Examining Variation within the Charter School Sector:

Academic Achievement in Suburban, Urban, and Rural Charter Schools

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Abstract

To date, there is a paucity of research that examines differences between charter schools that operate in suburban and urban contexts. This paper examines whether students in suburban charter schools perform better or worse than their counterparts in traditional public schools or students in urban charter schools. Boasting the largest and most diverse charter school population in the United States, California offers a fertile urban-suburban context for the study of geographically differentiated charter school impacts and thus serves as the focus of our study. The student achievement data (2009-10, 2010-11 and 2011-12 school years) for this study come from the California Department of Education. Using propensity score matching and virtual control records (VCR), we find that suburban charter schools do not improve academic achievement relative to the matched comparison group of traditional public schools. Suburban charter schools (namely, charters in high-income areas) appear to leave their students' achievement unchanged or diminished. This study adds to the existing literature by examining the effects of charter schools on the neighborhoods in which they operate. Methodologically, another important contribution of this study is that it supplements traditional selection criteria for suburban charters (NCES classification) with census-based neighborhood factors. Finally, this study provides evidence of the broader implications of school choice policies in a suburban setting.

Keywords: charter schools; propensity score matching; virtual control records (VCR); student performance; urban; suburban

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Introduction

To date, charter schools, one of the most prevalent forms of school choice, have received support from both sides of the political aisle largely because they have been framed to increase educational equity by providing disadvantaged students with greater access to potentially higher quality schools. In that charter schools tend to be in urban areas, serve disadvantaged families, and focus on improving student academic outcomes, this perception holds much merit. In fact, the federal Every Student Succeeds Act (ESSA) and the previous version of the law, the No Child Left Behind (NCLB) Act, offer public school choice to allow students at persistently underperforming schools to transfer to a higher-achieving public school. A relevant concern with school choice programs such as charter schools is that heterogeneity in parental preferences for education can result in unequal benefits to parents across the socioeconomic spectrum (Elacqua, Schneider, & Buckley, 2006; Hsieh & Urquiola, 2006).

As evidenced by prior studies (Ladd & Fiske, 2001), parents may have a variety of reasons for choosing schools, and we might expect this to lead to considerable variation in charter school impacts. Notably, however, there is a paucity of research that has taken a geographical approach, studying specific areas or groups of areas in depth to examine how local contexts bear on school choice outcomes (Burgess, Greaves, & Vignoles, 2019). That the effectiveness of charter schools varies from one geographic area to another would not be surprising given that charter schools serve students across a wide demographic spectrum and differing locational contexts. Previous studies have generally treated charters as a homogenous group, which masks the variation of performance among them.

The key objectives of this study are to determine the effect of charter school attendance on student achievement outcomes in California, to examine how achievement outcomes vary across charter schools in suburban, urban, and rural areas, and to relate the variation to charter school contexts and characteristics. This study seeks to draw attention to the considerable variation in student achievement outcomes when looking at charter schools that operate in suburban and non-suburban areas. We aim to contribute to this area of empirical work by answering the following research questions: (1) What are the impacts of the suburban and urban schools in this study on students' academic achievement? (2) How do we compare the academic performance of charter school students with matched comparison students in traditional public schools across geographic contexts?

Demand for Charter Schools in the Suburbs

The advent of a new breed of charter schools that locate in predominantly homogeneous, suburban locales and serve relatively affluent families challenges the oft-heard claim among advocates that charter schools reduce educational inequalities by providing a higher quality learning environment to disadvantaged students who would otherwise be locked into inferior neighborhood schools (Whitmire, 2015; Altenhofen, Berends, & White, 2016). These suburban charter schools attract families by providing unique educational programs not provided by traditional public schools. Such programs include progressive educational approaches (e.g., Montessori, Reggio Emilia, and Waldorf) and culturally oriented curricula such as dual language programs. Thus, rather than serving disadvantaged families with children stuck in failing public schools, these charter schools serve families with means who desire the freedom to choose schools that reflect their cultural and educational values. As the matching of parents to charter schools depends on both demand and supply factors, the efficiency in educational production (measured by test scores) of charter schools may be invariably weakened by responding to the heterogeneity in parental demand across school characteristics (i.e., curricular orientation and demographics) and not on academic quality. As Schneider and Buckley (2002) note, "To the extent that demographics displaces academic performance in the choices of economically advantaged parents, this could lower pressure on schools to enhance performance—negating one of the promises of choice" (p. 6).

There is theoretical study of the appeal of charter schools to suburban families. A study by Altenhofen, Berends, and White (2016) highlights the influence of parents' socio-economic status, social networks, education, aspirations, beliefs, and values on their children's educational participation and achievement. These suburban parents also utilize their resource-rich setting to scrutinize the school-related factors that will determine the best match between the school and their child. Such findings are consistent with our hypotheses in that charter school options may have different educational outcomes in suburban and urban settings. Previous literature has focused on the differences between charter schools and traditional public schools, treating all charter schools as an urban phenomenon (Gamoran & Fernandez, 2018; Glazer, Massell, & Malone, 2019). Within the framework of product differentiation, parents choose which school their child attends treating each school in its local geographic context as a differentiated product. We explicitly use the geographically differentiated contexts as a signal of unobservable differences, as is common in the research literature. Understanding the variation in the charter school sector is important for understanding educational outcomes.

The growth of charter schools in suburban areas presents a fascinating research opportunity (Altenhofen, Berends & White, 2016; Tuttle, Gleason, & Clark, 2012). If, as we hypothesize, these charter schools are not catering to parental demand for higher quality schools as occurs in urban charter schools, suburban charter schools should have less of an impact on student achievement relative to that of urban charter schools. Specifically, the academic achievement of a student in a suburban charter school should be no better than it would have been had the student remained in a traditional public school. In contrast, since urban charter schools are expected to serve families who are in need of higher quality schools, the academic achievement of a student who attends an urban charter school should be significantly higher than it would have been had the student remained in a traditional public school. Our study seeks to draw attention to the important heterogeneity in charter school contexts. Our empirical analysis examines whether students who attend charter schools in urban, suburban, and rural settings perform differently in terms of achievement gain scores than their counterparts in the traditional public schools.

Impact of Charter Schools on Student Outcomes

To date, there is a limited but growing body of research that examines achievement differences between charter schools that operate in suburban and urban contexts. Existing randomized control trial (RCT) studies based on admission lotteries show that charters in Boston, Chicago and New York boost academic achievement based on urbanicity, also called the "urban charter advantage" (Abdulkadiroğlu, Angrist, Dynarski, Kane, & Pathak, 2011; Dobbie, Fryer, & Fryer, 2011; Hoxby, Murarka, & Kang, 2009; Hoxby & Rockoff, 2005). This long line of RCT analysis, the gold standard for effectiveness research, reported positive effects in reading and math at both the middle and high school levels in urban charters compared to their counterpart traditional public schools. On the other hand, suburban charter schools fail to show achievement benefits for any group (Angrist, Pathak, & Walters, 2013). These lottery-based studies are focused either on single large urban areas or a small urban core in a largely suburban state (Massachusetts).

The broadest assessment of charter school effects across geographic locales (urban, suburban, town, and rural) comes from the Center for Research on Educational Outcomes at Stanford University (CREDO, 2019). CREDO's matching strategy is similar to more broadly used propensity score matching (PSM) techniques in that both methods match charter school students with TPS students based on observable characteristics, such as ethnicity, prior achievement, and special education status. CREDO's "Virtual Control Records" (VCR) technique, however, requires at least one exact TPS student match for each charter school student. The exact matches are generated from the records of up to seven students in "feeder" public schools (namely, those schools whose students transfer to charters). The 2015 CREDO report shows considerable range in charter school performance across regions, although the average outcome of students attending urban charter schools demonstrated a small but significant impact in math and reading. More recently, a multi-state supplementary analysis of charter school impacts reveals a more nuanced view of geographic variation in academic performance—that is to say, a much larger and more consistent achievement growth in urban areas than in non-urban areas (CREDO, 2019). In this study, we aim to contribute to this empirical literature by utilizing both conventional propensity-score matching (PSM) and CREDO's VCR methodology to estimate treatment effects of charter schools on academic outcomes.

This study also adds to the existing literature by examining the effects of charter schools on the neighborhoods and a delineation of geographical areas in which they operate. The national charter school study by Gleason, Clark, Tuttle, and Dwoyer (2010) uses the dummy variable indicating "Large City" to define urban versus nonurban areas. In this study, we supplement traditional selection criteria for suburban charters (NCES classification) with census-based neighborhood factors. Specifically, we follow Johnson and Shifferd's (2016) settlement classification for urban, suburban and rural areas, which account for population size, commuting connectivity, and data for urban and rural areas.[1] This classification circumvents the limitations of defining neighborhoods from the Census Bureau's American Community Survey (ACS) as essentially based on how many people settle in urban areas versus rural areas.

Although there is a large amount of research on the effects of charter schools in urban areas, only a small portion of the studies focused on how charter schools affect student achievement in other geographic contexts (i.e., urban versus suburban). This study aims to fill a gap in the literature. Our findings, with respect to the charter school achievement across geographic contexts, complement prior work that has provided empirical evidence documenting higher and more consistent student learning gains in urban areas versus suburban and rural areas (CREDO, 2019; Clark, Gleason, Tuttle, & Silverberg, 2015).

In the following sections, we take a closer look at the relevant literature on market/product differentiation and charter school achievement across geographic contexts. We next describe the data and how the measured characteristics of urban, suburban, and rural contexts are derived and implemented. This is followed by a presentation of the matching methodology used in CREDO's national charter school study and propensity score matching (PSM). The next section presents the findings. A final section summarizes the findings and their implications for policy.

[1] This study examines other measures of urban, suburban, and rural neighborhoods based on varied measures of population and housing densities (i.e., Housing Assistance Council's (2014) census tract classification of geographic areas based on housing unit density and tract-level population density by Lang (1986), Nelson (1992) and Lang, Sanchez and Oner (2009). The varied approaches produce relatively little variation in delineating urban, suburban, and rural areas. The results are available on request.

Literature

Theory of Product Differentiation

While theories and policies informing charter schools generally assume static consumer-provider relationships, emerging evidence indicates more dynamic interactions between supply and demand, as charter schools formulate responses not only to TPS but also to one another, as well as to their differentiated consumers (Lubienski & Lee, 2016; Brown & Makris, 2018). Whereas market-based reformers see students as a leveled client-source for schools to pursue (for per-pupil funding), research indicates that charter schools drawing students from unevenly developed social landscapes tend to differentiate their offerings to meet parental demand (Bau, 2015; Lacireno-Paquet, Holyoke, Moser, & Henig, 2002).

Although product differentiation has typically been adopted in a variety of fields, we apply key elements of this theory that are critical to this study. Conceptually, product differentiation contends that specific services or products tend to be tailored to specific groups of clients according to a common understanding of their interests and values. Education, most particularly charter schools, is a natural extension of product differentiation; thus, charters are expected to target and position their brand to the differing market segments consistent with parents' values and beliefs (Arce-Trigatti, Lincove, Harris, & Jabbar, 2016). With diverse parent preferences and charter schools operating in varied geographic contexts, there is the theoretical potential for an unprecedented level of product differentiation to emerge. Research examining product differentiation among charter schools finds evidence to support this theoretical expectation. Depending on parental demand, charter schools scan the local context and provide alternative programs of choice that fill a niche, either in terms of theme-based instruction, pedagogical focus (Carpenter, 2006), geography, such as the suburbs (Henig & McDonald, 2002;

Lubienski, Gulosino, & Weitzel, 2009), academic achievement, or by choosing to serve targeted populations to meet the needs of local students (Glomm, Harris, & Lo, 2005). Carpenter (2006) and Renzulli, Barr, and Paino (2015) find that charter schools are inherently different with a variety of types with different foci serving different student populations.

More recent evidence from a variety of national and international contexts indicates that families consider public choice programs as differentiated products (Burgess, Greaves, Vignoles, & Wilson, 2015; Arcidiacono, Muralidharan, Shim, & Singleton, 2017) and select alternative schooling options based on the attractiveness of their decision options (Hastings, Kane, & Staiger, 2006; Walters, 2018). A growing body of empirical studies has demonstrated that, when provided with information on test score aggregates, low-income families tended to experience the academic benefits from opting out of traditional public schools and into school choice programs (Friesen, Javdani, Smith, & Woodcock, 2012; Hastings & Weinstein, 2008; Koning & Van der Wiel, 2013).

Recent observations of the growing differentiation of the charter school sector based on geographic context has found its way into the economics of education research (Chabrier, Cohodes, & Oreopoulos, 2016). Following lottery-based charter school research, charters that choose to locate in disadvantaged and segregated neighborhoods tend to embrace a “No Excuses” approach, while nonurban charters are likely to embrace other preferred options, such as progressive education. A follow-up study by Angrist, Pathak, & Walters (2013) in Massachusetts finds no charter schools in nonurban areas classified as “No Excuses” schools, while two-thirds of charters in urban areas are classified as “No Excuses.”

By underscoring family preferences for different types of schools, parents are expected to assume responsibility for their “good” or “poor” choices of schooling for their children. The idea being that they will advocate for the educational needs of their child, and if a local school cannot fulfill their child's needs, they will move their child out of that school and into schools that are good matches. One reflection of school sorting is the wide variation in educational programs among charter schools. Several recent studies establish the dominance of urban school-reform models in the charter school sector under the "No Excuses" model, a model that combines traditional curriculum and direct instruction with a highly structured disciplinary system aimed at raising the achievement of low-income African-American and Hispanic students (Abrams, 2016; Golann, 2015; McShane & Hatfield, 2015). There is no official list of "No Excuses" schools, but this brand of schooling is widely considered an urban phenomenon. "No Excuses" schools are concentrated in urban neighborhoods replete with low-performing schools and scarce in nonurban areas. The success of the "No Excuses" charters in raising student achievement and their disproportionally large impact on low-income, non-White students represents a significant market segment for parents in the urban areas. On the other hand, the advent of options for specialty schools such as Montessori, Waldorf, and "boutique" (prestige) charters has been anecdotally observed to be prevalent in homogeneous (disproportionately White), suburban locales and to serve largely advantaged families (Brown & Makris, 2018). These charters are not founded out of a deliberate attempt to raise student achievement but rather to fulfill certain set of values, ideologies, or philosophies in education. Despite the preponderance of quantitative accountability measures, the rise in advantaged groups attending this type of charter school represents a new market segment that do not put a premium on test data as highly as other dimensions of education and societal values (Lareau & Goyette, 2014; Reay, Crozier, & James, 2011; Betebenner, Howe, & Foster, 2005; Carpenter, 2006; Wamba & Ascher, 2003).

Hypotheses

While our study does not present empirical evidence to directly link heterogeneous preferences (i.e., varied curricular themes) to the specific geographic context of charter schools, we aim to draw attention to the unobserved selection (endogeneity) bias that may invariably impact student outcomes. Addressing self-selection and endogenous location of charter schools is challenging. For example, we may be worried about positive bias in the urban areas where traditional public schools are considered failing and families who can get out send their children to charter schools in surrounding neighborhoods. Evidence gathered from lottery-based studies confirms that the highest improvement in test scores is found in areas where lottery losers end up in some of the lowest-performing schools; by contrast, charters with the lowest test score gains are in more suburban neighborhoods (Chabrier, Cohodes, & Oreopoulos, 2016). There may be negative bias in the suburbs where many parents are paying a premium in housing for access to better-performing schools and are only likely to consider charters if the local school is not a good fit for their children. Identifying true differences in the performance of charter school students can be problematic if heterogeneity of geographic context is not accounted for and invariably biases the differences in student performance. Therefore, ignoring heterogeneity in parental demand for different types of charter schools might lead a researcher to erroneously ignore the geographically differentiated charter school impacts. In this study, we explore the presence of this self-selection bias by introducing two research hypotheses:

1. Because suburban charter schools differentiate themselves in response to parental preferences, the net effect of suburban charter schools is to produce effects that are no different or worse than their counterparts from traditional public schools (TPS).
2. In the presence of consumer preference heterogeneity, we consider charter schools as differentiated products (Gilraine, Petronijevic, & Singleton, 2019). Examining the

> above hypothesis from a product differentiation perspective, we expect significant student achievement differences to appear in the learning outcomes that suburban and non-suburban parents deem as important. Suburban parents are not likely to sort into charter schools based on product differentiation in student outcomes, such as test scores. To the degree that charter school options in the suburbs may be viewed by families from a different market segment (representing specific interests and values), the incentives for suburban charters to influence student academic performance may in turn be muted. Although suburban parents' values about education are predicated on what is best for their children, the claim that we seek evidence for is that attending suburban charter schools will produce effects that are either negative or not discernibly different from traditional public schools. Urban charter schools improve academic achievement relative to the matched comparison groups of traditional public schools.

We examine the effects of charter schools on the neighborhoods in which they operate for a fairer comparison of student achievement. It is reasonable to assume that the traditional public school selected for comparison is likely to share the same neighborhood, same socio-demographic conditions, and the same population of students and parents. Our study builds on past research and uses the market or product differentiation to test the hypothesis that the academic impact of urban charter schools relative to their matched traditional public schools is positive and significant. In the last decade or so, there has been a rapid expansion in the number of charter schools, and researchers have estimated the academic impacts of charter schools using rigorous research designs. This new wave of studies indicates that students in racially and economically segregated urban neighborhoods are often characterized by poorly functioning schools, and thus student are expected to make greater achievement gains in urban charters than they would have in traditional public schools. To the extent that charter schools in suburban and rural contexts may be regarded by families from a market segment that puts a high premium on seeking better alternatives to their underperforming traditional public schools, the incentives for these charters to influence student academic achievement may in turn be amplified.

Charter School Achievement Across Geographic Contexts

Existing studies based on admission lotteries show that charter schools in Chicago, New York, and Boston significantly improve academic performance—test score gains of more than half a standard deviation after two years of attendance (Chabrier, Cohodes, & Oreopoulos, 2016). A study of Massachusetts charters in urban, suburban, and rural areas across the state found that urban charter middle schools generate much larger positive test score effects in math and reading for disadvantaged students than their counterparts in traditional public schools, including African-American and Hispanic students, those with low baseline scores, those who receive subsidized lunch, and English language learners (Angrist et al., 2013). At the same time, charters in relatively affluent suburbs produce zero to negative results for students across each of the subgroups. Angrist et al. (2013) conclude that something about the community type (high-poverty and segregated neighborhoods), rather than ability or peer composition, is driving these substantive academic gains in urban charter schools. The achievement results from other lottery-based charter school research continue to find positive average test score effects, but these significant results are confined to urban charter schools only and with wide variation across schools (Dobbie & Fryer, 2013; Gleason et al., 2010). An evaluation of 36 charter middle schools in states using RCT design conducted by Mathematica for the U.S. Department of

Education found more positive impacts for charter schools in urban areas (or serving more disadvantaged populations) but the opposite for charter schools in suburban and rural areas or serving more advantaged populations (Clark et al., 2015). Not surprisingly, in these studies of oversubscribed (high demand) charter schools, which are primarily restricted to samples of lottery applicants, researchers find generally positive results.

Other charter matching studies have used the Virtual Control Records (VCR) method developed by the CREDO Center at Stanford University to examine impacts in the academic growth of charter schools across geographic locales (urban, suburban, town, and rural) as part of supplementary analyses and, more recently, in the state reports for Pennsylvania, Ohio, New Mexico, Maryland, and Idaho (CREDO, 2019). CREDO's estimation strategy starts by identifying each charter school's feeder schools, which is the traditional public school (TPS) a student attended the year before entering a charter. For each charter student, a "virtual twin" is created using matched data based on students of similar demographic and academic characteristics at the feeder school. On average, CREDO reports indicate that charter schools in urban areas demonstrate much larger and more consistent positive achievement benefits than do charters in non-urban areas (CREDO, 2015, 2019). In Pennsylvania, students attending charter schools in suburban or town locales have significantly weaker gains in reading and math compared to their TPS counterparts. In rural areas, students perform similarly to their TPS peers in reading while showing significantly weaker growth in math. In Ohio, students attending suburban charter schools achieve comparable gains in reading but weaker gains in math compared to their TPS peers. Rural charter school students improve similarly to their TPS peers in both reading and math. Enrollment in charter schools in towns is associated with negative impact on math and reading achievement gains. In Idaho, urban, suburban, and town charter school students grow similarly to their TPS peers in both reading and math. Enrollment in rural charter schools produces stronger gains in both reading and math compared to their TPS peers. In New Mexico, enrollment in charter schools is not significantly associated with academic gains for students in suburban, town, and rural areas (CREDO, 2019).

Other studies have looked at the evolution of California charter schools and their academic impacts over time. Using longitudinally linked student-level data (1997-2001) and a fixed-effect approach to estimate the effect of attending a charter school for reading and math in six prominent districts, Zimmer et al. (2003) concluded that charters generally perform on par with traditional public schools across different grades and subjects. A study tracking students who switch into charter schools by Booker, Zimmer, and Buddin (2005) found that switchers had lower achievement scores prior to moving than their peers who chose to remain in a traditional public school. Their follow-up studies also found that the effectiveness of charter schools in the state varies by charter type (instructional approaches) and age of the school (Buddin & Zimmer, 2005; Zimmer & Buddin, 2007). Our current analysis builds upon these studies by estimating the effects of charter schools on math and ELA test scores across geographic locales. We draw attention to the heterogeneity across geographical school choice markets that may invariably impact student outcomes.

Research Setting

There are several features of the California context that make it ideal for a study of product differentiation within a schooling market. As a state that is widely considered large and diverse, California represents an illuminating case for studying charter school impacts and the distribution of education options. The state Legislature passed the Charter School Act of 1992, the second state in the nation to enact a charter school law after Minnesota. In the fall of 1993, one charter school (San Carlos Elementary School in San Mateo County) was opened and enrolled 220 students (EdSource, 2004). Since then, California has experienced fast and steady growth in both the number of charter schools and charter school enrollment. The total number of charter schools has grown to 1,275 in the 2017–18 school year, enrolling 630,300 charter school students (David & Hesla, 2018). In comparative terms, two of every 20 public schools are charter schools (California Department of Education, 2018). According to the most recent estimates of the California Department of Education, one out of every 10 students is being educated in one of these schools, which can operate in suburban, urban, and rural areas across the state. Considering its population size of 40 million in 2018, touted as the seventh youngest population in the nation and dubbed as a "minority-majority state" (Johnson, 2017),[2] the potential for further charter school growth to fill unmet needs should come as no surprise. Nationally, the state's charter expansion in 2017 is considered the fifth largest charter sector in the nation (David & Hesla, 2018). Geographically, it consistently ranks as one of the largest states with the highest percentages of non-rural residents, a combination of residents living in urban and suburban areas (Cox, 2018). California's high-density urban areas, dense suburbs, and significant rural land mass offer a compelling study for examining achievement outcomes for charter school students in diverse educational contexts.

Socio-Demographic Characteristics of Census Tracts With and Without Charter Schools

This section presents a general overview of the charter school environment across geographic locales in California. The geographic analysis presented in Tables 1–2 and Maps 1–7 is based on

[2] According to the 2014 population estimates found on American Factfinder, Latinos/Hispanics surpassed whites as the largest single racial/ethnic group in California's total population.

all census tracts in California (*N*=8,057). A total of 1,039 charter schools are located in 762 census tracts in California. There are 7,295 census tracts without charter schools. For example, Map 1 illustrates the suburban census tracts in the northern and southern regions of the state containing charters and those without. The suburban tracts with charters are widely dispersed in non-contiguous areas. Maps 2 and 3 show pockets of poverty in suburban tracts with and without charter schools, but sparsely distributed. Maps 4 and 5 demonstrate irregular patterns of high median household income in suburban tracts with and without charter schools and dispersed over larger areas. Finally, Maps 6 and 7 feature very low percentages of African American residents in suburban tracts with and without charter schools.

[INSERT MAPS 1-7 HERE]

Additionally, inferential statistics (t-test) is used to systematically test for the presence of statistically significant differences in the socio-demographic attributes of census tracts with and without charter schools across urban, suburban, and rural contexts (See Table 1). The differences in socio-demographic attributes of census tracts with and without charter schools are statistically significant for 8 out of 10 attributes in urban and suburban contexts. In the urban context, census tracts with charters have a higher share of African-Americans, Hispanics, households below poverty, and a higher Gini index (a measure of income inequality) than tracts without charter schools. By contrast, the median household income, Asian population, and population density are lower in census tracts with charters compared to those without. In the suburban context, the White and African-American population, median household income, population below poverty, and population density are lower in census tracts with charters compared to those without. On the other hand, the Gini index is higher in census tracts with charter schools than those without, demonstrating a greater degree of income inequality. Only four socio-demographic variables are statistically significant in the rural context. The Hispanic population, minority population, and population below poverty are lower in census tracts with charters compared to those without. Census tracts with charter schools have a higher share of White population than tracts without charters.

[INSERT TABLE 1 HERE]

As Table 2 illustrates, post hoc comparisons using the Tukey HSD test indicate that suburban tracts with charter schools have a higher share of White population than all urban tracts with charters. Rural tracts with charters also have a higher share of White population than both urban and suburban tracts with charters. On the other hand, rural tracts with charters have a lower share of African-American and Hispanic populations than both urban and suburban tracts with charters. Patterns of the Asian population coincide with the percentage of the minority population; the minority population do not predominate in suburban tracts when compared to urban tracts with charters. Median household incomes, on the other hand, are higher in suburban tracts than both urban and rural tracts with charters. Urban tracts with charters have a higher share of population below poverty than both suburban and rural tracts. The Gini index is higher in urban tracts than both suburban and rural tracts, indicating greater income inequality. The Gini index for suburban tracts is not statistically significantly different from rural tracts. As expected, urban tracts have a higher share of population density per square mile than both suburban and rural tracts.

[INSERT TABLE 2 HERE]

The inferential statistics and Geographic Information System (GIS) mapping mask important heterogeneity in charter school contexts, like those found in other studies. For example, a few studies have found evidence of charter schools attracting disproportionately White students in some areas (Institute of Race & Poverty, 2008; Renzulli & Evans, 2005). Absent controls for these differences, selection bias, which is one form of an endogeneity problem, can lead to inappropriate inferences about charter school effects on student achievement. In the presence of observed heterogeneity in charter school contexts, this study examines the geographically differentiated charter school impacts. Given the heterogeneity in charter school contexts, questions emerge about who truly benefits with increased academic achievement.

Data and Methods

We obtained data from a variety of sources. A student-level data file (2009-10 through 2012-13 school years) from the California Department of Education (CADOE) links the school codes used in the test-score and enrollment files to school name, district name, and an indicator for charter schools. Each student has a unique identifier that is linked to the universe of charter schools and public schools in the state, which allows us to follow students and schools for three school years. The data contains longitudinal test scores for each student in mathematics and English Language Arts (ELA) on standardized end-of-grade exams, which we use to track individual academic performance. Test scores are reported on a developmental scale, designed such that each additional point represents the same knowledge gain, regardless of the student's grade or baseline ability. To create comparability of test scores across grades and subjects, we standardize this scale at the student level to have a mean of zero and standard deviation of one for each grade-year combination. In addition to test scores, the student data contain information regarding student grade, socioeconomic status, race and ethnicity, and special education status.

From the original record of 10,741 school codes, we removed records (*N*=618 school codes) with no information on school name, agency/district name, address, and other institution identification, resulting in a total of 10,123 schools with complete information. Next, we merged the CADOE data with other school-level data from the National Center for Education Statistics Common Core of Data (CCD) and the American Community Survey (ACS) for data on school, demographic, geographic, and neighborhood characteristics. Using standard GIS procedures, we geocoded school locations and determined their host census tracts. The percentage of data geocoded at the census tract level obtained a match rate of 100% for the charter schools and traditional public schools in the K–12 range in the study. This information was then joined to data on demographic, economic, social, and geographic variables at the census-tract. In addition, California has a total of 8,057 census tracts but only 4,955 tracts have charters or traditional public schools in them. Census tracts that host no publicly funded schools were consequently removed from the analysis.

After matching the geographic information with the student and school information, we cleaned the data to prepare it for analysis. We removed students who were not tracked for all three years in our sample or who were missing achievement, demographic or other critical information. The final dataset includes 8.6 million observations across the three study years, which is about three million students.

Indicator of Suburbanization

This study also employs the general strategy adopted by Johnson and Shifferd (2016) to categorize census tracts into urban, suburban, and rural areas. Johnson and Shifferd combine aspects of the Office of Management and Budget's (OMB) metropolitan and micropolitan categories and the U.S. Census definition of urbanized areas (UA). UA refers to "urbanized area" as areas with a population of 50,000 or more. The OMB categorizes every U.S. county or county equivalent as being in a metropolitan (MSA), micropolitan statistical area, or neither. A metropolitan is a city within a metropolitan area which is the central city of such area, while a micropolitan is a smaller population nucleus and adjacent communities to a metropolitan area that are economically and socially connected by commuting flows (Sunstein, 2010). Following Johnson and Shifferd (2016), urban areas are identified as the most populous in each MSA. Suburban areas are the census-tract designated urbanized areas (UAs) that contain each MSA's most populous city but with that most populous city's population removed. Rural areas are outside of MSAs and all areas not urban.

Empirical Strategy

For the purpose of our empirical analysis, the measure of educational outcome is the student's gain score (i.e., the difference in achievement scores between the present and prior year). This allows us to examine student learning, which previous charter school research suggests is a more relevant outcome than achievement at a point-in-time. We use the standardized gain scores for students who have test scores on the California Standardized Tests (CSTs) in math and ELA.

Propensity Score Matching (PSM)

We use a PSM procedure to minimize the bias in the treatment effect (i.e., the effect of a student participating in charter schools) by an estimated propensity score (Caliendo & Kopeinig, 2008; Dehejia & Wahba, 1999; Rosenbaum & Rubin, 1983). The propensity score calculates the likelihood of attending a charter school based on a given set of characteristics.

This single value can then be used to match treatment (charter) and comparison (non-charter) students by finding those that have similar propensity scores. As Rubin (1997) suggests, propensity score matching estimator performs better with large data sets. The PSM approach involves three main steps. First, we utilize logistic regression (1 = charter; 0 = traditional public) as a function of aggregate student characteristics. This model allows us to estimate the probability of receiving the treatment, given grade level, demographic inputs (race/ethnicity, gender), programs (free-lunch eligibility, special education status, and English learner designation), and prior-year achievement. Second, we use these probabilities as an estimate of the propensity of each student to receive the treatment. We take the inverse of the propensity estimated via the logistic regression model—the Inverse Probability Weight (IPW)—and use them to weight the control units in the study so that they statistically match the treated units. In this weighting process, the treated units are given a weight of one, and the control units are given the inverse probability weights. We repeated this process for the 2011–12 and 2012–13 cohorts of students. Tables 3 and 4 illustrate the success of the matching process in that the treatment and control units share essentially identical values on the matching variables. The tables also show no statistically significant differences between the treatment and control groups on any of the matching characteristics. The non-significant differences in the means of our treated and non-treated groups imply high-quality matching. Finally, after constructing the matched comparison group, we estimated the impact of charter school attendance on charter school students using regression models.

[INSERT TABLES 3 AND 4 HERE]

Virtual Control Record (VCR) Matching

PSM based on IPWs uses statistical adjustments to match the treatment and control groups by weighting control units based on their probability of receiving the treatment. This approach allows us to use nearly the entire sample without needing to drop students, which should improve generalizability of the results. However, this method is not as precise as finding an exact match for each treated student among the control group. VCR, in contrast, is an exact-matching procedure that searches for statistical twins for each treated unit and drops observations from the control group that do not have an exact match in the treatment group.

Following CREDO (2009, 2013), our estimation strategy begins by identifying each charter school's feeder school(s), defined as the universe of traditional public schools (TPS) previously attended by any student currently enrolled at a charter school. Next, we match each charter school student with up to seven TPS students from the TPS feeder pool for that charter school who share the exact same demographic characteristics and baseline achievement within .1 standard deviations to create a "virtual twin" for each charter student. The matched TPS students exactly match the charter student with respect to grade level, year, race/ethnicity, free or reduced-price lunch eligibility, Limited English Proficient (LEP) status, special education status, and prior test score on state achievement tests. Instead of one-to-one matching, the CREDO algorithm allows us to generate as many as seven VCR-eligible TPS students for each charter student, averaging their achievement scores to create a "virtual control record." The VCR represents an appropriate counterfactual for the treatment group (i.e., what would have happened to these students had they attended a TPS rather than a charter). We estimate charter effectiveness by comparing gain scores of charter students and their VCRs, separately for math and ELA.

Following CREDO's approach, the basic econometric model (OLS regression) takes the form:

Equation (1)

$$\Delta A = \theta A + \beta X + \gamma C, + \varepsilon,$$

where the dependent variable, gain in student achievement, is: $\Delta A = A - A$

Here, $A_{i,t}$ is the gain score, measured in standard deviation units, for student i in math and ELA in period t; $A_{i,t-1}$ is the z-score for student i in period $t-1$, which is included as a control variable because achievement growth can vary with prior achievement levels due in part to regression to the mean. X is a set of control variables of student observable characteristics and years; C is a dummy variable indicating whether the student is enrolled in a charter school; *yt* is a year fixed effect, and ε is the error term. ELA and math scores are standardized into z-scores, with a mean of 0 and a standard deviation of 1, so that each student is placed relative to his/her peers in the state. Using achievement gains accounts for underlying achievement trajectories or prior educational experiences that are not expected to influence test score gains in the current year (Bifulco & Ladd, 2006; Ladd & Walsh, 2002). γ is an unobserved parameter reflecting the possible effect of charter school attendance on the gain score. Equation 1 seeks to estimate a charter school's effect on a student achievement gain in the form: $\gamma = \mu_0^{\text{charter}} - \mu_0^{\text{feeder}}$. Thus, the achievement model can be written as:

Equation (2)

$$A - A = \theta A + \beta X + \mu_0^{\text{charter}} + \varepsilon,$$

Equation (3)

$$A - A = \theta A + \beta X + \mu_0^{\text{feeder}} + \varepsilon,$$

Under OLS specification, X_i contains a set of demographic variables that serve as proxies for differences in individual demographic characteristics, such as race/ethnicity, free or reduced-price lunch status, special education status, and grade-level.

To tease out the achievement effects of attending a charter school in a specific geographic area (urban, suburban, and rural), we interact geographic locale with charter school attendance:

Equation (4)

$$A-A=\theta A+ \beta X+\beta Localei+ \mu_0^{\text{charter}}\beta Localei *\mu+ \varepsilon,$$

The interaction term tells us whether and to what extent charter school achievement depends on geography, which is the core focus of this study.

In the initial empirical approach (Model 1), we look at the effect of charter schools on student yearly gains across student-level demographic characteristics, but without the implementation of matching techniques for removing selection bias (i.e., propensity score matching). It is possible that an individual's choice between charter school and traditional brick-and-mortar public school is affected by unobservable differences (Equations 2 and 3). In this case, OLS estimates of the parameters of Equation (1) will be biased and inconsistent due to the endogeneity of the charter school dummy variable C_{it}. The lagged achievement gain score regressor will be correlated with the lagged measurement error, and thus OLS estimates will be biased.

Throughout the analysis, we use R software for data management and implementation of the VCR methodology via exact match in the matching package (Sekhon, 2011). We use STATA 14 for propensity score matching, regression analysis, and organizing the results. The next section examines the pooled estimates of charter school effectiveness for suburban and non-suburban charter school students.

To adjust for potential heteroscedasticity, we use robust standard errors to obtain unbiased standard errors of OLS coefficients under. To adjust for clustering, we cluster the standard errors by school in the unmatched samples and by feeder patterns in PSM and VCR analyses.

Results

Descriptive statistics

Tables 3 and 4 show the English Language Arts (ELA) and math baselines for students included in the unmatched and the TPS-matching analyses (PSM and VCR). In Table 3, our estimation sample consists of 89,854 charter students and 2,742,631 TPS students in the unmatched sample, 89,854 charter students and 2,373,431 TPS students in the PSM sample, and 74,928 charter and TPS students in the VCR sample. In Table 4, our estimation sample consists of 94,280 charter students and 2,800,414 TPS students in the unmatched sample, 94,280 charter students and 2,436,968 TPS students in the PSM sample, and 79,344 charter and TPS students in the VCR sample. Both tables show that the differences in academic achievement between charter and TPS students prior to matching are significant across baseline covariates (see unmatched sample column). In the PSM sample columns, performance on standardized tests are very similar between charter and TPS students, indicating no systematic differences between groups. The only exception is the median income covariate, which shows that charter schools tend to locate in lower-income areas compared to TPSs. This difference, however, is no longer statistically significant in the VCR samples, resulting in a smaller standardized mean difference. The VCR columns show identical results across nearly all covariates, suggesting no systematic differences in the characteristics between charter and TPS students. The comparison between the matched charter schools and TPS students in PSM and VCR samples generates more robust methods for reducing bias due to the differences in observed factors. Overall, groups can be directly compared, and causal inferences inferred.

Analytic Findings

The three estimation strategies yield similar results with respect to the impact of attending a charter school. Model 1 of the unmatched sample (Table 5) indicates negative growth in math achievement of charter school students relative to their TPS counterparts, but this finding is only marginally significant at the $p < .1$ level and the effect size is trivial. Model 1 of the PSM math results (Table 6) has a similar effect size and significance, and the VCR model shows no difference in math learning across sectors.

[INSERT TABLES 5 AND 6 HERE]

The ELA results are statistically significant and robust across methods. The models suggest that charter school students make larger improvements in year-over-year ELA achievement compared to TPS students.

The results provide evidence for geographic differences in math performance, but the sign of this difference switches between the matched and unmatched samples. More specifically, the unmatched sample suggests that suburban students tend to improve more rapidly in math compared to urban and rural students. However, the matched samples suggest the opposite: Urban students tend to make larger gains in math compared to suburban students, while rural students make smaller gains than their suburban counterparts. The ELA results are less consistent in providing evidence of urban-suburban differences in learning, but there is consistent evidence that suburban students outperform their rural counterparts in ELA.

[INSERT TABLE 7 HERE]

One fascinating driver of the overall differences in achievement by subject may be geographic differences in performance across sectors. We can see evidence of this in the marginal effects that derive from the interaction terms between charter school attendance and geographic locale. Specifically, we see consistent support for our hypothesis that students in urban charter schools outperform their urban TPS counterparts in both math and ELA in the VCR and unmatched analyses. The effect sizes (generally .03-.04 standard deviations) for this comparison are all statistically significant except for math gains in the PSM method. This result suggests that urban charter schools, which account for about 60% of all charter schools, consistently drive up charter school achievement growth.

In contrast, the models suggest that students in suburban charter schools make significantly smaller gains in math achievement than suburban public-school students. In ELA, suburban charter students make gains that are no better or worse than their suburban counterparts. Finally, the results suggest that rural charter school students make significantly smaller gains in math across all model specifications and do no better than rural TPS students in ELA. These results suggest that geography matters.

Discussion and Summary of Findings

Our analysis reveals that students in suburban charter schools are performing worse than their peers in traditional public schools in math and no better than their peers in ELA. The results indicate that charter school students in rural schools are not learning at the same rate as their peers in traditional public schools, mirroring findings from suburban environments. These findings further highlight the importance of exploring the full range of charter school performance across geographic contexts.

The differences in performance among charter schools across geographic locales in our analysis are compelling and underscore the importance of considering these differences when interpreting charter school results. Consistent with our predictions, suburban charter schools do not boost achievement when compared to urban charter schools. The evidence of charter effects on student achievement is in line with findings of previous quasi-experimental studies. While a few researchers have examined variation in charter school performance across different types of locales, the main draw of this article is arguing that the school choice market itself may be fundamentally different in urban areas compared to suburban areas, largely consistent with product differentiation. We call attention to this variation and highlight the need for researchers to more carefully address the endogeneity problem caused by heterogeneity across geographical locales that may invariably affect estimates of charter school impacts.

This article covers two nonexperimental comparison group approaches, each of which can theoretically account for selection bias. The first approach, virtual control record (VCR), uses all available observable charter student characteristics and prior performance to create a composite comparison record (Davis & Raymond, 2012). The second approach, propensity score matching (PSM), restricts the comparison group to those comparison group students who look most similar to the treatment group along observable dimensions. The analysis aims to add depth to the empirical evidence in relation to the comparison between charter school performance and TPS performance in suburban and non-suburban contexts.

Implications and Future Directions for Research

One fascinating finding that warrants further research is the geographic differences in achievement by subject. Our results show that urban charters push the academic growth of the charter sector upwards in math, while suburban and rural charters drive improvement in math downward relative to TPS. The downward trend in suburban and rural schools is much larger than the upward trend in urban charters, which clearly contributes to the overall negative growth in math achievement across the charter sector in California.

In contrast, while ELA growth is significantly greater in urban charters compared to urban TPSs, the academic gains of suburban charter students are no better than their suburban TPS counterparts. Are suburban charter schools more focused on language and thus perform relatively better on ELA compared to math because that is how they differentiate from suburban public schools? Further research should explore this question in order to deepen our understanding of market differentiation in the charter sector.

The variation in charter school performance in math and ELA and across different types of locales could be driven by differences in family needs and values, maximizing social efficiency by matching parents' demands with the supply of schools by geographic locale. The entry of charter schools in suburban areas provides opportunities for middle-class and suburban parents to utilize new school options for all families rather than a single approach geared toward serving high-poverty families and communities in urban areas (Bifulco, 2012; Coons & Sugarman, 1978). Just as parents may seek education alternatives to their neighborhood schools based on family needs and values, charter schools have the incentive to expand educational opportunities which transmit and reinforce those values. For example, while charter schools may have incentives to adopt "No Excuses" practices likely to close the achievement gap in math in urban areas (Abdulkadiroğlu et al., 20011; Angrist et al., 2013; Dobbie et al., 2011, 2013; Golann, 2015), charter schools in suburban and rural areas may have to offer alternative pedagogical approaches focused on art, music, crafts, and project-based learning (Langhorne, 2018). Understanding these differences in educational preferences (i.e., curriculum, values, philosophy) and school choice markets by geographic locale have substantial implications for how one interprets the outcomes of charter schools and the policy implications we derive. Future work focused on understanding how important qualities of geographical perspective on school choice are manifested in the operation of charter schools would provide valuable insights into how these schools are differentiating themselves in the marketplace (i.e., missions, instructional themes and curricula, general disciplinary philosophies).

Another major research direction is to examine non-score outcomes, including the attendance rate, on-time grade progression, and disciplinary outcomes such as suspension/expulsion rates. More research is needed to extend the time horizon beyond the K-12 setting to determine whether the heterogeneous findings for achievement within the charter school sector have longer-term consequences, extending into college and potentially the labor market. Prior studies have shown that students' standardized test performance (a proxy of cognitive skills) is positively correlated with future earnings, although not as strongly as some might think (Griliches & Mason, 1972; Murnane, Willett, & Levy, 1995). As charter schools in different geographic contexts produce more and more graduates, longer term outcomes such as career choices, youth entrepreneurship, high school graduation, college enrollment, earnings, unemployment, and criminal records provide other examples. Research evidence to support these educational outcomes is limited, but it deserves further investigation.

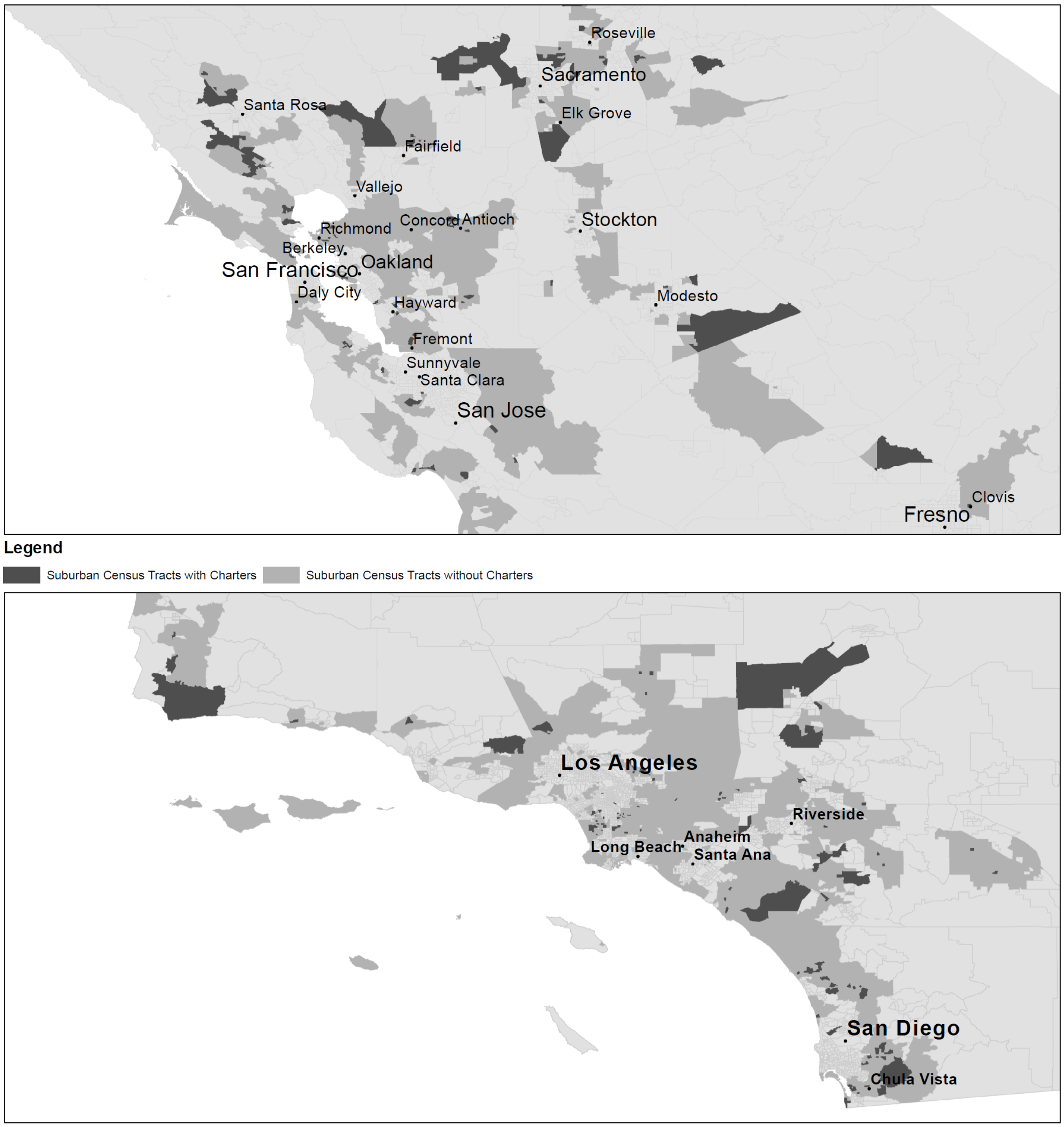
Our understanding of suburban, urban, and rural contexts should be expanded to accommodate the changing realities of neighborhood change, such as migration patterns, city-suburb shifts, gentrifying communities, exurban development, and patterns of income segregation (Owen, Reardon, & Jencks, 2016; Reardon & Bischoff, 2011; Reardon & Yun, 2001). These changes underscore the importance of research aimed at better understanding geographic contexts. This study provides a foundation into which the urban, suburban, and rural classification can be integrated and analyzed in the future; this is one of the benefits of relying on proxies that can be revisited. Subsequent research that brings forth unique combinations of data and methods will deepen our understanding of these and other geographic characteristics.

We also acknowledge the various scholars who have called attention to the technical and conceptual issues involved in the methods employed by the CREDO charter school studies (Hoxby, 2009; Maul & McClelland, 2013; Miron & Applegate, 2009). Primarily, the VCR technique is exposed to common threats to external validity in that the construction of "virtual twins" are not drawn from the general population of traditional public schools, but rather, only from the subset of such schools from which students leave to matriculate in charter schools (Maul, 2015). The PSM has similar threats to validity in this area, as does any analytic method that uses samples of a population (Cook, Shadish, & Wong, 2008). A potential weakness in both methods is that charter and TPS students matched on observable characteristics may still differ in unobserved ways. Notwithstanding, we systematically compare the two methods based on objective criteria, in contrast to previous studies that have only utilized one matching technique to evaluate the effect of a treatment.

Despite the limitations, the results serve to reinforce what has become a familiar refrain in recent charter school research: Charter school effectiveness is geographically uneven. It is worth noting that the charter school effect heterogeneity documented here is relevant to the ongoing debate over charter expansion, particularly in suburban areas. Our findings show how a distinction between suburban and non-suburban charters can be grounded in rigorous empirical analysis. As researchers strive to understand how charter schools across geographic locales could be employed to improve student outcomes, there is a great need for research to contextualize findings in order to determine how geographic locales may likely determine the drivers of school effectiveness and point to specific charter school environments.

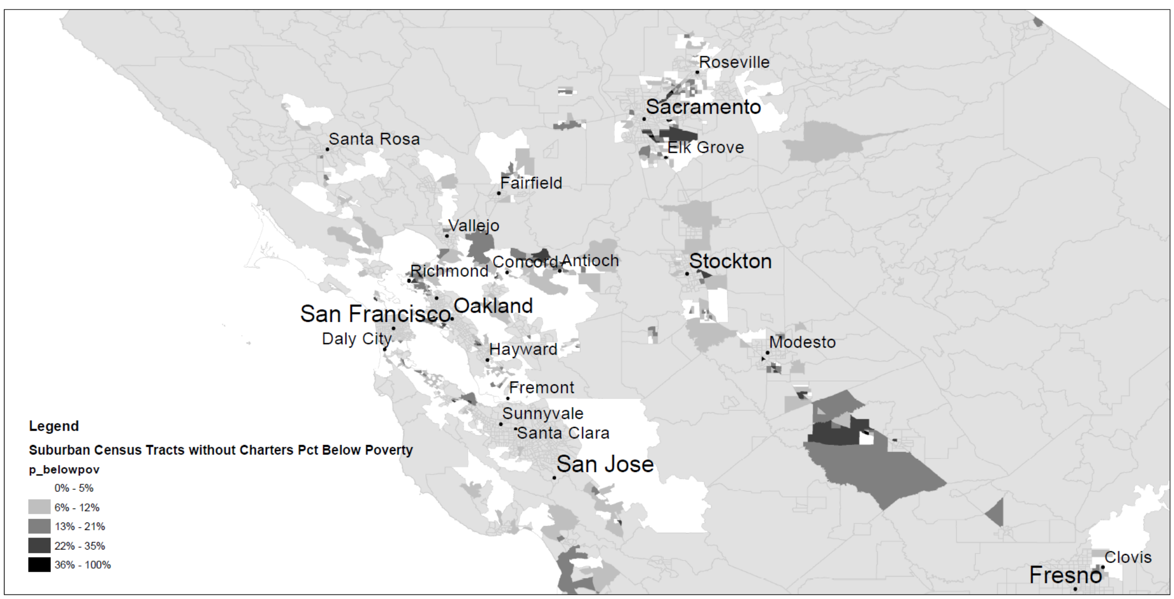
Map 1

California Suburban Census Tracts With and Without Charter Schools – Northern and Southern Regions



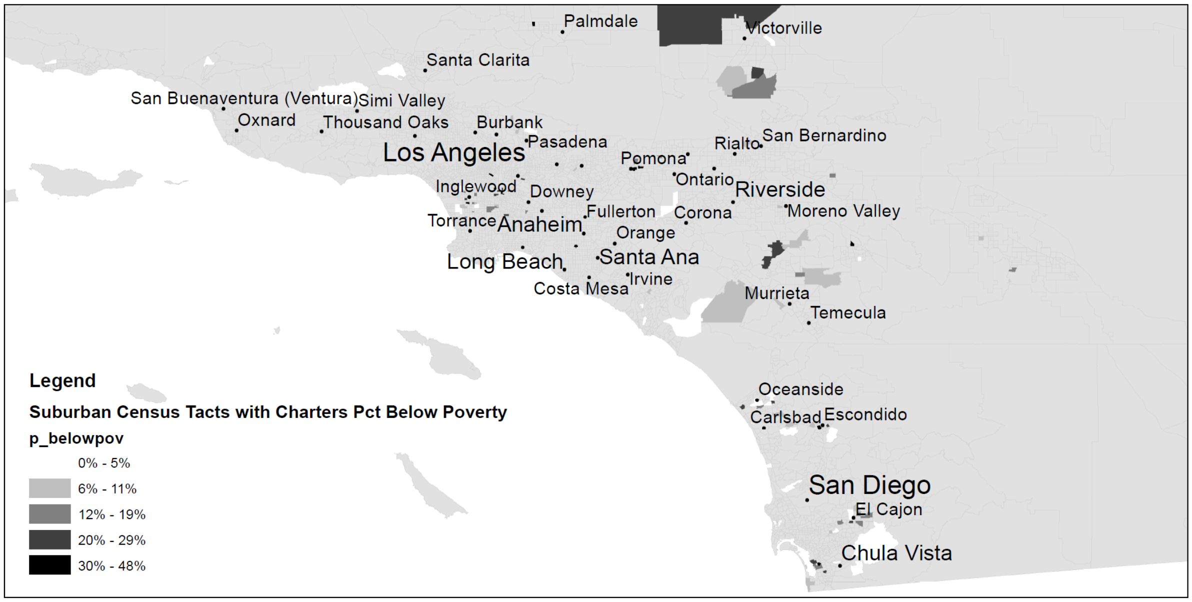
Map 2

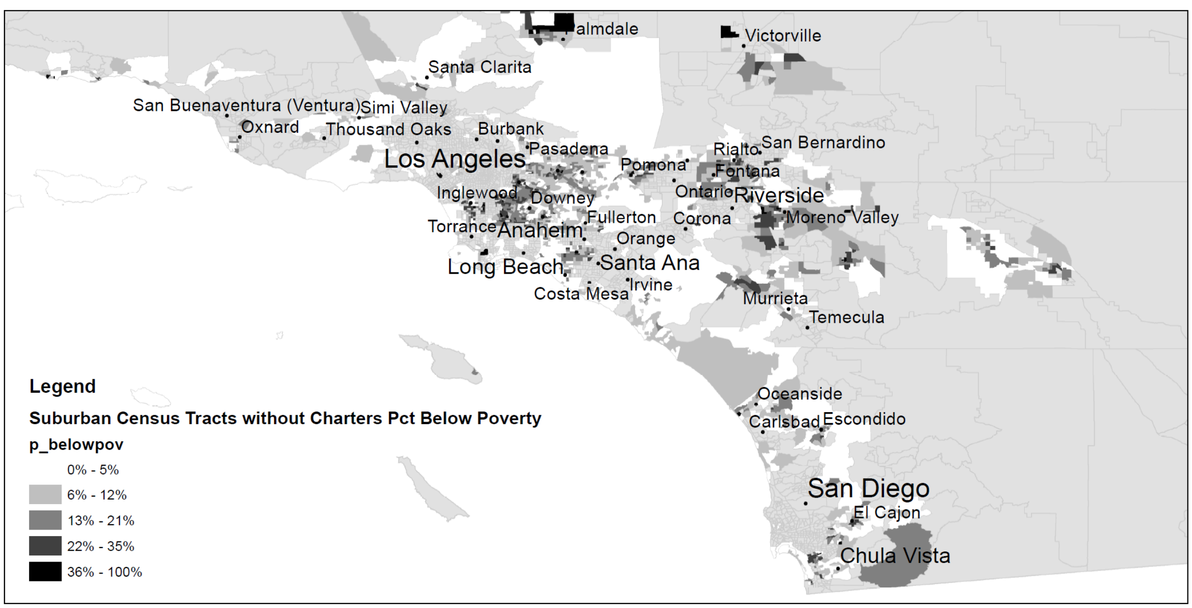
Northern California Suburban Census Tracts With and Without Charter Schools – Percent Below Poverty



Map 3

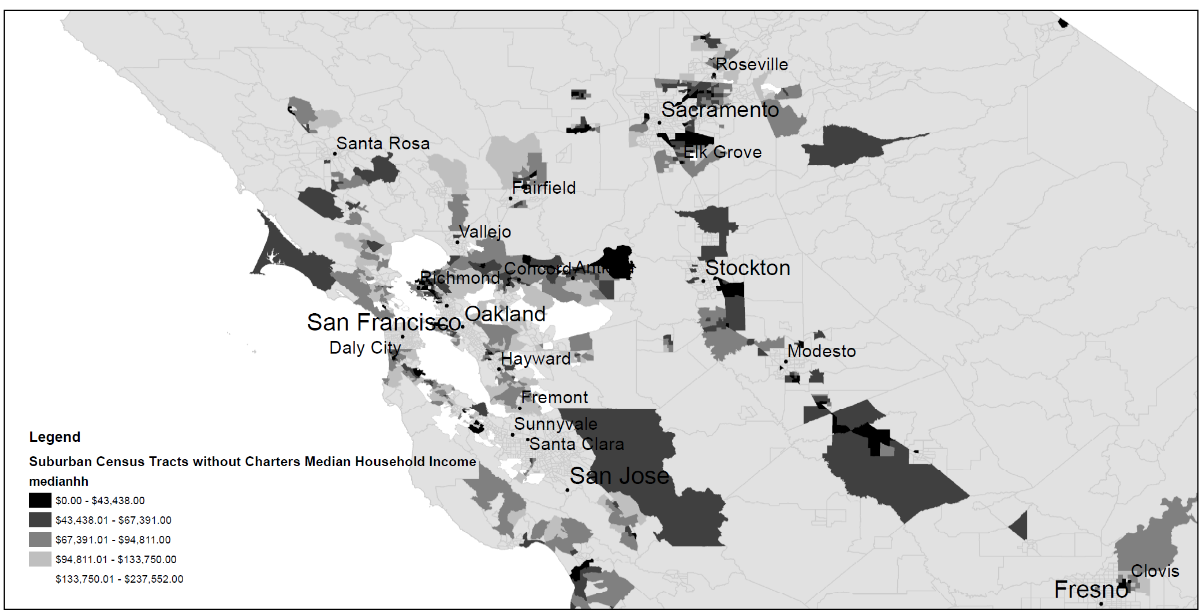
Southern California Suburban Census Tracts With and Without Charter Schools – Percent Below Poverty





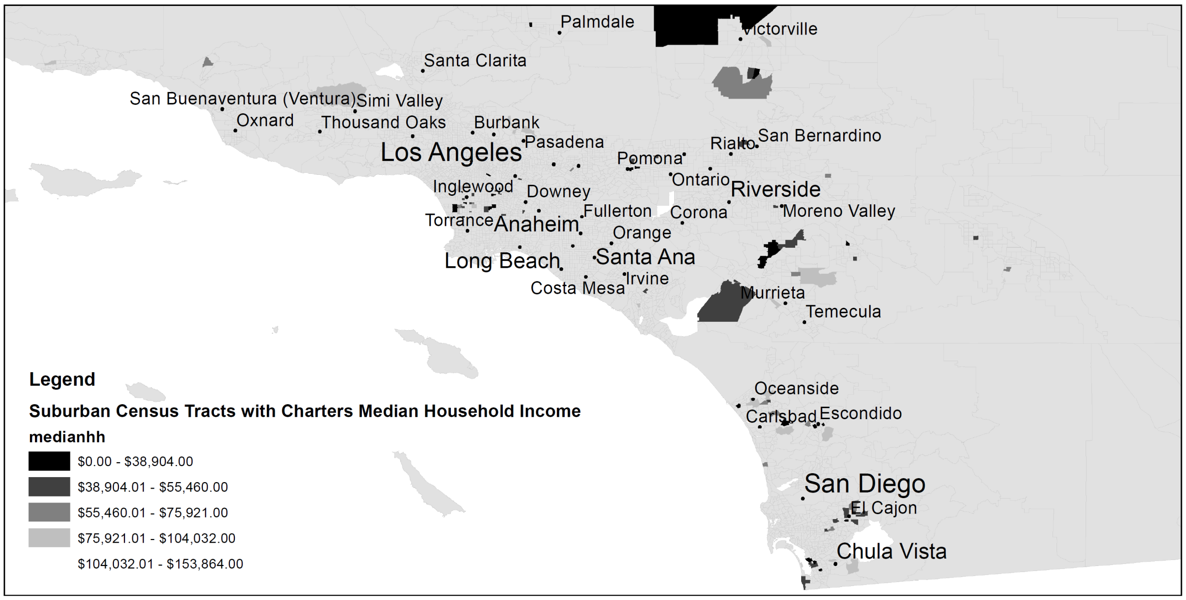
Map 4

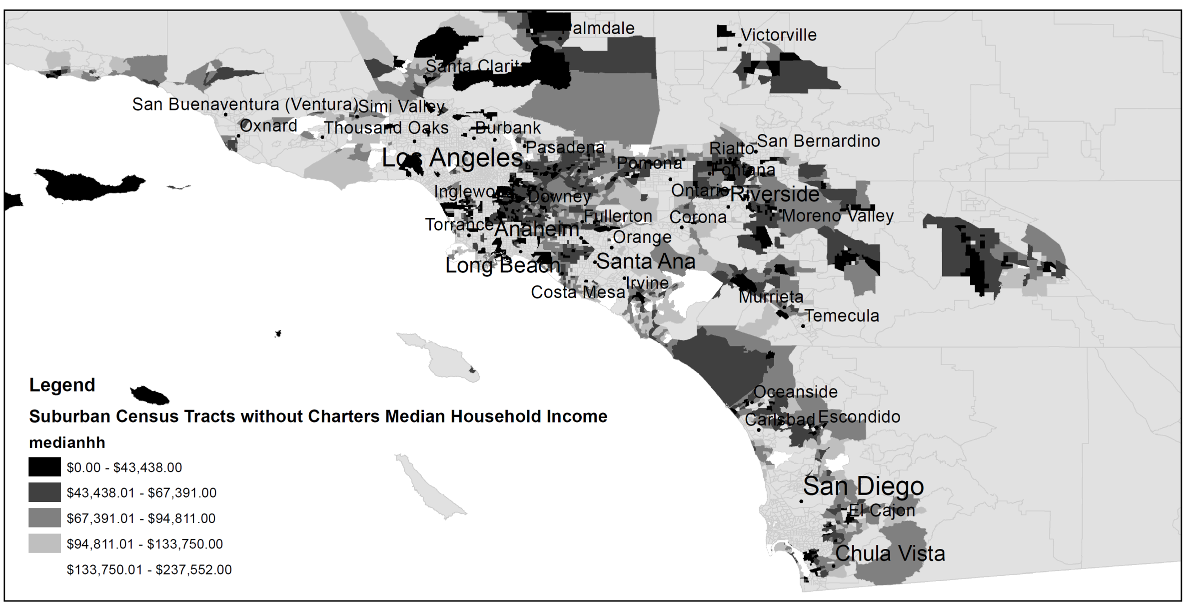
Northern California Suburban Census Tracts With and Without Charter Schools – Median Household Income



Map 5

Southern California Suburban Census Tracts With and Without Charter Schools – Median Household Income



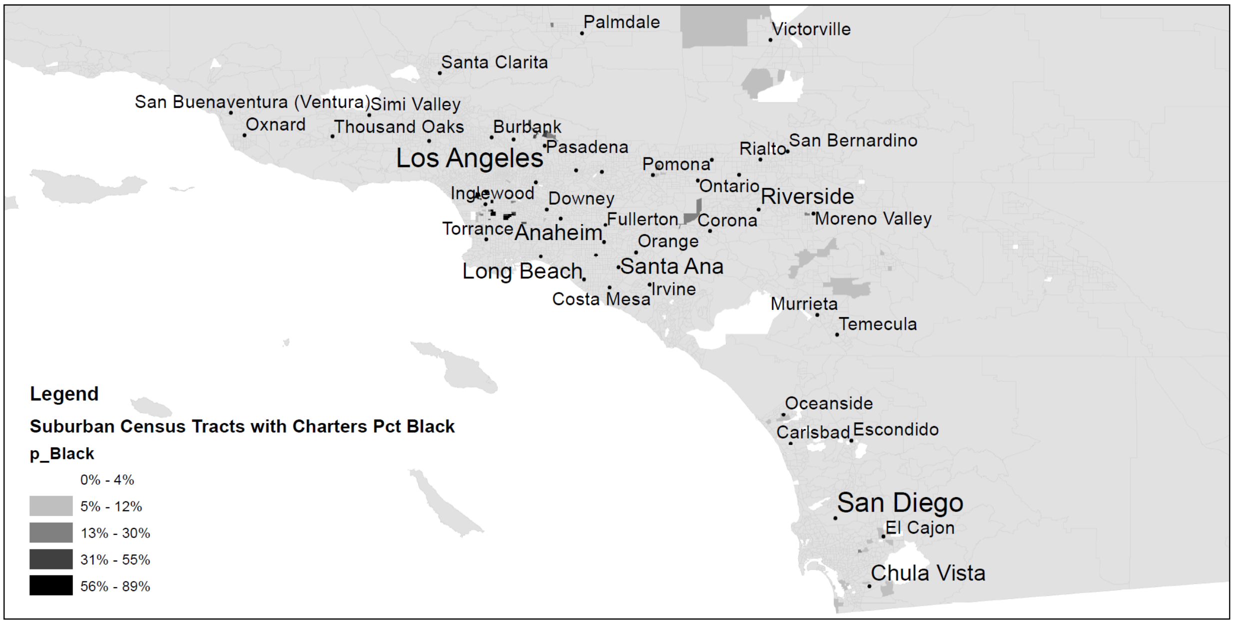


Map 6

Northern California Suburban Census Tracts With and Without Charter Schools – Percent Black/African-American

Map 7

Southern California Suburban Census Tracts With and Without Charter Schools – Percent Black/African-American



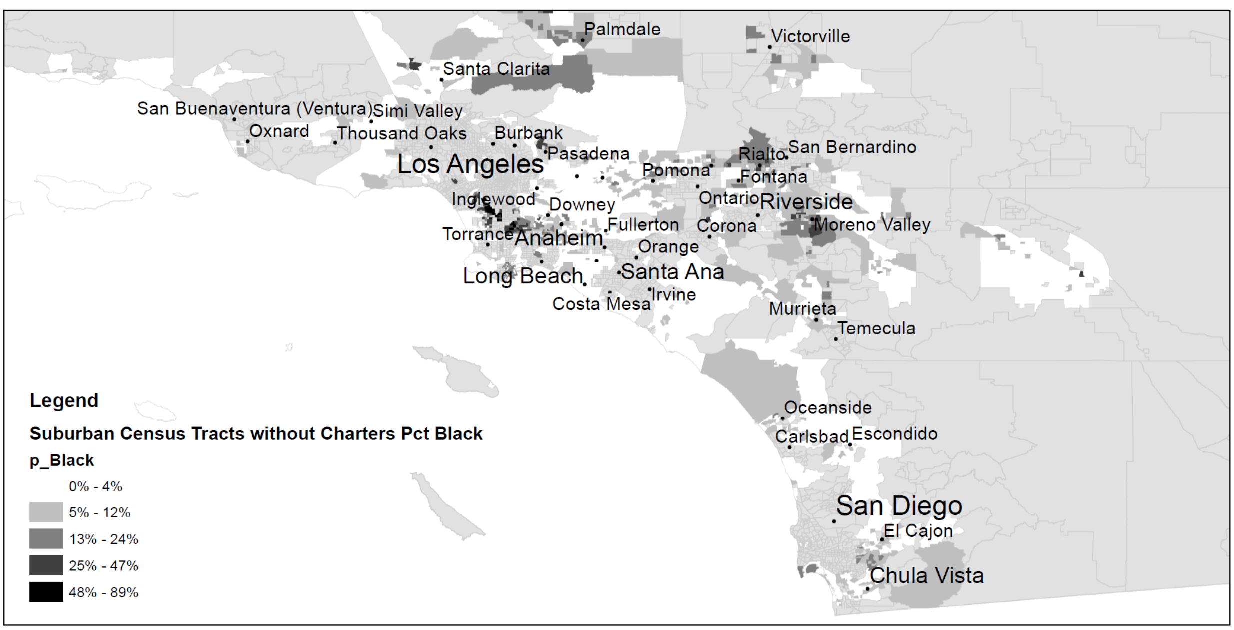


Table 1. Independent Samples t-Test for Census Tracts in California (Urban, Suburban, and Rural)

Panel A. Urban Census Tracts								
	With Charters		Without Charters					
Socio-demographic Indicators	*M*	*SD*	*M*	*SD*	*df*	*t*	*p*	*d*
Percent White	36.57	27.75	38.43	26.31	512.19	1.30	[0.194]	0.07
Percent African-American	10.09	14.73	7.04	10.66	470.59	-4.10	[0.000]***	-0.27
Percent Asian	11.65	12.46	15.84	15.70	592.16	6.28	[0.000]***	0.27
Percent Hispanic	38.84	26.38	35.62	26.33	523.18	-2.35	[0.019]**	-0.12
Percent of tract's minority population	63.43	27.75	61.42	26.38	512.69	-1.40	[0.161]	-0.08
Median household income	55785.39	29467.91	63356.19	30957.92	534.18	4.91	[0.000]***	0.25
Percent of population below poverty	14.99	12.67	12.12	11.41	502.82	-4.40	[0.000]***	-0.25
Gini index	0.42	0.06	0.41	0.06	544.44	-3.05	[0.002]***	-0.15
Population density (per square mile)	9690.03	9619.68	11714.85	11559.03	575.18	3.95	[0.000]***	-0.08
Total census tracts	416		3361					

Panel B. Suburban Census Tracts								
	With Charters		Without Charters					
Socio-demographic Indicators	*M*	*SD*	*M*	*SD*	*df*	*t*	*p*	*d*
Percent White	45.74	27.29	42.55	27.49	248.29	-1.67	[0.096]*	-0.12
Percent African-American	8.37	15.42	5.06	8.63	226.46	-3.14	[0.002]***	-0.36
Percent Asian	7.37	8.54	12.59	15.34	323.13	8.17	[0.000]***	0.35
Percent Hispanic	34.88	24.77	35.92	26.98	253.79	0.60	[0.549]	0.04
Percent of tract's minority population	53.80	27.36	56.45	27.74	248.72	1.38	[0.168]	0.10
Median household income	62159.58	27830.34	70370.90	31891.00	258.00	4.17	[0.000]***	0.26
Percent of population below poverty	11.25	9.95	8.93	8.86	240.40	-3.34	[0.001]***	-0.26
Gini index	0.40	0.05	0.39	0.06	257.77	-3.28	[0.001]***	-0.20
Population density (per square mile)	5609.73	5794.45	6715.04	5678.92	246.66	2.73	[0.007]***	0.19
Total census tracts	213		3195					

Panel C. Rural Census Tracts	With Charters		Without Charters					
Socio-demographic Indicators	*M*	*SD*	*M*	*SD*	*df*	*t*	*p*	*d*
Percent White	66.35	22.59	57.84	27.90	201.81	-3.79	[0.000]***	-0.31
Percent African-American	1.98	3.87	2.24	4.53	193.67	0.68	[0.499]	0.06
Percent Asian	2.84	2.99	3.07	4.46	239.60	0.86	[0.389]	0.06
Percent Hispanic	24.26	21.68	31.31	27.00	203.12	3.27	[0.001]***	0.27
Percent of tract's minority population	33.65	22.59	40.26	27.29	198.37	2.96	[0.003]***	0.25
Median household income	55147.66	19661.57	53062.48	23974.03	198.33	-1.07	[0.288]	-0.09
Percent of population below poverty	10.30	8.27	11.63	9.62	192.68	1.64	[0.100]*	0.14
Gini index	0.42	0.06	0.42	0.06	180.24	-0.76	[0.448]	-0.07
Population density (per square mile)	769.63	1416.58	923.61	1745.66	202.50	1.09	[0.276]	0.09
Total census tracts	133		739					

Note: d represents Cohen's *d.*

Table 2. Tukey HSD Comparison for Census Tracts with Charter Schools

	Mean Difference		95% Confidence Interval		Mean Difference		95% Confidence Interval		Mean Difference		95% Confidence Interval	
Variables	Suburban vs. Urban	Std. Error	Lower Bound	Upper Bound	Rural vs. Suburban	Std. Error	Lower Bound	Upper Bound	Rural vs. Urban	Std. Error	Lower Bound	Upper Bound
Percent White	9.2***	2.2	3.9	14.4	20.6***	3.0	13.6	27.6	29.8***	2.7	23.4	36.1
Percent African-American	-1.7	1.1	-4.4	1.0	-6.4***	1.5	-10.0	-2.8	-8.1***	1.4	-11.4	-4.8
Percent Asian	-4.3***	0.9	-6.3	-2.2	-4.6***	1.2	-7.3	-1.9	-8.8***	1.0	-11.3	-6.4
Percent Hispanic	-4.0	2.1	-8.9	1.0	-10.6***	2.8	-17.2	-4.0	-14.6***	2.5	-20.6	-8.6
Percent of tract's minority population	-9.6***	2.2	-14.9	-4.4	-20.2***	3.0	-27.2	-13.1	-29.8***	2.7	-36.1	-23.4
Median household income	6374.2**	2307.9	954.5	11793.9	-7011.9*	3080.0	-14244.7	220.9	-637.7	2798.0	-7208.3	5932.8
Percent of population below poverty	-3.7***	0.9	-6.0	-1.5	-1.0	1.3	-3.9	2.0	-4.7***	1.1	-7.4	-2.0
Gini index	-.01***	0.0	0.0	0.0	.01**	0.0	0.0	0.0	-.002	0.0	0.0	0.0
Population density (per square mile)	-4080.3***	650.5	-5607.9	-2552.7	-4840.1***	866.4	-6874.6	-2805.6	-8920.4***	786.4	-10767.1	-7073.7

Table 3. Baseline Summary Statistics for Math with Unmatched, PSM, and VCR Samples

	Unmatched Sample		PSM Sample		VCR Sample	
	Charter Students	TPS Students	Charter Students	TPS Students	Charter Students	TPS Students
Baseline Math Score[a]	-0.16	0.01**	-0.16	-0.16	-0.18	-0.18
Locale Type (%)						
Urban	58.92	41.35**	58.92	58.94	60.35	60.35
Suburban	32.40	47.42**	32.40	32.37	32.52	32.52
Rural	8.69	11.23**	8.69	8.69	7.13	7.13
Median Income[b] (000s)	54.4	67.2**	54.4	65.9**	54.6	62.8
Grade (%)						
2nd	0.15	0.18*	0.15	0.15	0.03	0.03
3rd	9.12	13.38**	9.12	9.14	8.47	8.47
4th	8.99	13.38**	8.99	9.00	8.46	8.46
5th	9.50	13.04**	9.50	9.52	9.09	9.09
6th	13.39	12.56**	13.39	13.39	13.49	13.49
7th	14.13	12.53**	14.13	14.13	14.41	14.41
8th	12.55	12.46**	12.55	12.54	12.89	12.89
9th	17.86	12.06**	17.86	17.81	18.83	18.83
10th	14.08	10.39**	14.08	14.08	14.30	14.30
11th	0.24	0.02**	0.24	0.25	0.02	0.02
Female (%)	51.38	49.83**	51.38	51.36	51.74	51.74
Race/Ethnicity (%)						
Asian	3.82	8.29**	3.82	3.83	2.74	2.74
Black	13.00	6.25**	13.00	13.03	12.55	12.55
Hispanic	47.16	51.00**	47.16	47.03	49.73	49.73
Multiracial	7.11	6.25**	7.11	7.12	4.98	4.98
White	28.91	28.21**	28.91	28.99	30.00	30.00
English Proficiency (%)	15.16	21.14**	15.16	15.12	14.30	14.30
Free-lunch Eligible (%)	57.89	56.94**	57.89	57.78	59.37	59.37
Special Education (%)	4.86	4.85	4.86	4.87	2.61	2.61
Number of Students	89,854	2,742,631	89,854	2,373,431	74,928	74,928

[a] All test scores are standardized separately for each grade level and each year, such that the ELA/math scores have a mean of 0 and a standard deviation of 1 among all students in California who have taken the test.

[b] Median income as not included as a matching characteristic in propensity score matching or virtual control method.

[c] Unmatched sample assumes that the two samples (charter and TPS students) are independent; PSM and VCR samples are aimed at overcoming observed differences between treatment and comparison.
* $p < .05$, ** $p < .01$

Table 4. Baseline Summary Statistics for English Language Arts (ELA) with Unmatched, PSM, and VCR Samples

	Unmatched Sample		PSM Sample		VCR Sample	
	Charter Students	TPS Students	Charter Students	TPS Students	Charter Students	TPS Students
Baseline ELA Score[a]	-0.06	0.00**	-0.06	-0.06	-0.07	-0.07
Locale Type (%)						
Urban	59.36	41.32**	59.36	59.34	60.84	60.84
Suburban	31.81	47.43**	31.81	31.81	31.87	31.87
Rural	8.84	11.26**	8.84	8.86	7.29	7.29
Median Income[b] (000s)	55.1	67.1**	55.1	66.1**	55.4	63.1
Grade (%)						
2nd	0.14	0.17*	0.14	0.14	0.05	0.05
3rd	8.54	12.98**	8.54	8.55	7.70	7.70
4th	8.45	12.98**	8.45	8.47	7.84	7.84
5th	8.82	12.66**	8.82	8.84	8.31	8.31
6th	12.60	12.26**	12.60	12.61	12.66	12.66
7th	13.53	12.24**	13.53	13.53	13.71	13.71
8th	12.13	12.22**	12.13	12.12	12.42	12.42
9th	18.79	12.45**	18.79	18.74	19.78	19.78
10th	16.62	11.97**	16.62	16.60	17.46	17.46
11th	0.39	0.07**	0.39	0.40	0.07	0.07
Female (%)	51.53	49.90**	51.54	51.51	51.86	51.86
Race/Ethnicity (%)						
Asian	3.71	8.15**	3.71	3.72	2.76	2.76
Black	12.96	6.32**	12.96	12.97	12.57	12.57
Hispanic	46.79	51.00**	46.79	46.63	49.22	49.22
Multiracial	7.20	6.23**	7.20	7.21	5.20	5.20
White	29.34	28.30**	29.34	29.47	30.25	30.25
English Proficiency (%)	14.69	20.90**	14.69	14.64	13.74	13.74
Free-lunch Eligible (%)	57.88	56.85**	57.88	57.72	59.54	59.54
Special Education (%)	4.64	4.40**	4.64	4.65	2.45	2.45
Number of Students	94,280	2,800,414	94,280	2,436,968	79344	79344

[a] All test scores are standardized separately for each grade level and each year, such that the ELA/math scores have a mean of 0 and a standard deviation of 1 among all students in California who have taken the test.

[b] Median income as not included as a matching characteristic in propensity score matching or virtual control method.
[c] Unmatched sample assumes that the two samples (charter and TPS students) are independent; PSM and VCR samples are aimed at overcoming observed differences between treatment and comparison.
* p < .05, ** p < .01

Table 5. Overall and Marginal Effects of Charter School Attendance

	Unmatched Sample (OLS)			
	Math		ELA	
Variable	Model 1	Model 2	Model 1	Model 2
All Charter Students	-0.027*		0.019***	
	(0.016)		(0.007)	
Urban Charter Students		0.038**		0.041**
		(0.018)		(0.01)
Suburban Charter Students		-0.114**		-0.014
		(0.03)		(0.012)
Rural Charter Students		-0.162**		-0.013
		(0.026)		(0.013)
Urban	-0.013***	-0.019***	-0.004*	-0.006***
	(0.004)	(0.004)	(0.002)	(0.002)
Rural	-0.028***	-0.027***	-0.020***	-0.019***
	(0.006)	(0.006)	(0.003)	(0.003)
Charter*Urban		0.151***		0.055***
		(0.035)		(0.015)
Charter*Rural		-0.048		0.000
		(0.039)		(0.018)
prior year Math	-0.313***	-0.313***		
	(0.001)	(0.001)		
prior year ELA			-0.228***	-0.228***
			(0.001)	(0.001)
Median Income	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Grade				
2nd	0.944***	0.943***	1.133***	1.132***
	(0.014)	(0.014)	(0.014)	(0.014)
3rd	0.018***	0.018***	0.020***	0.020***
	(0.005)	(0.005)	(0.003)	(0.003)
4th	0.007	0.007	0.008***	0.008***
	(0.004)	(0.004)	(0.003)	(0.003)
6th	-0.007	-0.008	-0.008***	-0.009***
	(0.005)	(0.005)	(0.003)	(0.003)
7th	-0.012**	-0.012**	-0.013***	-0.013***
	(0.006)	(0.006)	(0.003)	(0.003)
8th	-0.015**	-0.015**	-0.017***	-0.017***
	(0.007)	(0.007)	(0.003)	(0.003)

9th	-0.003	-0.004	0.002	0.002
	(0.008)	(0.008)	(0.003)	(0.003)
10th	-0.041***	-0.042***	-0.041***	-0.042***
	(0.006)	(0.006)	(0.003)	(0.003)
11th	-0.037***	-0.038***	-0.035***	-0.036***
	(0.005)	(0.005)	(0.003)	(0.003)
Female	0.001	0.001	0.046***	0.046***
	(0.001)	(0.001)	(0.001)	(0.001)
Race/Ethnicity				
Asian	0.215***	0.215***	0.106***	0.106***
	(0.005)	(0.004)	(0.002)	(0.002)
Black	-0.158***	-0.159***	-0.132***	-0.132***
	(0.004)	(0.004)	(0.002)	(0.002)
Hispanic	-0.061***	-0.062***	-0.058***	-0.059***
	(0.003)	(0.003)	(0.001)	(0.001)
Multiracial	-0.004	-0.004	-0.015***	-0.015***
	(0.003)	(0.003)	(0.002)	(0.002)
Special Education	-0.114***	-0.114***	-0.114***	-0.115***
	(0.002)	(0.002)	(0.002)	(0.002)
English Learners	-0.112***	-0.112***	-0.131***	-0.131***
	(0.002)	(0.002)	(0.001)	(0.001)
Free-Lunch Eligible	-0.085***	-0.085***	-0.080***	-0.080***
	(0.002)	(0.002)	(0.001)	(0.001)
Year	-0.004**	-0.004**	-0.003***	-0.003***
	(0.002)	(0.002)	(0.001)	(0.001)
Constant	0.052***	0.055***	0.037***	0.038***
	(0.007)	(0.007)	(0.004)	(0.004)
Observations	5,673,705	5,673,705	5,789,388	5,789,388
R-squared	0.157	0.158	0.116	0.116

Notes: Model 1 refers to the overall effect of charter schools. Model 2 shows the interaction between geographic locale and charter status. Marginal effects are calculated for urban charter students, suburban charter students and rural charter students. The reference category for geographic locale is suburban. The reference category for grade is 5th grade. Robust standard errors are in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 6. Overall and Marginal Effects of Charter School Attendance

	Propensity Score Matching			
	Math		ELA	
Variable	Model 1	Model 2	Model 1	Model 2
All Charter Students	-0.031*		0.015**	
	(0.018)		(0.007)	
Urban Charter Students		0.029		0.034**
		(0.019)		(0.009)
Suburban Charter Students		-0.114**		-0.015
		(0.031)		(0.012)
Rural Charter Students		-0.146**		-0.007
		(0.027)		(0.013)
Urban	0.038**	-0.031***	0.015**	-0.009***
	(0.015)	(0.006)	(0.007)	(0.004)
Rural	-0.046**	-0.031***	-0.022**	-0.027***
	(0.019)	(0.010)	(0.009)	(0.005)
Charter*Urban		0.143***		0.049***
		(0.034)		(0.014)
Charter*Rural		-0.033		0.008
		(0.041)		(0.018)
prior year Math	-0.314***	-0.317***		
	(0.004)	(0.004)		
prior year ELA			-0.222***	-0.222***
			(0.003)	(0.003)
Median Income	0.000**	0.001**	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Grade				
2nd	0.915***	0.908***	1.094***	1.092***
	(0.051)	(0.051)	(0.062)	(0.062)
3rd	-0.024	-0.024	0.011	0.011
	(0.015)	(0.015)	(0.009)	(0.009)
4th	-0.019	-0.019	-0.014*	-0.014*
	(0.013)	(0.013)	(0.008)	(0.008)
6th	-0.014	-0.017	-0.048***	-0.049***
	(0.017)	(0.017)	(0.009)	(0.009)
7th	-0.013	-0.016	-0.014**	-0.016**
	(0.014)	(0.013)	(0.006)	(0.006)
8th	-0.054***	-0.058***	-0.035***	-0.036***
	(0.017)	(0.017)	(0.007)	(0.007)
9th	0.071***	0.064***	0.012	0.010
	(0.022)	(0.023)	(0.008)	(0.008)
10th	-0.058***	-0.064***	-0.051***	-0.053***
	(0.019)	(0.019)	(0.010)	(0.010)
11th	-0.042**	-0.047**	-0.060***	-0.062***
	(0.019)	(0.019)	(0.010)	(0.010)
Female	-0.005**	-0.005**	0.039***	0.039***

	(0.002)	(0.002)	(0.002)	(0.002)
Race/Ethnicity				
Asian	0.231***	0.233***	0.110***	0.111***
	(0.015)	(0.015)	(0.007)	(0.007)
Black	-0.132***	-0.136***	-0.120***	-0.121***
	(0.011)	(0.012)	(0.007)	(0.007)
Hispanic	-0.034***	-0.041***	-0.050***	-0.052***
	(0.008)	(0.009)	(0.005)	(0.005)
Multiracial	-0.008	-0.009	-0.023***	-0.023***
	(0.008)	(0.008)	(0.005)	(0.005)
Special Education	-0.111***	-0.112***	-0.118***	-0.118***
	(0.006)	(0.006)	(0.004)	(0.004)
English Learners	-0.087***	-0.092***	-0.119***	-0.120***
	(0.008)	(0.008)	(0.005)	(0.005)
Free-Lunch Eligible	-0.059***	-0.062***	-0.074***	-0.075***
	(0.007)	(0.007)	(0.004)	(0.004)
Year	-0.006	-0.007	0.001	0.001
	(0.005)	(0.005)	(0.003)	(0.003)
Constant	0.021	0.068***	0.058***	0.076***
	(0.026)	(0.026)	(0.013)	(0.013)
Observations	4,962,471	4,962,471	5,096,999	5,096,999
R-squared	0.160	0.162	0.116	0.117

Notes: Model 1 refers to the overall effect of charter schools. Model 2 shows the interaction between geographic locale and charter status. Marginal effects are calculated for urban charter students, suburban charter students and rural charter students. The reference category for geographic locale is suburban. The reference category for grade is 5th grade. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 7. Overall and Marginal Effects of Charter School Attendance

	Virtual Control Record			
	Math		ELA	
Variable	Model 1	Model 2	Model 1	Model 2
All Charter Students	-0.002		0.018***	
	(0.016)		(0.006)	
Urban Charter Students		0.065**		0.039**
		(0.017)		(0.008)
Suburban Charter Students		-0.1**		-0.018*
		(0.028)		(0.011)
Rural Charter Students		-0.165**		-0.016
		(0.021)		(0.011)
Urban	0.031**	-0.051***	0.012	-0.017***
	(0.016)	(0.008)	(0.007)	(0.005)
Rural	-0.046**	-0.014	-0.023**	-0.025***
	(0.020)	(0.011)	(0.009)	(0.006)
Charter*Urban		0.166***		0.058***
		(0.032)		(0.013)
Charter*Rural		-0.065*		0.003
		(0.036)		(0.016)
prior year Math	-0.325***	-0.325***		
	(0.004)	(0.004)		
prior year ELA			-0.215***	-0.215***
			(0.003)	(0.003)
Median Income	0.000	0.000	0.000**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Grade				
2nd	0.917***	0.917***	1.145***	1.145***
	(0.104)	(0.104)	(0.104)	(0.104)
3rd	-0.025	-0.025	-0.004	-0.004
	(0.018)	(0.018)	(0.010)	(0.010)
4th	-0.018	-0.018	-0.026***	-0.026***
	(0.011)	(0.011)	(0.007)	(0.007)
6th	-0.041**	-0.041**	-0.078***	-0.078***
	(0.016)	(0.016)	(0.008)	(0.008)
7th	-0.026**	-0.026**	-0.025***	-0.025***
	(0.013)	(0.013)	(0.007)	(0.007)
8th	-0.088***	-0.088***	-0.045***	-0.045***
	(0.016)	(0.016)	(0.007)	(0.007)
9th	0.061***	0.061***	0.001	0.001
	(0.020)	(0.020)	(0.008)	(0.008)
10th	-0.097***	-0.097***	-0.055***	-0.055***
	(0.019)	(0.019)	(0.009)	(0.009)
11th	-0.059***	-0.059***	-0.064***	-0.064***
	(0.021)	(0.021)	(0.009)	(0.009)

Female	-0.008***	-0.008***	0.035***	0.035***
	(0.003)	(0.003)	(0.002)	(0.002)
Race/Ethnicity				
Asian	0.254***	0.254***	0.116***	0.116***
	(0.015)	(0.015)	(0.007)	(0.007)
Black	-0.146***	-0.146***	-0.130***	-0.130***
	(0.011)	(0.011)	(0.007)	(0.007)
Hispanic	-0.046***	-0.046***	-0.048***	-0.048***
	(0.009)	(0.009)	(0.005)	(0.005)
Multiracial	0.000	0.000	-0.018***	-0.018***
	(0.008)	(0.008)	(0.005)	(0.005)
Special Education	-0.116***	-0.116***	-0.119***	-0.119***
	(0.008)	(0.008)	(0.007)	(0.007)
English Learners	-0.112***	-0.112***	-0.137***	-0.137***
	(0.008)	(0.008)	(0.005)	(0.005)
Free-Lunch Eligible	-0.064***	-0.063***	-0.072***	-0.072***
	(0.007)	(0.007)	(0.004)	(0.004)
Year	-0.009	-0.009	0.001	0.001
	(0.011)	(0.011)	(0.006)	(0.006)
Constant	0.037	0.085***	0.074***	0.092***
	(0.029)	(0.028)	(0.013)	(0.013)
Observations	346,416	346,416	368,356	368,356
R-squared	0.212	0.217	0.145	0.146

Notes: Model 1 refers to the overall effect of charter schools. Model 2 shows the interaction between geographic locale and charter status. Marginal effects are calculated for urban charter students, suburban charter students and rural charter students. The reference category for geographic locale is suburban. The reference category for grade is 5th grade. Robust standard errors are in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

References

Abdulkadiroğlu, A., Angrist, J. D., Dynarski, S. M., Kane, T. J., & Pathak, P. A. (2011). Accountability and flexibility in public schools: Evidence from Boston's charters and pilots. *The Quarterly Journal of Economics*, *126*(2), 699-748.

Abrams, S. E. (2016). *Education and the commercial mindset*. Cambridge, MA: Harvard University Press.

Altenhofen, S., Berends, M., & White, T. G. (2016). School choice decision making among suburban, high-income parents. *AERA Open,* 2(1), 2332858415624098.

Angrist, J. D., Pathak, P. A., & Walters, C. R. (2013). Explaining charter school effectiveness. *American Economic Journal: Applied Economics,* 5(4), 1-27.

Arce-Trigatti, P., Lincove, J. A., Harris, D. N., & Jabbar, H. (2016). *Is there choice in school choice? Investigating product differentiation across New Orleans district and charter schools.* Technical Report. Education Research Alliance for New Orleans. Retrieved from https://educationresearchalliancenola.org/files/publications/NicheMkts_Technical-Report.pdf

Arcidiacono, P., Muralidharan, K., Shim, E. Y., & Singleton, J. D. (2017). Valuing school choice: Using a randomized experiment to validate welfare evaluation of private school vouchers. Retrieved from https://www.sole-jole.org/17654.pdf

Bau, N. (2015). School competition and product differentiation. Working Paper. Toronto, Canada. Retrieved from https://scholar.harvard.edu/nbau/publications/school-competition-and-product-differentiation

Betebenner, D. W., Howe, K. R., & Foster, S. S. (2005). On school choice and test-based accountability. *Education Policy Analysis Archives,* 13(41), 1-22

Bifulco, R. (2012). Can nonexperimental estimates replicate estimates based on random assignment in evaluations of school choice? A within-study comparison. *Journal of Policy Analysis and Management*, 31(3), 729-751.

Bifulco, R., & Ladd, H. F. (2006). The impacts of charter schools on student achievement: Evidence from North Carolina. *Education Finance and Policy,* 1(1), 50-90.

Booker, K., Zimmer, R., & Buddin, R. (2005). The effects of charter schools on school peer composition. Santa Monica, CA: Rand Corporation.

Brown, E., & Makris, M. V. (2018). A different type of charter school: In prestige charters, a rise in cachet equals a decline in access. *Journal of Education Policy, 33*(1), 85-117.

Buddin, R., & Zimmer, R. (2005). Student achievement in charter schools: A complex picture. *Journal of Policy Analysis and Management,* 24(2), 351-371.

Burgess, S., Greaves, E., Vignoles, A., & Wilson, D. (2015). What parents want: School preferences and school choice. *The Economic Journal*, 125(587), 1262-1289.

Burgess, S., Greaves, E., & Vignoles, A. (2019). School choice in England: evidence from national administrative data. *Oxford Review of Education*, 45(5), 690-710.

Schneider, M., & Buckley, J. (2002). What do parents want from schools? Evidence from the Internet. *Educational Evaluation and Policy Analysis,* 24(2), 133-144.

Caliendo, M., & Kopeinig, S. (2008). Some practical guidance for the implementation of propensity score matching. *Journal of Economic Surveys,* 22(1), 31-72.

California Department of Education. (2018). *Fingertips facts on education in California—CalEdFacts.* Retrieved from https://www.cde.ca.gov/ds/sd/cb/ceffingertipfacts.asp

Carpenter, D. (2006). Modeling the charter school landscape. *Journal of School Choice,* 1(2), 47-82.

Center for Research on Education Outcomes. (CREDO). 2019. Charter school studies. Technical Report. Stanford, CA: Author. Retrieved from https://credo.stanford.edu/studies/charter-school-studies

Center for Research on Education Outcomes. (CREDO). 2009. Multiple choice: Charter school performance in 16 States. Technical Report. Stanford, CA: Author.

Center for Research on Education Outcomes. (CREDO). 2013. Multiple choice: Charter school performance in 16 States. Technical Report. Stanford, CA: Author. Retrieved from https://credo.stanford.edu/sites/g/files/sbiybj6481/f/ncss_2013_final_draft.pdf

Center for Research on Educational Outcomes (CREDO). (2015). Urban charter school study report on 41 regions. Technical Report. Stanford, CA: Author.

Chabrier, J., Cohodes, S., & Oreopoulos, P. (2016). What can we learn from charter school lotteries?. *Journal of Economic Perspectives*, 30(3), 57-84.

Clark, M. A., Gleason, P. M., Tuttle, C. C., & Silverberg, M. K. (2015). Do charter schools improve student achievement?. *Educational Evaluation and Policy Analysis,* 37(4), 419-436.

Cook, T. D., Shadish, W. R., & Wong, V. C. (2008). Three conditions under which experiments and observational studies produce comparable causal estimates: New findings from within-study comparisons. *Journal of Policy Analysis and Management*27(4), 724-750.

Coons, J. E., & Sugarman, S. D. (1978). *Education by choice: The case for family control.* Univ of California Press.

Cox, W. (2018). *California's dense suburbs and urbanization.* Retrieved from http://www.newgeography.com/content/005908-californias-dense-suburbs-and-urbanization

David, R., & Hesla, K. (2018). *Estimated public charter school enrollment, 2017-2018.* Retrieved from https://www.publiccharters.org/sites/default/files/documents/2018-03/FINAL%20Estimated%20Public%20Charter%20School%20Enrollment%2C%202017-18.pdf

Davis, D. H., & Raymond, M. E. (2012). Choices for studying choice: Assessing charter school effectiveness using two quasi-experimental methods. *Economics of Education Review,* 31(2), 225-236.

Dehejia, R. H., & Wahba, S. (1999). Causal effects in nonexperimental studies: Reevaluating the evaluation of training programs. *Journal of the American Statistical Association,* 94(448), 1053-1062.

Dobbie, W., & Fryer Jr, R. G. (2013). Getting beneath the veil of effective schools: Evidence from New York City. *American Economic Journal: Applied Economics,* 5(4), 28-60.

Dobbie, W., Fryer, R. G., & Fryer Jr, G. (2011). Are high-quality schools enough to increase achievement among the poor? Evidence from the Harlem Children's Zone. *American Economic Journal: Applied Economics*, 3(3), 158-187.

Elacqua, G., Schneider, M., & Buckley, J. (2006). School choice in Chile: Is it class or the classroom?. *Journal of Policy Analysis and Management,* 25(3), 577-601.

Finkel, S. E. (1995). Causal analysis with panel data (No. 105). London, UK: Sage.

Friesen, J., Javdani, M., Smith, J., & Woodcock, S. (2012). How do school 'report cards' affect school choice decisions?. *Canadian Journal of Economics/Revue canadienne d'économique,* 45(2), 784-807.

Gamoran, A., & Fernandez, C. M. (2018). Effective schools for the urban poor: What do charter schools offer? In I. Rotberg & J. L. Glazer (Eds.), Choosing charters: Better schools or more segregation (pp. 133–152). New York, NY: Teachers College Press.

Glazer, J. L., Massell, D., & Malone, M. (2019). Charter schools in turnaround: competing institutional logics in the Tennessee Achievement School District. *Educational Evaluation and Policy Analysis,* 41(1), 5-33.

Gilraine, M., Petronijevic, U., & Singleton, J. D. (2019). Horizontal differentiation and the policy effect of charter schools. Unpublished manuscript, New York University.

Gleason, P., Clark, M., Tuttle, C. C., & Dwoyer, E. (2010). *The evaluation of charter school impacts:* Final Report. NCEE 2010-4029. National Center for Education Evaluation and Regional Assistance.

Glomm, G., Harris, D., & Lo, T. F. (2005). Charter school location. *Economics of Education Review,* 24(4), 451-457.

Golann, J. W. (2015). The paradox of success at a no-excuses school. *Sociology of Education,* 88(2), 103-119.

Griliches, Z., & Mason, W. M. (1972). Education, income, and ability. *Journal of Political Economy,* 80(3, Part 2), S74-S103.

Hastings, J. S., Kane, T. J., & Staiger, D. O. (2006). Preferences and heterogeneous treatment effects in a public school choice lottery (No. w12145). Cambridge, MA: National Bureau of Economic Research.

Hastings, J. S., & Weinstein, J. M. (2008). Information, school choice, and academic achievement: Evidence from two experiments. *The Quarterly Journal of Economics*, 123(4), 1373-1414.

Henig, J. R., & MacDonald, J. A. (2002). Locational decisions of charter schools: Probing the market metaphor. *Social Science Quarterly,* 83(4), 962-980.

Hoxby, C. M., Murarka, S., & Kang, J. (2009). *How New York City's charter schools affect achievement.* Cambridge, MA: New York City Charter Schools Evaluation Project..

Hoxby, C. M., & Rockoff, J. E. (2005). Findings from the city of big shoulders. *Education Next,* 5(4), 52-58

Hoxby, C. M. (2009). A serious statistical mistake in the CREDO study of charter schools. Center for Research on Education Outcomes (CREDO). Retrieved from https://pdfs.semanticscholar.org/a65c/6f9366eafe11477d716b958b1b7957240624.pdf

Housing Assistance Council. (2014). *HAC's rural and small town typology database.* Washington, D.C.

Hsieh, C. T., & Urquiola, M. (2006). The effects of generalized school choice on achievement and stratification: Evidence from Chile's voucher program. *Journal of Public Economics,* 90(8-9), 1477-1503.

Institute on Race & Poverty. (2008). *Failed promises: Assessing charter schools in the Twin Cities*. Retrieved from http://www.law.umn.edu/uploads/5f/ca/5fcac972c2598a7a50423850eed0f6b4/8-Failed-Promises-Assessing-Charter-Schoolsin-the-Twin-Cities.pd

Johnson, B. E., & Shifferd, J. (2016). Who lives where: A comprehensive population taxonomy of cities, suburbs, exurbs, and rural areas in the United States. *The Geographical Bulletin,* 57(1), 25-40.

Johnson, H. (2017). *Just the facts. California's population.* Retrieved from http://www.ppic.org/content/pubs/jtf/JTF_PopulationJTF.pdf

Koning, P., & Van der Wiel, K. (2013). Ranking the schools: How school-quality information affects school choice in the Netherlands. *Journal of the European Economic Association,* 11(2), 466-493.

Lacireno-Paquet, N., Holyoke, T. T., Moser, M., & Henig, J. R. (2002). Creaming versus cropping: Charter school enrollment practices in response to market incentives. *Educational Evaluation and Policy Analysis,* 24(2), 145-158.

Ladd, H. F., & Walsh, R. P. (2002). Implementing value-added measures of school effectiveness: getting the incentives right. *Economics of Education Review*, 21(1), 1-17.

Ladd, H. F., & Fiske, E. B. (2001). The uneven playing field of school choice: Evidence from New Zealand. *Journal of Policy Analysis and Management,* 20(1), 43-64.

Lang, R. E., Sanchez, T. W., & Oner, A. C. (2009). Beyond edge city: Office geography in the new metropolis. *Urban Geography*, 30(7), 726-755.

Lang, M. (1986). Redefining urban and rural for the US Census of Population: Assessing the need and alternative approaches. *Urban Geography,* 7(2), 118-134.

Langhorne, E. (2018). Why suburban districts need public charter schools too. Retrieved from https://www.progressivepolicy.org/wp-content/uploads/2018/10/PPI_SuburbanCharterSchools_2018.pdf

Lareau, A., & Goyette, K. (Eds.). (2014). Choosing homes, choosing schools. New York, NY: Russell Sage Foundation.

Lubienski, C., & Lee, J. (2016). Competitive incentives and the education market: How charter schools define themselves in metropolitan Detroit. *Peabody Journal of Education*, 91(1), 64-80.

Lubienski, C., Gulosino, C., & Weitzel, P. (2009). School choice and competitive incentives: Mapping the distribution of educational opportunities across local education markets. *American Journal of Education,* 115(4), 601-647.

Maul, A. (2015). NEPC Review: Urban charter school study report on 41 regions: 2015. Boulder, CO: National Education Policy Center. Retrieved from https://nepc.colorado.edu/%20thinktank/review-urban-charter-school

Maul, A., & McClelland, A. (2013). Review of national charter school study 2013. Boulder, CO: National Education Policy Center. Retrieved from https://nepc.colorado.edu/thinktank/review-credo-2013

McShane, M. Q., & Hatfield, J. (2015). *Measuring diversity in charter school offerings.* Washington, DC: American Enterprise Institute. Retrieved from http://policy.nl.go.kr/cmmn/FileDown.do?atchFileId=134035&fileSn=13693

Miron, G., & Applegate, B. (2009). Review of" Multiple Choice: Charter School Performance in 16 States". Boulder, CO: National Education Policy Center. Retrieved from https://nepc.colorado.edu/thinktank/review-multiple-choice

Murnane, R. J., Willett, J. B., & Levy, F. (1995). *The growing importance of cognitive skills in wage determination* (No. w5076). National Bureau of Economic Research.

Owens, A., Reardon, S. F., & Jencks, C. (2016). Income segregation between schools and school districts. *American Educational Research Journal,* 53(4), 1159-1197.

Reardon, S. F., & Bischoff, K. (2011). Income inequality and income segregation. American *Journal of Sociology*, 116(4), 1092-1153.

Reardon, S. F., & Yun, J. T. (2001). Suburban racial change and suburban school segregation, 1987-95. *Sociology of Education,* 74(2), 79-101.

Renzulli, L. A., & Evans, L. (2005). School choice, charter schools, and white flight. *Social Problems,* 52(3), 398-418.

Renzulli, L. A., Barr, A. B., & Paino, M. (2015). Innovative education? A test of specialist mimicry or generalist assimilation in trends in charter school specialization over time. *Sociology of Education,* 88(1), 83-102.

Reay, D., Crozier, G., & James, D. (2011). White middle-class identities and urban schooling. New York, NY: Springer.

Rosenbaum, P., & Rubin, D.B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika,* 70(1), 4155.

Rubin, D. B. (1997). Estimating causal effects from large data sets using propensity scores. *Annals of Internal Medicine*, 127(8, 757-763.

Sekhon, J. (2011). Multivariate and propensity score matching software with automated balance optimization: The matching package for R. *Journal of Statistical Software*, 42(7), 1-52.

Smith, J. A., & Todd, P. E. (2005). Does matching overcome LaLonde's critique of nonexperimental estimators?. *Journal of Econometrics,* 125(1), 305-353.

Schneider, M., & Buckley, J. (2002). What do parents want from schools? Evidence from the Internet. *Educational Evaluation and Policy Analysis,* 24(2), 133-144.

Sunstein, C. R. (2010). Standards for Delineating Metropolitan and Micropolitan Statistical Areas. *Federal Register,* 75(123), 37246-37252.

Tuttle, C. C., Gleason, P., & Clark, M. (2012). Using lotteries to evaluate schools of choice: Evidence from a national study of charter schools. *Economics of Education Review,* 31(2), 237-253.

Walters, C. R. (2018). The demand for effective charter schools. *Journal of Political Economy,* 126(6), 2179-2223.

Wamba, N. G., & Ascher, C. (2003). An examination of charter school equity. *Education and Urban Society,* 35(4), 462-476.

Whitmire, R. (2015). More middle-class families choose charters: A political game changer for public school choice. *Education Next,* 15(3), 32-40.

Zimmer, R., Buddin, R., Chau, D., Daley, G., Gill, B., Guarino, C., Hamilton, L., Krop, C., McCaffrey, D., Sandler, M., & Brewer, D. (2003). Charter school operations and performance: Evidence from California. Santa Monica, CA: RAND Corporation.

Zimmer, R., & Buddin, R. (2007). Getting inside the black box: Examining how the operation of charter schools affects performance. *Peabody Journal of Education*, 82(2-3), 231-273.