schools

Micere Keels\*  
*University of Chicago*

Julia Burdick-Will  
*Brown University*

Sara Keene  
*Cornell University*

Gentrification is generally associated with improvements in neighborhood amenities, but we know little about whether the improvements extend to public schools. Using administrative data (from spring 1993 to spring 2004) from the third largest school district in the United States, we examine the relationships between gentrification and school-level student math and reading achievement, and whether changes in the composition of the student body account for any changes in achievement. After testing several alternative specifications of gentrification, we find that, in Chicago, gentrification has little effect on neighborhood public schools. Neighborhood public schools experience essentially no aggregate academic benefit from the socioeconomic changes occurring around them. Furthermore, they may even experience marginal harm, as the neighborhood skews toward higher income residents. For the individual student, starting first grade in a school located in a gentrifying neighborhood has no association with the relative growth rate of their test scores over their elementary school years.

## INTRODUCTION

Improved public services—street repair, sanitation, policing, and firefighting—are often listed as benefits of gentrification (Freeman 2006). However, we know little about whether neighborhood public schools, a critical public amenity, also benefit from being located in revitalizing neighborhoods, or whether the children of low-income families that remain in gentrifying neighborhoods benefit from any public school improvements. The scant research on the relationships between gentrification and schools is limited. Some examine a single gentrifying neighborhood and its associated schools (DeSena 2006; Hall 2007), while other studies examine a single school in a gentrifying neighborhood that was selected because the student population was undergoing change (Cucchiara and Horvat 2010; Hassrick and Schneider 2009). These approaches make it difficult to generalize

\*Correspondence should be addressed to Micere Keels, Department of Comparative Human Development, University of Chicago, 5730 S. Woodlawn Ave, Chicago, Illinois 60637; micere@uchicago.edu.

about the association of gentrification with school-level achievement of students, and whether any increases in achievement are simply due to the replacement of low-income with middle-income students.

In this article, we use system-wide administrative data from the Chicago Public School (CPS) district to explore what happens to the achievement levels of low-performing, high-poverty, neighborhood public schools when the neighborhood undergoes revitalization, and whether any observed increases in achievement can be explained by changes in the composition of the student population. Specifically, we explore three research questions. First, given the substantial gentrification that has occurred in many Chicago neighborhoods, what are the aggregate relationships between changes in neighborhood socioeconomic composition and third grade achievement in Chicago's neighborhood public elementary schools? Second, to what extent can any such observed relationships be explained by changes in the composition of the student body; that is, is school-level achievement increasing because students from more advantaged families are enrolling? Third, do low-income students who start first grade in neighborhood schools in gentrifying areas have a steeper rate of growth in their reading and math skills than students who start first grade in public schools located in neighborhoods that are not undergoing gentrification?

## NEIGHBORHOOD EFFECTS OF GENTRIFICATION

By the 1980s, there was substantial movement of higher socioeconomic status (SES) residents into depopulated urban neighborhoods that had suffered from crippling disinvestments. The trend increased during the 1990s and has continued into the first decade of the new millennium (Brueckner and Rosenthal 2009; Smith 1996). The resulting neighborhood economic revitalization is associated with improvements in amenities, such as health services, retail stores, housing quality, and lower crime (Freeman 2006; Kennedy and Leonard 2001). The changing neighborhood socioeconomic composition also has direct and indirect implications for the achievement level of neighborhood public schools.

The most direct effect would be through an increase in the proportion of students from higher income families, who are more likely to have higher test scores, thereby increasing the average achievement level of the school (Kahlenberg 2001). More indirectly, aggregate increases in the education, occupational status, and income of a neighborhood's residents would positively affect children through improved neighborhood institutional resources, increased collective socialization, and contagion effects (Ellen and Turner 1998; Jargowsky et al. 2005; Jencks and Mayer 1990; Leventhal and Brooks-Gunn 2000; Sampson et al. 2002). Taken together, schools located in gentrifying neighborhoods should show increasing aggregate levels of student achievement, resulting from: (1) the higher achievement of students from middle-income families, and (2) the increasing achievement of students from low-income families.

However, not all residents, and primarily not the remaining low-income residents, are able to share equally in this economic revitalization. Neighborhood effects theories that emphasize competition for resources and relative deprivation remind us that higher SES families are better situated to take advantage of neighborhood opportunities, particularly when considering competitive social processes such as academic achievement (Johnson 2008; Turley 2002). Research shows that low-income residents in gentrifying

neighborhoods tend to report no change in subjective neighborhood quality, and have even shown evidence of harm (Atkinson 2002; Vigdor 2002). For example, Barrett et al. (2008) found a negative association between economic growth in gentrifying neighborhoods and the health of the low-income residents. Specifically, economic growth was associated with an increased risk of distant metastasis at diagnosis of breast cancer. Barrett and colleagues concluded that, in part, neighborhood economic growth disrupts low-income residents' access to low-cost health care, as more costly service providers provide an increasing share of the neighborhood's health care. The extent to which this occurs with access to the myriad of public and private educational opportunities in a neighborhood is unknown.

## GENTRIFICATION AND THE PUBLIC SCHOOL

Given the rhetoric of the back to the city movement, which includes a middle-class desire for urban culture and diversity, the idealized gentrification scenario is one in which gentrifying families enroll their children in the local public school, where they interact with children of low-income residents and learn from each other (Cucchiara and Horvat 2010; Kahlenberg 2001). In addition, gentrifying and original parents socialize at school functions and PTA meetings, leading to a transfer of information and ideas. Furthermore, gentrifying parents use their economic, political, and social resources to improve the quality of the education in the neighborhood's public schools.

The reality is often different, however, as many gentrifying families do not have school-aged children and those who do have nonneighborhood public and private school options. Kennedy and Leonard (2001) reviewed much of the existing literature and found that, in the majority of cases, gentrification is not associated with school improvement. This is because many of the artists, young professionals, empty nesters, and gay and lesbians credited with initiating gentrification are childless households, and thus have little incentive to focus on improving schools. Furthermore, gentrifiers with children have a high likelihood of using their economic, political, and social resources to send their children to magnet or charter public schools, or private schools, oftentimes outside the neighborhood.

Given current evidence on the processes by which middle-income urban parents select schools, the more likely scenario is one in which low-income children continue to predominate in the majority of neighborhood public schools, and these schools remain uninfluenced by gentrifying families (Kimelberg and Billingham 2012). In her ethnographic account of one Brooklyn community in New York, DeSena (2006) found that both middle- and low-income mothers were concerned with securing a good education for their children. However, low-income mothers chose between public and private schools within the neighborhood, while middle-income mothers focused on securing slots in schools outside of the neighborhood (despite similar quality schools within the neighborhood). Such actions reinforce stratification within the community and reduce any effect of gentrification on the composition or achievement of local public schools.

Hall (2007) examined the effects of gentrification on public schools in Chicago's Bronzeville community, a historically African American community. Between 1990 and 2000, Bronzeville experienced black gentrification, a substantial rise in median income, and improvements in the housing stock. However, despite the opening of new

neighborhood schools, there was little to no change in the overwhelmingly low-income population of students that attended the old and new public schools within the neighborhood. Furthermore, parent and community members' assessments of the quality of both the old and new schools remained low.

This leads some to hypothesize indirect benefits of gentrification, where even without the incentive of having children attending local schools, gentrifying families invest in them and in other public neighborhood institutions out of civic-mindedness or self-interest in property values or planning for the schooling needs of their future children (Kennedy and Leonard 2001). Further, as noted above, the increasing presence of higher SES families in the community can lead to other types of neighborhood change that could indirectly affect the achievement of the neighborhood's low-income children (Formoso et al. 2010). These might include shifts in neighborhood educational norms, increased safety, and improved childcare or after-school opportunities.

The final gentrification scenario is one of direct and indirect harm to the children of low-income families. A set of recent studies on urban schools that experienced an influx of middle-income students examined how the remaining low-income students fared (Cucchiara 2008; Cucchiara and Horvat 2010; Hassrick and Schneider 2009; Posey 2012). These studies suggest that there may be tipping points after which the number of middle-income students begins to harm the remaining low-income students. Because urban schools view middle-income parents as sought-after constituents, they give these parents disproportionate influence over school policies and actions. In addition, middle-income parents are better positioned to make demands that teachers provide *their* children with academic and disciplinary advantages that are not necessarily conferred on all children in the school (Cucchiara 2008; Cucchiara and Horvat 2010; Hassrick and Schneider 2008). Low-income children are further disadvantaged when middle-income families band together to attract more middle-income children into the school, pushing out lower income children. Middle-income parents often desire a similarly socioeconomically situated peer group for their children, and believe that attracting such families into the school would further increase the school's overall resources and political clout (Cucchiara and Horvat 2010; Posey 2012). Essentially, increasing the fraction of middle-income families may increase the school's aggregate cultural, economic, and social capital, but at the student level, within-school inequality may be exacerbated.

## SCHOOL CHOICE

The school choice policies of most large urban school districts and the availability of private schools have eroded the relationship between neighborhood of residence and school of attendance (Bielick and Chapman 2003). In general, research shows that higher educated, higher income, and nonminority parents are more likely to exercise school choice options (Lauen 2007; Teske and Schneider 2001). Burgess et al. (2004) found that, conditioning on neighborhood sorting, postresidential sorting into different quality schools correlates with the degree to which the school system allows choice. Other researchers have found that this postresidential segregation extends to ability sorting, such that the more choice there is in the public school system, the higher the level of school-based versus neighborhood-based segregation of students by achievement level (Epple and Romano 2003; Nechyba 2003, 2004). In sum, cities with school systems that have

numerous choice options have schools with higher levels of economic, ethnic, and ability segregation than the levels in the neighborhoods in which children reside. These school choice findings suggest that gentrifying families with school-aged children will have many choices other than the local neighborhood school, and a high likelihood that they will exercise those choices.

## SCHOOL CHOICE IN CHICAGO

The CPS system is composed of a varied mix of neighborhood assignment schools, nonability-based choice schools, and ability-based choice schools that are quite segregated by income and race/ethnicity. The overwhelming majority of Chicago's middle-income and white families long ago opted out of the public school system entirely; CPS is more than 90 percent low income and less than 10 percent white. The students from middle-income and white families remaining in the system are clustered in nonneighborhood schools. In the 2009–2010 academic year, there were approximately 481 elementary schools, and 395 were traditional schools with neighborhood attendance boundaries (based on CPS listing of schools). The ability-based choice schools were approximately 60 percent low income and 20 percent white, compared to about 89 percent low income and 9 percent white in neighborhood schools, and about 89 percent low income and 4 percent white in nonability-based choice schools.

To pull higher income families back into the public school system, in fall 2004 CPS implemented an aggressive set of school choice policies under its “Renaissance 2010” initiative. Approximately 7 percent of CPS's elementary students were enrolled in magnet, gifted, or charter schools in the 1990–1991 academic year, and this doubled to approximately 14 percent by the 2010–2011 academic year. Some argue that Chicago's expanding school choice policies and the use of magnet schools as real estate anchors in gentrifying neighborhoods may lead to differing access to high-quality public schools among low- and high-income children residing in the same neighborhood (Lauen 2007; Lipman 2002).

## DEFINING AND MEASURING GENTRIFICATION

There are many ways to define and measure gentrification, and variation in the criteria and the level of stringency used to measure gentrification has significant effects on the number and location of areas considered to have gentrified (Galster and Peacock 1986). Scholars have measured gentrification with various combinations of a neighborhood's proportion black, proportion college-educated, real incomes, real property values, proportion of professionals, household characteristics (e.g., single and childless), proportion of homeowners or of long-term residents, and change in the “character” of the neighborhood (Galster and Peacock 1986; Griffith 1996; Kennedy and Leonard 2001; Levy et al. 2006; London et al. 1986; Taylor and Puente 2004). Variation in the definition and measurement of gentrification reflects contestation over the meaning and processes of gentrification itself.

Although there is consensus that changes in income and property values are defining features of gentrification, there is considerable ambiguity surrounding whether displacement versus replacement of the lowest income residents occurs, and whether racial/ethnic change is a defining feature. Regarding displacement versus replacement,

current best evidence shows that gentrification is the result of a shift in the normal pattern of residential turnover, rather than the active pushing out of low-income residents (Freeman 2005; Freeman and Braconi 2004; Vigdor 2002). As the neighborhood's low-income residents move, (1) they are less likely to relocate within the neighborhood, and (2) they are more likely to be replaced by higher income rather than by similarly low-income households.

Most emphasize a racialized view of replacement, with middle- and upper-income white households displacing lower income, minority households (Elmelech 2004; Kennedy and Leonard 2001; Lipman 2005; Massey and Denton 1993; Wyly and Hammel 2004). However, reexaminations of gentrification in U.S. cities have shown that middle-income black homeowners have been a gentrifying force, effectively displacing low-income black households (Bostic and Martin 2003; Pattillo 2008; Taylor 2002). These findings add nuance to the simple picture of concomitant racial/ethnic and SES turnover.

After testing several alternative specifications, we settled on a categorical and a linear method of measuring gentrification. The categorical measure allows us to use an empirical definition of gentrification that is grounded in the Chicago data, and has been used by several researchers and policy groups (Mir and Sanchez 2009; Pattillo 2008). The linear method uses percent change in census indicators of SES to approximate the extent of gentrification. This approach allows for a more precise estimation of the effects of socioeconomic change. Acknowledging the continued debate about whether the racial/ethnic characteristics of the gentrifiers matter, we also examine the extent of concomitant racial/ethnic change.

## METHOD

### DATA

Our research analyzes CPS student-level administrative data obtained from the Consortium on Chicago School Research for students in neighborhood elementary schools. The data span the 1992–1993 through 2003–2004 academic years. The one-mile radius surrounding the school is used to define each school's neighborhood rather than the official attendance area in order to minimize errors from ad hoc changes to schools' catchment areas. Even though neighborhood schools have an officially defined local attendance boundary, if enrollment declines, students in overcrowded schools from other neighborhoods can be bussed in. This is particularly relevant for schools in gentrifying neighborhoods, as research shows that CPS schools in the fastest-growing census tracts had sharp drops in the fraction of students who were from the local attendance area (Weissmann 2002). In addition, the one-mile radius maps on to the one-mile grid used to plan the city of Chicago. Each mile encompasses eight blocks. Neighborhood characteristics refer to 1990 and 2000 census data, with census tract data normalized to 2000 tract boundaries based on the Neighborhood Change Database (Geolytics 2003). We replicated all analyses using a half-mile radius, and using only the census tract in which the school is located, and the pattern of relationships remained the same.

During the 1992–1993 academic year, CPS had 454 neighborhood elementary schools.<sup>1</sup> Our analyses include 398 neighborhood schools. We excluded 31 schools because they closed before the end of our time period; this includes schools that were closed and

reopened as charter or other nonneighborhood schools. We excluded 25 schools because they did not serve third graders. No schools were excluded because of missing neighborhood data.<sup>2</sup>

## DEPENDENT VARIABLES

Our dependent variables are third grade students' annual reading and math scores. These are measured as average normalized standard scores from the subtests of the Iowa Test of Basic Skills (normalized ITBS score).<sup>3</sup> We use third grade test scores because we believe that any effects of gentrification on schooling will first become evident among children in the earliest grades, versus children in higher grades who may have completed several years of schooling before the neighborhood began experiencing gentrification. Third grade is the earliest grade in which standardized testing occurs. Our time series ends in spring 2004 because of changes in the test that make it difficult to compare earlier test scores with those in later years.

## INDEPENDENT VARIABLES

As stated above, we use a categorical and a linear method of measuring gentrification. The categorical method of measuring gentrification is based on Taylor and Puente's (2004) work on gentrification in Chicago. A neighborhood is considered to have gentrified during a given decade if it undergoes at least two of the following: 9 percent increase in the percent of residents with a college education, 29 percent consumer price index (CPI)-adjusted increase in average household income, 65 percent CPI-adjusted increase in average home value, or 11 percent increase in CPI-adjusted median rent.

The linear method is based on Griffith's (1996, p. 241) inclusive definition of gentrification as the "in-migration of middle- and upper-income households into existing lower income urban neighborhoods and the upgrading of the housing stock therein." Gentrification thus drives and is driven by changes in the socioeconomic composition of residents. Regardless of whether gentrification begins with improvements in the housing stock and other amenities, or begins with increases in the number of higher SES residents, the long-run effect is a change in residents and housing stock. Because we are concerned with student achievement, we focus on changes in the characteristics of the residents rather than the housing stock or neighborhood amenities.

### Neighborhood Composition

Neighborhood SES is measured by the percentage of residents with a bachelor's degree and by the median household income. Racial/ethnic composition is measured by the percentage of residents who are black, Hispanic, or white. For all census variables, we include the 1990 start value and the percent change from 1990 to 2000. Demographic characteristics in the one-mile radius of the school were estimated using an area-weighted average of the proportion of the census tracts that fell into that area. For example, if a school's one-mile radius fell completely within our census tract, we would use that tract's SES and racial/ethnic composition. However, if a school's radius fell equally in four different tracts, we used an average of the characteristics of those four tracts.

### Student Body Composition

To measure the school's student body composition, we used annual average third grade student characteristics, including: (1) enrollment level, (2) percent who reside outside the one-mile radius, (3) percent who are eligible for free lunch, (4) percent who are eligible for reduced-price lunch, (5) percent black, (6) percent Hispanic, and (7) percent white. Enrollment level is the total number of students in the third grade. Eligibility for free- or reduced-price lunch is based on the federal poverty level. Families with household incomes that are below 130 percent of the federal poverty level are eligible for free meals, and families between 131 and 185 percent are eligible for reduced price meals. Two additional census variables are included to describe how gentrification is associated with changes in neighborhood composition and public school attendance: the fraction of children under age 9, and the percent of school-aged children attending CPS.

### ANALYSIS

These variables are used to estimate a linear growth model that tests whether the rates of growth in test scores for each school are associated with the extent of neighborhood change. We use interactions between year and percent change in each neighborhood characteristic to determine whether test scores at schools experiencing significant neighborhood change improved at a different rate than those with more stable neighborhoods. We estimate the following model:

$$Y_{jt} = \beta_0 + \beta_1 Year_t + \beta_2 NI1990_j + \beta_3 NChange_j + \beta_4 (Year_t * NI1990_j) + \beta_5 (Year_t * NChange_j) + \beta_6 School_{jt} + e_{tj} + u_j,$$

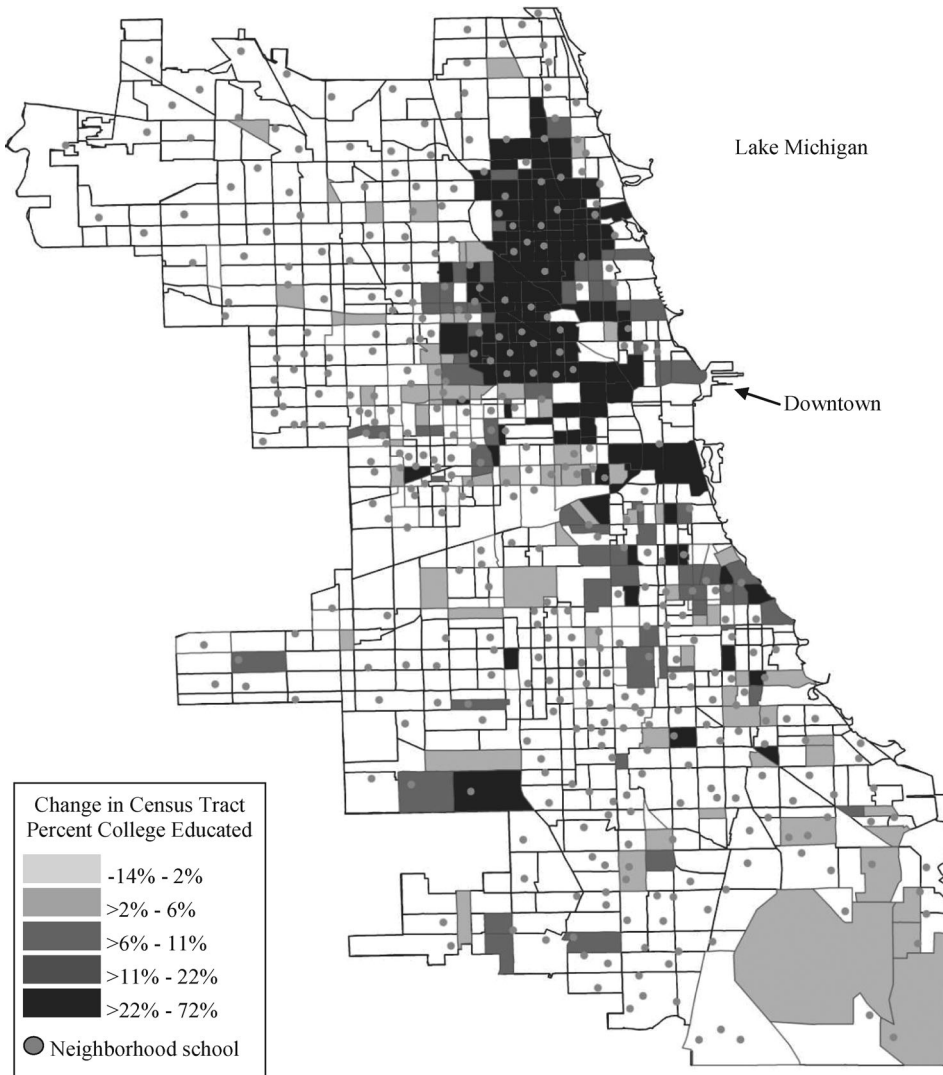
where  $Y_{jt}$  is the third grade outcome measure, either math or reading scores, for school  $j$  at time  $t$ .  $Year$  is an indicator of the number of calendar years since spring 1993.  $NI1990_j$  represents neighborhood composition of the area within a one-mile radius around school  $j$  based on the 1990 census measures of education, income, and race/ethnicity described above.  $NChange_j$  represents the percent change in those demographic measures between 1990 and 2000 around each school.  $School_{jt}$  represents the annual measures of the third grade student body described above.  $e_{tj}$  are the error terms for each school  $j$  in year  $t$ , and  $u_j$  are fixed effects for each school. These school-fixed effects are necessary because schools vary in ways that do not change over time, but are not measured with our data, such as the physical size of their facilities and their proximity to public transportation or major roads. Hausman tests indicate that these unobserved differences between schools are not normally distributed, meaning that a fixed effect is more appropriate than a random intercept for each school.

## FINDINGS

### 1990s GENTRIFICATION IN CHICAGO

Using the categorical measure of gentrification, Figure 1 shows that during the 1990s, gentrification was clustered on the North and East sides of the city, with some pockets





**FIG. 1.** 1990–2000 change in census tract percent college-educated.

*Note:* Only census tracts that underwent gentrification are shaded.

of a few contiguous gentrifying tracts on the West and South sides of Chicago. Gentrifying neighborhoods exhibited considerable variability in both their 1990 starting point (Figure S1), and amount of gentrification over the decade (Figure 1). In these figures, 1990 percent college-educated and percent change in the proportion of college-educated residents are used as the proxies for starting SES and amount of gentrification. Consistent with what is known about gentrification in Chicago, averaging across all the gentrified tracts, there was limited concomitant racial change; gentrified tracts showed 1.0 percentage point increase in percent white, 1.6 percentage point decrease in percent Hispanic, and 0.4 percentage point decrease in percent black.

GENTRIFICATION AND NEIGHBORHOOD PUBLIC SCHOOLS

TABLE 1. Census Characteristics and Third Grade School Characteristics

Census Characteristics				Third Grade School Characteristics			
		Neighbor- hood schools <sup>a</sup>	All Chicago			Neighbor- hood schools	All schools
% Bachelor's deg.	1990	12.77 (10.18)	16.58 (18.72)	Reading scores	1993	34.88 (9.22)	36.31 (9.27)
	2000	17.50 (13.95)	22.89 (22.73)		2004	41.30 (8.86)	42.54 (8.90)
	$\Delta 90-00; p$ -value	***	***	$\Delta 93-04; p$ -value		***	***
Median HH income	1990	37,173 (9,656)	40,004 (19,151)	Math scores	1993	37.40 (12.02)	39.18 (12.00)
	2000	41,659 (10,854)	46,640 (18,837)		2004	43.28 (11.31)	44.62 (11.49)
	$\Delta 90-00; p$ -value	***	***	$\Delta 93-04; p$ -value		***	***
% Black	1990	47.52 (38.38)	41.63 (44.28)	% Free-lunch	1993	88.40 (11.20)	86.62 (13.19)
	2000	48.67 (37.97)	42.40 (43.54)		2004	86.66 (14.79)	84.55 (16.51)
	$\Delta 90-00; p$ -value	***	**	$\Delta 93-04; p$ -value		**	***
% Hispanic	1990	16.97 (19.50)	19.03 (26.17)	% Reduced-lunch	1993	8.20 (8.03)	9.13 (8.98)
	2000	20.20 (21.99)	22.49 (28.51)		2004	7.99 (7.38)	8.53 (7.53)
	$\Delta 90-00; p$ -value	***	***	$\Delta 93-04; p$ -value		Not sig.	Not sig.
% White	1990	26.25 (26.66)	34.33 (35.04)	% Black	1993	55.91 (43.14)	55.40 (41.91)
	2000	21.26 (23.31)	29.20 (31.70)		2004	55.19 (43.51)	54.66 (42.48)
	$\Delta 90-00; p$ -value	***	***	$\Delta 93-04; p$ -value		Not sig.	Not sig.
Med. home value	1990	118,856 (54,730)	142,750 (109,464)	% Hispanic	1993	27.18 (33.08)	26.53 (31.98)
	2000	168,076 (83,730)	210,849 (146,878)		2004	29.35 (34.21)	28.62 (33.30)
	$\Delta 90-00; p$ -value	***	***	$\Delta 93-04; p$ -value		***	***
Median rent	1990	663 (96)	711 (187)	% White	1993	13.88 (20.56)	14.65 (20.73)
	2000	686 (108)	751 (208)		2004	12.10 (19.14)	12.93 (20.18)
	$\Delta 90-00; p$ -value	***	***	$\Delta 93-04; p$ -value		***	***
% Attending CPS	1990	79.59 (19.01)	76.85 (20.86)	% Outside 1 mile	1993	15.13 (18.91)	20.30 (25.61)
	2000	83.12 (18.43)	80.44 (19.44)		2004	15.70 (18.73)	20.95 (25.38)
	$\Delta 90-00; p$ -value	***	***	$\Delta 93-04; p$ -value		Not sig.	Not sig.
# Of schools		398		# Of schools		398	433

<sup>a</sup>Based on the one-mile radius surrounding the school. \*\* $p$ -value < 0.01, \*\*\* $p$ -value < 0.001.

Focusing on change in education and income, Chicago experienced moderate increases in both during the 1990s (Table 1). In 1990, 16.6 percent of Chicagoans had a bachelor's degree and the median household income was \$40,004 (2010 dollars). Over the decade, the population share with bachelor's degrees increased to 22.9 percent, median household income increased to \$46,640. In contrast, in gentrifying neighborhoods,

the share with bachelor's degrees increased from 17.2 percent in 1990 to 29.3 percent in 2000, and median income went from \$28,446 to \$39,778 (not shown in tables). Neighborhood schools, on average, were located in neighborhoods that had education levels and household incomes that were lower than the city average, and were in neighborhoods that underwent less than average change during the 1990s (Table 1). However, as can be seen in Figure 2, a substantial minority of neighborhood schools were located in census tracts that underwent meaningful change in the SES of its residents.

The 1990–2000 change in the fraction of college-educated residents was significantly correlated with neighborhood schools' changing third grade student characteristics from spring 1993 to spring 2004 (Table S1). As the fraction of college-educated residents increased, there were significant but small increases in reading ( $r = 0.11$ ) and math ( $r = 0.16$ ) scores. Regarding the composition of the student body, as the fraction of college-educated residents increased, enrollment decreased ( $r = -0.34$ ); a larger fraction of the students came from outside the one-mile radius surrounding the school ( $r = 0.24$ ); and the fraction of students eligible for free lunch decreased ( $r = -0.15$ ). This latter change was offset by increases in the fraction of students eligible for reduced-price lunch ( $r = 0.19$ ). With regard to the school's racial/ethnic composition, as the fraction of college-educated residents increased, the fraction of Hispanic students decreased ( $r = -0.21$ ); the fraction of white students increased ( $r = 0.15$ ); and the share of black students was unchanged ( $r = 0.07$ ). The same pattern was found for the correlations between change in household income as a gentrification indicator and change in school characteristics.

## EFFECTS OF CHANGING RESIDENT CHARACTERISTICS ON AGGREGATE SCHOOL ACHIEVEMENT

The effects of changes in neighborhood SES on third grade test scores are shown in Table 2 (Bivariate and Model 1). The coefficient for year represents the number of years since spring 1993. We centered all other variables on the sample mean. Therefore, the constant coefficient represents the average test score in spring 1993 and the year coefficient represents the annual test score growth of the average school. The coefficients for the neighborhood composition and change measures indicate the difference in the predicted annual rate of change for a one-unit increase in each of these variables.

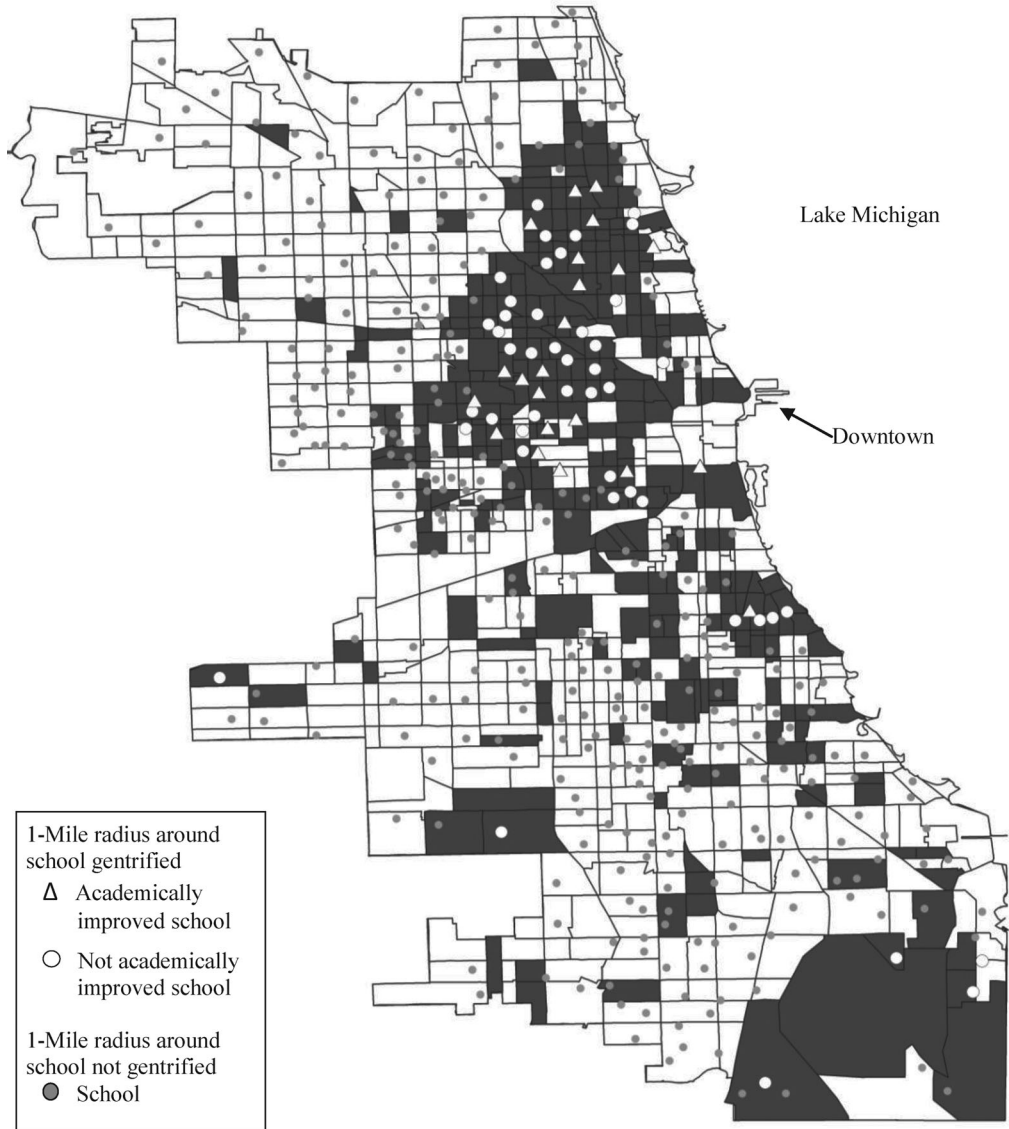
The bivariate relationships between reading and math test score growth and the percent change in neighborhood income and education are all positive (Table 2), suggesting that the more SES change in the area around a school, the faster that school's test scores rose.

Model 1 predicts growth in third grade test scores controlling for both the share with a bachelor's degree and median household income in 1990, and the percent change in each those measures. Focusing first on the effects of the percent of neighborhood residents with a bachelor's degree, the bivariate and multivariate models show a consistent pattern of association. For reading, a 1 percent increase in the fraction of residents with a bachelor's degree is associated with an annual increase in reading scores that was 0.002 points higher than the CPS average (Table 2, Model 1). This is less than one-half of 1 percent of the average annual growth each year. Over the 12-year period, schools gain an extra 0.024 points for every percentage point increase in neighborhood education, just a small fraction of the 9-point standard deviation of test scores across schools. This is a small

TABLE 2. Regression Models Using Census Characteristics to Predict Trend in Third Grade Reading and Math Scores

	Reading Scores				Math Scores					
	Bivariate	Model 1	Model 2	Model 3	Model 4	Bivariate	Model 1	Model 2	Model 3	Model 4
Census characteristics										
1990 % with BA	0.007 <sup>***</sup> (0.002)	0.016 <sup>***</sup> (0.003)	0.013 <sup>***</sup> (0.003)	0.017 <sup>***</sup> (0.003)	0.014 <sup>***</sup> (0.003)	0.008 <sup>**</sup> (0.002)	0.023 <sup>***</sup> (0.004)	0.021 <sup>***</sup> (0.004)	0.022 <sup>***</sup> (0.004)	0.024 <sup>***</sup> (0.004)
% Δ90 to 00 % with BA	0.001 <sup>**</sup> (0.000)	0.002 <sup>*</sup> (0.001)	0.004 <sup>***</sup> (0.001)	0.002 <sup>**</sup> (0.001)	0.001 <sup>***</sup> (0.001)	0.001 <sup>***</sup> (0.000)	0.004 <sup>***</sup> (0.001)	0.004 <sup>***</sup> (0.001)	0.004 <sup>***</sup> (0.001)	0.004 <sup>***</sup> (0.001)
1990 HH income (\$1,000s)	-0.003 (0.002)	-0.014 <sup>***</sup> (0.003)	-0.011 <sup>**</sup> (0.003)	-0.012 <sup>***</sup> (0.003)	-0.012 <sup>***</sup> (0.003)	-0.004 (0.002)	-0.023 <sup>***</sup> (0.004)	-0.020 <sup>***</sup> (0.004)	-0.022 <sup>***</sup> (0.004)	-0.021 <sup>***</sup> (0.004)
% Δ90 to 00 HH income	0.004 <sup>**</sup> (0.001)	-0.003 (0.002)	-0.003 (0.002)	-0.003 (0.002)	-0.004 (0.002)	0.004 <sup>**</sup> (0.001)	-0.007 <sup>**</sup> (0.002)	-0.008 <sup>**</sup> (0.002)	-0.008 <sup>**</sup> (0.002)	-0.008 <sup>**</sup> (0.002)
1990 % Hispanic			-0.009 <sup>***</sup> (0.001)					-0.002 (0.001)		
Δ90 to 00 % Hispanic			-0.000 (0.000)					-0.000 (0.000)		
1990 % Black				0.001 <sup>*</sup> (0.000)					0.000 (0.001)	
Δ90 to 00 % Black				0.000 (0.000)					-0.000 (0.000)	
1990 % White					-0.000 (0.001)					-0.001 (0.001)
Δ90 to 00 % White					0.001 (0.000)					0.001 (0.001)
Year	0.652 <sup>***</sup> (0.037)	0.803 <sup>***</sup> (0.021)	1.025 <sup>***</sup> (0.076)	0.861 <sup>***</sup> (0.100)	0.995 <sup>***</sup> (0.083)	0.803 <sup>***</sup> (0.021)	0.746 <sup>***</sup> (0.027)	0.973 <sup>***</sup> (0.038)	1.069 <sup>***</sup> (0.130)	1.039 <sup>***</sup> (0.107)
Constant	33.001 <sup>***</sup> (0.122)	33.020 <sup>***</sup> (0.139)	33.001 <sup>***</sup> (0.121)	33.001 <sup>***</sup> (0.121)	33.001 <sup>***</sup> (0.121)	33.016 <sup>***</sup> (0.139)	37.594 <sup>***</sup> (0.175)	33.016 <sup>***</sup> (0.138)	37.519 <sup>***</sup> (0.155)	37.519 <sup>***</sup> (0.155)
R <sup>2</sup>	0.123	0.079	0.106	0.082	0.098	0.069	0.041	0.038	0.035	0.034

\*p-value < 0.05, \*\*p-value < 0.01, \*\*\*p-value < 0.001.



**FIG. 2.** CPS neighborhood schools by gentrification and academic improvement.  
*Note:* Only census tracts that underwent gentrification are shaded.

effect compared with the coefficient for a neighborhood's starting point (level of education in 1990); every percentage point increase in the initial 1990 percent with a bachelor's degree predicts an increase in growth eight times that size. A school that began in a neighborhood with an average proportion of college-educated residents in 1990 would need to experience a percent increase in education of more than two standard deviations in order to catch up by 2004 with the predicted reading scores of a school that began the period with just 10 percent more college-educated residents. For schools in neighborhoods

starting with below-average education, this amount of change would have to be even higher. This suggests that a neighborhood's initial SES matters substantially more than the amount of neighborhood change in SES that occurred during this period.

For math, a 1 percent increase in the fraction of residents with a bachelor's degree is associated with an annual increase in math scores that was 0.004 points larger than the average school (Table 2, Model 1), and, over the 12-year period, an increase that was 0.048 points larger than the average school. Again, this is a small effect, compared with the coefficient for a neighborhood's starting level of education in 1990. A school beginning the period in a neighborhood with average education levels would need to increase its percent of college-educated adults by nearly two standard deviations to catch up with the predicted math scores of a school that started in a neighborhood with just 10 percent more college-educated residents.

Turning to the effects of neighborhood median household income, the bivariate relationship between change in median household income and change in test scores gives a misleading picture of the direction of the relationship. The bivariate relationship is positive and significant, but after controlling for the fraction of college-educated adults, household income has a negative relationship to test scores. Schools located in neighborhoods with an increasing fraction of higher income residents, but not better-educated residents, saw slower-than-average annual increases in third grade test scores. For reading, the effect of change in median household income is negative, but not significant. For math, a 1 percent increase in the median household income is associated with an annual increase in math scores that was 0.007 points *lower* than the average school; this increase was 0.084 points *smaller* than the average school over the 12-year period. Two schools that began the period with the same neighborhood income level, but with one experiencing an increase in neighborhood income of two standard deviations, would only be expected to differ at the end of the 12-year period by 3 points, or approximately one-quarter of a standard deviation in the distribution of math test scores.

### Robustness Checks

First, we examined whether the effect of change in neighborhood SES depended on whether the neighborhood began as a very low SES neighborhood in 1990. We included dummy variables for quartiles of the 1990 percentage of residents with a bachelor's degree and median household income, and interacted these dummy variables with the 1990–2000 change. These interactions were not significant (results not shown). We conducted additional analyses using dummy variables for quartiles of change in neighborhood SES to determine if the effect was not linear. We did not identify any nonlinear relationships for education level or household income (results not shown).

Second, we examined the extent to which changes in neighborhood racial/ethnic composition moderated the effect of changes in neighborhood SES (Models 2, 3, and 4 in Table 2). These results show that accounting for changes in neighborhood racial/ethnic composition does not substantively alter the relationships between neighborhood SES and school test scores. Furthermore, adding racial/ethnic composition reduced the overall variance explained. Therefore, the most parsimonious model includes only measures of neighborhood SES.

Third, we examined the extent to which adding changes in the composition of the student body accounted for the effects of changes in neighborhood SES on changes in test scores (Table 3). As stated above, reading scores were not very responsive to changes

TABLE 3. Regression Models Using School Characteristics to Predict Trend in Third Grade Test Scores

	Reading Scores					Math Scores				
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 1	Model 2	Model 3	Model 4	Model 5
Census characteristics										
1990 % BA	0.016*** (0.003)	0.015*** (0.003)	0.013*** (0.003)	0.012*** (0.003)	0.011*** (0.003)	0.023*** (0.004)	0.028*** (0.004)	0.022*** (0.004)	0.020*** (0.004)	0.020*** (0.004)
% Δ90 to 00 % BA	0.002* (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.003)	0.0004 (0.001)	0.004*** (0.001)	0.004*** (0.001)	0.003*** (0.001)	0.003*** (0.001)	0.003*** (0.001)
1990 HH Inc. (\$1,000s)	-0.014*** (0.003)	-0.012*** (0.003)	-0.016*** (0.003)	-0.009** (0.003)	-0.011** (0.003)	-0.023*** (0.004)	-0.024*** (0.004)	-0.018*** (0.004)	-0.017*** (0.004)	-0.022*** (0.005)
% Δ90 to 00 HH Inc.	-0.003 (0.002)	-0.003 (0.002)	-0.003 (0.002)	-0.001 (0.002)	-0.002 (0.002)	-0.007** (0.002)	-0.007** (0.002)	-0.005** (0.002)	-0.006** (0.002)	-0.006** (0.002)
School Characteristics										
Enrollment		-0.015*** (0.004)			-0.009* (0.004)		0.003 (0.005)			0.011* (0.005)
% Outside 1 mile		-0.012 (0.009)			0.008 (0.009)		-0.005 (0.012)			0.018 (0.013)
% Free lunch (omitted)										0.056*
% Reduced lunch			0.105*** (0.016)		0.092*** (0.016)			0.073** (0.019)		0.056*
% Not free lunch			0.123*** (0.015)		0.107*** (0.015)			0.118*** (0.020)		0.102*** (0.021)
% Black (omitted)										
% Hispanic				0.032 (0.021)	0.033*** (0.021)				-0.005 (0.029)	-0.010 (0.031)
% White				0.193*** (0.026)	0.141*** (0.026)				0.164*** (0.033)	0.160*** (0.033)
Year	0.901*** (0.021)	0.771*** (0.020)	0.831*** (0.022)	0.853*** (0.032)	0.746*** (0.027)	0.734*** (0.042)	0.715*** (0.027)	0.776*** (0.028)	0.685*** (0.043)	0.685*** (0.043)
Constant	34.789*** (0.139)	31.721*** (0.195)	29.426*** (0.805)	29.866*** (0.960)	37.594*** (0.175)	37.374*** (0.511)	36.577*** (0.242)	35.437*** (1.096)	33.365*** (1.266)	33.365*** (1.266)
R <sup>2</sup>	0.095	0.308	0.423	0.449	0.041	0.034	0.169	0.356	0.392	0.392

\*p-value &lt; 0.05, \*\*p-value &lt; 0.01, \*\*\*p-value &lt; 0.001.

in neighborhood SES. However, for math, although the composition of the student body was significantly associated with math scores (schools with smaller fractions of students eligible for free lunch and larger fractions of white students had higher math scores), adding school characteristics to the model did not account for the relationship between changes in neighborhood SES and school-level math scores. Nonetheless, these student body coefficients help put the effects of neighborhood change in perspective. A 1 percent increase in the proportion of the student body that is white and does not receive free lunch predicts improvements in average school test scores that are 15–30 times the size of the effects of a 1 percent change in neighborhood education or income.

### INDIVIDUAL-LEVEL EFFECTS OF ATTENDING SCHOOLS IN GENTRIFYING NEIGHBORHOODS

We also examined whether there are individual-level benefits for low-income children in attending schools in gentrifying neighborhoods. This analysis used the categorical measure of gentrification. We examined the effect of students beginning their schooling (first grade) in a gentrifying neighborhood, and not the effect of the number of years spent in such schools. There is substantial student mobility in CPS, and estimating the effects of time spent at a particular school would introduce substantial selection bias (de la Torre and Gwynne 2009). Specifically, the analyses would no longer be about the effects of neighborhood change, but about who stays and who leaves a changing neighborhood.<sup>4</sup> We examined two cohorts of students: those entering first grade during the 1992–1993 academic year ( $n = 21,607$ ), and those entering first grade during the 1997–1998 academic year ( $n = 25,494$ ).

We found no difference between the growth rate of students' third through eighth grade reading or math scores based on starting first grade in neighborhood schools located in gentrifying neighborhoods versus starting in ones located in nongentrifying neighborhoods (results not shown). CPS's high rate of student mobility is a substantial factor in explaining these insignificant findings. Of the students who started first grade in neighborhood schools located in gentrifying neighborhoods, a large fraction transferred out before third grade and only a minority remained in the same school through eighth grade (most of Chicago's elementary schools are K through eight). This high rate of student mobility, which is in line with CPS's system-wide high mobility rate, means that students shuffle across neighborhood schools. Therefore, if schools located in gentrifying neighborhoods were to improve, the low-income students who begin their schooling careers there would not stay around long enough to benefit from any school improvements. It is important to remember that middle-income students did not come to populate the majority of schools in gentrifying neighborhoods; these schools maintained a highly mobile population of mostly low-income students.

### LIMITATIONS

Unlike prior research, which focused only on one neighborhood or one school, we examined all neighborhood elementary schools in a large central city public education district. Research examining only one neighborhood or one school can be misleading, depending on the reasons for choosing the neighborhood or school to study. While having data



on all elementary schools in the system allowed us to estimate the district-wide effects of gentrification, using administrative data comes with its own limitations.

These analyses only speak to the average effect across all gentrifying neighborhoods and their associated schools in Chicago. They do not tell us whether increases in the socioeconomic characteristics of a given neighborhood will have a significant effect on the demographic and achievement characteristics of its associated schools. As research on mixed-income schools has shown, district policies, principals, and/or parent groups can successfully encourage gentrifiers to place their children in select local public schools (Cucchiara and Horvat 2010; Kahlenberg 2001; Kimelberg and Billingham 2012). Other research has shown that, once gentrifying neighborhoods reach a tipping point with enough middle- and upper-income families, gentrifiers begin to place their children in the local school rather than going outside the neighborhood for their children's education (Butler and Robson 2003).

The use of administrative data did not allow us to explain the outcomes of schools that did not fit the dominant pattern. One-third of schools located in gentrifying neighborhoods (22 of 66 schools) exhibited an increase of one standard deviation or more in their reading and math test scores. These schools, most of which continued to be overwhelmingly low income, were in neighborhoods that experienced large changes in the SES of their residents. As can be seen in Figure 2, there is no clear geographic pattern to these schools, as those that experienced academic improvement were often in close proximity to schools that did not. Our administrative data did not allow us to account for why. Among the subset of schools that exhibited academic improvement, some had a concomitant decrease in the poverty status of their students, but others did not. Detailed ethnographic work is needed to understand the factors that determine when gentrification does and when gentrification does not drive school-level change.

The use of administrative data also limited our ability to measure student background characteristics precisely. The proportion of students who receive free or reduced lunch is a very rough measure of student background, and most likely fails to capture the subtlety of the changes in student population at these schools. For example, we do not know which low-income families are likely to stay in or move into gentrifying neighborhoods. These neighborhoods were becoming less affordable, so the low-income families who stayed or moved into these gentrifying neighborhoods may be those who are better able to manage their limited resources and/or see the value in making difficult choices that would allow them to reside in these revitalizing neighborhoods.

Our research was also limited in the extent to which we could pinpoint when gentrification began; we were only able to identify whether significant neighborhood change occurred during the 1990s. In other words, it is impossible to tell whether a neighborhood changed slowly and steadily over the decade, or whether it experienced rapid change during in the first or second half of the decade. Therefore, we are unable to make any statements about the lag between neighborhood change and any resulting school change.

Future research on the effects of gentrification on children's achievement should be both qualitative and quantitative. In-depth qualitative research should compare improving and stable low-performing schools located in a range of gentrifying neighborhoods to identify the factors that mediate the relationship between neighborhood and school revitalization. In addition, the extent to which the school system allows choice may affect how gentrification affects the demographic and achievement characteristics of

neighborhood public schools. Therefore, future research should replicate system-wide analyses in a range of cities and school districts with different levels of school choice.

## DISCUSSION

In this study, we examined the extent to which increases in the SES of neighborhood residents are associated with concomitant changes in students' academic achievement in that neighborhood's public school. Although it is reasonable to assume that neighborhood revitalization would be associated with public school revitalization, there are also reasons to believe that gentrification would not affect the students who primarily attend urban public schools. On the one hand, gentrifying families are less likely to have children, and if they do, they have a high likelihood of opting out of the neighborhood public school (Kennedy and Leonard 2001; Lauen 2007). On the other hand, neighborhood effects theories suggest that higher income families, even if they do not have children in the local school, would push for improvements in their neighborhood schools, out of self-interest and public interest (Formoso et al. 2010).

Given the importance of and potential for racial/ethnic turnover in gentrifying neighborhoods, we examined but found no significant effects of racial/ethnic change. Unlike Papachristos et al.'s (2011) study of the effects of gentrification on crime in Chicago, we found no race-specific effects of gentrification based on neighborhood initial racial/ethnic composition or change in racial/ethnic composition.

With regard to whether an influx of middle-income households is associated with a meaningful increase in the fraction of middle-income students in the local neighborhood public school, the answer is no. Overall, schools in gentrifying neighborhoods experienced significant, but not substantive, reductions in the fraction of the poorest third graders (those eligible for free lunch), which was offset by increases in the fraction of somewhat less poor third graders (those eligible for reduced-price lunch). For example, schools in neighborhoods that were in the top quartile of neighborhood change experienced only a 4 percentage point decrease in the fraction of poor students over 12 years (from 92 to 88 percent). Therefore, if low-income children attending public schools in gentrifying neighborhoods are to benefit academically from the socioeconomic changes occurring around them, it will more likely be through indirect neighborhood effects externalities that result from having SES families within the neighborhood.

However, we found that even these neighborhood effects externalities are relatively small, and can even be negative. For example, after controlling for the educational makeup of the neighborhood, increasing neighborhood household income predicted lower-than-average increases in school-level test scores. One potential explanation for this may be that gentrifiers, by reducing the local population of children, increasingly exercising public school choice, or increasing private school choice, negatively affect enrollment at local public schools, which in turn, negatively affects school budgets. Consistent with this, we found that neighborhoods in the top quartile of neighborhood change saw a 3 percent decline in the fraction of young children over the decade. This compares with no change for the city on average. In addition, as neighborhood income increased, so too did the fraction of students from outside the one-mile radius of the school. In three gentrifying Chicago communities, depopulation of neighborhood children resulted in a drop in local school enrollment, which led to a drop in supplemental funding, increased

teacher layoffs, and the elimination of some discretionary programs (Weissmann 2002). Ironically, gentrification may result in fewer financial resources for local neighborhood schools.

Finally, we turn to student-level effects. Was it advantageous for low-income students to start their schooling careers in schools located in gentrifying neighborhoods? We found no effects on the growth trajectory of low-income students' reading and math scores. This null effect may be explained, in part, by the high level of school mobility among CPS students; the modal elementary school experience is one of mobility (de la Torre and Gwynne 2009). Furthermore, it is likely that the residential instability of low-income families increases children's vulnerability to the negative academic effects of school mobility (Mehana and Reynolds 2004).

## POLICY IMPLICATIONS

Large, disadvantaged urban school districts are steadily embracing the idea that increasing the fraction of higher SES families who stay in the city, and whose children attend public schools, is one way to bring new resources into the school system that will benefit *all* children (Kahlenberg 2001). However, our findings add to a burgeoning set of studies that cast doubt on the idea that low-income children will benefit (Cucchiara 2008; Cucchiara and Horvat 2010; Hassrick and Schneider 2009; Posey 2012).

Over the past two decades, Chicago has increasingly turned to public school choice to create incentives for middle-income parents to stay in or move into city neighborhoods. Supporting these efforts, the previous and current mayors have repeatedly made public pleas to middle-income parents, letting them know that if they stay in the city their children's educational needs will be met through the development of "elite" public school options (Ihejirika 2012; Olszewski and Sadovi 2003). However, these are precisely the actions that spur higher status parents to prioritize the achievement of their own child over collective improvement (Cucchiara and Hovart 2010). It also increases their ability to obtain classroom advantages for their children (Hassrick and Schneider 2008) and concentrates higher status children in select public schools that only replicate larger societal inequalities (Posey 2012). As Cucchiara (2008) argues, cities' marketing of public schools to middle- and upper-middle-income parents can create a paradoxical situation in which new public educational resources and opportunities go to those who are least in need. Together, these findings suggest that public school districts with high levels of concentrated disadvantage need to ensure that efforts to bring higher status families into the system do not reinforce and even heighten the unequal distribution of public educational resources (Joseph and Feldman 2009).

## Acknowledgment

The authors would like to thank Stephen Raudenbush, Mario Small, and anonymous reviewers for helpful feedback on this paper. We also thank the Consortium on Chicago School Research for supportive technical assistance with the data used in this paper. This research was supported by a grant from the John D. and Catherine T. MacArthur Foundation.

## Notes

<sup>1</sup>During the 1992–1993 year, CPS had 32 magnet and no charter elementary schools.

<sup>2</sup>All missing variables were imputed using *SAS proc mi*. None of the schools were missing neighborhood variables. Fewer than 2 percent of school-by-year observations were missing reading and math scores and fewer than 1 percent of school-by-year observations were missing free or reduced lunch percentages.

<sup>3</sup>Reading and math scores are normalized standard scores that cover the same range as percentile ranks (1–99). In these data, they have an annual standardized mean of 50 and a standard deviation of 21.06. The normalized score is used because it can be averaged to obtain school-level characteristics and used to compare change over time. Normalized scores were created from students' national percentile rank.

<sup>4</sup>We do not report the comparative outcomes of individual stayers versus movers nor of stayers alone in the different school types because, without multiple levels of controls, the simple estimates of the effects of mobility on achievement are highly misleading.

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## Los Efectos de la Gentrificación en Escuelas Públicas Locales (Micere Keels, Julia Burdick-Will y Sara Keene)

### Resumen

La gentrificación está generalmente asociada a mejoras en los servicios locales. Sin embargo, sabemos poco sobre si estas mejoras se extienden a las escuelas públicas. Usando información administrativa (desde el verano del 1993 a la primavera del 2004) del tercer distrito escolar más grande los EE.UU. examinamos la relación entre gentrificación y rendimiento a nivel escuela en matemáticas y lectura, y si los cambios en la composición del alumnado tienen efectos en dicho rendimiento escolar. Luego de probar varias alternativas, encontramos que, en Chicago, la gentrificación tiene poco efecto en las escuelas públicas locales. Las escuelas públicas locales no experimentan en general algún beneficio académico agregado de los cambios socioeconómicos que ocurren alrededor de ellas. Es más, estas incluso pueden experimentar un daño marginal en la medida que el espacio local es colmado de residentes de mayores ingresos. Para el estudiante, empezar el primer grado en una escuela ubicada en un barrio en gentrificación no guarda alguna relación con la mejora en sus pruebas escolares a lo largo de sus años de educación primaria.

### Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web site:

**Table S1:** Correlation between Change in School's Neighborhood SES and Change in School's Third Grade Characteristics.

**Figure S1:** 1990 census tract percent college-educated.