Annenberg Institute
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EdWorkingPaper No. 24-1049

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VERSION: September 2024

Suggested citation: Lincove, Jane Arnold, Salem Rogers, Alex Handler, Tara Kilbride, and Katharine O. Strunk. (2024). Does Charter School Autonomy Improve Matching of Teacher Attributes with Student Needs?. (EdWorkingPaper: 24-1049). Retrieved from Annenberg Institute at Brown University: https://doi.org/10.26300/zb37-xp47

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Abstract

We examine the efficiency of traditional school districts versus charter schools in providing students with teachers who meet their demographic and education needs. Using panel data from the state of Michigan, we estimate the relationship between enrollment of Black, Hispanic, special education, and English learner students and the presence of Black, Hispanic, Special Education, and ESL teachers, and test whether this relationship differs at charter and traditional district-run schools. Because charter schools typically have less market power in hiring than large districts, we compare charter school employment practices to traditional public schools in districts of comparable size. Our results suggest that charter schools are more likely to employ same race teachers for Black students but not Hispanic students, and districts schools are slightly better at providing ESL and SPED teachers. We conclude that charter autonomy does not necessary generate better student-teacher matches, but Michigan charters may occupy a market niche by serving Black students and staffing Black teachers.

JEL Codes: D22 I22 I24 I28 J45
Keywords: Charter Schools, Specialized Staffing, Special Education, ESL

[*] **Disclaimer and Acknowledgements:** This research result used data structured and maintained by the MERI-Michigan Education Data Center (MEDC). MEDC data are modified for analysis purposes using rules governed by MEDC and are not identical to those data collected and maintained by the Michigan Department of Education (MDE) and/or Michigan's Center for Educational Performance and Information (CEPI). Results, information, and opinions solely represent the analysis, information, and opinions of the author(s) and are not endorsed by, or reflect the views or positions of, grantors, MDE and CEPI, or any employee thereof. Institutional support was provided by Michigan State University and the University of Maryland, Baltimore County. We are grateful to Emily Mohr, Michelle Huhn, and Wei-Chu Chen at MSU for research, data, and formatting support and to Ann Green, Sarah-Kate Lavan, Katelyn Boswell Gallagher, and Kelli Brozanski from MDE.

Introduction

A longstanding critique of US school districts is that their HR practices are subject to substantial restrictions imposed by laws, regulations, and collective bargaining agreements (Chubb and Moe, 1991). Chubb and Moe (1991) argue that decentralizing human resource decisions and eliminating long-term teacher contracts will enable school managers to better match teacher skills and experience to student needs. As schools of choice, charters are subject to competitive pressure and must respond to parent demand. Having teachers who are demographically similar to the target student population and trained to meet special needs might be effective strategies to attract and retain students and to meet accountability goals in charter contracts. Most empirical evidence suggests that resource-constrained charter schools typically offer lower pay than traditional public-school districts, and thus attract lower performing, less experienced teachers (Carruthers, 2012; Epple, Romano, and Zimmer, 2016; Jackson, 2012) and have higher turnover (Cowen and Winters, 2013). However, there is also evidence that charters managers think strategically about how to attract and retain students (Jabbar, 2015) and differentiate pay and teacher retention decisions in ways that improve student performance (Barrett et al., 2022). This study seeks to further test the theory that charter schools have more responsive human resources strategies by asking whether charters are more likely to hire teachers who are well matched with students.

Research has long recognized the importance of specialized teacher training and culturally appropriate instruction to address students' diverse educational needs. Whether in sheltered classrooms or in the general classroom, students with special education and language needs benefit from specialized teacher training (Boe, 2006; Feng & Sass, 2013; McLesky, Tyler, and Flippin, 2004; Nusche, 2009; Peyton et al., 2021). Students with disabilities who are taught

by teachers with training in special education have higher achievement (Hanushek, Kain, and Rivkin, 2002), and certification in ESL is associated with higher levels of efficacy among all teachers of English language learners regardless of the classroom setting (Harklau, 1994; Master et al., 2016; Thomas and Collier, 2002; Tran, 2015). More recent empirical evidence on access to demographically similar teachers highlights benefits of a teacher workforce that reflects the racial and ethnic experiences of students (Redding, 2019). Empirical studies of demographically matched teachers suggest that having a same race/ethnicity teacher can improve course grades (Harbatkin, 2021), course taking (Lavy and Sand, 2015), standardized test scores (Egalite, Kisida, and Winters, 2015; Dee 2004, 2005), attendance and suspensions (Lindsay and Hart, 2017; Holt and Gershenson, 2015), and identification for discretionary educational services (Hart and Lindsay, 2024). Calls for expanding access to teachers with specialized training for instruction of special education students and English learners are now accompanied by urgent recommendations to recruit more teachers of color in districts that enroll large numbers of students of color (Goldhaber, Theobald, and Chien, 2019; Partelow, Brown, and Johnson, 2017).

In most settings, Black and Hispanic students are over-represented in the charter sector (Berends, 2015), and national comparison suggests that Black and Hispanic students, on average, show faster performance growth in charter settings (Raymond et al., 2023). Although the reasons are unclear, charters across the US are often less likely to enroll SPED students (Bernard-Brak, Schmidt, and Almekdash, 2018; Winters, 2013). Evidence regarding EL students is mixed. For example, in studies in New York City, Winters (2014) finds under enrollment of EL students in charters overall, while Satin-Bajaj and Suarez-Orozco (2012) find that some charters specialize in language education and provide innovative services to ELs. In Texas, Carlson (2023) finds that charters are more likely to enroll ELs and that ELs in charter schools

outperform peers in other settings. Looking at both ELs and SPED students in Boston, Setren (2021), finds that numbers of SPED and EL students are lower in charters only because charters are more likely to remove classifications of SPED and EL for their students once enrolled – a strategy that Setren finds to have positive effects on student outcomes. In the most recent national study of charter school effects, Raymond et al. (2023) find that Black, Hispanic, and ELs experience faster performance growth at charter schools, while SPED students in charters underperform relative traditional public schools (TPS).

Since public school teaching often pays less than other jobs for college graduates, the supply of teachers with specialized training and teachers of color often does not meet demand, and schools of all types face shortages of both teachers of color and teachers trained in special education or ESL (Sindelar et al., 2018; Katsiyannis, Zang, and Conroy, 2003; Flynn and Hill, 2005). Because of these shortages, charters and districts in many settings might compete for well-matched teachers as a scare resource. States vary widely in their current capacity to employ a teacher workforce that matches student racial and ethnic representation. Statewide ratios of Black students to Black teachers range from 15:1 in Louisiana and Washington, DC, to 89:1 in Minnesota (Black Teacher Collaborative, (n.d.)). The current SPED teacher shortage affects nearly all states, and 98% of school districts (Monin et al., 2023). The shortage of ESL certified teachers is particularly challenging, as greatest increases in enrollment of English language learners are occurring in areas with historically lower English language learner populations (Ramsey & O'Day, 2010). Three of the five states with the highest concentrations students identified as English learners report having too few specially trained teachers (Sanchez, 2017).

While there is substantial evidence on enrollment and performance of subgroups students in charters, less is known about whether teacher matching is a mechanism for improvement that

results from charter autonomy. While charters can differentiate many factors that might attract well-matched teachers (location, mission and curricula, recruitment strategies, compensation, etc.) these mechanisms likely work differently for demographic matching and specialized training. Race and ethnicity are fixed teacher characteristics that can only be selected at hiring, and it is not legal in the US to hire or compensate teachers based on race or ethnicity. Charters can implement targeted recruitment strategies and control program elements that might attract teachers of color such as culturally focused curricula, values statements, and school location. It is legal to offer preferential hiring and compensation for teachers with specialized training or to financially motivate current teachers to seek additional endorsements to better meet student needs. However, there are financial reasons why charters, which typically operate with per-pupil funding, might avoid attracting enrollment of students who need costly additional services. The financial disincentive for charters to enroll SPED and EL students are a particular concern in literature on behavior of charter managers (Jabbar, 2015) and equitable access to school choice (Holme, 2002; Mead and Green, 2012).

In the context of teacher shortages and complex incentives for charter schools, the question of which students have access to teachers who are well-matched to their educational needs and social context is critical to understanding and improving student outcomes. In this study, we ask whether the mechanism of charter school autonomy is a pathway to better matching between student needs and teacher demographics and training. We set our study in Michigan for several reasons. The primary reason is a unique governance structure that allows us to tease out multiple theoretical mechanisms. Chubb and Moe (1991) theorize that charters will provide better-matched teachers due to a combination of market incentives to improve educational outcomes and autonomy over hiring, assignment, and compensation of teachers as a

critical educational input. Conversely, Levin (2012) argues that centralized school districts enjoy economies of scale that will lead to more efficient and effective hiring practices than charter schools. Economies of scale might enable large districts to offer more generous compensation, greater job security, and expanded outreach and recruitment to attract well-matched teachers.

Identifying the mechanism through which charters and TPS differ in hiring practice is complicated when both autonomy and economies of scale vary across the sectors, so we set our study in the well-suited context of Michigan public schools. Michigan has a substantial charter sector that disproportionately serves students of color and English learners (Binelli, 2017). Critical for this study, the Michigan context also includes substantial competition between TPS and charters, including within a substantial number of traditional school districts that are comparable in scale to charter schools. In this context, we are able separate autonomy and economies of scale by testing for robustness of differences when comparing charter schools only to comparably sized districts.

While Michigan is relatively unique in terms of a governance structure that includes numerous small districts, it is similar to many states in relevant characteristics of the teacher labor market. Michigan reports a statewide shortage of teachers that match the demographics and needs of students in many areas, most relevantly for our work, in both special education and ESL certification as well as teachers of color (OEE, 2022). This scarcity reflects the context in many states and can provide insight into how teachers as scare resources are distributed across students.

Data and Context

Our study uses teacher employment and student enrollment records provided by the Michigan Department of Education (MDE) and the state's Center for Educational Performance and Information (CEPI). We merge records of teacher demographics and SPED and ESL endorsements with teacher employment records from 2012-13 through 2019-20 to create school-level aggregate counts of teachers, observing all traditional public and charter schools in Michigan. We focus on well-matched teachers for four potentially overlapping student subgroups that represent a sufficient portion of Michigan charter school enrollment to facilitate analyses: Black, Hispanic, English learners, and students with identified special educational needs. School aggregate counts of these student subgroups from enrollment files are matched, respectively, to counts of teachers from personnel and certification files who are: Black, Hispanic, certified in ESL, and certified in special education. We end our analysis with the last available school year in which fall hiring decisions were unaffected by the Covid-19 pandemic, which may have affected charter schools and traditional schools in different ways that are beyond the scope of this paper.

The Michigan context includes over 300 charter schools that enroll over 140,000 students. Approximately 10% of public-school students attend charter schools, but within subgroups, 30% of Black students, 12% of Hispanic students, and 16% of English learners attend charter schools[2]. Like many states, Michigan experiences a substantial mismatch between the supply of teachers and the demographics and educational needs of students. Statewide, 64% of students are White, 18% are Black, and 9% are Hispanic, while 92% of teachers are White, 6% are Black, and fewer than 2% are Hispanic. The supply of teachers with specialized training for teaching students with disabilities, as evidenced by a Michigan special education teaching

[2] This breakdown of student demographics is calculated for the 2022 – 2023 school year from publicly available enrollment counts through MI School Data. https://www.mischooldata.org/

endorsement, is more balanced with approximately 11% of students identified for special education services and approximately 13% of teachers holding a special education endorsement[3]. While 6% of students are identified as English learners, only 3% of teachers have state endorsements in ESL.

In our analysis, we first compare charters to all TPS in Michigan. Next, we limit the comparisons sample to TPS in similarly sized school districts by creating a subsample of small districts that serve up to 4,000 students. To avoid inappropriate comparison to very rural districts or newly opened small charters, we omit charters and districts that serve fewer than 200 students. Our size restrictions create a primary analytic subsample that includes 504 of Michigan's 545 total traditional school districts and 332 of Michigan's 382 total charter schools[4]. The subset of small districts and charters, which holds economies of scale constant, includes 436 traditional districts.

Student-Teacher Ratios in Michigan

Figure 1 illustrates statewide student-teacher ratios from 2012-13 to 2019-20 for our four student subgroups. We calculate ratios by dividing the total number of subgroup students in each school type by the total number of well-matched teachers. "Well-matched teachers" include Black teachers for Black students, Hispanic teachers for Hispanic students, ESL teachers for EL students, and SPED teachers for SPED students. The statewide ratio (solid black lines) tells us

[3] Michigan offers ten distinct endorsements in special education that correspond to distinct student needs, such as an endorsement in autism spectrum disorder. For the purpose of this analysis, we include all teachers who hold at least one specialized endorsement in special education in our count of special education teachers. However, we note that a special education teacher's specific endorsement area may not correspond to the specific disabilities of the students in their school.

[4] All but one of the charter school exclusions are due to enrollment of fewer than 200 students. The one charter school that enrolled over 4,000 students is a virtual school and likely has a different staffing context due to the lack of a central school location. We also omit special schools such as alternative programs, residential schools, and schools that enroll over 80% SPED students.

the overall availability of matched teachers for students in Michigan. To observe differences by both autonomy and scale, we also display ratios for charter schools (grey lines), comparably sized school districts of up to 4,000 students (dotted black line), and larger school districts (dashed black lines).

For Black students, the statewide ratio is approximately 60:1 across the study period. Ratios for Black students vary substantially from approximately 40:1 at TPS in larger districts to over 100:1 at TPS in small districts. Charters are most similar to the statewide ratio, with 60-70 Black students per teacher. Over the panel period, ratios improved for Black students, particularly in small districts and charters. For the Hispanic subgroup, there are approximately 100 students per teacher statewide. Like the Black subgroup, large districts have the lowest ratios at approximately 80 students per teacher, followed by charter schools. Small districts have the highest ratios at over 120 Hispanic students per Hispanic teacher. Hispanic ratios also improved over time in charters and small districts. EL student to ESL teacher ratios declined statewide from 60 to 40 students per teachers during the panel. Both large and small districts are similar to the statewide EL ratio, while charters have substantially more ELs per ESL teacher. SPED student teacher ratios are substantially lower than the other subgroups across all school types at less than 20 students per teacher. Ratios at charters are slightly higher than small and large districts across the panel with an increasing gap in later panel years. Overall, the trends in Figure 1 suggest that charters might provide better matches by student race/ethnicity than traditional districts with similar scale but not larger districts, while traditional districts of all sizes have a small advantage in staffing ratios of teachers with specialized training in ESL and SPED. These averages ignore the distribution of subgroup students across schools, which we explore further in regression analysis.

Regression Models

Our empirical objective is to: 1) estimate the relationship between subgroup student enrollment and the presence of well-matched teachers at public schools, and 2) test whether this relationship differs at charter and traditional district-run schools, and 3) test whether differences persist when comparing charters to TPS with similar economies of scale and context. There are two key empirical challenges in this analysis. The first is the nature of teacher counts as dependent variable, and the second is potential confounding differences between charter schools and TPS. Addressing the first challenge, our estimation strategy considers that teacher counts can only take on integer values greater than or equal to zero. In the special case of count variables, the floor effect of zeros means that linear models often predict implausible negative values, and the literature recommends exponentiated functional forms (Long and Freese, 2014). We estimate the relationship between students and teachers as:

$$\text{Log}(n\ teachers_{git}) = \beta_0 + \beta_1 n\ students_{git} + \beta_2 charter_i + \beta_3 n\ students_{git} \cdot charter_i + \theta_i + \varepsilon_{git} \quad [1]$$

where the number of teachers in school *i* in year *t* who are well-matched to student subgroup *g* is an exponentiated function of the number of subgroup students enrolled, the school's charter status, and the interaction of the two. $\beta_1$estimates the change in the (logged) number of teachers with the addition one subgroup student at a TPS, β_2 estimates an intercept shift in the baseline number of subgroup teachers at charter schools, and β_3 estimates the differential effect of additional subgroup students at charter schools. Thus, eq [1] estimates both whether charter schools hire more subgroup teachers in general and whether the number of subgroup teachers at charters is more responsive to enrollment of subgroup students. To account for fixed school-level

factors such as local labor markets and district policies, we decompose the error in eq [1] into error into shared components at the school level (θ_i) and random error ε_{git} using a random effects model.

Eq [1] can be estimated multiple ways depending on the underlying structure of the data. A Poisson regression model (PRM) addresses the challenge of count data by fitting a distribution where estimated values cannot fall below zero. However, PRM can produce inflated standard errors in cases where count data are over-dispersed (i.e., the mean number of teachers in a subgroup is less than its standard deviation). Since over-dispersion is present for most subgroup teacher counts in our data, we account for this in several ways, following the recommendation of Long and Freese (2014) and Cameron and Trivedi (2013). Underlying overdispersion, we find that a substantial number of Michigan schools have zero teachers in some subgroups. For example, while 36% of TPS in Michigan have 10 or more Black students, only 11% have at least one Black teacher. It is possible that schools with zero subgroup teachers face different hiring obstacles than other schools – for example a low supply of teachers in the region, noncompetitive salaries, or seniority rules. In these cases, hiring the first subgroup teachers might be more challenging than hiring the second, third, etc. In cases where schools often have no subgroup teachers, we estimate a two-stage hurdle model (Williams, 2021):

$$\text{Log}[prob(teachers_{gijt} > 0)] = \alpha_0 + \alpha_1 n\ students_{git} + \alpha_2 charter_i + \alpha_3 n\ students_{git} \cdot charter_i + \theta_i + \varepsilon_{git} \quad [2.1]$$

$$\text{Log}\left[n\ teachers_{git} \middle| n\ teachers_{git} \geq 1\right] = \delta_0 + \beta_1 n\ students_{git} + \beta_2 charter_i + \beta_3 n\ students_{git} \cdot charter_i + \theta_i + \varepsilon_{git} \quad [2.2]$$

where [2.1] estimates the probability that a school gets over the initial hurdle to employ at least one subgroup teacher in year *t,* and [2.2] estimates the relationship between student counts and continuous teacher counts after the initial hurdle is passed. Thus, the hurdle analysis allows a deeper investigation of differences between charters and TPS as a multi-stage process – first, how many subgroup students are typically present before a school hires one subgroup teacher, and second, once the first teacher is hired, how is the number of subgroup students related to the number of subgroup teachers? We estimate the dichotomous outcome in eq [2.1] using a probit model and teacher counts in eq [2.2] using PRM.

All models must also address threats to the independence of the error terms (ε_{git}) in the context of Michigan charter schools. We employ panel data that measures annual student and teacher counts from fall 2012 to 2019. To adjust for unobserved school factors that are stable over time, we deconstruct the error term and include a within-school random effect in all models. With school random effects, coefficients can be interpreted as the relationship between a change in the number of students and a change in the number of teachers. As additional efforts to counter overdispersion, we estimate PRMs with bootstrapped standard errors and test robustness to estimates with the negative binomial regression model (NBRM) (Long and Freese, 2014; Cameron and Trivedi, 2013). In general, our coefficients and standard errors are similar across regression models and standard error estimation strategies.

Our second empirical challenge is the possibility results are driven by that contextual factors other than autonomy that differ across charters and TPS. To address research question 3, we repeat our analysis with a subset of TPS that are located in small districts with comparable economies of scale to charter schools (i.e. fewer than 4,000 students). Within this restricted sample, we also run several robustness checks focused on ensuring that charters schools and TPS

are comparable in local labor market conditions and the supply of teachers. For example, if charter schools are located in areas with more Black college graduates, this might facilitate employing more Black teachers in ways that are unrelated to autonomy. In Michigan, charter schools are concentrated in several urban areas and the greater Detroit area, so we replicate our analysis for two subsets of schools. The first subset includes only schools in urban areas, as defined by geography indicators in the NCES Common Core of Data (CCD). The second subset includes only schools in the Detroit metro area, which includes Wayne County (home to the City of Detroit) and four adjacent suburban counties that form the greater Detroit labor market. We also control for local labor markets in models that include both school and county-level random effects. Finally, we address other potential differences between charters and TPS by adding control variables that address potential variation in resource constraints and demand for teachers. We add indicators of student need (percent of students who are economically disadvantaged (ED), SPED, and EL), omitting percent SPED and percent ESL from estimates of SPED teachers and ESL teachers, respectively. We also add controls for the median experience level of the teaching faculty and the annual return rate. High median experience might increase a school's likelihood of having teachers progress to certification in SPED and ESL, but teaching openings through lower retention are required to change the demographics of the faculty.

Analytic Samples

Table 1 displays summary statistics by school type, including charter schools, all TPS, and TPS in small districts. As a result of school openings and closures during the span of the panel, not all schools are represented in all years[5]. Table 1 includes 332 charter schools and

[5] Because closings are often planned years in advance and such announcements would trigger teacher exits and limit new hiring, we omit closing schools from regression analysis in the final two years before closure.

2,475 TPS that meet the restrictions described above. The sample includes 1,550 TPS that operated in districts with fewer than 4,000 students. We observe substantial differences in average size and student composition at charters and TPS. Charter schools are larger overall and enroll substantially more Black, Hispanic, and English learner students, while TPS enroll a larger average number of special education students. While almost all schools enroll special education students and employ at least one special education teacher, overall means include many schools that enroll zero Black, Hispanic, or EL students or employ zero Black, Hispanic, or ESL teachers. Charters are substantially more likely to employ ESL, Black, and Hispanic teachers than TPS in small districts, but differences decrease or disappear as school district size increases. We note that gaps between charters and TPS in small districts are larger than those for charters and TPS overall.

To better estimate the relationship between student enrollment and the presence of well-matched teachers, we restrict our regression samples for each subgroup to schools that enroll at least 10 students within the subgroup of interest. This restriction creates a unique school sample for each subgroup analysis. Table 1 reports the percentage of schools that meet this criterion for each subgroup within the primary analytic sample. For example, 53% of all TPS and 90% of charter schools have 10 or more Black students, while 97% of TPS and 98% of charter schools have 10 or more special education students. Appendice 1 and 2 illustrate that, despite differences in means, district and charter schools in the analytic subsamples with 10 or more subgroup students reflect nicely overlapping distributions of subgroup student counts and are therefore suitable for regression analysis.

Table 2 displays a similar comparison for our analytic datasets that include only schools with at least 10 students in the targeted subgroup. This restriction substantially reduces, but does

not fully eliminate, schools with zero subgroup teachers. Table 2 highlights (in bold) cases where overdispersion of the dependent variable of teacher counts creates the needs for the hurdle estimation model. This occurs in all school samples for ESL teachers, Black teachers, and Hispanic teachers. Special education teacher counts do not indicate over-dispersion. To further inform selection of one-stage or hurdle models, Table 2 also reports the proportion of schools that have no subgroup teachers. While the majority of schools have at least one special education teacher, it is very common for schools in Michigan to have zero Black, Hispanic, or ESL teachers. For example, in the statewide regression sample only 41% of TPS and 73% of charter schools with 10 or more Black students have at least one Black teacher, and 28% of TPS and 40% of charters schools with 10 or more Hispanic students have at least one Hispanic teacher. In these cases, we estimate hurdle models to provide additional insight into when schools initially add a Black, Hispanic, or ESL teacher.

Regression Results

We conduct regression analyses for each of four student-teacher matches: 1) Black students and Black teachers, 2) Hispanic students and Hispanic teachers, 2) English learners and ESL teachers, and 4) special education students and special education teachers. We begin by comparing charter schools to all TPS in Michigan. For Black, Hispanic, and ESL teachers, we first estimate the probability of one teacher with a probit model, and then the number of teachers conditioned on having any teachers with a PRM model. For SPED only, we estimate the one-stage PRM model of the unconditioned numbers of teachers. We report as our main analysis probit and PRM specifications with no added control variables, school random effects, and bootstrapped standard errors.

Our regression tables display results as exponentiated coefficients that reflect the relationship between each additional subgroup student and the probability of hiring an additional subgroup teacher. Coefficients greater than 1.0 indicate that a marginal change in a dependent variable increases the probability or count of teachers, while coefficients less than 1.0 indicate decreases. Significant coefficients for the charter indictors and interaction terms point to differences in the probability of staffing teachers at charter schools, compared to a TPS with a similar number of subgroup students. Because it is difficult to discern the magnitude of nonlinear regression coefficients, we use these coefficients to estimate probabilities and counts of subgroup teachers at charter and traditional schools as the number of subgroup students grows from 0 to 200. We depict these estimates in figures showing expected probabilities and expected numbers of teachers (and 95% confidence intervals) graphed against growing numbers of subgroups students.

Table 3 displays our initial results that compare charters to TPS in districts of all sizes. Coefficients for subgroup student count indicate that in all subgroups, there is a positive and significant relationship between the number of subgroup students and both the probability and number of subgroup teachers. This suggests that Michigan teachers are distributed across schools overall in a way that reflects subgroup enrollment. Results regarding the hypothesis that charters use autonomy to provide better teacher matches are mixed. Significant charter indicators suggest that charter schools, on average, are more likely to staff at least one Black teacher and at least one Hispanic teacher, while the number of Black, Hispanic and ESL teachers (conditioned on having at least one) is statistically similar at charters and TPS. In terms of responsiveness to subgroup enrollment, charters are significantly less responsive than TPS to Black, Hispanic, and EL student counts in probit estimates and to EL students in the Poisson estimate. While charters

staff significantly fewer SPED teachers on average, they are also significantly more responsive to SPED student counts than TPS.

The substance of these differences is illustrated in Figures 2 and 3. Figure 2 shows estimated teacher probabilities based on the first-stage hurdles for Black, Hispanic, and ESL teachers. Charter schools are represented by grey circles and grey confidence interval lines; TPS are represented by black x's and black confidence interval lines. Charter schools have a substantially higher probability of employing Black teachers at least until Black enrollment reaches 200 students, while TPS have a higher probability of employing ESL teachers when EL enrollment exceeds 140 students. We note that no subgroup reaches a 100 percent probability of having a well-matched teacher even with enrollment of 200 subgroup students charter schools or TPS. Figure 3 shows the estimated number of Black, Hispanic, and ESL teachers based on the second-stage hurdles (conditioned on hiring one teacher) and the number of SPED teachers based on a one-stage (unconditioned) estimation. There is no apparent different in the number of Black and Hispanic teachers relative to students in charters and TPS. TPS employ significantly more ESL teachers only with enrollment of 160 or more EL students, and the difference is less than one teacher. TPS also employ slightly more SPED teachers at SPED enrollment levels of 40 to 120 students, after which there is no difference. What is most striking is the low number of well-matched teachers that are expected even as enrollment reaches 200 subgroup students for Black students (3-4 teachers), Hispanic students (1-2 teachers), and EL students (2-3 teachers) compared to SPED students (15-20 teachers).

These results suggests that overall, Michigan charters schools are more likely to provide demographically matched teachers for Black students but not Hispanic students, while TPS are slightly more likely to provide specially trained teachers for EL and SPED students. We next

investigate if these differences are attributable to differences in economies of scale by limiting the sample of TPS to schools in districts with enrollment that is comparable to charter schools. Table 4 displays regression results for this restricted comparison, and estimated values are illustrated in Figure 4 for probabilities and Figure 5 for teacher counts. The results are substantively different from the first comparison in two ways. First, when compared only to schools in comparably sized districts, the gap between charters and TPS in the probability of staffing Black teachers is larger and persists at all levels of Black student enrollment. Second, expected Black teachers counts are also significantly and substantially higher at charters compared to the small districts TPS. For other subgroups, the results are quite similar to the first comparison except that the small differences between TPS and charters for ESL and SPED teachers are even smaller.

Regression results for geographic school subsets are presenting in Table 5, including only urban schools (Panel A) and only Detroit area schools Panel B. Compared to results from Table 4 including all TPS in small districts, the urban analytic samples include 5 to 11% of TPS, and 28 to 38% of charter schools. The Detroit area analytic samples, which include both urban and suburban, include are more small districts and charters, with 18 to 33% of TPS and 49 to 68% of charter schools in the subgroup samples. Figures 6 and 7 depicts differences in estimate teacher probabilities and counts in urban areas, respectively. We continue to see an advantage for charter schools in both the probability and count of Black teachers. Urban TPS are significantly more likely to provide an ESL teacher, with the probability of an ESL teacher reaching 100% with enrollment of over 180 EL students in a TPS in a small district. However, the estimated number of ESL teachers is similar in urban TPS and charter schools and not very responsive to student count. Urban TPS also have more estimated SPED teachers when SPED enrollment exceeds 40

students, and estimated gaps in numbers of SPED teachers are quite large (up to 5 more teachers at TPS than charters) at higher levels of SPED enrollment.

Figures 8 and 9 depict differences in estimated teacher probabilities and counts, respectively, within the Detroit metro area. Here, we are comparing charters to TPS with similar scale that are also within commuting distance of each other, making it more likely they hire from the same pool of teachers. Within this subset of schools, we see an even larger advantage for charter schools in hiring Black teachers. Across levels of Black enrollment, charters are twice as likely to staff a Black teacher as TPS, and charters employ 1-2 more Black teachers than TPS across levels of Black enrollment. Within Detroit, TPS are still more likely to employ an ESL teacher and to employ more ESL teachers at high levels of EL enrollment. While the difference in probability is large, the difference in count is less than 1 teacher, and ESL teacher counts in either setting are not very responsive to student count. We find no statistically significant differences for staffing Hispanic and SPED teachers in metro Detroit.

Additional robustness checks for these results are displayed in Appendices 3 to 6 for more comparisons of charters to TPS of similar scale. We include specifications with: 1) additional control variables for school context and teacher demand, 2) county random effects, 3) and negative binomial models as an alternative to PRM. The are no substantive differences in results from these alternative specifications that would alter our conclusions. We note that adding county random effects to control for local labor market conditions increases the magnitude of estimated differences between charters and TPS in most specifications, which suggests that differences are not driven by charters and TPS locating in different labor markets.

Discussion and Policy Implications

Overall, we find mixed results regarding whether charters are better at matching teachers with student needs. Descriptively, we find that charters are more likely to staff both Black and Hispanic teachers. In regression analysis that investigates teacher sorting relative to student enrollment, we find strong evidence that charters are more likely to staff Black teachers than TPS with similar Black enrollment. When comparing charters to TPS of similar scale within the same labor markets and similar characteristics, this difference is even larger, and charters are also likely to hire *more* Black teachers than comparable TPS. However, we find that charters and TPS with similar Hispanic enrollment have no differences and staffing of Hispanic teachers and neither has responded to recent increases in Hispanic enrollment with comparable increases in Hispanic teachers. The descriptive differences between charters and TPS are likely due to the tendency of charters to enroll more Hispanic students, on average.

Because we see no substantive differences in staffing Hispanic teachers, we cannot conclude that charters are better overall in providing demographically matched teachers. While both Black and Hispanic students are overrepresented in Michigan charter enrollment, the gap is much larger for Black students. Arce-Trigatti et al. (2015) argue that charters may fill niche markets by specializing in programs that are attractive to parents. It is possible that in Michigan, part of the charter sector specializes in educational models that are attractive to both Black teachers and parents of Black students. Substantial prior research suggests that parents of Black students often prefer schools with a concentration of Black students (Weiher and Tedin, 2002). Our results suggest that one reason for this preference might be the presence of Black teachers and the potential education and social benefits they provide. With a smaller share of Hispanic students and a more severe shortage of Hispanic teachers, less specialization may be occurring in the Michigan context.

We find no evidence that charters are better able to provide well-matched teachers for students with special education needs. It is possible that charter school budget constraints continue to create disincentives for charters to provide high quality services for these students. However, we note that the advantages for TPS over charter schools in teacher matching for EL and SPED students are very small and do not point to systematic understaffing at charter schools. Instead, we observe that Michigan EL students overall are far less likely to encounter a specially trained teacher than Michigan SPED students, who have relatively high access to SPED teachers in both settings. While there is some evidence that Black, Hispanic, and EL students have faster test score growth at charters while SPED students perform better at TPS (Raymond et al., 2023), our results suggest that this is likely not attributable to charters systematically using human resource autonomy to provide teachers who well-matched in demographics and training. Other uses of autonomy, such the ability to reward teacher performance may be more common in cases of shortages of well-matched teachers. For example, Barrett et al. (2022) find that charter schools in the majority-Black student setting of New Orleans are more likely to retain high-performing teachers and to exit low-performing teachers than traditional districts in the same regional labor market, while Lincove, Barrett, and Strunk (2018) document a concurrent exit of Black teachers from New Orleans schools regardless performance. This combined evidence suggests that at least in one setting, charters do use human resource autonomy but not through the mechanism of demographically matched teachers.

With an increased understanding and emphasis on the importance of providing students with a well-matched teacher workforce in recent years, it is critical for research to inform public investment in how to achieve this teacher workforce. Student populations of schools change faster than the teaching population. A faculty that may have been well-tailored to the student

body 20 years ago, may no longer be. Adapting staff to the arrival of new student subgroups can be particularly challenging when those subgroups make up a small portion of overall enrollment. However, students who are in a small subgroup in a school still need access to these teachers. The presence of any special education teacher and any ESL teacher will improve identification of special education students and English learners. The presence of any Black teacher and any Hispanic teacher may improve sense of belonging for Black and Hispanic students and may improve their white coworkers' effectiveness when teaching Black and Hispanic students (Gershenson et al., 2023).

While Michigan's teacher workforce is significantly less diverse than its student population, the charter sector outperforms traditional districts in staffing Black teachers for Black students. We note these differences are even larger within metro Detroit, so they are unlikely to merely represent a geographic divide in the location of charters. However, charter schools don't outperform their traditional counterparts in all regards. Consequently, there may be tradeoffs for parents to consider, particularly for parents of students of color with special needs. Traditional public schools offer more experienced teachers, an area in which traditional schools outperform charter schools, but students may be less likely to be exposed to teachers of their own race/ethnicity, an area in which charter schools dominate. Such decisions are familiar to the parents of Black students in particular and shape their school choices (Posey-Maddox et al., 2021).

We also note the implications of our findings for Black teachers. Although there are no studies of charter salaries in Michigan or Detroit, studies in other settings suggest that charter schools offer lower salaries, lower benefits, and less job security (Carruthers, 2012; Lincove, Barrett, and Strunk, 2018). It is possible that the tendency of charters to employ Black teachers is

the result of labor market sorting in a context of racial discrimination by school districts. This might occur directly through racial bias in HR decisions, or indirectly through district recruitment strategies that ignore pathways and preparation programs that are attractive to Black teacher candidates (e.g. Historically Black Colleges or alternative certification at community colleges). If Black teachers are sorting into the charter sector either voluntarily or through discrimination, it is important to investigate the implications for wage disparities and career trajectories.

We note several policy recommendations that emerge from our findings. Improving the provision of specially certified teachers and the provision of teachers of color in the schools where they are most needed require different strategies. In 2021, less than 3% and 4% of teacher preparation program completers in Michigan were Black and Hispanic respectively (OEE, 2022). Given the existing ratios of students to teachers in Michigan and the demographics of teachers entering the profession, Michigan and similarly situated states must, at least in part, rely on training their existing teacher workforce to meet student needs. For English learners and special education students this means incentivizing existing teachers to acquire additional certification in these areas as well as providing relevant professional development in these areas as *all* teachers can benefit from more ESL and special education training (de Jong et al., 2013). Indeed, some such efforts are already underway in Michigan where special education is currently the second most commonly added endorsement area to existing teaching certificates (OEE, 2022).

For students of color, given the pool of existing teachers, it is not possible in the near term to reduce the student to same race/ethnicity teacher ratio to something close to what we see for special education students to teachers. Currently, the state-wide ratio for Black students to Black teachers in Michigan is 46:1 and the ratio of Hispanic students to Hispanic teachers is

119:1, though we know these ratios can vary dramatically by district and even within districts (OEE, 2022). As Michigan continues to work towards lowering these ratios statewide, districts and charter schools alike must continue to equip their existing, largely white, teacher workforce to meet the educational needs of students of color and address achievement gaps. Professional development in culturally responsive pedagogy (CRP) is a promising strategy to improve student outcomes, and much progress has been made in identifying what defines effective professional development in CRP since Sleeter (2012) called for more usable research for practitioners (Aronson and Laughter, 2016).

References

Arce-Trigatti, P., Harris, D., Jabbar, H., and Lincove, J.A. (2015). Many options in New Orleans choice system. *Education Next*, 15(4). https://educationresearchalliancenola.org/files/publications/ednext_XV_4_Many-Options-arce_trigatti.pdf

Aronson, B., & Laughter, J. (2016). The theory and practice of culturally relevant education: A synthesis of research across content areas. Review of Educational Research, 86(1), 163-206. https://doi-org.proxy1.cl.msu.edu/10.3102/0034654315582066

Barnard-Brak, L., Schmidt, M., & Almekdash, M. H. (2018). Enrollment of Students with Disabilities in Charter Schools: Contemporary National and State Level Findings. *Education Policy Analysis Archives*, *26*(43), n43. https://doi.org/10.14507/epaa.26.3276

Barrett, N., Carlson, D., Harris, D., & Lincove, J. (2022) When the walls come down: evidence on charter schools' ability to keep their best teachers without unions and certification rules. Education Evaluation and Policy Analysis, 44(2), 283-312. https://journals.sagepub.com/doi/full/10.3102/01623737211047265

Berends Mark. 2015. "Sociology and school choice: What we know after two decades of charter schools." Annual Review of Sociology 41(1):159–80. https://doi-org.proxy1.cl.msu.edu/10.1146/annurev-soc-073014-112340

Binelli, M. (September, 2017) Michigan gambled on charter schools. its children lost. The New York times Magazine. https://www.nytimes.com/2017/09/05/magazine/michigan-gambled-on-charter-schools-its-children-lost.html

Black Teacher Collaborative. (n.d.). *Data and Statistics*. Retrieved July 23, 2023 from https://blackteachercollaborative.org/stats/

Boe, E. (2006) Long-term trends in the national demand, supply, and shortage of special education teachers. The Journal of Special Education, 40(3), 138-150. https://doi-org.proxy1.cl.msu.edu/10.1177/00224669060400030201

Cameron, A. C., & Trivedi, P. K. (2013). *Regression analysis of count data* (Vol. 53). Cambridge university press.

Carlson, D. (2023). Charter Schools and English Learners in the Lone Star State. *Thomas B. Fordham Institute*. https://files.eric.ed.gov/fulltext/ED628973.pdf

Carruthers, C. (2012) The qualifications and classroom performance of teachers moving to charter schools. Education Finance and Policy, 7(3), 233-268. https://direct.mit.edu/edfp/article/7/3/233/10154/The-Qualifications-and-Classroom-Performance-of

Chubb, J. & Moe, T. (1991) Politics, markets and America's schools. British Journal of Sociology of Education, 12(3), 381-396, https://doi.org/10.1080/0142569910120306

Cowen, J. M., & Winters, M. A. (2013). Do charters retain teachers differently? Evidence from elementary schools in Florida. Education Finance and Policy, 8(1), 14-42.

de Jong, E. J., Harper, C. A., & Coady, M. R. (2013). Enhanced knowledge and skills for elementary mainstream teachers of English language learners. *Theory into Practice*, *52*(2), 89-97. https://doi.org/10.1080/00405841.2013.770326

Dee, T. (2004). Teachers, race, and student achievement in a randomized experiment. Review of Economics and Statistics, 86(1), 195–210. https://doi-org.proxy1.cl.msu.edu/10.1162/003465304323023750

Dee, T. (2005). A teacher like me: Does race, ethnicity, or gender matter? The American Economic Review, 95(2), 158–165. https://pubs-aeaweb-org.proxy1.cl.msu.edu/doi/pdf/10.1257/000282805774670446

Egalite, A. J., Kisida, B., & Winters, M. A. (2015). Representation in the classroom: The effect of own-race teachers on student achievement. Economics of Education Review, 45, 44–52. https://doi.org/10.1016/j.econedurev.2015.01.007.

Epple, D., Romano, R., & Zimmer, R. (2016). Charter schools: A survey of research on their characteristics and effectiveness. Handbook of the Economics of Education, 5, 139-208. https://doi-org.proxy1.cl.msu.edu/10.1016/B978-0-444-63459-7.00003-8

Feng, L. & Sass, T. (2013) What makes special-education teachers special? Teacher training and achievement of students with disabilities. *Economics of Education Review*, 36, 122-134. https://eric.ed.gov/?id=ED511762

Flynn, K. and Hill , J. 2005. English language learners: A growing population Denver, CO : Midcontinent Research for Education and Learning. http://chansenedconsultantaea11.pbworks.com/w/file/fetch/50595003/McRelenglishlanguagelearnerspop.pdf

Gershenson, S., Lindsay, C., Papageorge, N., Campbell, R., & Rendon, J. (2023). Spillover effects of Black teachers on white teachers' racial competency: Mixed methods evidence from North Carolina. EdWorking Paper No. 23-794. https://edworkingpapers.com/sites/default/files/ai23-794.pdf

Goldhaber, D., Theobald, R., & Tien, C. (2019) Why we need a diverse teacher workforce. Phi Delta Kappan, 100(5), 25-30. https://journals.sagepub.com/doi/10.1177/0031721719827750

Hanushek, E.A., Kain, J.F. & Rivkin, S.G. (2002). Inferring Program Effects for Specialized Populations: Does Special Education Raise Achievement for Students with Disabilities? Review of Economics and Statistics 84(4): 584–99. https://doi-org.proxy1.cl.msu.edu/10.1162/003465302760556431

Harklau, L. (1994). ESL versus mainstream classes: Contrasting L2 learning environments. *TESOL Quarterly*, *28*(2), 241-272. https://doi.org/10.2307/3587433

Harbatkin, H. (2021). Does student-teacher race match affect course grades? Economics of Education Review, 81:102081. https://doi-org.proxy1.cl.msu.edu/10.1016/j.econedurev.2021.102081

Hart, C. M. D., & Lindsay, C. A. (2024). Teacher-Student race match and identification for discretionary educational services. American Educational Research Journal, forthcoming. https://doi-org.proxy1.cl.msu.edu/10.3102/00028312241229413

Holme, J. J. (2002). Buying homes, buying schools: School choice and the social construction of school quality. *Harvard Educational Review*, *72*(2), 177-206. https://doi-org.proxy1.cl.msu.edu/10.17763/haer.72.2.u6272x676823788r

Holt, S., & Gershenson, S. (2015). The impact of teacher demographic representation on student attendance and suspensions. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2708367

Jabbar, H. (2015). "Every kid is money": Market-like competition and school leader strategies in New Orleans. *Educational Evaluation and Policy Analysis*, *37*(4), 638-659. https://doi-org.proxy1.cl.msu.edu/10.3102/0162373715577447

Jackson, C. K. (2012). School competition and teacher labor markets: Evidence from charter school entry in North Carolina. Journal of Public Economics, 96(5-6), 431-448. https://doi-org.proxy1.cl.msu.edu/10.1016/j.jpubeco.2011.12.006

Katsiyannis, A., Zhang, D., & Conroy, M. A. (2003). Availability of special education teachers: Trends and issues. *Remedial and Special Education*, *24*(4), 246–253. https://doi.org/10.1177/07419325030240040701

Lavy, V., & Sand, E. (2015). On the origins of gender human capital gaps: Short and long term consequences of teachers' stereotypical biases (No. w20909). National Bureau of Economic Research. https://www-nber-org.proxy1.cl.msu.edu/papers/w20909

Levin, H. (2012) Some economic guidelines for design of a charter school district. Economics of Education Review, 31, 331-343. https://www.sciencedirect.com/science/article/pii/S0272775711001439

Lincove, J.A., Barrett, N., and Strunk, K.O. (2018) Lessons from Hurricane Katrina: The Employment Effects of the Mass Dismissal of New Orleans Teachers. *Educational Researcher*, 47(3), 191-203. https://doi-org.proxy1.cl.msu.edu/10.3102/0013189X18759542

Lindsay, C., & Hart, C. M. (2017). Exposure to same-race teachers and student disciplinary outcomes for Black students in North Carolina. Educational Evaluation and Policy Analysis, 39(3), 485--510. https://doi-org.proxy1.cl.msu.edu/10.3102/0162373717693109

Long, J. S., & Freese, J. (2014). *Regression models for categorical dependent variables using Stata*. 3rd Edition. Stata press.

Master, B., Loeb, S., Whitney, C., & Wyckoff, J. (2016). Different skills? Identifying differentially effective teachers of English language learners. *The Elementary School Journal*, *117*(2), 261-284. https://doi.org/10.1086/688871

McLeskey, J., Tyler, N., & Flippin, S. (2004) The supply of and demand for special education teachers: A review of the research regarding the chronic shortage of special education teachers. The Journal of Special Education, 38(1), 5-21. https://doi-org.proxy1.cl.msu.edu/10.1177/00224669040380010201

Mead, J. F., & Green III, P. C. (2012). *Chartering equity: Using charter school legislation and policy to advance equal educational opportunity.* Boulder, CO: National Education Policy Center. https://eric.ed.gov/?id=ED529628

Monin, K., Day, J., Morgan, S., & Dye, K. (2021). The special education teacher shortage: A policy analysis. Council for Exceptional Children https://exceptionalchildren.org/blog/why-now-perfect-time-solve-special-education-teacher-shortage

Nusche, D. (2009). What works in migrant education?: A review of evidence and policy options. https://doi-org.proxy1.cl.msu.edu/10.1787/227131784531

Office of Educator Excellence (OEE) (2022). *Educator Workforce Data Report.* Michigan Department of Education. https://bit.ly/EWDR2022

Partelow, L, Spong, A., Brown, C, & Johnson, S. (2017) America needs more teachers of color and a more selective teaching profession. Center for American Progress. 1-49. https://www.americanprogress.org/wp-content/uploads/sites/2/2017/09/TeacherDiversity-report1.pdf

Peyton, D, Acosta, K., Harvey, A., Pua, D., Sindelar, P., Mason-Williams, L., Dewey, J., Fisher, T., & Crews, E. (2021) Special education teacher shortage: Differences between high and low shortage states. Teacher Education and Special Education, 44(1), 5-23. https://doi-org.proxy1.cl.msu.edu/10.1177/0888406420906618

Posey-Maddox, L., McKinney de Royston, M., Holman, A., Rall, R., & Johnson, R. (2021). No Choice is the "Right" Choice: Black parents' educational decision-making in their search for a "good" school. *Harvard Educational Review*, *91*(1), 38-61. https://doi-org.proxy1.cl.msu.edu/10.17763/1943-5045-91.1.38

Ramsey, A. and O'Day , J. 2010 . Title III policy: State of the states *Washington, DC: American Institutes for Research.* https://www.air.org/sites/default/files/Title-III-State-of-the-States-ELLs-May-2010.pdf

Raymond, M. E., Woodworth, J. L., Lee, W. F., Bachofer, S., Cotter Mazzola, M. E., Snow, W. D., & Sabkova, T. (2023). As a matter of fact: The national charter school study III 2023. *Center for Research on Education Outcomes (CREDO)*. https://ncss3.stanford.edu/

Redding, C. (2019). A teacher like me: A review of the effect of student–teacher racial/ethnic matching on teacher perceptions of students and student academic and behavioral outcomes. Review of Educational Research, 89(4), 499-535. https://doi-org.proxy1.cl.msu.edu/10.3102/0034654319853545

Sanchez, C. (2017, February 23). English language learners: how your state is doing. National Public Raio (NPR). https://www.npr.org/sections/ed/2017/02/23/512451228/5-million-english-language-learners-a-vast-pool-of-talent-at-risk

Sattin-Bajaj, C., & Suárez-Orozco, M. (2012). English Language Learner students and charter schools in New York state: Challenges and opportunities. *New York, NY: New York Governor's Leadership Team for High Quality Charter Public Schools*. https://centerforschoolchange.org/wp-content/uploads/2012/09/ELL-Report-.pdf

Setren, E. (2021). Targeted vs. general education investments: Evidence from special education and English language learners in Boston charter schools. *Journal of Human Resources*, *56*(4), 1073-1112. https://doi.org/10.3368/jhr.56.4.0219-10040R2

Sindelar P. T., Bettini L., Fisher T., Mason-Williams L., Rosenberg M. (2018, November). *Back to the future: Special education, teacher supply, and dynamic labor markets* [Paper presentation]. Presentation at the annual meeting of the Teacher Education Division of the Council for Exceptional Children, Las Vegas, NV, United States.

Sleeter C. (2012). Confronting the marginalization of culturally responsive pedagogy. *Urban Education*, 47, 562–584. https://doi-org.proxy1.cl.msu.edu/10.1177/0042085911431472

Strunk K. O. (2012). Policy poison or promise? Exploring the dual nature of California School district collective bargaining agreements. Educational Administration Quarterly, 48(3), 506-547. https://journals.sagepub.com/doi/10.1177/0013161X11432923

Thomas, W., & Collier, V. (2002). *National study of school effectiveness for language minority students' long-term academic achievement*. Retrieved from http://escholarship.ucop.edu/uc/item/65j213pt

Todd, P. & Wolpin, K. (2007). The production of cognitive achievement in children: Home, school, and racial test score gaps. Journal of Human Capital, 1(1), 91–136. https://doi-org.proxy1.cl.msu.edu/10.1086/526401

Tran, Y. (2015). ESL pedagogy and certification: Teacher perceptions and efficacy. *Journal of Education and Learning*, *4*(2), 28-42. https://files.eric.ed.gov/fulltext/EJ1075156.pdf

Weiher, G. R., & Tedin, K. L. (2002). Does choice lead to racially distinctive schools? Charter schools and household preferences. *Journal of Policy Analysis and Management*, *21*(1), 79-92. https://doi-org.proxy1.cl.msu.edu/10.1002/pam.1041

Williams, R. (2021). Models for Count Variables. Published on-line at: https://www3.nd.edu/~rwilliam/stats3/CountModels.pdf

Winters, M. A. (2013). Why the Gap? Special Education and New York City Charter Schools. *Center on Reinventing Public Education*. https://crpe.org/wp-content/uploads/CRPE_report_speced_gap-nyc-charters.sept13.pdf

Winters, M. A. (2014). Why the Gap? English Language Learners and New York City Charter Schools. Civic Report No. 93. *Manhattan Institute for Policy Research*. https://media4.manhattan-institute.org/pdf/cr_93.pdf

Table 1. Counts of Subgroup Students and Teachers at Michigan Charter Schools and TPS

	(1) Charter				(2) All TPS				(3) Small District TPS			
	mean	sd	min	max	mean	sd	min	max	mean	sd	min	max
all												
students	468.4	207.8	100	1000	434.8	185.0	100	1000	414.4	185.1	100	1000
teachers	25.9	11.7	1	109	26.8	10.2	1	92	25.1	10.0	1	92
Black subgroup												
students	248.3	227.9	0	999	62.8	122.1	0	992	35.2	84.5	0	883
teachers	3.9	5.1	0	29	1.3	4.1	0	40	0.3	1.3	0	33
% with >=10 Black students	89.1				53.5				36.2			
% with Black teachers	65.9				23.8				11.6			
Hispanic subgroup												
students	43.8	91.5	0	673	32.9	57.3	0	869	28.5	43.7	0	457
teachers	0.5	0.9	0	8	0.3	0.8	0	26	0.2	0.6	0	9
% with >=10 Hispanic students	52.3				71.2				68.2			
% with Hispanic teachers	30.8				23.8				17.4			
EL/ESL subgroup												
students	45.6	89.9	0	537	26.6	61.2	0	746	13.2	36.2	0	577
teachers	0.6	1.0	0	6	0.5	1.3	0	23	0.3	0.7	0	13
% with >=10 EL students	39.1				40.5				24.9			
% with ESL teachers	33.9				27.8				17.9			
SPED subgroups												
students	46.8	23.8	2	166	52.9	28.3	0	271	51.8	26.9	0	196
teachers	2.5	1.6	0	16	4.0	2.5	0	28	3.7	2.2	0	16
% with >=10 SPED students	97.8				97.1				97.2			
% with SPED teachers	90.5				96.0				95.9			
N of schools	332				2475				1550			
N of school x year obs	1941				17652				10441			

Notes: Notes: Author calculations from MDE data. Includes fall student and teacher counts from 2012-2019 for charter schools and TPS in school districts with at least 200 students. The Small District TPS subsample includes schools in districts with up to 4000 students.

Table 2. Counts of Subgroup Students in Regression Subsamples

	(1) Charter		(2) All TPS		(3) Small District TPS	
	mean	sd	mean	Sd	mean	sd
Black subgroup						
students	278.2	223.8	114.4	148.8	91.6	121.4
teachers	**4.3**	**5.2**	**2.3**	**5.4**	**0.8**	**2.0**
has teachers	72.6%		41.4%		27.8%	
N of schools	305		1538		736	
Hispanic subgroup						
students	81.4	114.2	44.3	64.4	39.5	49.2
teachers	**0.6**	**1.0**	**0.4**	**0.9**	**0.3**	**0.6**
has teachers	40.1%		28.4%		21.8%	
N of schools	188		2015		1238	
EL/ESL subgroup						
students	114.5	113.4	62.3	84.2	47.9	60.3
teachers	**1.1**	**1.2**	**1.1**	**1.8**	**0.7**	**1.3**
has teachers	56.1%		50.9%		43.3%	
N of schools	138		1265		571	
SPED subgroup						
students	47.7	23.3	54.3	27.4	53.1	26.1
teachers	2.5	1.6	4.1	2.5	3.8	2.2
has teachers	91.3%		97.7%		97.5%	
N of schools	329		2407		1511	

Notes: Author calculations from MDE data. Includes fall student and teacher counts from 2012-2019 for charter schools and TPS in districts with at least 200 students. Each subgroup sample is restricted to schools with at least 10 subgroup students. Cases of overdispersion in the number of teachers are highlighted in bold. The Small District TPS subsample includes schools in districts with up to 4,000 students.

Table 3. Regression Results for Charter Schools and Full TPS Sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Black		Hispanic		ESL		SPED
VARIABLES	probability	count	probability	count	probability	count	count
subgroup student count	1.0163**	1.0023**	1.0140**	1.0025**	1.0171**	1.0033**	1.0105**
	(0.0015)	(0.0001)	(0.0023)	(0.0001)	(0.0022)	(0.0001)	(0.0002)
chater school	4.0729**	1.0169	3.2657**	1.0058	1.3721	1.0245	0.5421**
	(1.1798)	(0.0513)	(0.8863)	(0.0243)	(0.3292)	(0.0332)	(0.0168)
charter x student count	0.9960**	1.0002	0.9933*	0.9999	0.9918**	0.9985**	1.0032**
	(0.0014)	(0.0002)	(0.0028)	(0.0001)	(0.0025)	(0.0002)	(0.0006)
Observations	11,403	5,282	13,714	4,012	7,941	4,077	19,369
N TPS	1538	790	2015	862	1265	768	2407
N Charter	339	275	212	128	142	105	375

Notes: Table displays exponentiated regression coefficients estimated with school-level panel data from 2012-2019. Regression sample includes public charter schools and TPS in districts with at least 200 students. The probability of one or more teachers is estimated with a probit model. The teacher count is estimated with the poisson regression model and conditioned on having at least one teacher for Black, Hispanic, and ESL. The teacher count is unconditioned for SPED. All estimates include school random effects. Schools with fewer than 10 subgroup students and closing schools in the final two years of operation are excluded. Robust standard errors are estimated from 100 bootstrapped replications. ** $p<0.01$, * $p<0.05$

Table 4. Regression Results for Charter Schools and Small TPS Subsample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Black		Hispanic		ESL		SPED
VARIABLES	probability	count	probability	count	probability	count	count
subgroup student count	1.0132**	1.0031**	1.0160**	1.0023**	1.0184**	1.0038**	1.0114**
	(0.0013)	(0.0001)	(0.0024)	(0.0002)	(0.0026)	(0.0002)	(0.0002)
chater school	5.8786**	1.5752**	6.8108**	1.0350	1.9598*	1.1374**	0.6516**
	(1.5949)	(0.0701)	(2.0820)	(0.0328)	(0.5527)	(0.0399)	(0.0217)
charter x student count	0.9977	0.9994**	0.9916**	1.0001	0.9901**	0.9980**	1.0016**
	(0.0018)	(0.0002)	(0.0026)	(0.0003)	(0.0033)	(0.0002)	(0.0006)
Observations	5,508	2,306	8,135	1,960	3,361	1,553	12,049
N TPS	736	276	1238	407	571	287	1511
N charter	305	251	188	116	138	102	329

Notes: Table displays exponentiated regression coefficients estimated with school-level panel data from 2012-2019. Regression sample includes public charter schools and TPS in small districts (200-4,000 students). The probability of one or more teachers is estimated with a probit model. The teacher count is estimated with the poisson regression model and conditioned on having at least one teacher for Black, Hispanic, and ESL. The teacher count is unconditioned for SPED. All estimates include school random effects. Schools with fewer than 10 subgroup students and closing schools in the final two years of operation are excluded. Robust standard errors are estimated from 100 bootstrapped replications. ** $p<0.01$, * $p<0.05$

Table 5. Regression Results for Charter Schools and Small TPS Subsamples in Urban Areas and Metro Detroit

Panel A: Schools in Urban Areas

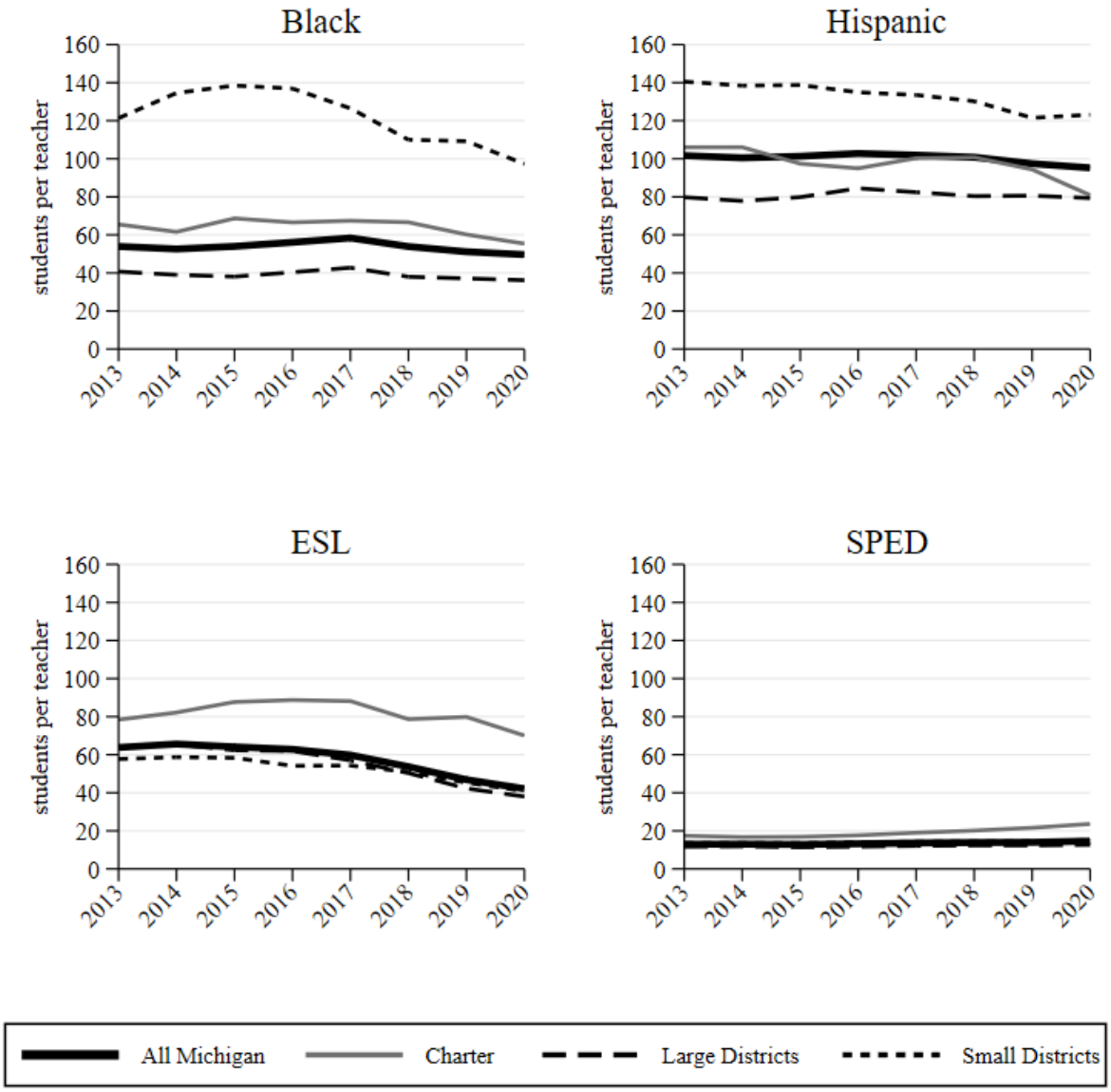
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Black		Hispanic		ESL		SPED
VARIABLES	probability	count	probability	count	probability	count	count
subgroup student count	1.0122**	1.0033**	1.0046*	1.0018**	1.0193**	1.0035**	1.0115**
	(0.0039)	(0.0003)	(0.0019)	(0.0005)	(0.0058)	(0.0004)	(0.0006)
chater school	3.6300	1.9075**	1.1846	0.9061	1.2887	1.0521	0.6509**
	(2.6197)	(0.1458)	(0.3360)	(0.0703)	(0.5317)	(0.0582)	(0.0454)
charter x student count	1.0008	0.9990**	1.0008	1.0006	0.9873*	0.9989*	1.0003
	(0.0037)	(0.0003)	(0.0017)	(0.0005)	(0.0057)	(0.0004)	(0.0010)
Observations	1,150	811	688	274	629	426	1,160
N TPS	81	54	76	43	63	52	80
N charter	117	109	53	35	43	38	118

Panel B: Schools in Metro Detroit

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Black		Hispanic		ESL		SPED
VARIABLES	probability	count	probability	count	probability	count	count
subgroup student count	1.0103**	1.0028**	1.0169**	1.0010	1.0163**	1.0039**	1.0107**
	(0.0016)	(0.0002)	(0.0061)	(0.0006)	(0.0042)	(0.0003)	(0.0003)
chater school	5.1192**	1.6603**	4.1974**	0.9976	1.3241	1.0797	0.5827**
	(2.1461)	(0.1101)	(2.0770)	(0.0428)	(0.4100)	(0.0587)	(0.0330)
charter x student count	1.0006	0.9996	0.9913	1.0014*	0.9905*	0.9978**	1.0042**
	(0.0019)	(0.0002)	(0.0051)	(0.0006)	(0.0044)	(0.0004)	(0.0009)
Observations	2,623	1,586	1,744	565	1,399	734	2,874
N TPS	244	146	231	91	193	111	273
N charter	208	189	90	58	91	67	210

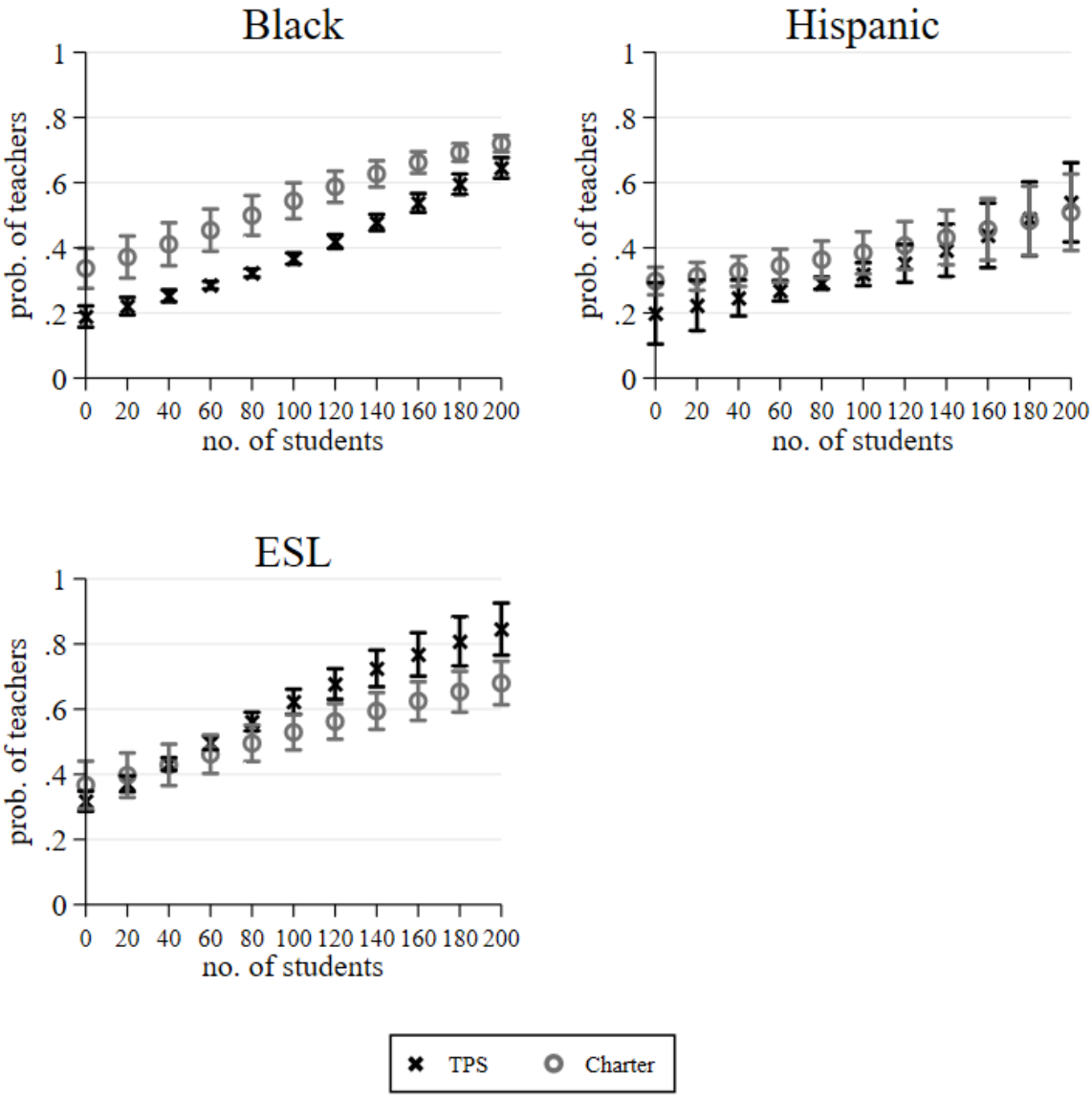
Notes: Table displays exponentiated regression coefficients estimated with school-level panel data from 2012-2019. Regression sample includes public charter schools and traditional schools in small districts (200-4,000 students). The urban subsample includes schools designated as "city" in NCES CCD geodata. The Detroit Metro subsample includes Wayne County and four adjacent suburban counties. The probability of one or more teachers is estimated with a probit model. The probability of one or more teachers is estimated with a probit model. The teacher count is estimated with the poisson regression model and conditioned on having at least one teacher for Black, Hispanic, and ESL. The teacher count is unconditioned for SPED. All estimates include school random effects. Schools with fewer than 10 subgroup students and closing schools in the final two years of operation are excluded. Robust standard errors are estimated from 100 bootstrapped replications. ** $p<0.01$, * $p<0.05$

Figure 1. Student:Teacher Ratios at Charter and District Schools



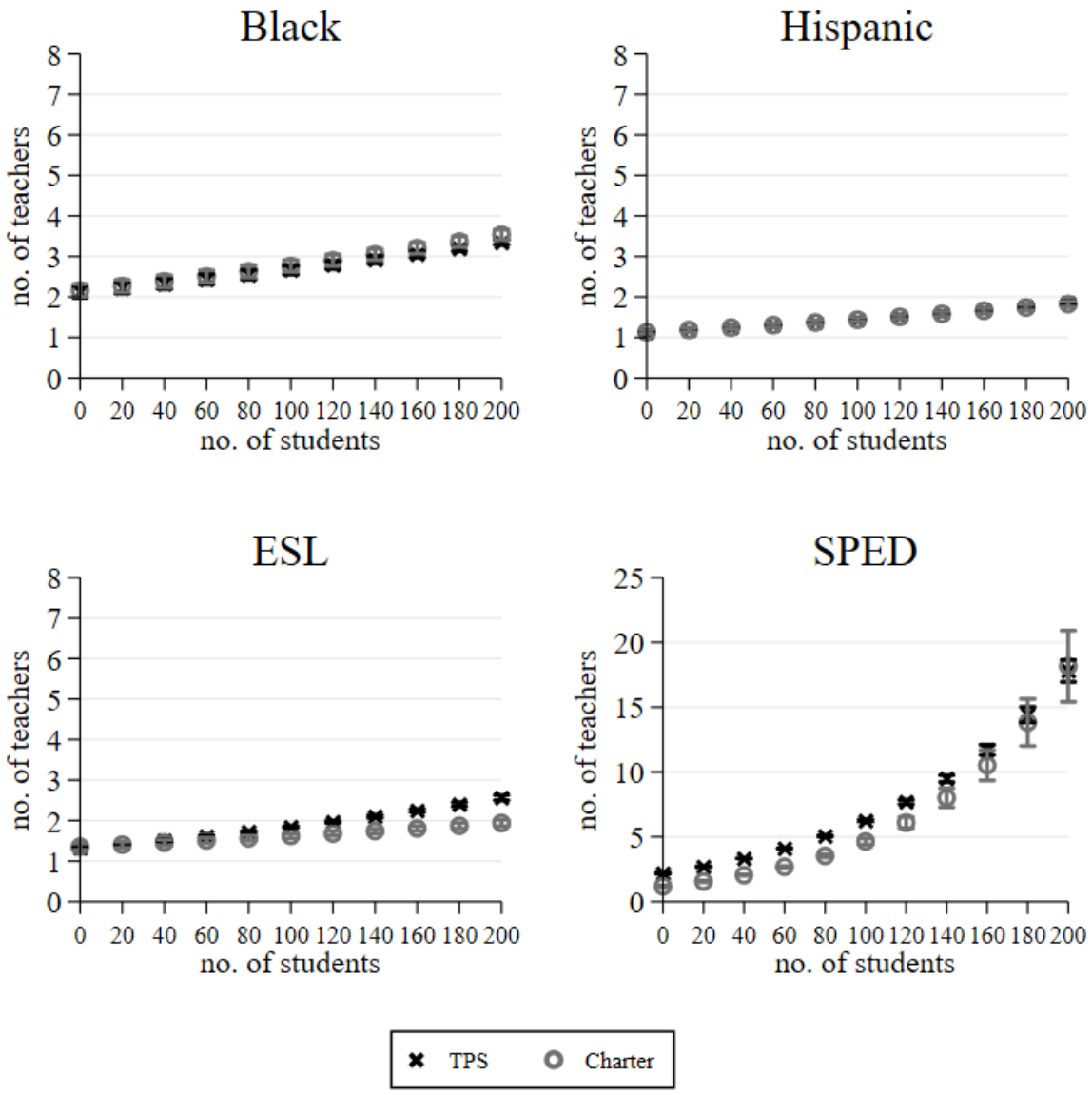
Notes: Author calculations from MDE data from 2012-2019. Small districts enroll 200-3,999 students. Large districts enroll at least 4,000 students.

Figure 2. Estimated Probability of Subgroup Teachers in Charter Schools and TPS



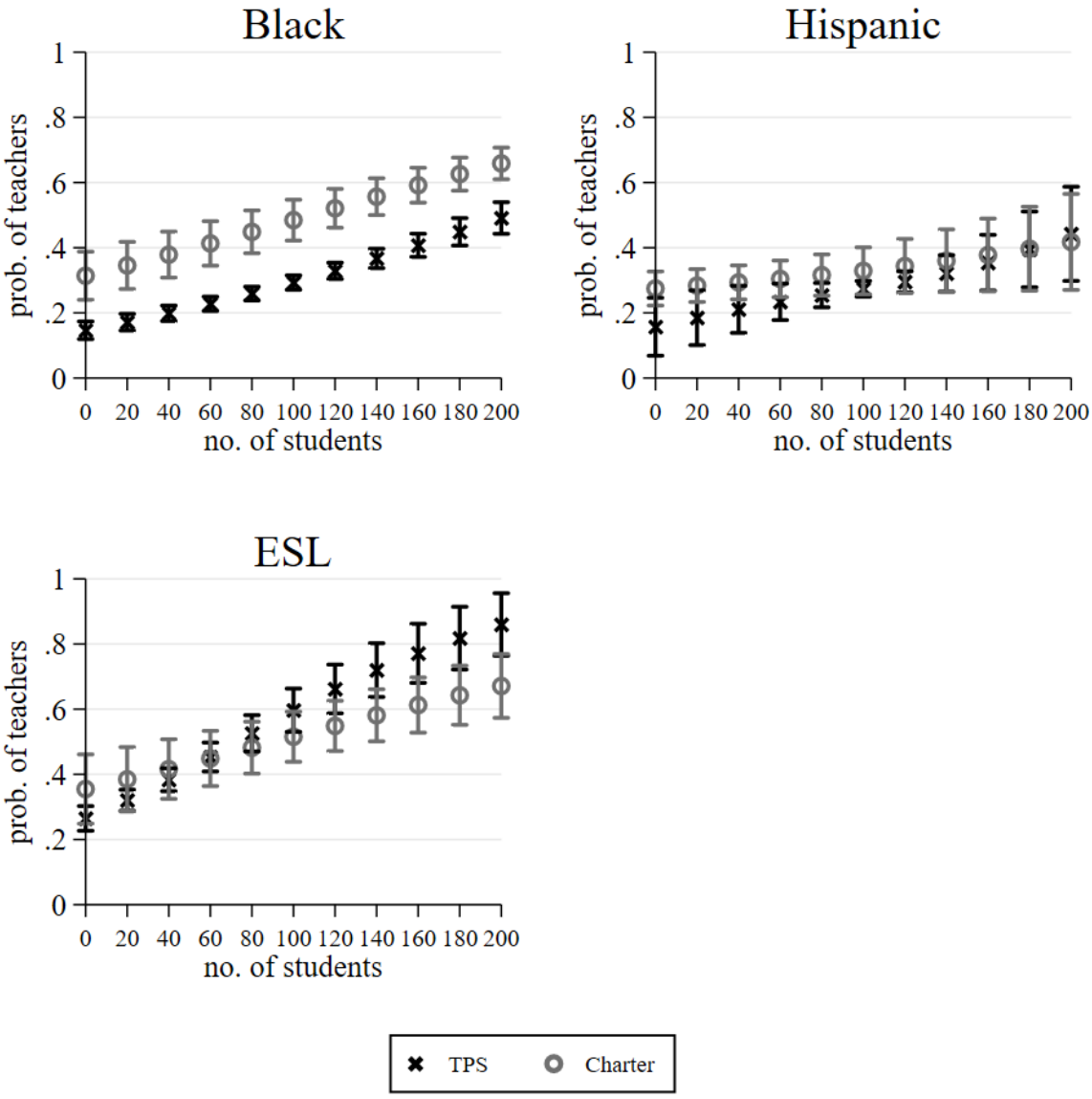
Notes: Estimates and confidence intervals based on probit regression results in Table 3.

Figure 3. Estimated Number of Subgroup Teachers in Charter Schools and Full TPS Sample



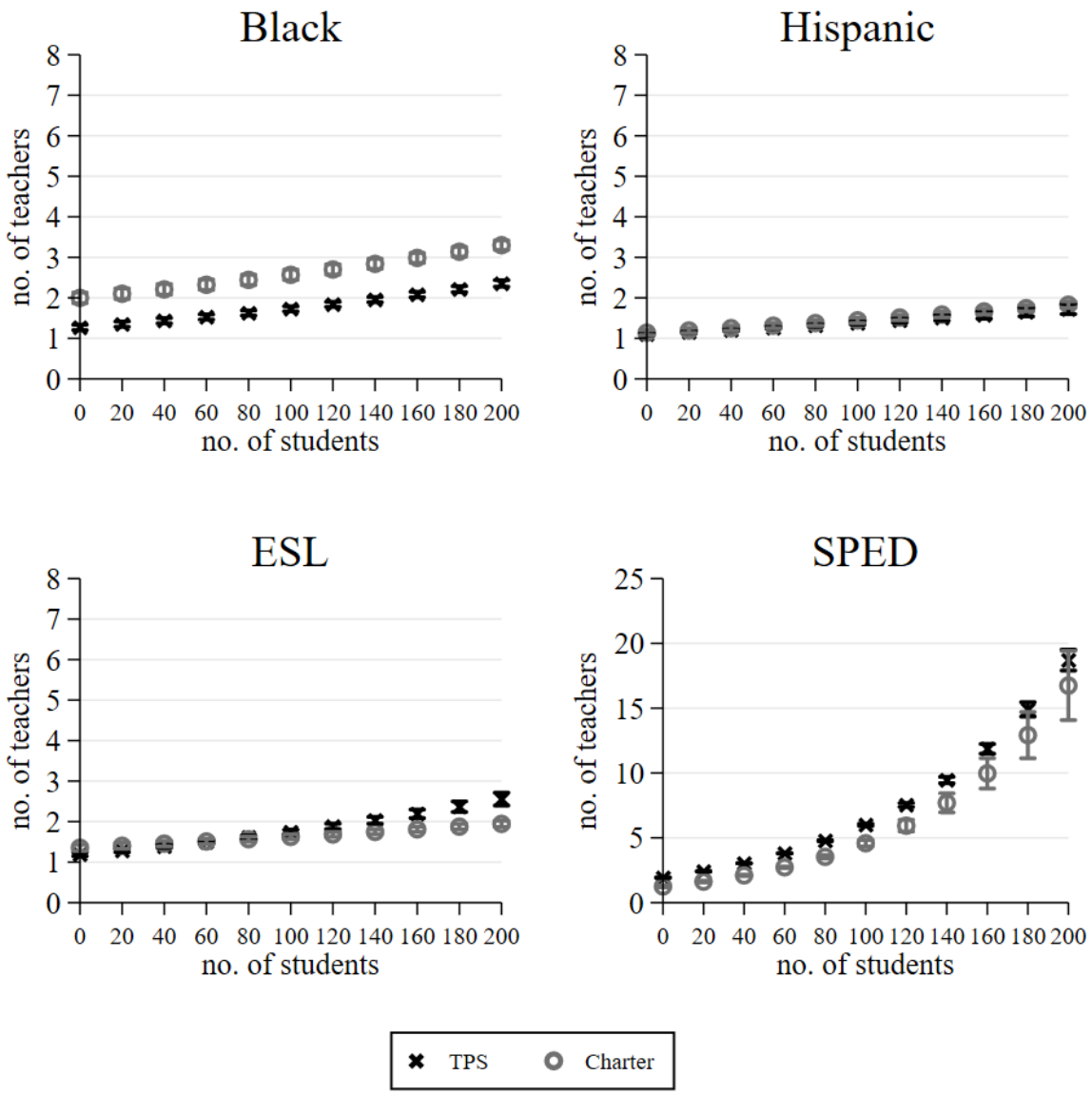
Notes: Estimates and confidence intervals based on poisson regression results in Table 3. Counts for Black, SPED, and ESL teachers are conditioned on having at least one teacher.

Figure 4. Estimated Probability of Subgroup Teachers in Charter Schools and TPS in Small District Subsample



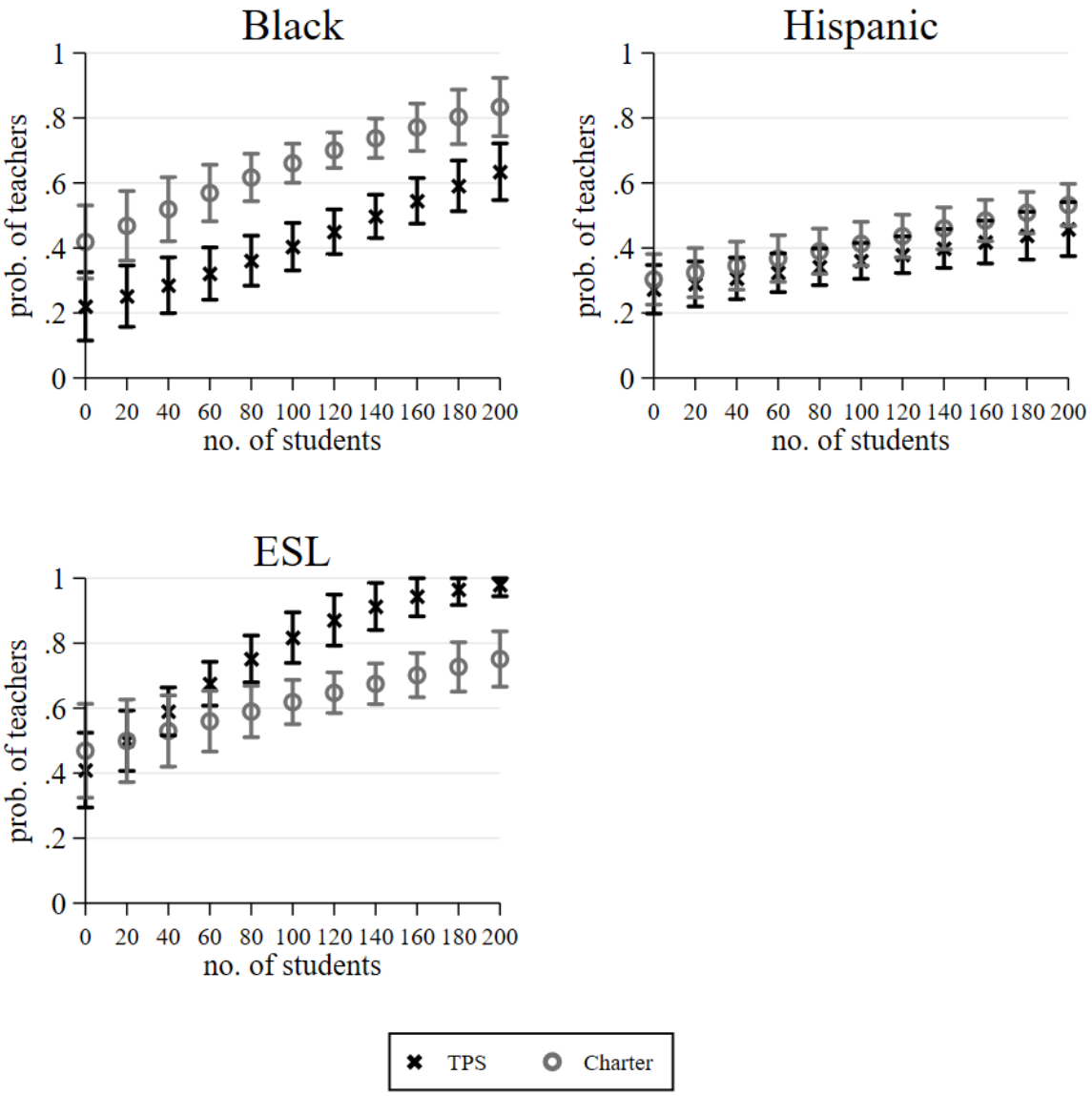
Notes: Estimates and confidence intervals based on probit regression results in Table 4.

Figure 5. Estimated Number of Subgroup Teachers in Charter Schools and Small TPS Subsample



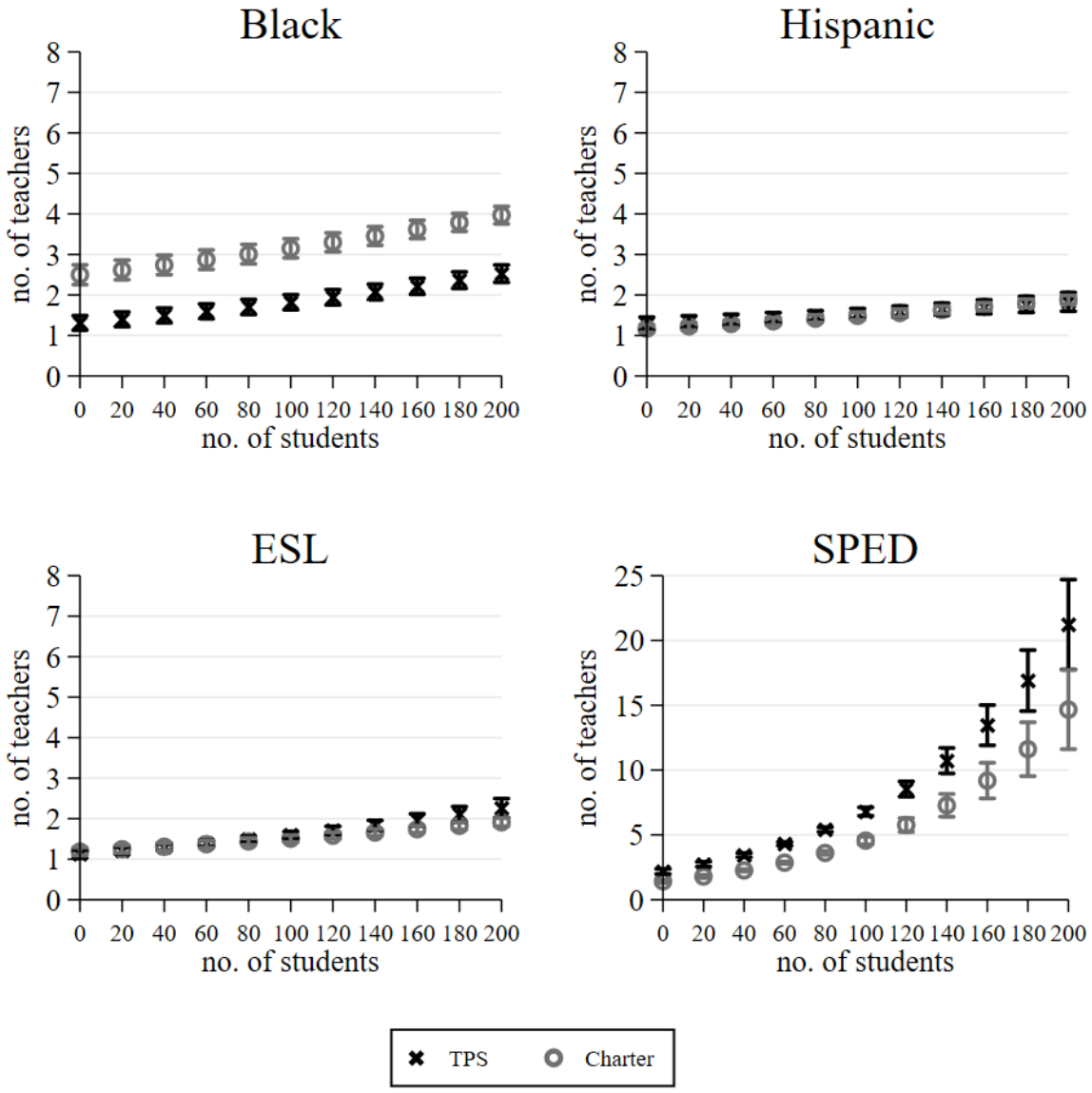
Notes: Estimates and confidence intervals based on poisson regression results in Table 4. Counts for Black, SPED, and ESL teachers are conditioned on having at least one teacher.

Figure 6. Estimated Probability of Subgroup Teachers in Charter and TPS in Small Districts, Urban Subset



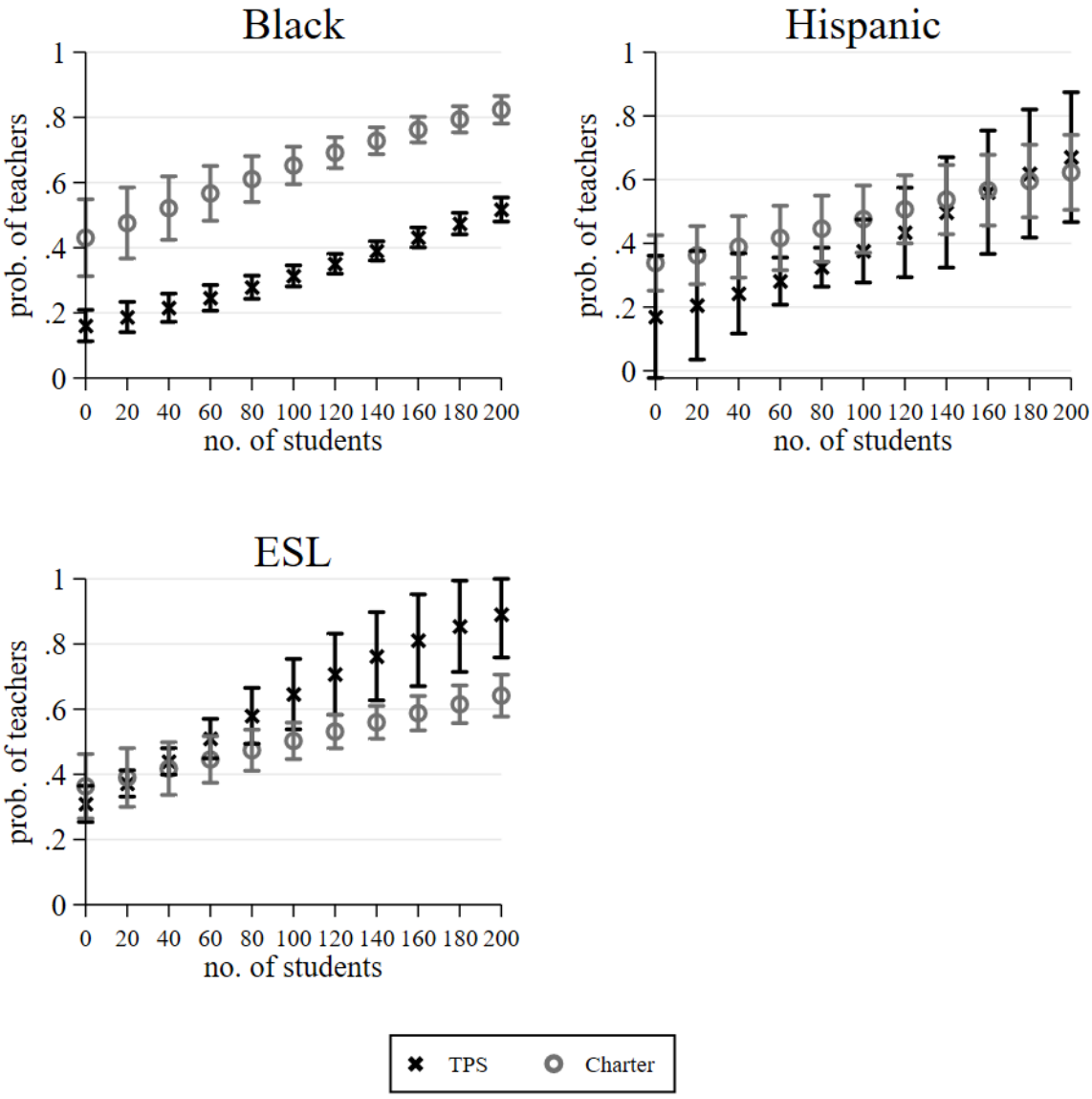
Notes: Estimates and confidence intervals based on probit regression results in Table 5, Panel A.

Figure 7. Estimated Number of Subgroup Teachers in Charter and TPS in Small Districts, Urban Subset



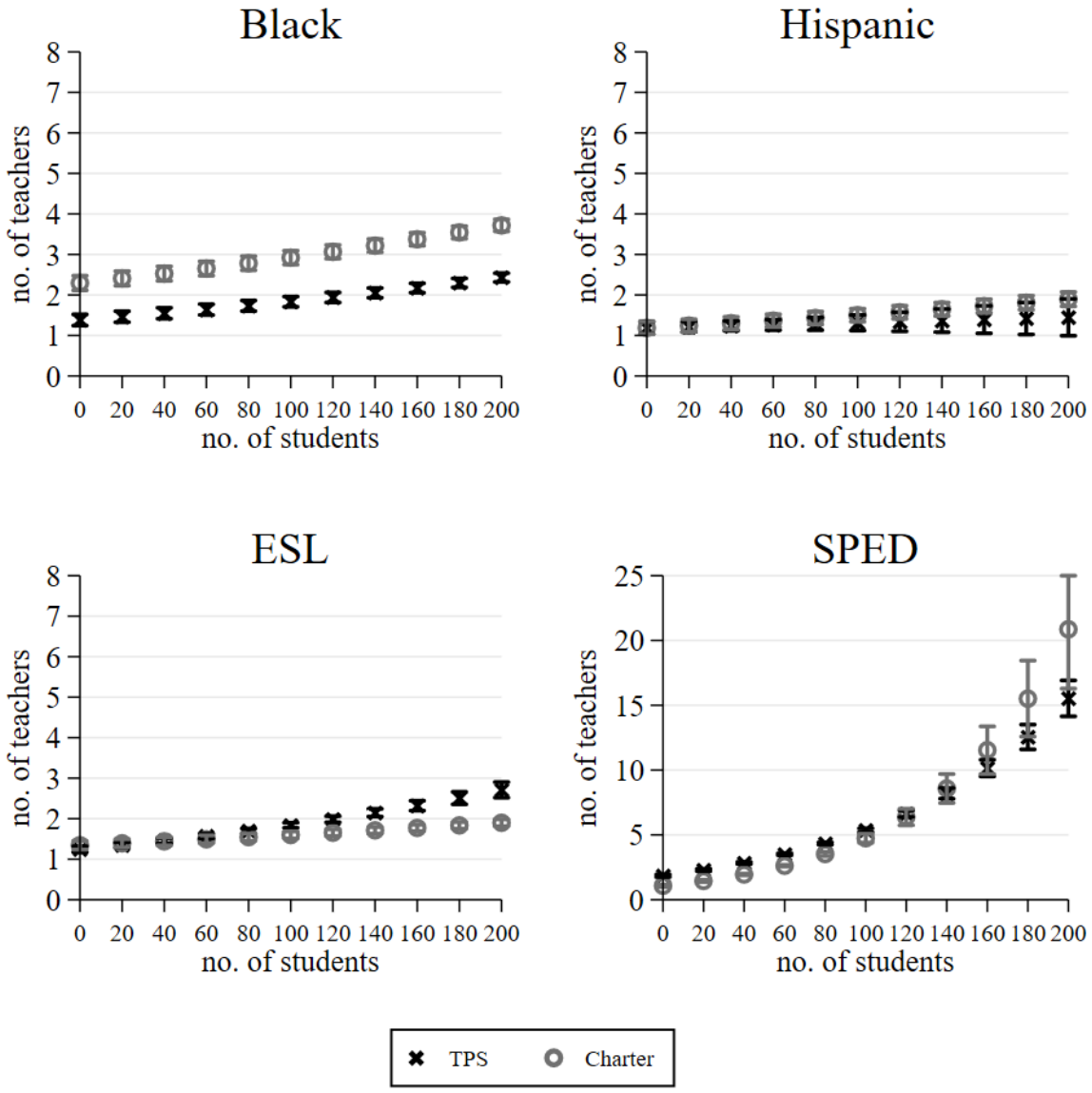
Notes: Estimates and confidence intervals based on poisson regression results in Table 5, Panel A. Counts for Black, SPED, and ESL teachers are conditioned on having at least one teacher.

Figure 8. Estimated Probability of Subgroup Teachers in Charter and TPS in Small Districts, Detroit Subset



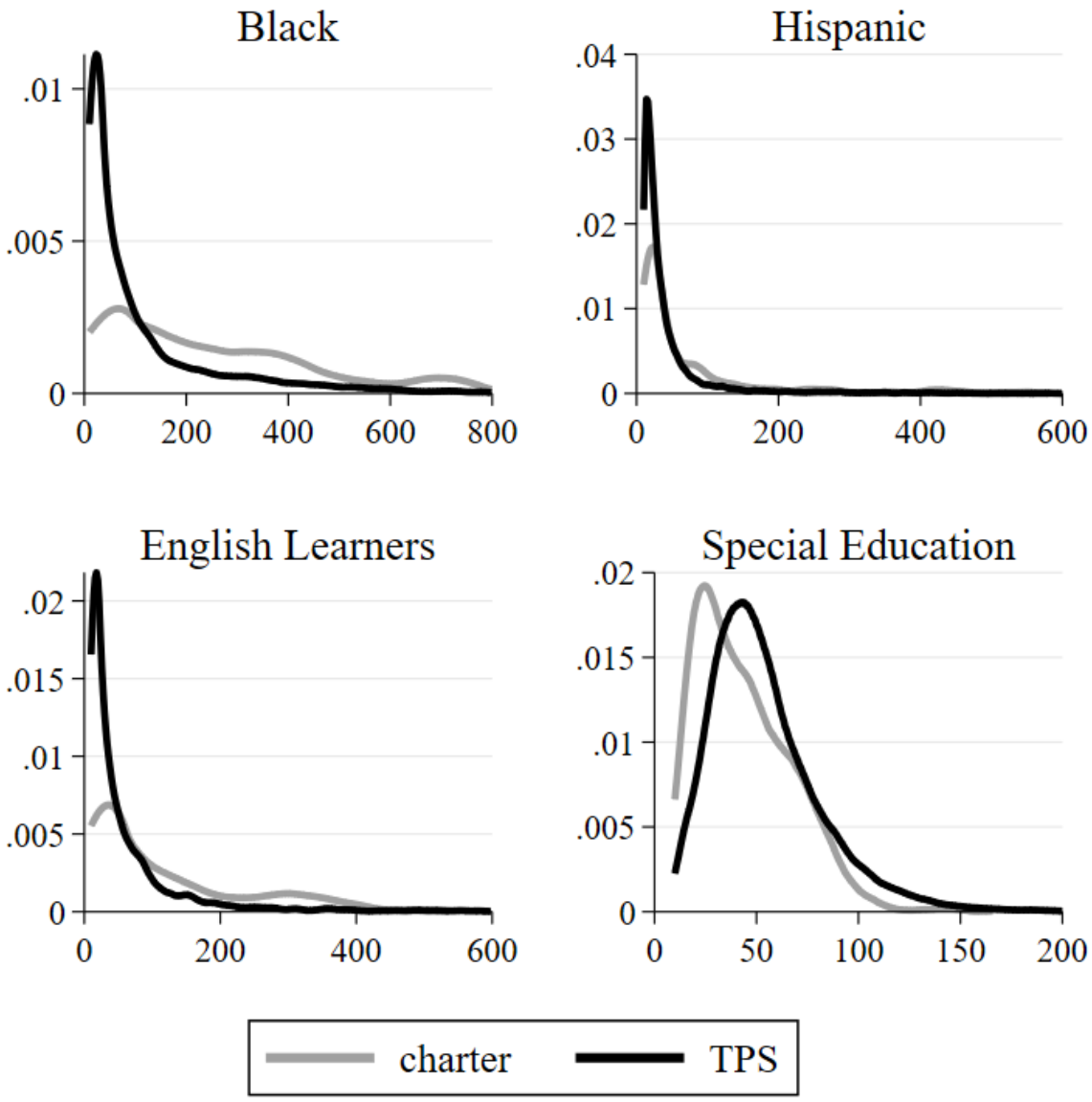
Notes: Estimates and confidence intervals based on probit regression results in Table 5, Panel B.

Figure 9. Estimated Number of Subgroup Teachers in Charter and TPS in Small Districts, Detroit Subset

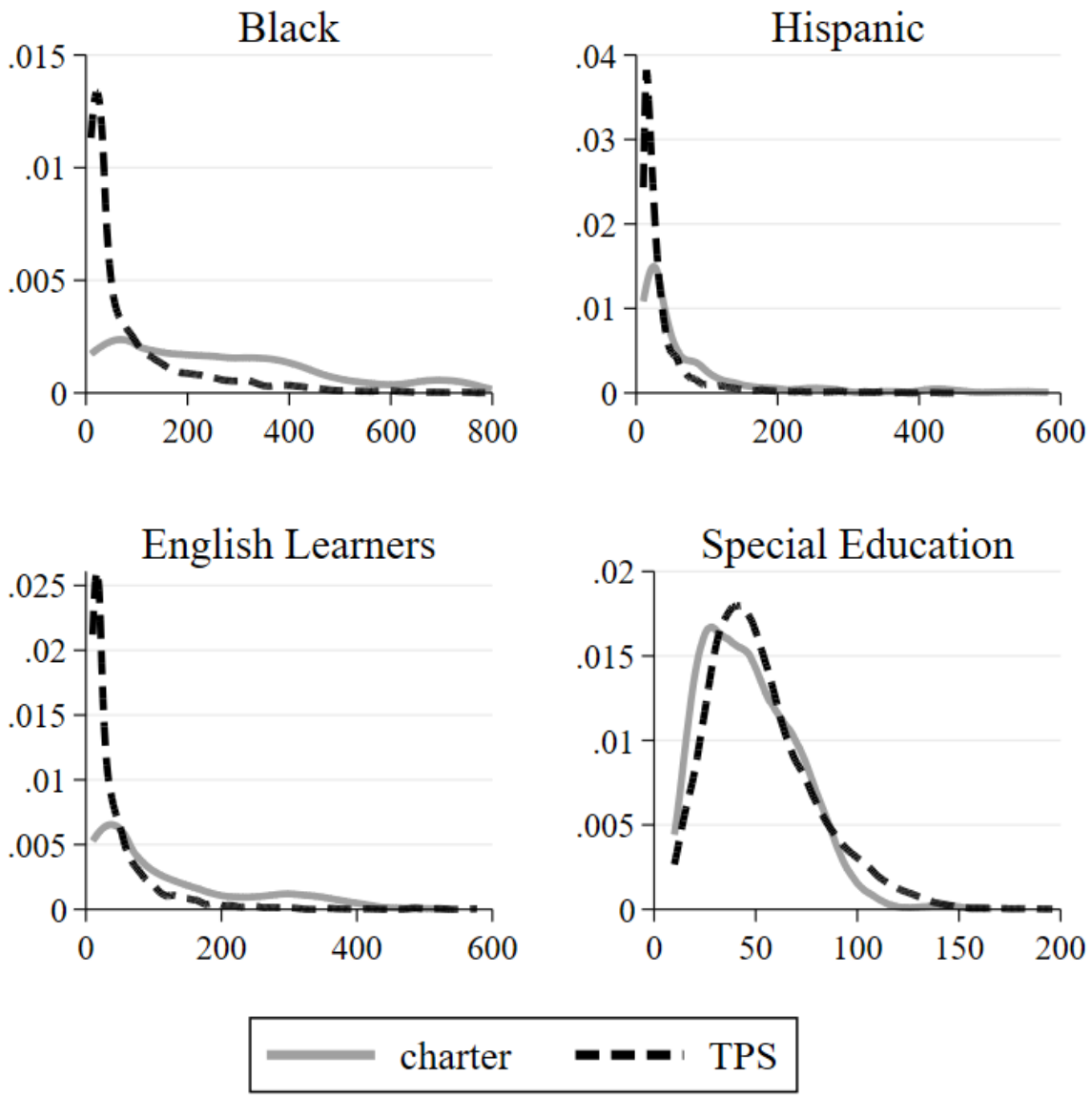


Notes: Estimates and confidence intervals based on poisson regression results in Table 5, Panel B. Counts for Black, SPED, and ESL teachers are conditioned on having at least one teacher.

Appendix 1. Distribution of Students in Subgroups at Charter and TPS – Full Sample



Appendix 2. Distribution of Students in Subgroups at Charter and TPS – Small TPS Sample



Appendix 3: Regression Robustness Checks for Black Subgroup

VARIABLES	(1) probability	(2) count: poisson	(3) probability	(4) count: poisson	(5) count: negative binomial
Black student count	1.0116**	1.0030**	1.0121**	1.0030**	1.0030**
	(0.0013)	(0.0001)	(0.0009)	(0.0002)	(0.0002)
charter school	3.6409**	1.2909**	4.4001**	1.2927**	1.3594**
	(1.1361)	(0.0742)	(1.0949)	(0.1025)	(0.1104)
charter school x Black student count	0.9983	0.9996**	0.9982	0.9996	0.9995*
	(0.0013)	(0.0001)	(0.0012)	(0.0002)	(0.0002)
% Economically disadvantaged	1.0217**	1.0055**			
	(0.0039)	(0.0008)			
% Special education	1.0128	1.0045			
	(0.0124)	(0.0033)			
% English learners	1.0071	1.0017			
	(0.0054)	(0.0011)			
median teacher experience	0.9761	0.9960			
	(0.0187)	(0.0043)			
teacher return rate	1.1615	0.6254**			
	(0.5061)	(0.0599)			
School random effects	x	x	x	x	x
Country random effects			x	x	x
Observations	5,508	2,306	5,508	2,306	2,306
N counties			57	32	32
N TPS	736	276	736	276	276
N Charter	305	251	305	251	251

Notes: Table displays exponentiated regression coefficients estimated with school-level panel data from 2012-2019. Regression sample includes public charter schools and traditional schools in small districts (200-4,000 students). The probability of one or more teachers is estimated with a probit model. The teacher count is conditioned on having at least one teacher. Schools with fewer than 10 Black students and closing schools in the final two years of operation are omitted.
** p<0.01, * p<0.05

Appendix 4: Regression Robustness Checks for Hispanic Subgroup

VARIABLES	(1) probability	(2) count: poisson	(3) probability	(4) count: poisson	(5) count: negative binomial
Hispanic student count	1.0152**	1.0022**	1.0156**	1.0023**	1.0022**
	(0.0024)	(0.0003)	(0.0016)	(0.0003)	(0.0003)
charter school	4.5811**	1.0095	5.5874**	1.0337	1.0418
	(1.9741)	(0.0458)	(1.4295)	(0.0693)	(0.0668)
charter school x Hispanic student count	0.9917*	1.0001	0.9914**	1.0001	1.0002
	(0.0035)	(0.0002)	(0.0021)	(0.0004)	(0.0004)
% Economically disadvantaged	1.0014	0.9997			
	(0.0042)	(0.0007)			
% Special education	1.0438**	1.0072*			
	(0.0149)	(0.0029)			
% English learners	1.0118	1.0012			
	(0.0097)	(0.0012)			
median teacher experience	0.9620*	0.9969			
	(0.0165)	(0.0030)			
teacher return rate	0.5619	0.9190			
	(0.2780)	(0.1176)			
School random effects	x	x	x	x	x
Country random effects			x	x	x
Observations	8,135	1,960	8,135	1,960	1,960
N counties			76	54	54
N TPS	1238	407	1238	407	407
N Charter	188	116	188	116	116

Notes: Table displays exponentiated regression coefficients estimated with school-level panel data from 2012-2019. Regression sample includes public charter schools and traditional schools in small districts (200-4,000 students). The probability of one or more teachers is estimated with a probit model. The teacher count is conditioned on having at least one teacher. Schools with fewer than 10 Hispanic students and closing schools in the final two years of operation are omitted. ** $p<0.01$, * $p<0.05$

Appendix 5: Regression Robustness Checks for EL/ESL Subgroup

VARIABLES	(1) probability	(2) count: poisson	(3) probability	(4) count: poisson	(5) count: negative binomial
English Learner student count	1.0184**	1.0040**	1.0160**	1.0038**	1.0038**
	(0.0028)	(0.0003)	(0.0019)	(0.0003)	(0.0003)
charter school	1.7651	1.1448**	1.1363	1.1374	1.1374
	(0.6618)	(0.0495)	(0.2748)	(0.0945)	(0.0945)
charter school x EL count	0.9902**	0.9980**	0.9923**	0.9980**	0.9980**
	(0.0032)	(0.0003)	(0.0022)	(0.0005)	(0.0005)
% Economically disadvantaged	1.0000	0.9980**			
	(0.0044)	(0.0007)			
% Special education	1.0041	1.0003			
	(0.0170)	(0.0031)			
median teacher experience	0.9746	0.9984			
	(0.0213)	(0.0038)			
teacher return rate	2.0727	1.0417			
	(1.4618)	(0.1957)			
School random effects	x	x	x	x	x
Country random effects			x	x	x
Observations	3,361	1,553	3,361	1,553	1,553
N counties			46	34	34
N TPS	571	287	571	287	287
N charters	138	102	138	102	102

Notes: Table displays exponentiated regression coefficients estimated with school-level panel data from 2012-2019. Regression sample includes public charter schools and traditional schools in small districts (200-4,000 students). The probability of one or more teachers is estimated with a probit model. The teacher count is conditioned on having at least one teacher. Schools with fewer than 10 English Learner students and closing schools in the final two years of operation are omitted. ** $p<0.01$, * $p<0.05$

Appendix 6: Robustness Checks for SPED Subgroup

VARIABLES	(1) probability	(2) count: poisson	(3) count: negative binomial
Special education student count	1.0115**	1.0120**	1.0120**
	(0.0001)	(0.0003)	(0.0003)
charter school	0.7090**	0.6987**	0.6987**
	(0.0250)	(0.0379)	(0.0379)
charter school x SPED student count	1.0016**	1.0014	1.0014
	(0.0005)	(0.0009)	(0.0009)
% Economically disadvantaged	0.9967**		
	(0.0002)		
% English learners	1.0024**		
	(0.0004)		
median teacher experience	1.0024*		
	(0.0011)		
teacher return rate	1.0751		
	(0.0641)		
School random effects	x	x	x
Country random effects		x	x
Observations	12,049	12,049	12,049
N counties		82	82
N TPS	1511	1511	1511
N charters	329	329	329

Notes: Table displays exponentiated regression coefficients estimated with school-level panel data from 2012-2019. Regression sample includes public charter schools and traditional schools in small districts (200-4,000 students). Schools with fewer than 10 special education students and closing schools in the final two years of operation are omitted. ** $p<0.01$, * $p<0.05$