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Income Segregation between School Districts and Inequality in Students' Achievement

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Abstract

Large achievement gaps exist between high- and low-income students and between black and white students. This article explores one explanation for such gaps: income segregation between school districts, which creates inequality in the economic and social resources available in advantaged and disadvantaged students' school contexts. Drawing on national data, I find that the income achievement gap is larger in highly segregated metropolitan areas. This is due mainly to high-income students performing better, rather than low-income children performing worse, in more-segregated places. Income segregation between districts also contributes to the racial achievement gap, largely because white students perform better in more economically segregated places. Descriptive portraits of the school districts of high- and low-income students show that income segregation creates affluent districts for high-income students while changing the contexts of low-income students negligibly. Considering income and race jointly, I find that only high-income white families live in the affluent districts created by income segregation; black families with identically high incomes live in districts more similar to those of low-income white families. My results demonstrate that the spatial inequalities created by income segregation between school districts contribute to achievement gaps between advantaged and disadvantaged students, with implications for future research and policy.

Keywords

class inequality, race, segregation, achievement gap, poverty and education, quantitative research on education, school catchment zones, politically defined school boundaries

Educational inequalities between high- and low-income children have grown in recent decades. The gap between high- and low-income students' test scores is about 40 percent larger among children born in the early 2000s than among those born in the 1970s (Reardon 2011), and the gap between high- and low-income young adults' educational attainment and college enrollment has also grown (Bailey and Dynarski 2011; Duncan, Kalil, and Ziol-Guest 2017; Ziol-Guest and Lee 2016). Educational success affects many adult outcomes. Educational achievement and attainment gaps between high- and low-income youth may thus lead to greater inequality in future outcomes, like employment, income, neighborhood residence, criminality, and health. The income achievement gap has emerged as a growing problem requiring explanation and solutions.

One possible explanation for income achievement gaps is income segregation between children's school contexts. Like the income achievement gap,

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segregation of public school families by income between school districts has also increased, by over 15 percent from 1990 to 2010 (Owens, Reardon, and Jencks 2016). When families are highly segregated by income between school districts, resources that contribute to students' academic success, such as school funding, teacher quality, parents' social capital, and students' peer characteristics, are more unequally distributed. In segregated places, high-income students have access to highly advantaged districts, whereas low-income students attend school in disadvantaged districts. Income segregation between districts may contribute to the income achievement gap by boosting high-income students' achievement and/or reducing low-income students' test scores.

While inequality between high- and low-income children has increased, educational disparities between black and white students have remained stable but substantively large (National Center for Education Statistics [NCES] 2015; Reardon 2011). White and black students are highly segregated between schools and school districts (Fiel 2013; Stroub and Richards 2013), and a key distinction between the schools of white and black students is that white students are exposed to many fewer poor classmates (Orfield et al. 2016; Reardon 2016b). Income segregation creates very-high-income and very-low-income districts, and white families can better afford to live in affluent districts than can black families, on average. Even among families with identical incomes, black families may live in lower-income areas than white families due to racialized housing search processes and discrimination (Reardon, Fox, and Townsend 2015; Sharkey 2014). Therefore, income segregation may also contribute to the racial achievement gap.

In this article, I examine whether income achievement gaps are larger in metropolitan areas with greater income segregation between school districts. My results indicate that this is the case, primarily because the benefit of high family income for students' achievement is larger in highly segregated places. Then, I investigate the intersection of race and income. I find that the achievement gap between black and white students is also larger in places where income segregation between districts is higher. My analyses document how contextual inequality augments family advantage or disadvantage, and I assess income segregation as one potential explanation for educational disparities.

FAMILY INCOME AND CHILDREN'S TEST SCORES

Since the *Equality of Educational Opportunity* report (Coleman et al. 1966), scholars have investigated the socioeconomic status (SES) of children's families as a key predictor of their achievement. Past research, challenged by the difficulties of estimating causal effects, provides mixed evidence on the magnitude, timing, and duration of the effect of family income on children's educational outcomes (Brooks-Gunn and Duncan 1997; Haveman and Wolfe 1995; Mayer 1997). More recently, researchers have used exogenous shocks to family income due to transfer and welfare programs to generate causal estimates. These studies converge around a similar estimate: an additional $1,000 in family income among low-income families corresponds to a 5 to 7 percent standard deviation increase in children's test scores (Dahl and Lochner 2012; Duncan, Morris, and Rodrigues 2011; Milligan and Stabile 2011).

Why does family income matter? Two general pathways have been proposed (Mayer 1997). First, income has direct effects by increasing the resources invested in children. Family income provides for basic child well-being, such as food, clothing, shelter, childcare, and health care, as well as investment in child enrichment (e.g., educational tools, like books or technology; extracurricular activities; spending on higher-quality childcare). Second, income can have indirect effects on children that operate through family processes. Higher income can reduce parental stress or improve parental health, resulting in better parenting practices and role modeling. Research finds more support for the direct-effects pathway, indicating that increased income leads to expenditures on child well-being that promote academic achievement (Duncan et al. 2011; Jones, Milligan, and Stabile 2015; Milligan and Stabile 2011).

One family expenditure that affects children's outcomes is purchasing a residence in a particular neighborhood. Living in disadvantaged neighborhoods reduces cognitive test scores (Ainsworth 2002; Brooks-Gunn et al. 1993; Burdick-Will et al. 2011). For example, among black children in Chicago, Sampson, Sharkey, and Raudenbush (2008) found that growing up in a highly disadvantaged neighborhood reduced verbal ability by the equivalent of missing nearly a year of school. One way neighborhoods may affect children's educational achievement is via their link to local

schools. Non-neighborhood options (e.g., charter, magnet, and open-enrollment schools) have increased in recent decades, but about three quarters of schoolchildren still attend their neighborhood school (Grady and Bielick 2010). Neighborhoods remain strongly linked to school *districts*. Nearly all school choice and student assignment plans operate within districts: in 2008, fewer than 1 percent of public school students attended school in a different district than where they lived (NCES 2008). Therefore, high-income children may outperform low-income children because their family income provides access to residence in an advantageous school district that low-income parents cannot afford.

SEGREGATION BETWEEN SCHOOL DISTRICTS AND UNEQUAL RESOURCES

In this article, I focus on income segregation between school districts in the metropolitan area where a child lives. Income segregation between school districts creates inequalities in economic and social resources linked to students' achievement: in highly segregated places, high-income children access more resources and low-income children access fewer resources. First, school spending varies across districts. A substantial portion of school funding draws on local revenues based, in part, on district property taxes. Higher-income districts typically have greater property wealth and thus greater local revenues. Since the 1970s, nearly all states have reformed the role of local revenues in school finance, but many states still have regressive school finance systems in which high-income districts receive more resources than do low-income districts due to revenues from income and sales taxes (Baker and Corcoran 2012; Baker et al. 2017). Income segregation creates concentrations of very-low-income students, and these concentrations may raise the cost of providing safe environments, schools in good physical condition, and high-quality teachers (Boyd et al. 2013; Corcoran et al. 2004). Few states have sufficient compensatory funding to produce the same outcomes for a poor student in a low-income compared to a high-income district (Baker and Green 2015). Scholars debate whether school spending contributes to students' achievement (Hanushek 2003), but recent comprehensive causal evidence indicates that higher per-pupil spending increases students' educational attainment and future economic outcomes (Jackson, Johnson, and Persico 2016). Other research indicates that the test score gap between advantaged and disadvantaged students is smaller when school funding is more equal across high- and low-income districts (Card and Payne 2002; Downes and Figlio 1997). In summary, income segregation between school districts may contribute to the income achievement gap by exacerbating inequalities in spending in high- and low-income students' school districts.

Second, income segregation between districts creates inequality in the social resources available in high- and low-income students' districts. The income composition of a district determines students' school peers. The majority of income segregation between *schools* in a metropolitan area is due to segregation between *districts* (Owens et al. 2016). That is, schools are homogenously low income mainly because districts are homogenous; no amount of within-district integration will create diverse schools if segregation between districts is high. School composition may affect student achievement because it shapes school environment, parent involvement and social capital, student–teacher interactions, and peer interactions (Kahlenberg 2002; Rumberger and Palardy 2005; Schwartz 2012). There is debate over whether schools attended by disadvantaged students produce worse learning outcomes (Downey, von Hippel, and Hughes 2008; Jennings et al. 2015). However, Schwartz (2012) provides causal evidence that low-income children's achievement growth is larger in higher-income than in lower-income schools, and Reardon's (2016a) analyses of more than 200 million state accountability test scores show that students in affluent districts gain almost one more year of proficiency than students in the poorest districts. School district segregation also creates inequality in nonschool social contexts that may affect educational success, including the prevalence of adult role models and monitoring or safety, as the neighborhood effects literature describes (Sharkey and Faber 2014).

INCOME SEGREGATION AND RACIAL INEQUALITY

Income achievement gaps have grown over the past several decades, and achievement gaps between black and white students remain large and troubling.[1] Since 1990, white students have

scored nearly a standard deviation higher on reading and math achievement tests than black students (U.S. Department of Education 2016). One factor in the racial achievement gap is poverty segregation between schools (Reardon 2016b). Because black students have lower family incomes than white students, on average, racial segregation between schools results in stark differences in school poverty rates between black and white students. Black students attend schools with poverty rates that are, on average, double that of white students' schools (Orfield et al. 2016).

Income segregation creates districts of concentrated poverty or affluence, but high-income black families may be less likely than high-income white families to live in the affluent districts created by income segregation. Black households live in lower-income neighborhoods than do white households with similar incomes (Logan 2011; Reardon et al. 2015). In 2009, white middle-income households lived in neighborhoods with median incomes over $10,000 higher than black households with identical household incomes (Reardon et al. 2015). Racial discrimination and prejudice in the housing market, racial differences in wealth, and racially stratified residential preferences and locational networks contribute to these disparities (Pattillo 2005). Black middle-class neighborhoods also tend to be geographically proximate to low-income neighborhoods, unlike white middle-income neighborhoods (Sharkey 2014). School districts encompass larger geographic areas than single census tracts, so black middle- or high-income families may live in predominantly lower-income school districts even when they live in higher-income neighborhoods. Additionally, low-income black families may be more disadvantaged by income segregation than low-income white families, because low-income black families tend to live in higher-poverty areas than do white families with similar incomes (Logan 2011; Reardon et al. 2015). Therefore, income segregation may contribute to the racial achievement gap by exacerbating inequalities in the school contexts black and white families experience.

CONTEXTUAL ADVANTAGES AND DISADVANTAGES

I hypothesize that income segregation contributes to income and racial achievement gaps because, in highly segregated metropolitan areas, family advantage may be amplified by residence in highly resourced school districts, or family disadvantage may be exacerbated in very poor school districts.[2] Past research examines the impact of *racial* segregation on the black–white educational achievement gap (Card and Rothstein 2007; Cutler and Glaeser 1997), and the literature indicates that attending a school with more black peers is detrimental for black and, to a lesser degree, white students (Vigdor and Ludwig 2008). Less research examines the relationship between *income* segregation and achievement gaps. Most relevant to this study, Mayer (2002) and Quillian (2014) show that income segregation between neighborhoods contributes to an educational attainment gap between high- and low-income children. Quillian finds that segregation of poor and nonpoor households between neighborhoods reduces the likelihood of high school graduation for poor students but has no effect for nonpoor students. Mayer reports that higher between-neighborhood segregation boosts the educational attainment of children in the top half of the income distribution while reducing attainment for those in the bottom half.

These studies consider the impact of segregation for both advantaged and disadvantaged youth, but most research does not, focusing on effects either for all students or only for disadvantaged students. In a review of research on school SES segregation and its impact on science and math scores (Mickelson and Bottia 2009), only 5 of the 59 articles reviewed reported results across the SES spectrum, producing mixed results (e.g., Lee, Smith, and Croninger 1997; Palardy 2008; Rumberger and Palardy 2005). My analyses examine whether advantaged students benefit from, or disadvantaged students are harmed by, income segregation, as both outcomes contribute to achievement gaps.

ALTERNATIVE EXPLANATIONS

I argue that income segregation between school districts contributes to income and racial achievement gaps by exacerbating inequalities between advantaged and disadvantaged children's districts. Here, I consider several alternative explanations.

Selection

Studies of contextual effects on individual outcomes must address selection bias. For example,

family characteristics, like income or parental education, contribute to school district choice as well as to children's achievement, introducing bias in the estimation of district effects. Examining the association between achievement and segregation between districts in metropolitan areas, rather than district composition, reduces concerns about selection bias (Cutler and Glaeser 1997). Families typically choose metropolitan areas for jobs, family ties, or history with the area, and these characteristics are less confounded with children's outcomes. That said, high-income families of high-achieving students may be attracted to segregated metropolitan areas because of the affluent districts segregation creates.

Reverse Causality

The causal relationship between income segregation and achievement gaps may operate in both directions. Preexisting achievement differences between school districts may contribute to inequality in housing costs between districts and may shape residential outcomes as parents strive to live in the best school district they can afford (Nguyen-Hoang and Yinger 2011). The relationship is likely cyclical, with income segregation leading to achievement gaps that reify income segregation for future generations through housing market and search processes. Disentangling this cycle is challenging with observational data. Similar research has used municipal government fragmentation prior to the study period as an instrument for racial or economic segregation, providing evidence that segregation does contribute to inequality in children's educational outcomes (Cutler and Glaeser 1997; Quillian 2014). Identifying robust instruments is challenging, however.

Confounders

Several confounding characteristics of metropolitan areas may contribute to both income segregation between districts and achievement gaps. First, income inequality increases income segregation between neighborhoods, schools, and school districts by creating larger gaps in the housing that high- and low-income families can afford (Owens 2016; Owens et al. 2016; Reardon and Bischoff 2011). Income inequality may contribute to achievement gaps through pathways aside from income segregation, like inequality in parental spending on children (Kornrich 2016; Kornrich and Furstenberg 2013). Second, more racially diverse and racially segregated metropolitan areas have greater income segregation, due to racial disparities in income and because racial diversity and segregation shape the residential patterns of high-income families (South and Crowder 1998). Racial diversity and segregation may also affect achievement gaps in ways that income segregation does not, for example, by reifying stereotypes about minority students that dissuade higher-quality teachers from teaching in racially isolated low-income districts (Quillian 2014). Third, I must disentangle income segregation from income level in a metropolitan area. Metropolitan areas with higher median income have higher income segregation. The absolute level of resources in a metropolitan area may raise minimum test scores by providing basic resources in low-income districts. Finally, greater private school enrollment share in a metropolitan area may reduce income segregation among public school families as high-income families particularly sensitive to school composition opt out of the public system (Logan, Oakley, and Stowell 2008). Greater private school enrollment may also shape the public school income achievement gap by removing high-income high achievers. I account for these confounders in my analyses.

My findings show how income segregation moderates the association between achievement and income or race. I posit that income segregation is one pathway through which achievement gaps between advantaged and disadvantaged groups occur. Given the challenges that selection, reverse causality, and confounding variables present, my findings provide evidence consistent with, but not definitively demonstrating, a causal relationship between income segregation between school districts and achievement gaps.

DATA AND METHODS

Test Score, Family Income, and Child Race Data

This study investigates whether test score gaps by income and race vary by the level of income segregation between school districts within metropolitan areas. The Panel Study on Income Dynamics (PSID), a national longitudinal study of families since 1968, provides information on family income, children's race, children's test scores,

Table 1. Descriptive Statistics.

Variable	Mean or Proportion	Standard Deviation
Dependent variables		
Math standardized score	101.640	17.826
Reading standardized score	101.910	16.918
Key independent variables		
Lifetime mean family income (2002 dollars)	$57,588	$53,522
Income segregation between school districts	0.069	0.045
Individual control variables		
Child race		
White	0.426	
Black	0.459	
Hispanic	0.077	
Asian	0.013	
Other race	0.024	
Male	0.510	
Two-parent household	0.635	
Number of siblings	1.327	1.111
Years of parent education	13.375	2.648
Parent expects child to get BA	0.616	
CDS I math score	104.386	18.019
CDS I reading score	103.581	17.941
MSA control variables		
Income inequality (Gini coefficient)	0.432	0.022
Proportion Black	0.179	0.127
Proportion Hispanic	0.115	0.142
Multiracial segregation between school districts	0.200	0.126
Median household income	$53,931	$12,142
Private school enrollment share	0.115	0.042

Note: *N* = 1,202 children, 170 MSAs. Child and family variables from the Panel Study on Income Dynamics; MSA control variables from the 2000 census. CDS = Child Development Supplement; MSA = metropolitan statistical area.

and metropolitan area of residence, allowing examination of the relationships of interest. The PSID Child Development Supplement (CDS) collected test score data on children ages 0 to 12 years old in 1997, with two follow-up studies. I predict children's test scores from the CDS II, collected in 2002 to 2003, when the original CDS subjects were school age. Children's achievement was measured with the Woodcock-Johnson Revised Test of Achievement, a commonly used assessment with standardized scoring protocols that provides a measure of reading and math skills normed to the national average for the child's age. Reading scores come from a combination of the Letter-Word and Passage Comprehension tests; math scores come from the Applied Problems tests. Table 1 presents descriptive statistics. The CDS II collected assessment data from about 2,500 children; my analytic sample includes about 1,200 children because it is limited to public school children living in metropolitan areas who were assessed in the CDS I.

The longitudinal PSID collects rich information on children's families, including repeated measures of family income. I average family income from the child's birth until the CDS II, when children took the math and reading assessments.[3] Lifetime income provides a more complete portrait of family resources than does a single year, and it accounts for sudden changes or misreporting (Mayer 1997). I measure lifetime family income in continuous dollars (adjusted for inflation to 2002 dollars) as well as categorizing families by income quintiles, based on the U.S. income distribution in 2002. Child race, reported by the primary caregiver, is categorized as non-Hispanic

white, non-Hispanic black, Hispanic, non-Hispanic Asian, and non-Hispanic other race. The racial composition of the sample reflects the oversample of black families in the PSID.[4]

Income Segregation between School Districts

The PSID collects information about where children live. Via a restricted-use license, I identified the metropolitan statistical area (MSA; based on 2003 Office of Management and Budget definitions) in which a child lived at the CDS II. I estimate income segregation between elementary or unified school districts in subjects' MSAs with data from the School District Demographic System (SDDS), produced by the NCES. SDDS provides counts of families in 16 income categories in each school district based on 2000 census data. I estimate segregation among families who enroll at least one child in public school, which captures disparities in tax base as well as student body composition and available parent and peer resources. Analyses measuring segregation of all households produce substantively identical results.

I estimate segregation with the rank-order information theory index H, which captures how evenly families sort by income between school districts within MSAs. This index considers the entire income distribution, rather than just segregation between poor and nonpoor families. H compares the variation in family incomes within school districts to the variation in family incomes within the MSA (Reardon 2009). H extends the binary information theory (entropy) index by estimating entropy of each district and its MSA for every income threshold (defined by the 16 income categories) with the following equation (Theil 1972; Theil and Finezza 1971):

$$E(p)=p\log_2\frac{1}{p}+(1-p)\log_2\frac{1}{(1-p)}, \qquad (1)$$

where p is the proportion of families with incomes below each income threshold. Binary H is calculated as the average deviation of each district's entropy, $E_j(p)$, from the MSA entropy, $E(p)$, weighted by the number of households:

$$H(p)=1-\sum_j\frac{t_jE_j(p)}{TE(p)}. \qquad (2)$$

To estimate the rank-order information theory index H over all income categories, I use the following:

$$H=2\ln(2)\int_0^1 E(p)H(p)dp \qquad (3)$$

Theoretically, H can range from 0 to 1, with 0 representing no segregation (every district has the same income distribution as the MSA) and 1 representing complete segregation (all families in each district have the same income).

Analytic Approach

I examine the relationship between income segregation and the income achievement gap using the following equations:

$$Y_{ij}=\beta_{0j}+\beta_{1j}\mathrm{Inc}_{ij}+\beta_kX_{ijk}+\varepsilon_{ij}, \qquad (4)$$

where Y_{ij} is the reading or math score of student i in MSA j, Inc_{ij} is the average lifetime family income of the student (or a categorical quintile indicator in some models), and X is a vector of k individual controls, described below. One important control variable is a child's test score from the CDS I in 1997. The model therefore predicts test scores net of earlier achievement.

I use a multilevel model to allow the effect of family income to vary as a function of between-district income segregation:

$$\beta_{0j}=\gamma_{00}+\gamma_{01}\mathrm{Seg}_j+\gamma_{0k}C_{jk}+\varepsilon_0. \qquad (5)$$

$$\beta_{1j}=\gamma_{10}+\gamma_{11}\mathrm{Seg}_j+\gamma_{1k}C_{jk}+\varepsilon_1. \qquad (6)$$

Both the intercept (β_{0j}) and the coefficient for income (β_{1j}) are predicted from the level of income segregation between districts in MSA j (Seg_j). I report the key coefficient γ_{11} as an interaction term between family income and segregation. I hypothesize that the interaction term will be positive: the income achievement gap is larger in more segregated places because higher-income students perform better and/or lower-income students perform worse in highly segregated MSAs. I include MSA-level confounders of income segregation, C_{jk}, described below. I also examine how income segregation predicts the racial achievement gap by interacting child race, rather than family income, with income segregation between

districts. I limit this analysis to comparisons between non-Hispanic white and black students due to sample size.

My analysis sample includes 1,202 children in 170 MSAs (seven subjects per MSA, on average); this includes 35 MSAs (21 percent of MSAs; 3 percent of subjects) with only one subject. The literature on multilevel models provides varying recommendations on the number of observations per cluster and the number of clusters needed to obtain unbiased results (for a review, see McNeish and Stapleton 2016). Researchers concur that the number of clusters (here, MSAs) is more important than cluster size for obtaining unbiased results. Bell, Ferron, and Kromrey (2008) show that results from models with cross-level interactions are not biased by clusters with a small sample size, even a sample size of one, as long as the number of clusters is modestly large. I estimated models on the full analytic sample, as well as limiting the sample to MSAs with at least 5 or 10 children (90 percent of subjects live in an MSA with 5 or more subjects; 75 percent live in an MSA with 10 or more subjects). Results are substantively identical. Results may generalize more to large MSAs, from which there are more children in the sample.

Control Variables

I control for child and family characteristics associated with family income and test scores, including child's race (comparing black, Hispanic, Asian, and other race; white is the reference group), child's sex, family structure (dummy variable for a two-parent family), number of siblings, parent education (continuous measure of years), and whether the parent expects the child to complete a bachelor's degree.[5] I control for children's previous test scores, capturing how income segregation shapes achievement net of earlier test scores. In the 1997 CDS I, children ages 3 to 12 completed the Letter-Word and Applied Problems tests. Because the CDS I did not assess children under age 3, this limits the analytic sample to children ages 8 and older in the CDS II. To account for the MSA-level confounders discussed previously, I control for income inequality (Gini coefficient of household income); racial composition (proportion black, proportion Hispanic); multiracial segregation of black, white, Hispanic, Asian, and other-race students between school districts (measured with the information theory index); median household income; and private school enrollment share, using 2000 census data. I use multiple imputation to generate 20 plausible data sets that replace missing values (only child-level variables have missing data, and no variable is missing more than 10 percent of values). Following von Hippel (2007), I exclude imputations of the dependent variable in analyses.

RESULTS

Income Segregation and Income Gaps in Math and Reading Achievement

Table 2 presents results from multilevel models predicting children's math (top panel) and reading (bottom panel) achievement from their lifetime average family income and income segregation between school districts in their MSA, controlling for their prior test scores, race, sex, family composition, parent education, and parent expectations. Model 1 predicts math or reading score from family income with individual controls (Appendix Table A1 provides coefficients for control variables). The coefficient for family income is significant (borderline significant for reading) but very small: every $10,000 increase in average lifetime family income corresponds to roughly a 0.2-point test score increase, about 1 percent of a standard deviation. This is much smaller than the effect found in past research, demonstrating the challenges of isolating the causal effect of income.[6] I do not focus on estimating causal effects of income; instead, I focus on one pathway through which family income operates, exploring how the association between family income and achievement varies across MSAs with various levels of income segregation between districts.

Model 2 adds income segregation between school districts among public school families, which does not significantly predict reading or math achievement. Model 3 interacts income segregation between districts with family income. Examining only interaction terms' coefficients and standard errors is insufficient for interpretation (Brambor, Clark, and Golder 2006). The marginal effect of family income on achievement could be significant at some levels of income segregation even if the interaction term is nonsignificant. Estimates of marginal effects and their corresponding standard errors from Model 3 indicate that the association between family income and

Table 2. Multilevel Regression Models Predicting Test Scores from Family Income, Income Segregation between School Districts, and Their Interaction.

Variable	Model 1	Model 2	Model 3	Model 4
Math scores				
Family income ($10,000)	0.235*	0.216*	−0.198	−1.853
	(0.106)	(0.104)	(0.166)	(2.437)
Income segregation between school districts		7.643	−15.709	−5.293
		(9.173)	(13.443)	(23.292)
Family Income × Income Segregation			4.105*	7.347**
			(1.632)	(2.774)
MSA controls				Y
Constant	56.974	56.723	57.878	79.419
Reading scores				
Family income ($10,000)	0.221†	0.229*	0.144	0.528
	(0.114)	(0.115)	(0.204)	(2.620)
Income segregation between school districts		−7.531	−12.932	−54.974†
		(11.575)	(16.322)	(29.035)
Family Income × Income Segregation			0.944	6.707*
			(1.980)	(3.091)
MSA controls				Y
Constant	43.210	43.508	43.838	45.639

Note: All models include individual controls (prior test scores, race, sex, family composition, parent education, and parent expectations). Model 4 controls for MSA income inequality, racial composition and segregation, median income, and private school enrollment share. Full model parameters are presented in the appendix. N = 1,202 children in 170 MSAs. MSA = metropolitan statistical area; Y = Yes (included in the model).
†$p \leq .10$. *$p \leq .05$. **$p \leq .01$.

math achievement varies significantly by level of income segregation. In integrated MSAs, I find no significant association between family income and math achievement, but in highly segregated MSAs, family income positively and significantly predicts math achievement. Marginal effects estimates show that family income does not significantly predict reading achievement at any level of income segregation without accounting for MSA confounders.

Model 4 controls for MSA income inequality, racial composition, racial segregation between districts, median household income, and private school enrollment share to better isolate the role of income segregation between districts. Figure 1 plots marginal effects of family income on math achievement (y-axis) by income segregation percentile (x-axis), defined by the analysis sample, from Model 4. Below approximately the median level of income segregation, family income is not associated with math scores (the confidence interval contains zero), but in more segregated MSAs, the association between income and math achievement is significant and positive. The figure for reading achievement (not shown) is similar. The association between family income and students' achievement increases as income segregation between districts rises. This positive interaction indicates that the income achievement gap is larger in metropolitan areas with higher levels of income segregation, where more high-income families live in districts with other high-income families and more low-income families live in districts with other low-income families.

Exploring Trade-offs of Income Segregation

Income segregation between districts could contribute to the income achievement gap by boosting the achievement of high-income children, reducing the achievement of low-income children, or both. I explore this in Figures 2 and 3, which present predicted values of math and reading scores, respectively, on the y-axis against income segregation

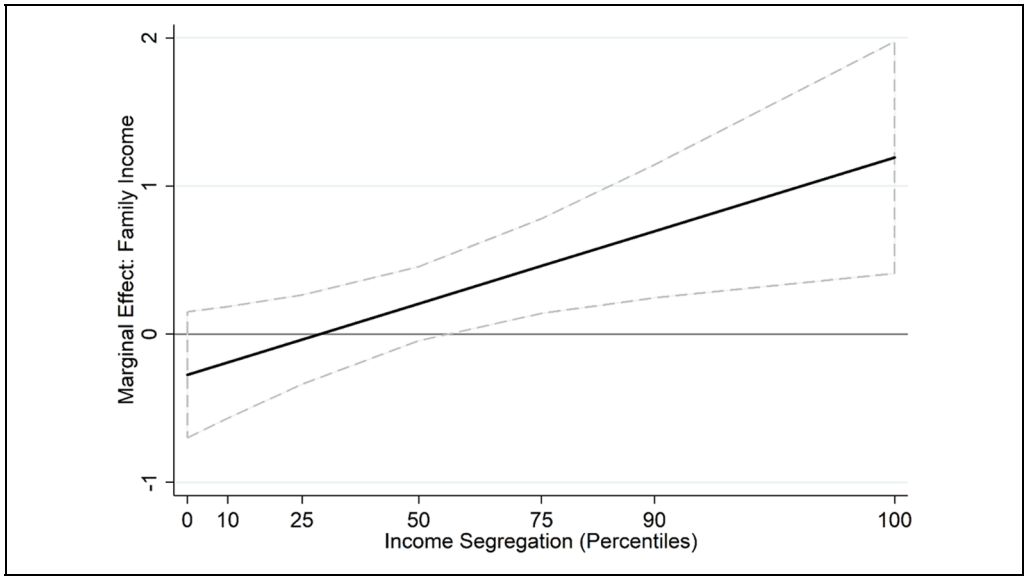

Figure 1. Marginal effects of family income on math achievement by income segregation between school districts.

Note: Black line estimates marginal effects from Table 2, Model 4; gray dashed lines represent 95 percent confidence interval.

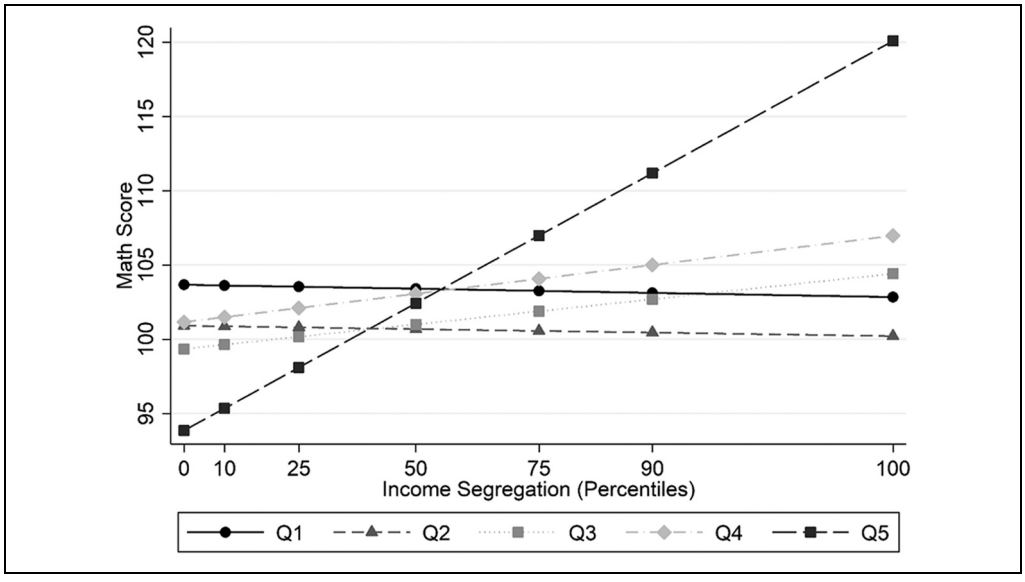

Figure 2. Predicted math scores by family income quintile and income segregation between school districts.

Note: Estimates from model similar to Table 2, Model 4, but categorizing family income by national income quintiles instead of continuously. All covariates held at their mean value. In all figures, income segregation percentiles are defined by the sample.

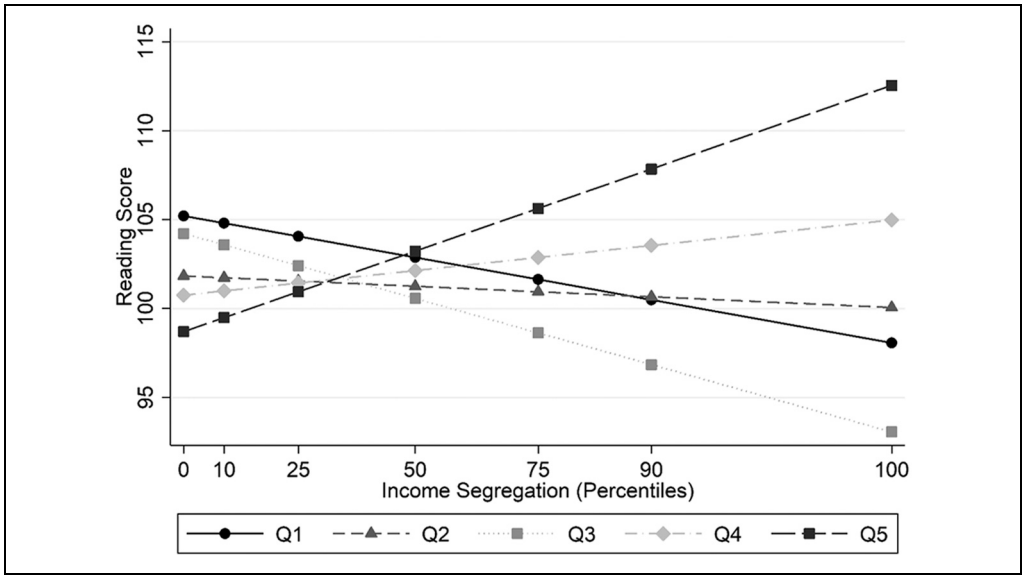

Figure 3. Predicted reading scores by family income quintile and income segregation between school districts.

Note: Estimates from model similar to Table 2, Model 4, but categorizing family income by national income quintiles instead of continuously. All covariates held at their mean value.

between districts (*x*-axis). The predicted values come from models like Model 4 in Table 2, with individual- and MSA-level controls. Instead of measuring family income continuously, I categorize families according to 2002 national income quintiles, with one line representing each income quintile. I predict scores at various percentiles of segregation in the sample.

For math, high family income is increasingly advantageous as income segregation increases. Students from affluent families, with incomes in the top quintile (Figure 2, dashed black line), achieve higher test scores in more segregated metropolitan areas. Achievement among the lowest-income children (solid black line) changes little as income segregation increases. For reading (Figure 3), the story looks different. Income segregation appears both advantageous for affluent students (dashed black line) and disadvantageous for the lowest-income students (solid black line).

To further test these results, I compared the test scores of affluent children (those whose lifetime average family income falls in the top national income quintile in 2002, over $84,016) and poor children (with lifetime average income in the bottom national income quintile, less than $17,916) to all others. The top panel of Table 3 presents results comparing affluent children to all others. Model 1, which includes only individual-level controls, shows that affluent students perform better than lower-income students in reading and math. Model 2 adds income segregation and its interaction with income quintile. Marginal effects plots from Model 2 indicate that family affluence is associated with higher math achievement at high levels of income segregation (Appendix Figure A1), but family affluence is not associated with reading achievement at any level of income segregation without accounting for covariates of MSA income segregation. This reflects that affluent families live in significantly higher-income, more racially diverse, and more economically unequal MSAs than do lower-income families.

Model 3 adds MSA controls. The positive interaction terms and marginal effects estimates indicate the gaps in reading and math achievement between affluent children and all others is larger in MSAs where income segregation between districts is higher. Figure 4 plots the relationship between income segregation and math scores for affluent children (dashed gray line) compared to children with family incomes in the bottom four income quintiles (solid black line). At the lowest levels of income segregation (left side of the figure), affluent children's math achievement is actually slightly lower than that of lower-income children,

Table 3. Multilevel Regression Models Predicting Test Scores from Family Affluence or Poverty, Income Segregation between School Districts, and Their Interaction.

Variable	Model 1: Math	Model 2: Math	Model 3: Math	Model 1: Reading	Model 2: Reading	Model 3: Reading
Family affluence						
Top income quintile	2.581*	−0.599	6.537	2.264†	1.119	−17.642
	(1.188)	(2.076)	(28.814)	(1.329)	(2.546)	(33.957)
Income segregation between school districts		1.309	15.069		−17.164	−31.026
		(10.862)	(18.490)		(14.686)	(24.329)
Top Quintile × Income Segregation		37.194†	116.117**		23.960	94.474*
		(21.448)	(38.252)		(27.215)	(46.578)
MSA controls			Y			Y
Constant	57.477	57.512	65.799	43.533	56.181	50.430
Family poverty						
Bottom income quintile	0.126	2.485	−11.674	−0.531	0.118	−11.824
	(1.293)	(2.099)	(41.582)	(1.512)	(2.439)	(47.574)
Income segregation between school districts		15.533†	46.051**		−2.285	0.700
		(9.064)	(16.122)		(11.588)	(20.589)
Bottom Quintile × Income Segregation		−35.698	−52.490		−9.670	−37.806
		(24.189)	(57.082)		(28.907)	(65.593)
MSA controls			Y			Y
Constant	55.615	55.014	59.864	42.403	42.413	42.103

Note: All models include individual controls (prior test scores, race, sex, family composition, parent education, and parent expectations). Model 3 controls for MSA income inequality, racial composition and segregation, median income, and private school enrollment. N = 1,202 children in 170 MSAs. MSA = metropolitan statistical area; Y = Yes (included in model).
†$p \leq .10$. *$p \leq .05$. **$p \leq .01$.

although the comparison group includes children with incomes up to the 80th percentile of the national income distribution. Beyond the median level of income segregation in the sample, affluent children increasingly score higher than all lower-income children, including middle-class children. At the highest level of between-district income segregation in the sample, the gap between affluent and lower-income children's math achievement is one standard deviation. As income segregation rises, the math achievement of children in the lower 80 percent of the income distribution changes little, although this may mask heterogeneity within the bottom 80 percent.

Figure 5 shows that income segregation contributes to the income achievement gap in reading both because high-income children's (dashed gray line) achievement is higher and because lower-income children's (solid black line) achievement is lower in more segregated metropolitan areas. Future research should examine these differences in contextual effects for math and reading. Perhaps math achievement depends more on formal instruction than does reading achievement. Districts of concentrated affluence might provide advanced curricular or instructional resources, whereas districts with lower-income students might provide sufficient resources for a minimum level of math achievement across segregation levels.

So far, I have compared affluent children to all lower-income children. Turing to the lower panel of Table 3, I examine the achievement of very-low-income children, comparing children in the bottom income quintile to those in the top 80 percent of the income distribution. Model 1 indicates that poor children's test scores do not differ from the achievement of all higher-income students (recall that the comparison group includes students with incomes just over the 20th percentile). In Models 2 and 3, the interaction term is negative, as expected—income segregation is hypothesized to be detrimental for low-income children—but nonsignificant. Marginal effects plots (Appendix Figures A2 and A3) confirm that the effect of family poverty is not significantly associated with achievement at any level of income segregation.

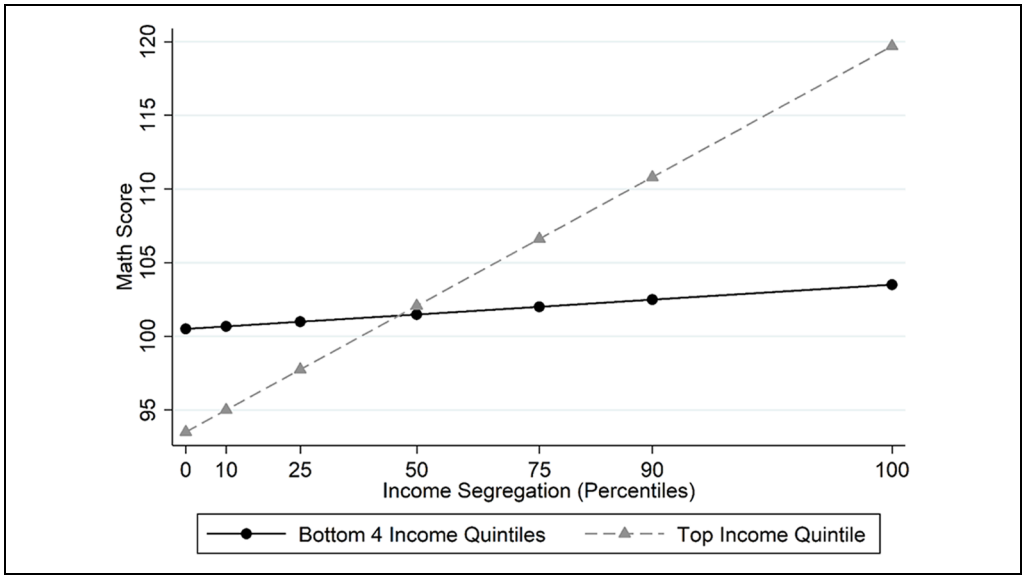

Figure 4. Predicted math scores for students with top quintile income compared to all others by income segregation between school districts.
Note: Estimates from Table 3, Model 3. All covariates held at their mean value.

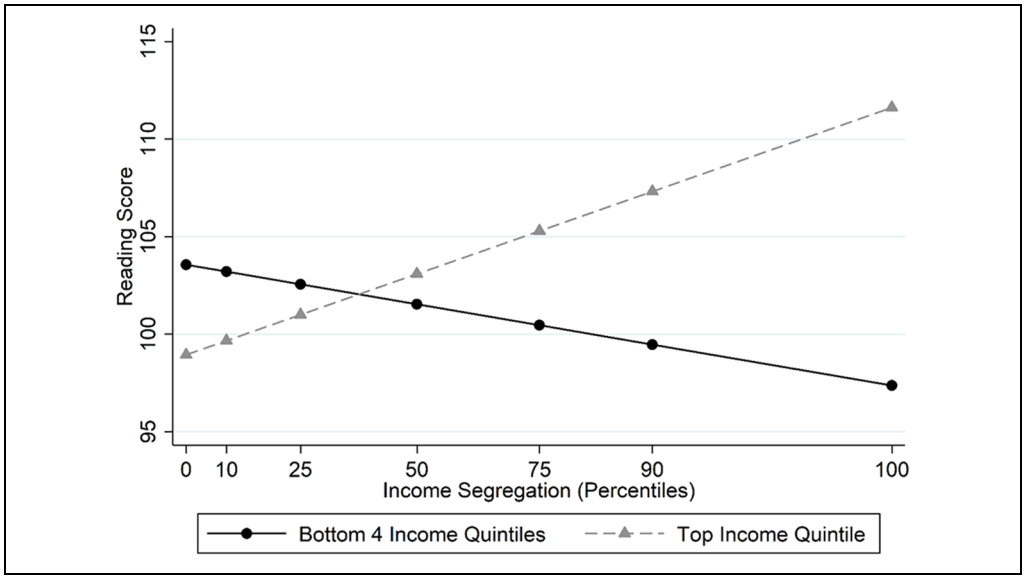

Figure 5. Predicted reading scores for students with top quintile income compared to all others by income segregation between school districts.
Note: Estimated from Table 3, Model 3. All covariates held at their mean value.

Therefore, I find little evidence that income segregation is detrimental for students in the lowest income quintile. Future research, however, should investigate other cut points in the income distribution, as Figure 3 provides some evidence that reading scores of children in the lower 80 percent of the income distribution decline as income segregation increases.

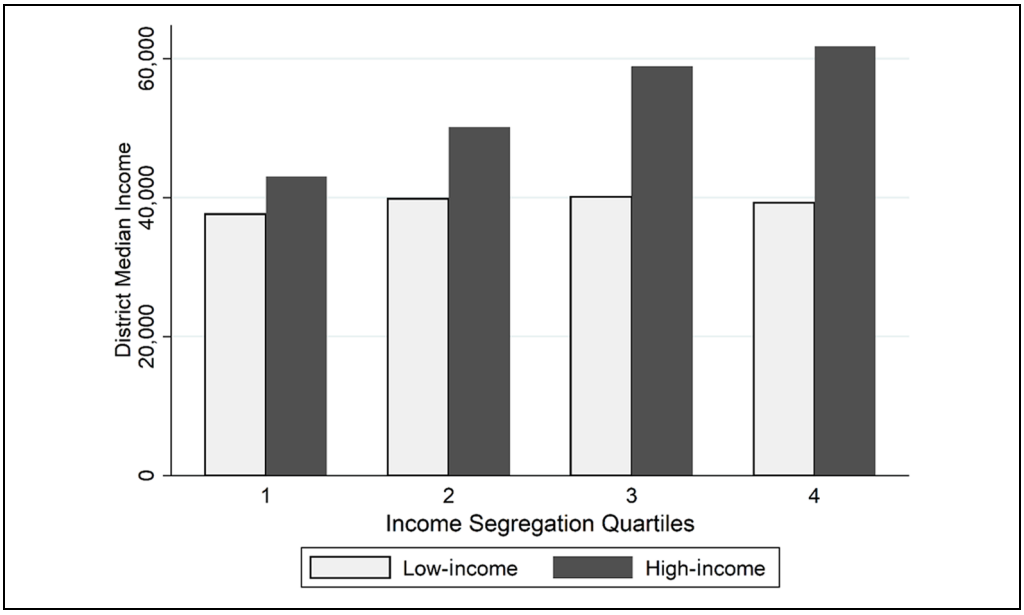

Figure 6. Median income in the school district of the average high- or low-income family, by metropolitan area income segregation.

Note: High- and low-income defined as the top and bottom national income quintiles in 2002. Income segregation quartiles defined by analysis sample.

These results prompted investigation into how income segregation shapes affluent and poor children's school districts. Using 2000 SDDS data, I estimated the median household income in school districts of high- and low-income families with children in more or less segregated metropolitan areas. Median income in a school district serves as a rough proxy for the district's financial and social resources. I calculated counts of highest- and lowest-income quintile families in each district. Then I divided MSAs into quartiles based on the distribution of segregation in my sample and used weighted means to estimate median household income in the school district of the average high- or low-income family with children in each income segregation quartile.

Figure 6 plots school district median income on the *y*-axis. The four sets of bars across the *x*-axis represent high-income (dark gray) and low-income (light gray) families in MSAs by income segregation quartile. The gap between high- and low-income families' median district income is larger in metropolitan areas with higher income segregation between school districts. This is due to high-income families living in increasingly affluent school districts as income segregation rises. The median income in low-income families' districts varies little between the most and least segregated MSAs (compare the right and left sets of bars), whereas the median income in high-income families' districts is nearly 40 percent higher in the most compared to least segregated MSAs. This is consistent with past research showing that segregation of the affluent is higher than segregation of the poor between school districts (Owens et al. 2016). Therefore, it is not surprising that results thus far indicate that the achievement gap is higher in more segregated places largely due to affluent students performing better—income segregation provides benefits for the advantaged yet does little to change the context for poor students. Of course, median district income hides diversity within districts, and low-income students likely live in more homogenously low-income districts in the most segregated MSAs.

Income Segregation and Black and White Children's Achievement

Next, I examine how the racial, rather than income, achievement gap varies by income segregation between districts. All models in Table 4 control for student traits, including family income.

Table 4. Multilevel Regression Models Predicting Test Scores from Child Race, Income Segregation between School Districts, and Their Interaction.

Variable	Model 1	Model 2	Model 3
Math scores			
White child (versus black)	8.309***	5.707***	16.767
	(0.984)	(1.491)	(22.307)
Income segregation between school districts		−9.656	9.627
		(11.924)	(23.674)
White × Income Segregation		39.729*	62.093†
		(17.112)	(33.103)
MSA controls			Y
Constant	50.031	51.478	57.278
Reading scores	Model 1	Model 2	Model 3
White child (versus black)	5.230***	2.003	−0.608
	(1.210)	(1.904)	(28.130)
Income segregation between school districts		−28.574†	−48.400
		(16.716)	(32.649)
White × Income Segregation		49.268*	73.071†
		(22.498)	(43.308)
MSA controls			Y
Constant	33.924	35.997	51.455

Note: All models include individual controls (prior test scores, family income, sex, family composition, parent education, and parent expectations). Model 3 controls for MSA income inequality, racial composition and segregation, median income, and private school enrollment share. Sample includes only white and black children. N = 1,064 children in 163 MSAs. MSA = metropolitan statistical area; Y = Yes (included in model).
†$p \leq .10$. *$p \leq .05$. ***$p \leq .001$.

I limit the sample to white and black students. As Model 1 indicates, white students' math (top panel) and reading (bottom panel) achievement is substantially higher than black students' achievement, net of earlier test scores. Model 2 adds income segregation and its interaction with income. The interaction between income segregation and child race is positive and significant for both reading and math scores. The gap between white and black students' achievement is larger in more economically segregated metropolitan areas.

Model 3 adds MSA controls. Marginal effects plots (presented in Appendix Figures A4 and A5) demonstrate that in *integrated* MSAs, white students do no better than black students (the confidence interval contains zero). As segregation rises, white students score increasingly and significantly higher on math and reading tests compared to black students. Predicted values from Model 3 (displayed in Figures 7 and 8) indicate a parallel pattern to the income results: for math, white students perform better in more segregated metropolitan areas; for reading, income segregation is associated with higher scores among white students and lower scores among black students. The black–white achievement gap in math and reading grows from less than 5 points in integrated MSAs to 15 points, nearly a full standard deviation, in the most segregated MSAs in the sample.

What advantages or disadvantages does income segregation provide to white and black families? Similar to Figure 6, I estimated how median household income in the school districts of black and white families with children varied by family income and income segregation in their MSA using 2000 SDDS data. I identified high- and low-income black and white families based on thresholds for the highest and lowest national income quintiles, divided MSAs into quartiles of income segregation, and estimated the median household income in the school districts of high- and low-income black and white families by income segregation quartile.[7] Figure 9 shows

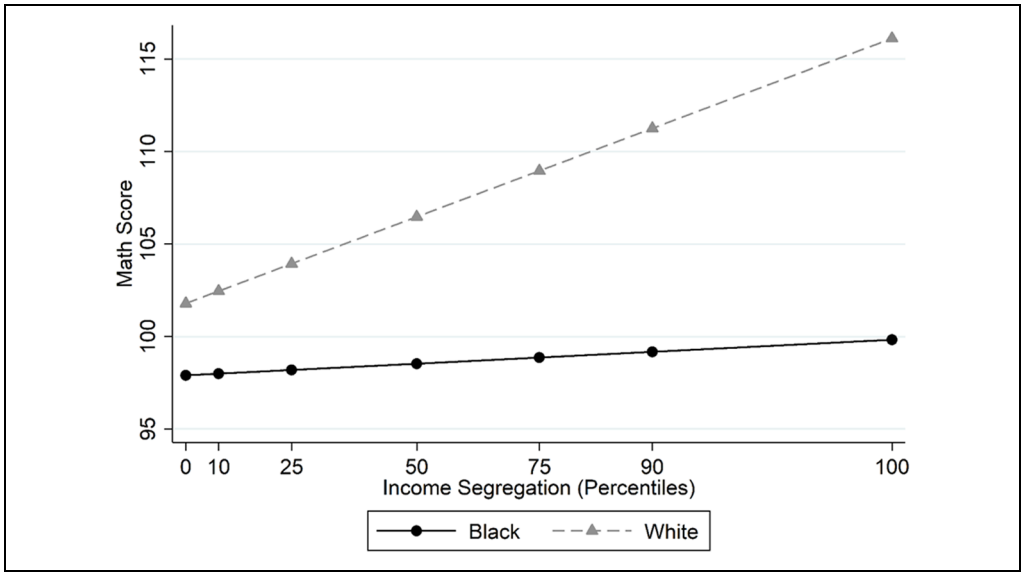

Figure 7. Predicted math scores for white and black students by income segregation between school districts.
Note: Estimates from Table 4, Model 3. All covariates held at their mean value.

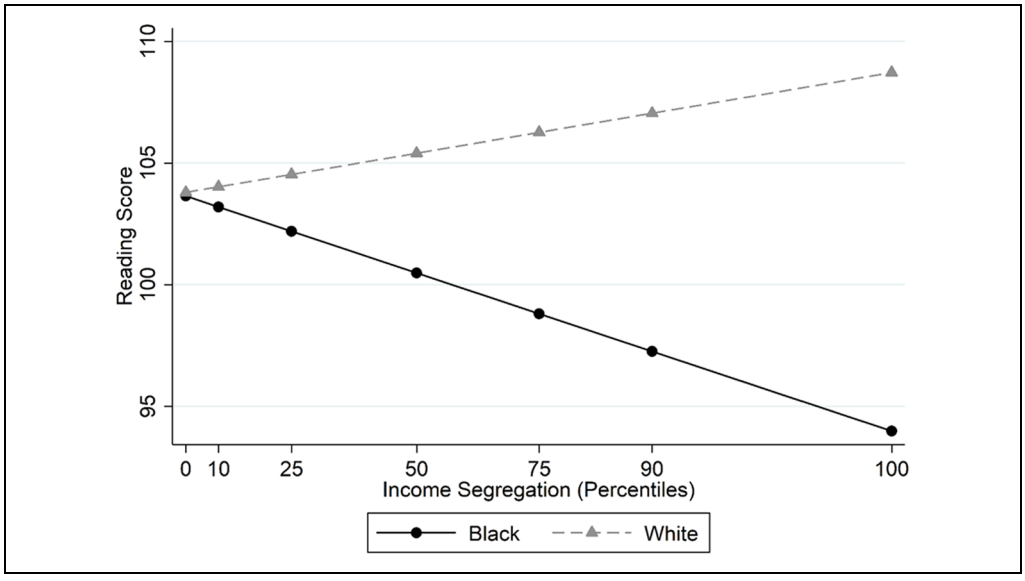

Figure 8. Predicted reading scores for white and black students by income segregation between school districts.
Note: Estimates from Table 4, Model 3. All covariates held at their mean value.

how income segregation provides advantages and disadvantages by race and income (again, using district median income as a rough proxy for economic and social resources).

The left set of bars in Figure 9 shows that, in MSAs with the lowest levels of income segregation (first quartile), black and white families live in fairly similar school districts. High-income

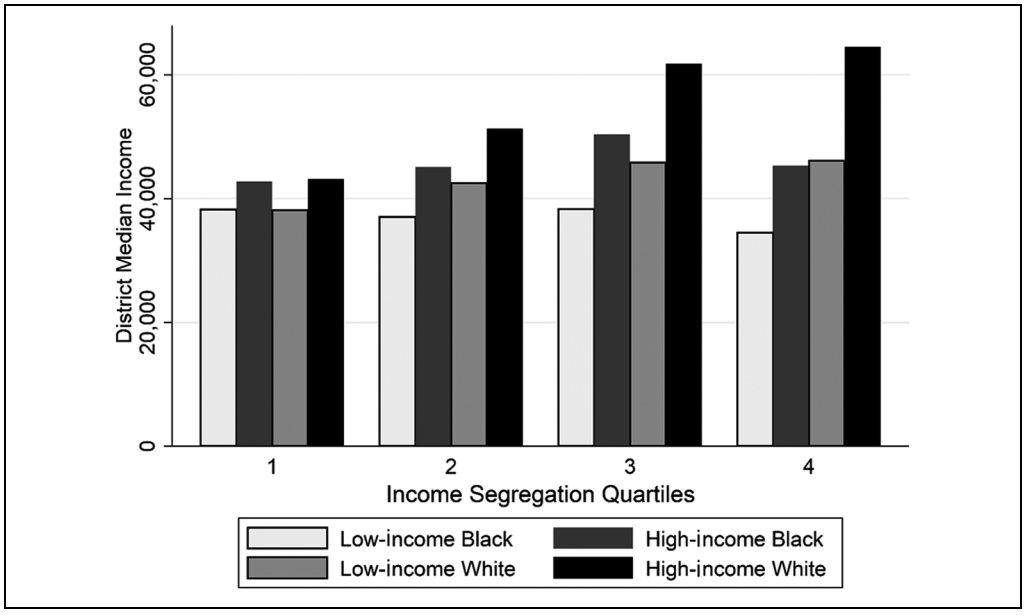

Figure 9. Median income in the school district of the average high- or low-income black or white family, by metropolitan area income segregation.
Note: High- and low-income defined as the top and bottom national income quintiles in 2002. Income segregation quartiles defined by analysis sample.

black families live in slightly-higher-income districts than do low-income black families, with a similar income gap among white families. The right set of bars, however, shows that income segregation provides large advantages for high-income white families but not for high-income black families. In fact, in highly segregated metropolitan areas, the average high-income black family lived in a school district with nearly identical median income as the average low-income white family ($45,000 versus $46,000). The racial achievement gap may be larger in highly economically segregated metropolitan areas because white students, particularly high-income ones, have access to more affluent districts than do nearly all black students, even high-income black students. This portrait of high- and low-income black and white families' school districts suggests that high family income translates to affluent school districts for white children but not for black children. This is consistent with research on differences in neighborhood attainment for black and white households with similar incomes (Reardon et al. 2015; Sharkey 2014). Future research should investigate whether contextual effects on the income achievement gap operate differently among black and white individuals (Lopez Turley 2003).

DISCUSSION

Since the mid-twentieth century, economic inequality has increased across several indicators, including income inequality; income segregation between neighborhoods, schools, and school districts; and income gaps in educational achievement. Economic stratification has serious consequences for intergenerational mobility and future disparities between the rich and the poor. I argue that income segregation creates inequalities in the economic and social resources of school districts serving advantaged and disadvantaged children, and my results indicate that income segregation between school districts contributes to the income achievement gap. While economic stratification has increased, racial inequality persists, and I find that income segregation between districts also contributes to the black–white test score gap. Considering students' race and income jointly, I find that high-income white families live in the affluent districts that income

segregation creates, whereas high-income black families do not access these advantageous contexts. This article contributes to the large body of research demonstrating that where children grow up and how much money their parents have do contribute to their future outcomes, in complex and interacting ways, despite the promise of the American Dream (Chetty et al. 2014).

Studies of inequality often focus on the disadvantaged group's outcomes, but my results emphasize that inequality also arises due to gains made by advantaged groups. The income achievement gap grows as income segregation increases mainly because high-income students benefit from high levels of income segregation. Similarly, income segregation contributes to the racial achievement gap largely by boosting white students' scores. Children from advantaged families accumulate additional resources in segregated places because their families can access the most advantaged contexts. Results for reading provide some evidence that income segregation is also detrimental for lower-income and black students' reading achievement, requiring further investigation. Broadly, these findings emphasize that segregation has trade-offs (Quillian 2014)—it may benefit advantaged families and harm disadvantaged families. Achievement gaps emerge not only because disadvantaged students fall behind but also because advantaged students pull away. My results are consistent with Reeves's (2017) argument that families with incomes in the top quintile are hoarding opportunities for their children. This has troubling implications for future economic, political, and social polarization.

My results differ somewhat from past research showing that racial and economic segregation between schools and neighborhoods has detrimental effects for disadvantaged—low-income and black—students and minimal effects on advantaged students (Quillian 2014; Vigdor and Ludwig 2008). This is in part due to design differences—research on economic segregation often distinguishes only between the poor and nonpoor and thus does not examine outcomes at the top of the income distribution. One substantive hypothesis is that segregation at different geographic or administrative levels contributes to inequality differently. Mayer (2002:167) also finds that income segregation between school districts is advantageous for high-income children's educational attainment but does not significantly predict outcomes for low-income children. Identifying how segregation at various geographic and administrative levels creates advantages and disadvantages for different groups is critical for understanding the mechanisms and policy approaches that could reduce inequality. This is an urgent task for future research. Perhaps in highly segregated metropolitan areas, high-income students benefit from high-quality teachers, better facilities, financial contributions and involvement from parents, or advanced curriculum in their very-high-income districts. Lack of these "extra" resources may not affect minimum levels of achievement, so low-income students' scores may not suffer as income segregation rises. Segregation *within* districts may also drive results for low-income students—if low-income students attend the most disadvantaged *schools* in mixed-income districts in integrated metropolitan areas, their economic and social contextual resources may not look much different from schools in low-income districts in segregated areas. Future research should investigate the mechanisms of school districts as sources of inequality, as well as segregation within and between multiple contexts.

To reduce the income achievement gap, policy makers and researchers must understand what characteristics of affluent contexts are beneficial for children and how those benefits can be reproduced. If instructional resources, high-quality curriculum, higher teacher salaries, or state-of-the-art facilities produce high math scores, school finance policies providing compensatory (beyond simply adequate) funding to low-income districts could help equalize outcomes. Evaluations of Title I funding indicate limited effects on low-income children's test scores (Borman 2000). Other studies, however, find that additional targeted resources may mitigate the effects of school segregation (Billings, Deming, and Rockoff 2014; Gamoran and An 2016). Alternatively, social resources in a district, like parents' social networks, information, or a culture organized around achievement, may be critically important elements of high-income students' districts, which suggests that promoting socioeconomic integration across district boundaries may be necessary. Income segregation between school districts creates spatial inequalities that contribute to the achievement gap. Policy makers must continue to work toward solutions that benefit all students. Whether integration is necessary or compensatory resources can overcome segregation remains an open and controversial question, but many policy makers,

activists, researchers, and parents cannot abide a return to "separate but equal."

Test score gaps between high- and low-income children have grown over the past few decades, but new evidence suggests the school readiness gap closed modestly between high- and low-income preschoolers during the 2000s (Reardon and Portilla 2016). Whether this progress bears out in later achievement and educational attainment remains to be seen, but this finding indicates there are lessons to be learned on closing the income achievement gap in an era of rising income inequality and income segregation. Income segregation is one avenue through which income differences play out, but family processes are also important. Research indicates that low-income parents invested more in their children via books, educational games and computers, and parental engagement during the 2000s, narrowing the income gap in childhood parental investment (Bassok et al. 2016). If low-income parents cannot buy their way into advantaged contexts, perhaps the income achievement gap can be narrowed by family expenditures on other experiences and resources that benefit children and raise their achievement level to that of affluent children. Other supports, like the expansion of welfare and health care policies for low-income children, also contribute to child well-being. Families, schools, school districts, and neighborhoods, along with state policy, are all important for children's well-being, and each area has potential policy levers that can be pushed to close achievement gaps.

APPENDIX

Table A1. Full Models Predicting Math and Reading Scores.

Variable	Table 2, Model 1: Math	Table 2, Model 1: Reading	Table 2, Model 4: Math	Table 2, Model 4: Reading
Family income ($10,000)	0.235*	0.221†	−1.853	0.528
	(0.106)	(0.114)	(2.437)	(2.620)
Income segregation between districts			−5.293	−54.974†
			(23.292)	(29.035)
Family Income × Income Segregation			7.347**	6.707*
			(2.774)	(3.091)
Prior test score	0.369***	0.464***	0.366***	0.464***
	(0.023)	(0.023)	(0.023)	(0.023)
Black	−7.970***	−5.366***	−7.966***	−5.032***
	(0.966)	(1.046)	(1.083)	(1.152)
Hispanic	−6.213***	−6.739***	−5.104**	−5.452*
	(1.750)	(1.960)	(1.967)	(2.192)
Asian	7.702*	−4.437	8.573**	−3.497
	(3.214)	(3.362)	(3.224)	(3.370)
Other race	0.688	−0.825	0.753	−0.581
	(2.403)	(2.502)	(2.379)	(2.495)
Male	2.495***	−0.482	2.342***	−0.462
	(0.723)	(0.744)	(0.720)	(0.745)
Two-parent family	−0.034	0.964	0.040	0.492
	(0.893)	(0.925)	(0.910)	(0.943)
Siblings	−0.187	−0.313	−0.276	−0.329
	(0.338)	(0.351)	(0.337)	(0.352)
Parent years of education	0.338†	0.674***	0.244	0.590**
	(0.195)	(0.204)	(0.198)	(0.210)
Parent expectations	5.870***	5.662***	5.828***	5.550***
	(0.824)	(0.850)	(0.818)	(0.850)
MSA income inequality			−57.880	−16.068
			(39.182)	(45.974)
MSA percentage black			16.155*	2.002
			(6.670)	(8.023)
MSA percentage Hispanic			3.289	2.316
			(6.241)	(7.398)
MSA racial segregation			−2.068	18.461†
			(7.956)	(10.142)
MSA median income ($10,000)			0.658	1.164†
			(0.537)	(0.663)
MSA private enrollment share			−18.591	−14.401
			(17.641)	(21.769)
MSA Income Inequality × Family Income			6.490	1.463
			(5.834)	(6.339)
MSA Percentage Black × Family Income			−1.962†	0.191
			(0.988)	(1.065)
MSA Percentage Hispanic × Family Income			−1.476	−2.115*
			(0.905)	(1.007)
MSA Racial Segregation × Family Income			−1.926*	−3.127**
			(0.988)	(1.168)
MSA Median Income × Family Income			−0.046	−0.078
			(0.051)	(0.055)
MSA Private Enrollment × Family Income			−0.576	0.103
			(2.804)	(3.122)
Constant	56.974	43.210	79.419	45.369

†$p \leq .10$. *$p \leq .05$. **$p \leq .01$. ***$p \leq .001$.

Table A2. Replication of Table 2 Using Ordinary Least Squares Regressions with Probability Weights and Clustered Standard Errors.

Variable	Table 2, Model 3	Table 2, Model 4
Math scores		
Family income ($10,000)	−0.163	−1.649
	(0.186)	(2.725)
Income segregation between districts	−3.024	−11.253
	(18.607)	(42.419)
Family Income × Income Segregation	2.985	7.590*
	(1.844)	(3.699)
MSA controls		Y
Constant	53.756	79.750
Reading scores		
Family income ($10,000)	−0.214	1.058
	(0.212)	(3.011)
Income segregation between districts	−15.322	−34.747
	(23.091)	(54.809)
Family Income × Income Segregation	2.400	5.902
	(1.984)	(4.315)
MSA controls		Y
Constant	45.049	37.511

Note: Models include control variables as in Table 2, Models 3 and 4. I weight analyses with the Panel Study on Income Dynamics child weight and cluster standard errors by MSA. As is typical, standard errors are larger than in nonweighted models. MSA = metropolitan statistical area; Y = Yes (included in model).
$^{\dagger}p \leq .10$. $^{*}p \leq .05$. $^{**}p \leq .01$. $^{***}p \leq .001$.

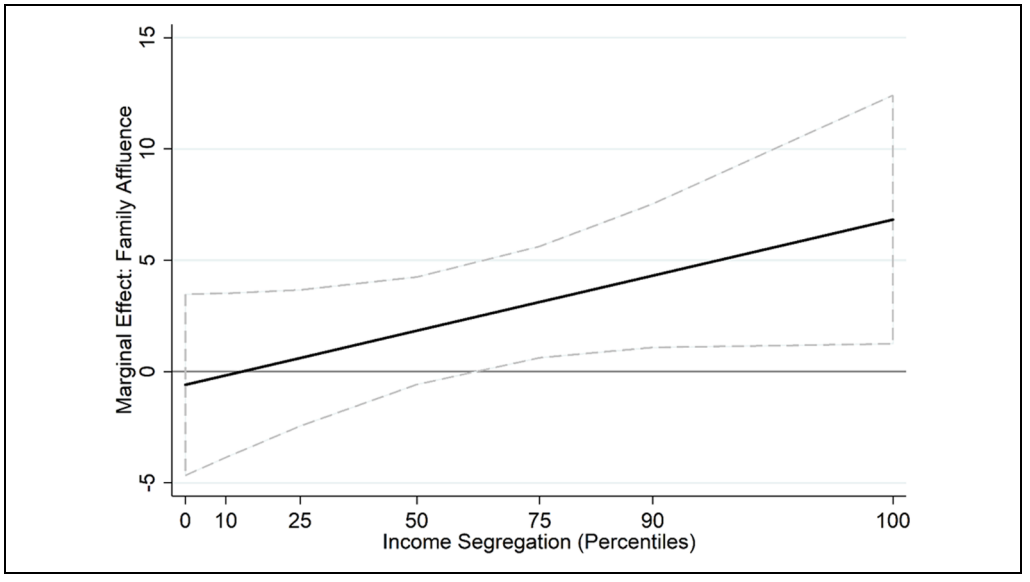

Figure A1. Marginal effects of family affluence on math scores by income segregation between school districts.
Note: Black line estimates marginal effects from Table 3, Model 2 (no MSA controls); gray dashed lines represent 95 percent confidence interval.

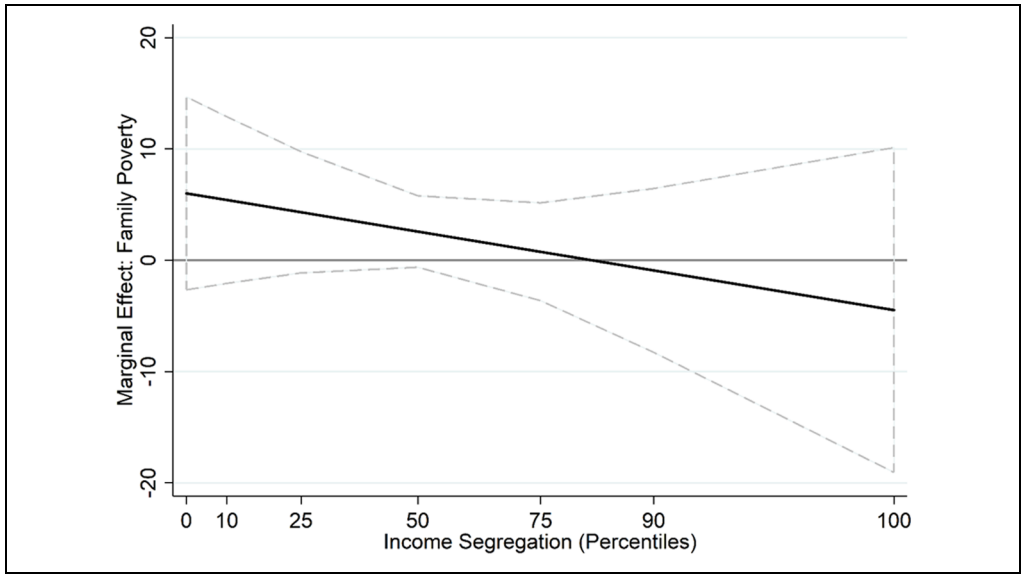

Figure A2. Marginal effects of child poverty on math scores by income segregation between districts. Note: Black line estimates marginal effects from Table 3, Model 3; gray dashed lines represent 95 percent confidence interval.

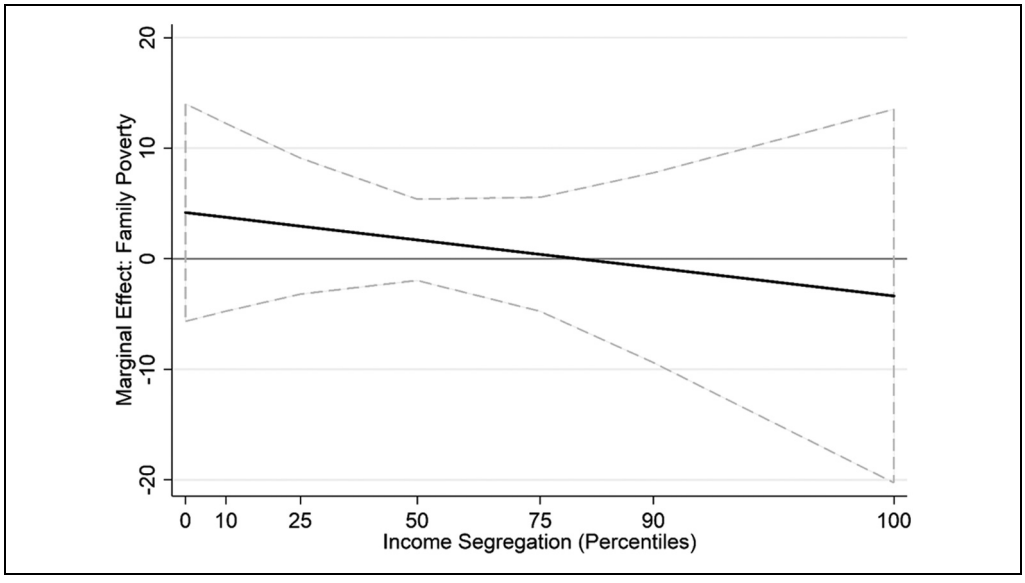

Figure A3. Marginal effects of child poverty on reading scores by income segregation between districts. Note: Black line estimates marginal effects from Table 3, Model 3; gray dashed lines represent 95 percent confidence interval.

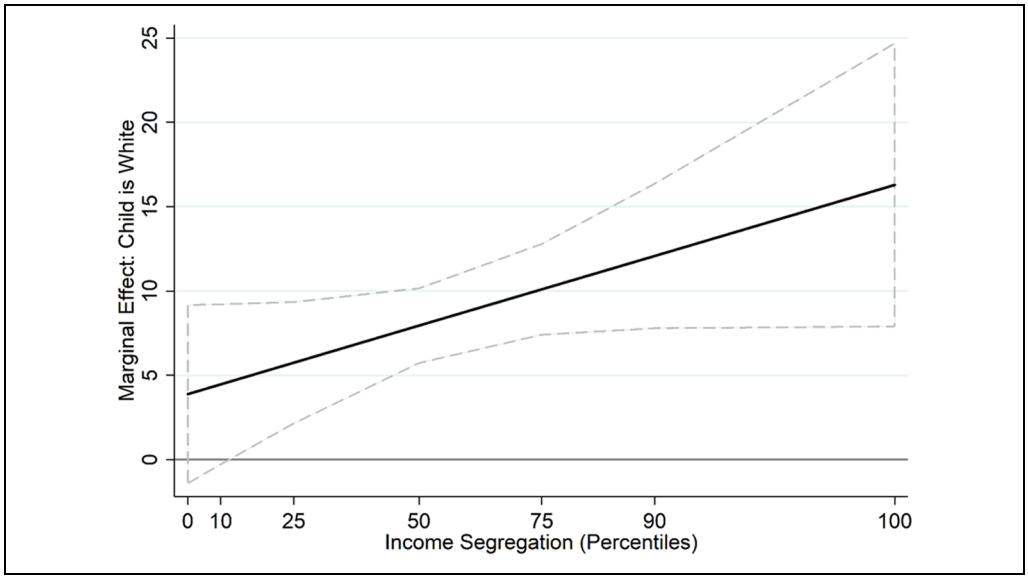

Figure A4. Marginal effects of child race on math scores by income segregation between districts.
Note: Black line estimates marginal effects from Table 4, Model 4; gray dashed lines represent 95 percent confidence interval.

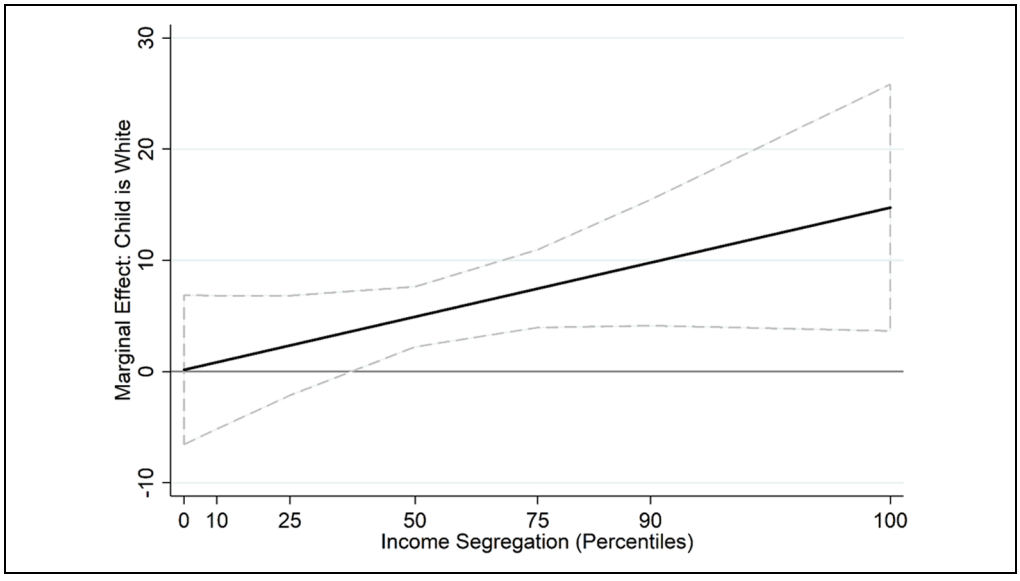

Figure A5. Marginal effects of child race on reading scores by income segregation between districts.
Note: Black line estimates marginal effects from Table 4, Model 4; gray dashed lines represent 95 percent confidence interval.

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Some of the data used in this analysis are derived from Restricted Data Files of the Panel Study of Income Dynamics (PSID), obtained under special contractual arrangements designed to protect the anonymity of respondents. These data are not available from the author. Persons interested in obtaining PSID Restricted Data Files should contact PSIDHelp@isr.umich.edu.

NOTES

1. Gaps between white and Hispanic students are also large and troubling; I focus on black–white gaps due to data availability in the Panel Study of Income Dynamics (PSID).
2. Other research notes that integration may bring the risk of relative deprivation or "frog pond" effects—that is, advantaged peers are disadvantageous for low-income children because low-income children may compare themselves unfavorably to higher-income peers, or low-income children may not successfully access resources in advantaged contexts (Jencks and Mayer 1990). Crosnoe (2009) finds that low-income students have lower self-image and feel more isolated in high-income schools but finds no effects on grades. My analyses allow for the possibility of frog pond effects.
3. Family income is the sum of the taxable and transfer income of the household head and spouse, if present, as well as the taxable and transfer income of other family members and the Supplemental Security Income (SSI), if any, of all family members.
4. I do not weight analyses because the PSID does not provide multilevel weights accounting for metropolitan statistical area residence. I replicate Table 2 in the appendix using weighted ordinary least squares regressions with standard errors clustered at the metropolitan area level.
5. The achievement tests are standardized by child's age, so I do not control for age. Two-parent families include married or cohabiting household heads. Parent education is the higher education level of household head or partner, if present.
6. Past research also often focuses only on very-low-income families and often does not control for prior achievement.
7. I replicated the analysis with race-specific income distributions, and results are substantively identical.

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