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Charter Schools and the Segregation of Students by Income

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The segregation of students by socioeconomic status has been on the rise in American public education between schools during the past several decades. Recent work has demonstrated that segregation is also increasing within schools at the classroom level. In this paper, we contribute to our understanding of the determinants of this increase in socioeconomic segregation within schools. We assess whether growth in the presence and number of nearby charter schools have affected the segregation of socioeconomically disadvantaged students by classroom in traditional public schools (TPS). Using data from North Carolina, we estimate a series of models exploit variation in the number and location of charter schools over time between 2007 and 2014 to estimate the impact of charter school penetration and proximity on levels of within school segregation in TPS classrooms serving grades 3-8. We find that socioeconomic segregation in math and English language arts increase in grades 3-6 when additional charter schools open within large urban districts. We find the largest impacts on schools that are closest to the new charter schools. We estimate that the impact of charter schools can account for almost half of the overall growth in socioeconomic segregation we see over the course of the panel within grades 3-6 in large urban districts.

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Charter Schools and the Segregation of Students by Income

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Abstract:
The segregation of students by socioeconomic status has been on the rise in American public education between schools during the past several decades. Recent work has demonstrated that segregation is also increasing within schools at the classroom level. In this paper, we contribute to our understanding of the determinants of this increase in socioeconomic segregation within schools. We assess whether growth in the presence and number of nearby charter schools have affected the segregation of socioeconomically disadvantaged students by classroom in traditional public schools (TPS). Using data from North Carolina, we estimate a series of models exploit variation in the number and location of charter schools over time between 2007 and 2014 to estimate the impact of charter school penetration and proximity on levels of within school segregation in TPS classrooms serving grades 3-8. We find that socioeconomic segregation in math and English language arts increase in grades 3-6 when additional charter schools open within large urban districts. We find the largest impacts on schools that are closest to the new charter schools. We estimate that the impact of charter schools can account for almost half of the overall growth in socioeconomic segregation we see over the course of the panel within grades 3-6 in large urban districts.

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The recent crisis of COVID-19 has made the inequities in American education plain – shuttered public-school buildings alongside open, highly resourced private schools; uneven access to technology for students; and substantial variation in delivery and quality of remote instruction by school and district. Yet, this calamity should not overshadow decades-long changes in educational equity.[1] Since at least the 1990s, children from low-income families have increasingly been attending different public schools than children from affluent families (Owens, et al., 2016). This has been driven by increasing residential segregation of income by neighborhood or location in metropolitan areas and rising socioeconomic segregation between school districts and between schools within districts. Further, there is evidence that students are coming to be more segregated within schools. Dalane and Marcotte (2020) find that segregation of students by income at the classroom level has increased in elementary and middle school grades in North Carolina schools between 2007 and 2015. Further, they find that districts with the most growth in socioeconomic segregation between schools saw larger growth in within school segregation during the period.

The segregation of students by socioeconomic status is an important subject for educators and policy makers because it can shape educational outcomes and social equity more broadly. The socioeconomic status of students is related to the average quality of teachers in a school and educational resources, which in turn affect educational outcomes (Jackson and Mackevicious, 2021). Student socioeconomic status is also related to other dimensions of need, disruptive behavior, and academic performance of peers. Consistent with these concerns, Fahle and Reardon (2018) find that states with the highest levels of between-district segregation of

[1] For an overview of various dimensions of issues of equity in education, see Duncan and Murnane (2011).

students by income also had the highest levels of test score variation between school districts, with the lowest scores in the most segregated states.

Because of potential effects on equity and achievement, researchers need a clearer understanding of changing patterns in the segregation of poor students from their wealthier peers. Further, policy makers have little guidance on what role education policy plays here, or on options to limit socioeconomic segregation. In this paper, we aim to contribute to the understanding of recent patterns in the socioeconomic segregation of students in American public education. We also assess the role of a prominent and growing educational policy in shaping segregation.

We examine how the growth of school choice in the form of charter schools has affected how students are sorted into classrooms within proximate traditional public schools (TPS). We make use of detailed, student-level administrative data from North Carolina, which provides a measure of a student's free/reduced price lunch eligibility, along with information on classroom assignments.[2] We refer to students who are eligible for free or reduced-price lunch as economically disadvantaged (ED) in accordance with our data-sharing agreement with the North Carolina Education Research Data Center. Using the ED status of each student in each classroom – and each student in the same grade – we assess whether ED students are assigned to classes in the same pattern as other students in the school, or are clustered/segregated into different classrooms.

[2] We discuss the limitations of ED status as a measure of socioeconomic status, below.

How students are assigned to classrooms in TPS can be influenced by the introduction of nearby charter schools through two potential mechanisms. First, if they attract students who are economically better or worse off than the average student at the nearby TPS, the introduction of a charter school can change the mix of ED students in TPS classrooms via a composition effect. Second, competition for students from nearby charters could induce TPS administrators to change classroom assignment strategies to cater to the students and parents who might otherwise opt for a charter school. Since income is an important predictor of achievement, any increase in ability grouping could play a part in increasing the uneven distribution of students by income.

In this paper, we lay out these composition and assignment mechanisms and describe our methods to estimate the effects of the introduction of charter schools on the segregation of students by ED status at the classroom level in nearby TPS. Since charter schools are likely opened strategically or in response to anticipated demand, evidence that TPS located near charter schools are more segregated than those further away is not sufficient for assessing treatment effects.[3] We exploit variation in the timing and location of charter schools to identify plausibly causal estimates of impacts on nearby traditional public schools. We estimate a series of school/grade level TPS fixed effects models of the marginal effect of one additional same-grade charter school opening within a district. We also model the impact of charter schools on within school segregation as a function of distance to the nearest same-grade charter school in a second series of fixed effects models. Because charter schools serve different grades, and because they sometimes change physical locations between years, the availability of charter

[3] See Gulosino (2011) on factors affecting location of charters.

schools as an alternative for students in the same traditional public school can vary by grade and by year. Our estimates are identified off of changes in the within school segregation at the TPS grade level that coincide with the opening of a charter school serving that grade nearby. We find evidence that the segregation of students by ED status at the classroom level increases, especially in elementary and grade 6 classrooms.

In the following sections, we seek to shed light on recent trends in within school segregation by ED status, and whether the growth of charter schools has played a role in shaping these trends. We begin with a review of the literature on school segregation by race and income, both between schools and within schools. We also provide an overview of what we know about how charter schools have impacted segregation given existing research. We next describe mechanisms through which charter school growth could impact levels of within school segregation in TPS and present the analytic model we use to determine if these theorized impacts are borne out by our data. We describe our data, present our results, and conclude with a discussion of implications of our results and further questions they raise.

1) Background

Researchers documenting trends in school segregation have primarily focused on race. After the 1954 *Brown vs. Board of Education* decision, beginning in the 1960s racial segregation between schools within districts fell rapidly, particularly in the South. However, between district racial segregation increased slightly over the same time period as Whites fled urban areas for suburban ones. Evidence on changing levels of segregation since this major shift is more mixed. This is in part due to differences in how segregation is measured, but also because measuring racial segregation over time is complicated by the changing composition of public school students in the United States. In 1968, 81% of US public school students were White, while in 2013 only 50% were, largely due to growing Asian and especially Hispanic student enrollments. (Whitehurst, Reeves, & Rodrigue, 2016).

Racial segregation research has focused on the sorting of students between different school buildings rather than the sorting of students between classrooms within school buildings, sometimes deemed "second generation segregation." This is in part because data about which schools students attend is much more widely available than data that allows researchers to map students to specific classrooms. Existing research on how students are sorted into classrooms within schools tends to focus not on segregation by race specifically, but on separating students by prior achievement, or academic tracking. Four existing studies do find within school racial segregation at all grades, though it is lower than between school levels of segregation (Morgan & McPartland, 1981; Clotfelter, Ladd, & Vigdor, 2002; Conger, 2005; Kalogrides and Loeb, 2013).

Segregation by income has received considerably less attention than segregation by race. Recent work provides evidence that both between school and within school levels of socioeconomic segregation have been on the rise in recent decades. Owens et al. (2016) use national data to estimate that between district segregation of students by income increased by 15% between 1990 and 2015. They also estimate that between school segregation within the largest 100 districts increased by 40% over the same time period. Marcotte & Dalane (2019) find similar trends, and also find that between school segregation increased more rapidly in districts that introduced charter schools.

We know less about within school segregation by income. Only two papers examine within school segregation by income to our knowledge. Kalogrides and Loeb (2013) examine within school segregation by race, income, and achievement in three large urban districts. The authors find much higher levels of segregation by all three characteristics across all grades than would be expected if students were randomly assigned to classrooms. The highest levels of segregation occurred in middle and high schools, where between school segregation tends to be lower due to larger school sizes. Much of the within school segregation the authors find can be explained by prior achievement levels. Lower-tracked classes with higher concentrations of both Black and low-income students were more likely to be taught by novice teachers, raising equity concerns. In the only work examining how within school socioeconomic segregation has changed over time, Dalane and Marcotte (2020) find that SES segregation within North Carolina elementary and middle schools grew by about 20% between 2007 and 2014.

How students are sorted into schools and how schools sort students into classrooms are questions of first order importance for students, parents, and policy-makers. The resources a student has access to are a direct result of the school he or she attends, and these resources affect long-run educational and economic outcomes (Jackson, Johnson, and Persico, 2016). The peers that a student is exposed to depend on both the school he or she attends and the specific classroom(s) to which he or she is assigned. The literature on peer effects shows that the makeup of students in each classroom also plays a role in shaping individual student outcomes (Hanushek, Kain, and Rivkin, 2003; Sacerdote, 2011). Teacher quality is another important factor that impacts students, and high-quality, experienced teachers are not distributed evenly across schools and classrooms. Goldhaber, Quince, and Theobald (2018) find that disadvantaged students are more likely to be exposed to lower quality teachers.

Given the potential consequences of rising levels of socioeconomic segregation both between and within schools, understanding how education policy might affect these trends is critical. The topic that receives the most attention in this area is school choice and charter schools. Like research on segregation generally, the bulk of research on how charter schools impact segregation focuses on between school segregation by race. Most studies find that the average public school student who moves to a charter school attends a more racially segregated school than the one she left (Booker, Zimmer, and Buddin, 2005; Bifulco & Ladd, 2007; Frankenberg, Siegel-Hawley, & Wang, 2010), though there is some variation by geography and grade level (Garcia, 2008; Kotok et al., 2017).

Similarly, Bifulco and Ladd (2009) examine segregation in Durham, North Carolina and find that between school socioeconomic segregation is higher in the district with families exercising choice options than it would be if all students attended their zoned public school, though of course families may have made different decisions about where to live had school choice options not been available. Saporito and Sohoni (2007) measure the concentration of low-income students in public schools and also find higher levels than would be expected if all students attended their zoned public school, suggesting the children of wealthier families are opting out of public schools for either public or private schools of choice. Ni (2012) provides further support for this idea by finding that students of higher SES status are more likely to leave TPS for charters, resulting in over-representation of low-income students in TPS. The net effect of this appears to be modestly higher levels of between school socioeconomic segregation as charter schools open and grow within a district (Dalane and Marcotte, 2019).

2) Analytic Approach

To assess whether the introduction of charter schools nearby affects the segregation of ED students in traditional public schools we first discuss how we measure segregation within schools. We then describe how nearby charter options could affect this measure, before turning to our empirical models and data.

2.1) Measuring Segregation

The first step in measuring student grouping based on economic dis/advantage requires us to confront the problem of measuring student socioeconomic status inherent in administrative data. We define ED status based on student eligibility for free meals from the U.S. Department of Education's National School Lunch Program (NSLP). Based on the federal poverty threshold, free-lunch eligibility is set at 130% of poverty while reduced-price lunch eligibility is set at 185% of poverty. There are well known limitations of these measures, including that not all qualified students are enrolled or have eligibility established, and some students are enrolled whose families do not actually meet the income requirements (Office of Research, Nutrition, and Analysis, 2007). Other critiques include the fact that a dichotomous measure obscures important variation in income at both high and low levels of income (Michelmore & Dynarski, 2017).

Domina et al. (2018) compared the validity of the ED measure we use to measures based on family income data obtained from Internal Revenue Service (IRS) records in Oregon and a district in California. They find that the dichotomous ED measure based on NSLP captured relatively little variation in IRS-reported family income. Nonetheless, they found that this ED measure is a better predictor of educational disadvantage. This is perhaps not surprising since income alone measures only one element of socioeconomic status, a construct that includes attributes like education and family background that are associated with student educational outcomes. While we recognize that relying solely on ED status to classify students as low-income is imperfect, given the limitations of administrative data and the lack of research in this area, we argue that it is still a worthwhile and defensible approach.

Using this dichotomous measure, we classify all students in a school as economically disadvantaged (ED), or not. Socioeconomic segregation within a school occurs when the characteristics of students in classrooms deviate from the characteristics of students in the school overall; with some classrooms having more ED students than the school mean, and some fewer. We measure segregation using the familiar dissimilarity index, applied to school (s) in year (t):

$$1) \qquad D_{s,t} = \frac{1}{2}\sum_{ct}\left|\frac{ED_{c,t}}{ED_{s,t}} - \frac{nonED_{c,t}}{nonED_{s,t}}\right|$$

where c indexes classrooms within the school. $ED_{c,t}$ and $nonED_{c,t}$ measure the number of economically disadvantaged and not economically disadvantaged students within the classroom in year t, while $ED_{s,t}$ and $nonED_{s,t}$ are respectively the school total number of economically disadvantaged and not economically disadvantaged students. We calculate dissimilarity indexes separately by grade within each school, and separately for math and English language arts (ELA) classrooms.

The magnitude of the dissimilarity index can be interpreted as the proportion of students that would need to be reallocated to equalize the proportion of low-income to higher-income students in each classroom. 0 means that no reallocation is needed, and 1 means all students would be affected by reallocation to equalize. An advantage of the dissimilarity index is that it makes clear that the level of segregation in a school is a function of both the total number of ED and non-ED students enrolled and how students are assigned to classrooms within schools

2.2) Conceptual Model

There are two determinants of a school's segregation index: The number of ED students and how they are assigned to classrooms. Each of these serves as a potential mechanism through which the introduction and expansion of schools of choice could affect segregation. First, charter schools and the attendant school choice could affect the composition of students remaining in traditional public schools. If students sorting into charter schools are more or less likely to be ED than the average student in the TPS they left behind, then the baseline ED rate against which all classrooms are compared changes, thereby affecting the segregation index. There is evidence that charter schools attract students from more socioeconomically advantaged families (Ni, 2012). If so, the proportion of students who remain in TPS who are ED might be expected to rise, which could impact the dissimilarity index even if there is no change in how students are assigned to classrooms.

The second mechanism that can affect segregation of students within schools is how students are assigned to classrooms. If the presence of nearby charters induces TPS administrators to change classroom assignment strategies to cater to the students and parents who might otherwise opt for a charter school, segregation by classroom might change even if there were no changes in the average characteristics of students. For example, to prevent the loss of students to a nearby charter touting an academic focus, TPS administrators might opt to increase the use of ability tracking or introduce new curricula. Schools-within-schools are an example of increasing within school grouping to cater to different student groups.

The assignment effect is most likely to increase segregation since principals are more likely to expand tracking in the face of competition from charters, while the composition effect could either increase or decrease segregation. Since it is not clear whether the composition and assignment effects work in opposite directions, or in tandem, whether the introduction of charter schools near a TPS increases or decreases the within school socioeconomic segregation of students is an empirical question.

2.3) Empirical Model

To estimate the net impact of the introduction of charter schools on socioeconomic segregation in TPS we model the dissimilarity index at the grade-school level as a function of school attributes and charter school growth over time. We exploit within-school segregation changes subsequent to the introduction of charters, over and above changes in the segregation in nearby school/grades. Our differences-in-differences estimates make use of the fact that nearby charters can serve only a subset of grades served by a TPS, and in our most saturated models, our identification strategy relies on grade-specific segregation changes, net of overall school fixed effects (or changes). We estimate each model separately twice for each grade, once with the within school math dissimilarity index as the outcome and once with the within school ELA dissimilarity index as the outcome. Specifically, we regress D_{st}, the segregation index within school (s) in year (t) on basic attributes of the school and district, along with linear trends:

$$2)\quad D_{st} = \alpha + \beta X_{st} + \delta C_{st} + \tau + \theta_{LEA} + \theta_s + \epsilon_{st}$$

Where X_{st} is a vector of basic attributes of the school, such as enrollment and racial composition; τ is a linear time trend[4]; θ_{LEA} is a district fixed effect, common to all years in the district; and θ_s is a school fixed effect. The LEA and school fixed effects are vital to control for the possibility that some areas are more/less segregated, and the unmeasurable factors that shape those patterns may be related to determinants of where charter schools open. For example, areas with more pronounced income inequality are likely to have higher within school segregation, and may also be areas where charter schools are most likely to open.

In our models, C_{st} measures exposure to charter schools for students in the relevant grade in year t, as we explain in the following section. The coefficient of interest is δ, which measures net change in within-school ED segregation for the relevant grade in the year a nearby charter serving that grade opened, net of changes unaffected schools see over the same period.

2.4) Data and Measuring Charter School Exposure

Using data from the North Carolina Education Research Data Center (NCERDC), we build a panel data set where the unit of analysis is at the school-grade level for all traditional public schools in North Carolina between 2007 and 2015. We restrict our analyses to grades 3-8. We do not have course assignment data in lower grades, and in high schools students are more likely to take courses with students in other grades, making the appropriate comparison group

[4] Our results are robust to controlling for underlying changes in segregation using year fixed effects.

unclear. We limit our estimation sample to school/grade observations in which at least 10 students are enrolled and exclude school/grade observation in which greater than 10% of students are missing an ED status since the dissimilarity indexes we generate are based on ED status.

We generate two subject-specific dissimilarity indexes to measure ED segregation at the school/grade level, one that measures segregation within only math courses and one that measures segregation within only ELA courses[5]. We start with student-level data that contains information on each student's school assignment, race, and critically for our analysis, ED status. The data also contains information on which courses a particular student is enrolled in each year. We use this data to aggregate students to the classroom level. Because some schools report classes over multiple semesters or terms, there are sometimes multiple iterations of the same course present in the data. Rather than isolating one iteration of each course, we use the full set of courses reported by each school. In order to calculate the subject-specific dissimilarity indexes for a particular school/grade/year, we select only the relevant course observations reported by that school for that grade (ELA or math). We then generate counts of the total number of ED and non-ED students within each course observation. We use the ED status counts from each reported course as the numerators and the sum of these counts as the denominators in the dissimilarity index calculation found in equation (1) on page 9.

[5] We calculate math and ELA dissimilarity indexes only if 90% or more of the students in a grade/school/year have at least one math or ELA course, respectively. Since some schools report general "elementary" courses rather than subject-specific courses, especially in grades 3-5 early on in the panel, we only calculate a math dissimilarity index for approximately 86% of our grade/school/year observations and an ELA dissimilarity index for approximately 87%of our grade/school/year observations.

We estimate the impact of charter schools on within school segregation of nearby traditional public schools in two ways. First, we estimate models that measure the number of charter schools open and located in the same district in a given year. This model measures the penetration of charter schools by grade in the district. Because all models control for district fixed effects, identification in our penetration model comes from within district variation in the presence and number of charters over time.

The penetration models provide insight into potential impacts of the introduction and growth of charter schools on TPS in the district as a whole. Since admitted students can attend charters regardless of where they live in the district, charter schools can affect all TPS in the district directly. To be sure, TPS that are most proximate to charters may be most affected. To assess this, we estimate models that measure proximity of each TPS to the closest charter school.[6] To do this, we use the latitude and longitude of each school to determine the distance from each traditional public school/grade to the nearest charter school serving the same grade in the same year.[7] In these models based on distance to the nearest charter, identification comes from variation over time in segregation in a school/grade subsequent to the opening (or relocation) of charter schools nearby, compared to changes for further TPS in the same district over the same period. So, unlike the measures of charter penetration, identifying variation is within district, over time.

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[6]This is regardless of whether or not the nearest charter was located in the district. In North Carolina, charters are granted by the state educational authority, not the local school district. Because they are governed by the state, students can attend charter schools regardless of whether the school is located in the district.

[7] The distances we calculate between schools are "as the crow flies," not the driving distance. Since the driving distances between schools vary based on the directness of the routes available, our measure does not perfectly capture the distance it would be necessary to travel to get from one school to the next. If anything, the resulting measurement error will attenuate our estimates, since exposure to charter schools is always less than implied by our measures.

For both our penetration and distance measures, it is important to recognize that charter schools and their expansion was uneven. During our panel, the number of charters serving grades 3-8 operating in North Carolina grew from 82 to 114. This is a relatively small number in a sprawling and populous state, so in practice charter schools are not a widespread option in the state. It is helpful for our identification strategy that the small total belies year-to-year change: Several charter schools opened and closed or changed physical locations during the panel. Nonetheless, the small total number of charter schools limits the number of TPS exposed to nearby charters for our purposes of estimating treatment effects.

In Figure 1, we show that charter schools are concentrated in the central part of the state, within large districts serving the state's main metropolitan areas: Charlotte, Raleigh, Greensboro, Winston-Salem, and Durham. These five districts are the largest urban districts in the state (Charlotte-Mecklenburg, Wake, Guilford, Durham, and Winston-Salem/Forsyth) and are the only districts with at least 5 operating charter schools by the final year of our panel.

Because charter schools are concentrated within these districts, we create two separate measures of charter penetration and proximity for the five largest urban districts and for the remaining 110 districts in the state. This is straightforward for the penetration models, that measure the number of charters located in the district. For the proximity measures, we use the distance measurement to create two dummy variables measuring whether or not a TPS was very close, or moderately close to a charter school in a given year. In both cases the reference group is the set of TPS farther away from any charter school in that grade/year. To define very close and moderately close, we use the density of distance from each TPS to the nearest charter. We define TPS as being very close if they were located within approximately 2 miles of a charter school in the large urban districts, or about 6 miles within other districts. We define TPS to be moderately close to a charter school if they are within approximately 2 to 5 miles in large urban districts, and 6 to 20 miles within other districts. [8]

In Figure 2, we summarize the distribution of distances from TPS to charter schools within the largest urban districts and schools in the rest of the state. Over 60% of observations within the five largest urban districts are located less than five miles from a charter school serving the same grade, while over 50% of schools in the rest of the state are further than 15 miles from a charter school serving the same grade.

3) Results

3.1) Descriptive Statistics

To begin understanding changes in segregation of economically disadvantaged students by classroom, we present descriptive statistics of our sample in Table 1. In the top half of the table, we report dissimilarity indexes for math and ELA classes, by grade. We first present each index for all schools in our panel, then separately for the five largest urban districts and other districts. The mean dissimilarity index for math classes in 3rd grade for all districts is 0.233, and slightly higher in urban districts (0.286) than elsewhere (0.217). The dissimilarity indices in ELA classrooms are comparable. Notably, classroom segregation in math and ELA are higher in middle school grades than elementary school grades, with an average dissimilarity index in math classes of 0.304 by 8th grade, and 0.346 in large urban districts. This higher rate of

[8] Our definitions were based on the density of distance to charter schools for TPS, by district type. The schools closest to charters are in the first quartile of the distribution of distance to charters, while schools defined as moderately close are those in the middle two quartiles. Because they are more dense and are home to more charters, these distances are smaller in large urban districts.

classroom segregation of students by income in middle school is consistent with prior research, and due to a higher level of tracking in these grades.

Table 1 also includes descriptive statistics on school/grade characteristics. The average elementary school grade enrolls just under 90 students, while the average middle school grade has more than 180 students. On average, school districts in North Carolina have more than 30 elementary schools and approximately 13 middle schools. The percent of students who are economically disadvantaged is slightly higher in earlier grades, with about 58% of 3rd grade students classified as ED, compared to approximately 54% by 8th grade. This is consistent with prior research finding that lower grades tend to have higher levels of enrollment in school meal programs. A bit more than 50 percent of students across all grades are white, non-Hispanic; and just over 25 percent are black, non-Hispanic.

To illustrate how within-school segregation as measured by the math dissimilarity index has changed over time, in Figure 3 we plot trends by grade for the five largest urban districts in Panel (a) and all other districts in Panel (b). It is clear that within school segregation levels are higher in middle grades than elementary grades and in the five largest urban districts than all other districts. All grades in the five largest urban districts and all other districts appear to experience modest increases in within school math segregation over the course of the panel, though this trend is less clear in the five largest districts, especially in elementary grades.

3.2) Charter Penetration Models

Next, we turn to our multivariate models of changes in the dissimilarity index over time. In Table 2, we present the results of our models of charter penetration on within school segregation for elementary grades for ELA and math courses, respectively, and then for middle-school grades we present the same results in Table 3. In both tables, we model the dissimilarity index as a function of our charter school exposure variables, time-varying school controls, district and school fixed effects, and a linear time trend. As expected from the time series graphs of segregation, the linear trends illustrate that the average ED segregation is going up overall within schools during the panel.

In row 1 of Table 2, we estimate that each additional charter opening in a district increased the ED dissimilarity index in ELA and math classrooms at elementary TPS in large urban districts between 0.004 an 0.009. We see no similar impacts in other districts, where charter schools are rare. This is an increase in classroom segregation of 0.02 to 0.05 standard deviations for each additional charter school opening in the district. The average elementary grade within large districts saw 3 charter schools open over the course of the panel. Our results would imply this led to an increase in segregation of students in ELA and math classes by ED status of between 0.06 and 0.15 standard deviations in 3rd through 5th grade classrooms in the average TPS in large districts.

In Table 3, we present results of the same models for middle school grades. As charters open in the district, we find that segregation increases within TPS only for 6th grade, but not for later grades in middle school. This is true for both math and reading. We estimate that the dissimilarity index increases by about 0.008 for each charter serving grade 6 opening in the same district. The point estimate is comparable to what we observed tor grades 4 and 5. The finding that 6 stands out as the only middle school grade where segregation is affected by the opening of charter schools in the district is interesting. One potential explanation for this pattern is that students are transitioning from elementary school to middle school between grades 5 and 6. This change of schools may make the charter school options available in grade 6 particularly appealing since a school change is inevitable. A change at this point may be viewed by families as less disruptive and more natural than pulling their child from a school in which they are not already enrolled in the terminal grade. Other middle school grades could be less likely to experience increased within school segregation levels when charter schools open nearby if the main mechanism at play is the assignment effect, since middle school grades tend to already have higher levels of academic tracking than elementary school grades.

3.3) Charter Proximity Models

In Tables 4 and 5, we present the results of our models of charter proximity on within school segregation for elementary grades. We find evidence in large urban districts that TPS most proximate to a new charter school see increases in ED segregation in math classes. In columns 1, 3 and 5 of Table 4, we estimate that the dissimilarity index rose from 0.076 to 0.06 for 3rd through 5th grade math classes for TPS within about 2 miles of a charter compared to other schools in the same district. When we include school fixed effects and estimate the impacts by comparing changes in a school's dissimilarity index subsequent to the opening of a charter within 2 miles compared to changes for the same school during other years, the point estimates are smaller: 0.032 for 3rd grade and 0.04 for 4th grade. These are sizeable increases of more than 10 percent of the mean. As was the case for the models of charter penetration, the impact of charters on school segregation is concentrated in large urban districts.

In Table 7, we see a similar pattern for segregation in ELA classrooms: Large average increases in schools nearest charters compared to other schools in the district. However, the within-school estimates are not statistically significant. In Tables 8 and 9, we see that this same pattern for ED segregation by math and ELA classrooms in middle schools. In middle schools nearest charter schools as well as those about 2-6 miles away, ED segregation in math and reading classes increases more in TPS in the same district that were furthest from new charters. Again, the within school estimates smaller, and not statistically significant.

4) Discussion

In sum, we find clear evidence that within schools in large urban districts, economically disadvantaged students are becoming more segregated in math and ELA classrooms subsequent to the opening of charter schools. We estimate that ED segregation is increasing in elementary schools as charters open in the district. We find some evidence for increasing segregation in 6^{th} grade classrooms, but not other middle school grades. Further, we find that traditional public schools closest to where a charter opens or relocates see the largest increases.

Within school segregation can be affected either by changes in the proportion of students who are economically disadvantage among all students attending public schools over time, or by changes in how ED and non-ED students are assigned/grouped in classrooms. We have used the terms composition and assignment effects to describe these mechanisms. While it is difficult to get information on school decisions about how students are assigned to classrooms, we can measure changes in the composition of students by ED status over time. To assess the importance of changes in the composition of ED and non-ED students in TPS subsequent to the introduction of charters within a district, we estimate the relationship between charter penetration in district and enrollment growth of students by ED status. To do this, we use the same specification for models as in Tables 2 and 3, but change the dependent variables from the grade-specific dissimilarity indexes to grade specific enrollments of ED and non-ED students. The thought experiment here is to see if charters opening within a district causes ED and non-ED students to sort out of TPS at differential rates, which would suggest that the composition effect could be a mechanism through which charter penetration increases within school segregation.

We present the results from these model in Figure 4. The figure shows the point estimates and confidence intervals for the marginal effect of one additional charter school opening within large urban districts on ED and non-ED student enrollment, separately by grade. The point estimates are all centered around 0, with very tight confidence intervals in elementary grades and slightly larger intervals in middle school grades. We find no evidence that ED or non-ED students are differentially sorting into charter schools, suggesting the composition effect is not the mechanism through which socioeconomic segregation is increasing when charter schools open. Since the composition effect cannot be driving increases in within school segregation, this provides some evidence that the assignment mechanism is at play. Students in grades 3 and above are commonly assigned to classes based on ability grouping. For example, students may be assigned to a classroom using a standard curriculum or one for “gifted and talented” students. Importantly, ED status is strongly correlated with the achievement scores that serve as the basis of such assignments. Our finding that charter school growth had negligible effects on the relative enrollment of students by ED status in traditional public schools suggests that expansion of ability grouping is the most likely mechanism affecting socioeconomic segregation.

5) Conclusions

The segregation of students by socioeconomic status in U.S. public schools has been on the rise for the past few decades. Much of that increase has been between schools – economically disadvantaged students are increasingly attending different schools than their better off peers (e.g. Owens et al., 2016). Much less is known about within school segregation – the concentration of ED students at the classroom level. In this paper, we have attempted to advance understanding of trends in within school segregation by socioeconomic status by assessing the role of charter school growth on segregation of students within nearby traditional public schools. We exploit variation in the timing and location of charter schools to identify plausibly causal estimates of impacts on nearby traditional public schools.

We estimate that in large urban districts, the expansion of charter schools increased segregation of students by ED status in both math and ELA classrooms in TPS elementary school grades, and in the first middle school grade. Our findings imply that the marginal effect of each new charter school in an urban district led to an increase in the dissimilarity index measuring within school segregation in TPS math and ELA classrooms by between 0.004 and 0.009 for grades 3 through 6. We also find relatively large effects in TPS nearest new charter schools.

To put the magnitude of these effects in context, consider that the enrollment-weighted mean dissimilarity index for 6th grade math classrooms increased in large urban districts from 0.335 to 0.372 between 2007 to 2014. This is an increase of approximately .037, or 11% of the unconditional mean. The point estimate on the linear trend in the 6th grade math model presented in Table 3 indicates that each year in the panel is associated with a .002 increase in the math dissimilarity index, which equates to an increase of approximately .016 over the course of our 8-year panel. So, approximately 57 percent of the total increase in math segregation can be explained by changes in school characteristics and other attributes we include in our model.[9] The point estimate on charter schools from this same model suggests that each additional charter school in large urban districts increased the math dissimilarity index by an additional .008. Because the number of charters serving grade 6 students increased by between 2 and 3 within large urban districts over this period, our estimates imply that charter school growth led to an increase of approximately .016-.024 in the math dissimilarity index. The impact of charter growth on segregation is large, relative to the overall growth in the dissimilarity index and the conditional change we observe in our multivariate models. The same calculations for elementary school grades in large urban districts yield similar conclusions for both math and ELA segregation: charter school growth can explain a sizeable share of the overall increase in segregation in math and ELA classes in these grades.

Finally, it is important to recognize that charter school growth in North Carolina was modest during this period because of a state cap in the number of charters. It is an open question whether TPS in other states and districts that have experienced more rapid growth in competition from charter schools have seen similar changes in ED segregation at the classroom level.

[9] 1 - (0.016/0.037)

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Figure 1: North Carolina Charter Schools by County, 2015

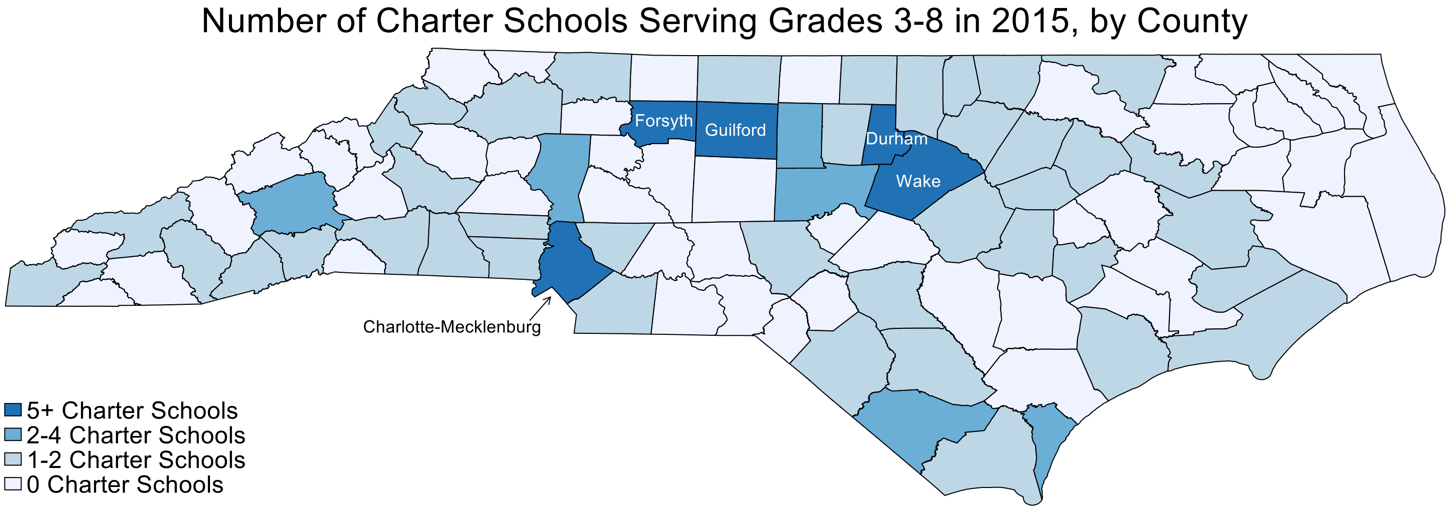


Figure 2: Distance to the Nearest Same-grade Charter by District Size

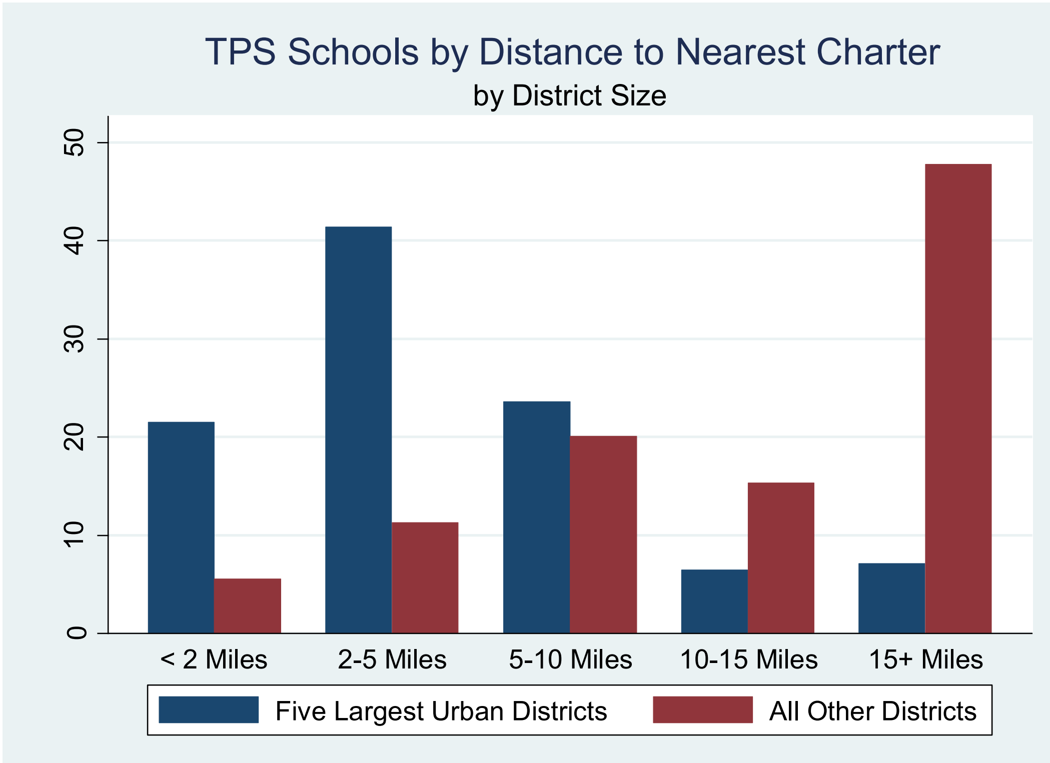
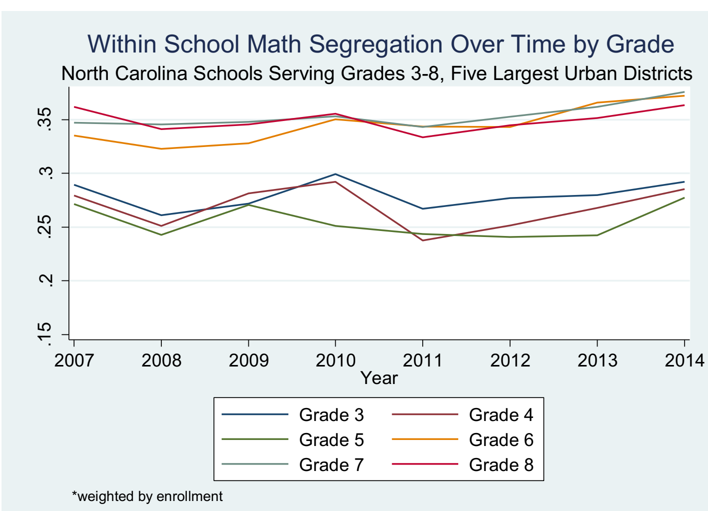


Figure 3: Math Dissimilarity Index by Grade Over Time in Five Largest Urban Districts and All Other Districts

(a)



(b)

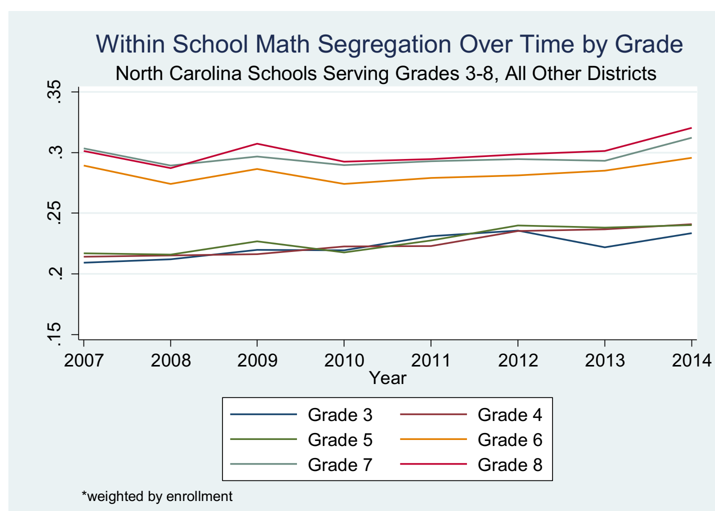


Figure 4

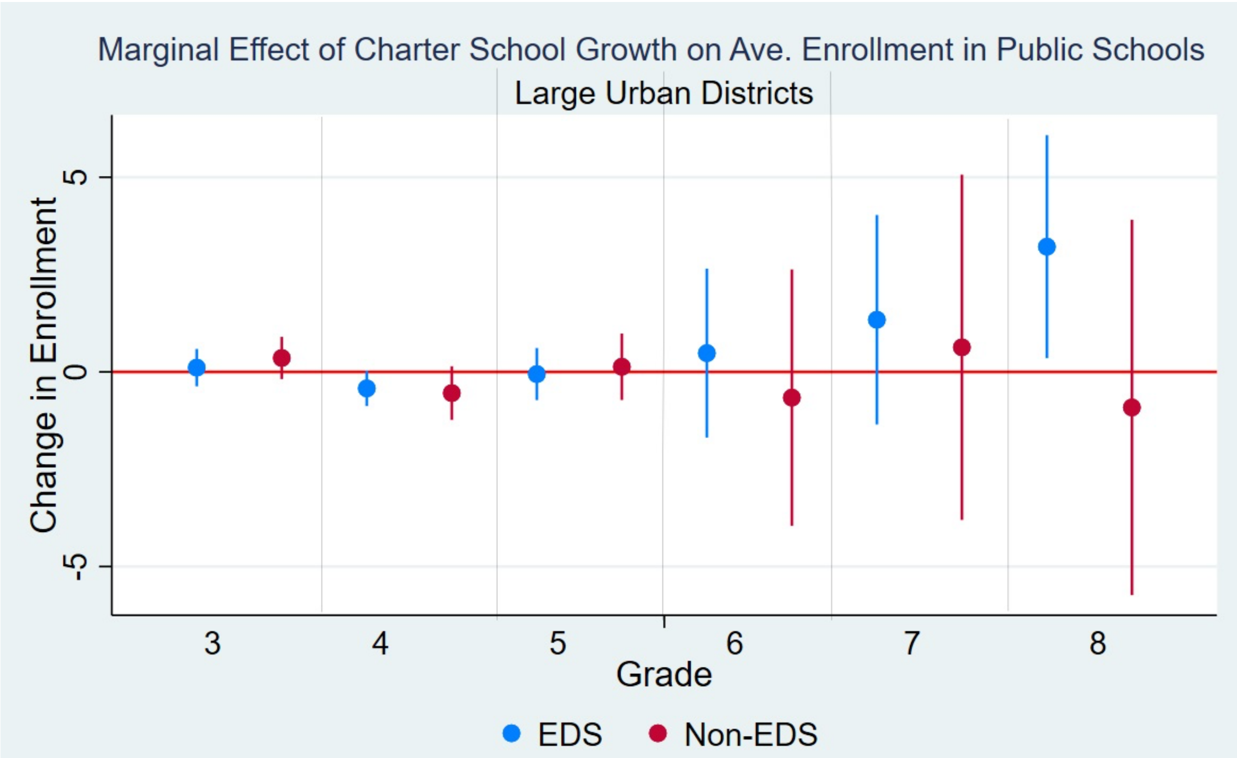

Marginal Effect of Charter School Growth on Ave. Enrollment in Public Schools
Large Urban Districts
Change in Enrollment
5
0
-5
3
4
5
6
7
8
Grade
EDS
Non-EDS

Table 1. Descriptive Statistics

		Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
Math Dissimilarity Index							
All Districts	mean	0.233	0.230	0.228	0.281	0.297	0.301
	sd	0.143	0.147	0.144	0.133	0.128	0.124
	N	8200	8191	8099	4661	4491	4563
Largest Five Urban Districts	mean	0.286	0.271	0.260	0.343	0.353	0.342
	sd	0.170	0.169	0.167	0.137	0.132	0.130
	N	1807	1800	1819	985	982	985
All Other Districts	mean	0.217	0.218	0.218	0.264	0.281	0.290
	sd	0.131	0.138	0.136	0.127	0.122	0.120
	N	6393	6391	6280	3676	3509	3578
ELA Dissimilarity Index							
All Districts	mean	0.241	0.236	0.232	0.284	0.295	0.297
	sd	0.143	0.145	0.142	0.132	0.126	0.126
	N	8391	8402	8271	4675	4485	4533
Largest Five Urban Districts	mean	0.297	0.281	0.268	0.346	0.349	0.345
	sd	0.167	0.166	0.164	0.135	0.125	0.124
	N	1919	1925	1922	988	979	974
All Other Districts	mean	0.224	0.223	0.221	0.268	0.280	0.284
	sd	0.130	0.136	0.133	0.126	0.122	0.123
	N	6472	6477	6349	3687	3506	3559
Total Enrollment	mean	86.77	85.89	87.36	182.7	192.1	188.3
	sd	38.86	38.98	42.62	114.7	115.2	115.2
	N	10201	10175	10032	4766	4557	4633
Schools Per District	mean	33.73	33.94	34.45	13.69	13.40	13.31
	sd	35.16	35.43	36.13	13.61	13.43	13.06
	N	10201	10175	10032	4766	4557	4633
% Black	mean	26.58	26.83	27.29	27.06	28.64	29.21
	sd	24.59	24.70	24.82	23.81	24.01	24.22
	N	10201	10175	10032	4766	4557	4633
% Hispanic	mean	13.43	12.85	12.38	11.63	11.10	10.46
	sd	12.69	12.30	11.96	10.47	10.07	9.541
	N	10201	10175	10032	4766	4557	4633
% White	mean	52.06	52.49	52.69	53.54	53.21	53.42
	sd	28.92	29.01	29.07	27.83	27.60	27.63
	N	10201	10175	10032	4766	4557	4633
% ED	mean	57.62	56.91	56.09	56.49	55.35	54.10
	sd	22.99	22.91	22.75	20.31	20.32	20.28
	N	10201	10175	10032	4766	4557	4633
% Missing ED Status	mean	1.028	0.966	0.905	0.952	0.990	1.001
	sd	2.027	1.991	1.900	1.874	1.881	1.893
	N	10201	10175	10032	4766	4557	4633
Observations		10201	10175	10032	4766	4557	4633

Number of time periods: 8 (2007-2014)

Table 2: Charter School Penetration and Segregation in TPS Elementary School Classrooms

	3RD GRADE		4TH GRADE		5TH GRADE	
	ELA	Math	ELA	Math	ELA	Math
Charters in Largest Districts	0.004**	0.004**	0.006**	0.006***	0.009***	0.009***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Charters in Other Districts	0.006	0.005	-0.005	-0.006	-0.002	-0.002
	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)	(0.006)
Grade Enrollment (100s)	0.019*	0.021**	0.005	0.007	0.013	0.018
	(0.010)	(0.010)	(0.011)	(0.011)	(0.010)	(0.012)
Grade Percent Black	0.000	0.000	-0.000	-0.000	-0.002***	-0.002***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Grade Percent White	0.000	0.000	-0.000	-0.000	-0.001	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Grade Percent Hispanic	0.001**	0.001*	0.001	0.001	0.000	0.000
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Linear Time Trend	0.003***	0.004***	0.004***	0.005***	0.002***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
District FE	X	X	X	X	X	X
School FE	X	X	X	X	X	X
Obs.	8373	8181	8383	8170	8248	8066
R-squared	0.496	0.503	0.452	0.471	0.460	0.466

Standard errors are in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

Table 3: Charter School Penetration and Segregation in TPS Middle School Classrooms

	6TH GRADE		7TH GRADE		8TH GRADE	
	ELA	Math	ELA	Math	ELA	Math
Charters in Largest Districts	0.008***	0.008***	-0.000	0.003	-0.004	-0.003
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Charters in Other Districts	-0.002	-0.007	0.001	-0.000	0.001	0.002
	(0.006)	(0.006)	(0.007)	(0.008)	(0.007)	(0.007)
Grade Enrollment (100s)	-0.012*	-0.009	0.002	0.009	0.000	0.003
	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)	(0.006)
Grade Percent Black	0.000	0.000	-0.001	-0.000	-0.001**	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Grade Percent White	0.001	0.001	0.000	0.001	-0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Grade Percent Hispanic	0.002**	0.002	-0.000	0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Linear Time Trend	0.000	0.002*	0.001	0.001	0.001	0.001*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
District FE	X	X	X	X	X	X
School FE	X	X	X	X	X	X
Obs.	4649	4638	4465	4471	4503	4533
R-squared	0.538	0.534	0.544	0.564	0.549	0.557

Standard errors are in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

Table 4: Charter Proximity and Segregation in TPS Elementary School Math Classrooms

	3RD GRADE		4TH GRADE		5TH GRADE	
	(1)	(2)	(3)	(4)	(5)	(6)
Five Largest Urban Districts						
TPS Very Close to Charter	0.076***	0.032**	0.067***	0.040*	0.060***	0.020
	(0.017)	(0.015)	(0.016)	(0.021)	(0.018)	(0.020)
TPS Mod. Close to Charter	0.021*	0.015	0.012	-0.003	0.012	0.014
	(0.012)	(0.010)	(0.012)	(0.018)	(0.010)	(0.014)
All Other Districts						
TPS Very Close to Charter	0.008	0.008	0.020**	-0.002	0.002	-0.017
	(0.008)	(0.013)	(0.009)	(0.013)	(0.009)	(0.014)
TPS Mod. Close to Charter	-0.008	0.003	-0.006	0.011	-0.017***	-0.003
	(0.005)	(0.008)	(0.006)	(0.010)	(0.006)	(0.009)
Grade Enrollment (100s)	0.022***	0.022**	0.027***	0.007	0.023***	0.019*
	(0.006)	(0.010)	(0.007)	(0.011)	(0.006)	(0.012)
Grade Percent Black	0.000	0.000	-0.000	-0.000	0.000	-0.002***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)
Grade Percent White	-0.000	0.001	-0.001***	-0.000	-0.001*	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Grade Percent Hispanic	0.001	0.001*	0.000	0.001	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)
Linear Time Trend	0.005***	0.005***	0.006***	0.006***	0.005***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
District FE	X	X	X	X	X	X
School FE		X		X		X
Obs.	8200	8181	8191	8170	8099	8066
R-squared	0.165	0.503	0.162	0.471	0.155	0.465

Standard errors are in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

Table 5: Charter Proximity and Segregation in TPS Elementary School ELA Classrooms

	3RD GRADE		4TH GRADE		5TH GRADE	
	(1)	(2)	(3)	(4)	(5)	(6)
Five Largest Urban Districts						
TPS Very Close to Charter	0.076***	0.022	0.067***	0.025	0.059***	-0.008
	(0.017)	(0.016)	(0.015)	(0.020)	(0.018)	(0.018)
TPS Mod. Close to Charter	0.018	-0.000	0.009	-0.021	0.007	-0.008
	(0.011)	(0.011)	(0.011)	(0.015)	(0.010)	(0.014)
All Other Districts						
TPS Very Close to Charter	0.006	0.016	0.018**	0.011	-0.001	-0.019
	(0.008)	(0.013)	(0.009)	(0.013)	(0.009)	(0.013)
TPS Mod. Close to Charter	-0.008*	0.006	-0.006	0.009	-0.017***	-0.006
	(0.005)	(0.008)	(0.006)	(0.011)	(0.006)	(0.009)
Grade Enrollment (100s)	0.019***	0.020*	0.020***	0.005	0.015***	0.013
	(0.006)	(0.010)	(0.007)	(0.011)	(0.006)	(0.010)
Grade Percent Black	0.000	0.000	-0.000	-0.000	0.000	-0.002***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)
Grade Percent White	-0.001**	0.000	-0.001***	-0.000	-0.001*	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Grade Percent Hispanic	0.001	0.001**	0.000	0.001	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)
Linear Time Trend	0.003***	0.003***	0.004***	0.004***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
District FE	X	X	X	X	X	X
School FE		X		X		X
Obs.	8391	8373	8402	8383	8271	8248
R-squared	0.167	0.496	0.158	0.453	0.153	0.459

Standard errors are in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

Table 6: Charter Proximity and Segregation in TPS Middle School Math Classrooms

	6TH GRADE		7TH GRADE		8TH GRADE	
	(1)	(2)	(3)	(4)	(5)	(6)
Five Largest Urban Districts						
TPS Very Close to Charter	0.054***	0.022	0.054***	-0.002	0.049**	0.006
	(0.020)	(0.018)	(0.020)	(0.020)	(0.022)	(0.022)
TPS Mod. Close to Charter	0.044***	0.009	0.042***	-0.007	0.041***	-0.008
	(0.015)	(0.011)	(0.015)	(0.014)	(0.015)	(0.016)
All Other Districts						
TPS Very Close to Charter	-0.013	0.007	-0.012	0.002	-0.019*	0.018
	(0.010)	(0.010)	(0.011)	(0.012)	(0.010)	(0.012)
TPS Mod. Close to Charter	-0.024***	0.003	-0.021***	-0.003	-0.022***	0.021**
	(0.006)	(0.008)	(0.007)	(0.009)	(0.007)	(0.009)
Grade Enrollment (100s)	0.008**	-0.008	0.009**	0.009	0.005	0.003
	(0.004)	(0.006)	(0.004)	(0.007)	(0.004)	(0.006)
Grade Percent Black	-0.001*	0.000	-0.001	-0.000	-0.001*	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Grade Percent White	-0.001**	0.001	-0.001	0.001	-0.001*	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Grade Percent Hispanic	-0.002***	0.002	-0.002***	0.000	-0.003***	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Linear Time Trend	0.003***	0.002***	0.002***	0.002**	0.003***	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
District FE	X	X	X	X	X	X
School FE		X		X		X
Obs.	4661	4638	4491	4471	4563	4533
R-squared	0.225	0.532	0.249	0.564	0.252	0.558

Standard errors are in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 7: Charter Proximity and Segregation in TPS Middle School ELA Classrooms

	6^{TH} GRADE		7^{TH} GRADE		8^{TH} GRADE	
	(1)	(2)	(3)	(4)	(5)	(6)
Five Largest Urban Districts						
TPS Very Close to Charter	0.033*	0.014	0.041**	0.011	0.041**	0.006
	(0.020)	(0.020)	(0.019)	(0.021)	(0.021)	(0.022)
TPS Mod. Close to Charter	0.032**	-0.014	0.029*	-0.015	0.035**	0.008
	(0.015)	(0.013)	(0.015)	(0.016)	(0.016)	(0.016)
All Other Districts						
TPS Very Close to Charter	-0.021**	0.006	-0.021**	-0.014	-0.017*	0.020*
	(0.010)	(0.010)	(0.010)	(0.013)	(0.010)	(0.012)
TPS Mod. Close to Charter	-0.027***	-0.004	-0.025***	-0.011	-0.025***	0.014
	(0.006)	(0.009)	(0.007)	(0.010)	(0.007)	(0.009)
Grade Enrollment (100s)	0.007*	-0.012*	0.009**	0.002	0.009**	-0.000
	(0.004)	(0.006)	(0.004)	(0.007)	(0.004)	(0.006)
Grade Percent Black	-0.001*	0.000	-0.001	-0.001	-0.001*	-0.001**
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Grade Percent White	-0.001**	0.001	-0.001	0.000	-0.001	-0.000
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Grade Percent Hispanic	-0.001	0.002**	-0.001	0.000	-0.002**	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Linear Time Trend	0.002**	0.001*	0.001	0.001	0.002**	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
District FE	X	X	X	X	X	X
School FE		X		X		X
Obs.	4675	4649	4485	4465	4533	4503
R-squared	0.216	0.537	0.201	0.545	0.184	0.549

Standard errors are in parentheses
**** p<0.01, ** p<0.05, * p<0.1*