Do Low-Income Students Have Equal Access to Effective Teachers? Evidence from 26 Districts

October 2016

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Effie Metropoulos edited the report, Laura Sarnoski and Brigitte Tran created graphics for the report, and Sharon Clark carefully prepared the report for publication.

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EXECUTIVE SUMMARY

Inequity in educational outcomes is substantial and persistent in the United States. Students from high-income families outperform those from low-income families on achievement tests and educational attainment (Reardon 2011; Chetty et al. 2014a; U.S. Department of Education 2014). Recent policy initiatives to address these gaps have emphasized teachers' contributions to student achievement. These policy efforts are supported by evidence showing that teachers vary a great deal in their effectiveness (Rockoff 2004; Rivkin et al. 2005; Kane et al. 2008; Aaronson et al. 2007; Koedel and Betts 2009).

A key question for policymakers is whether inequality in educational outcomes is caused by differences in students' access to effective teachers. Are students from low-income families taught by less effective teachers than students from high-income families? Would a more equitable distribution of effective teachers narrow the gap in achievement between high- and low-income students?

In this report, we examine whether low-income students are taught by less effective teachers than high-income students, and if so, whether reducing this inequity would close the student achievement gap. We also describe how the hiring of teachers and their subsequent movement into and out of schools could affect low-income students' access to effective teachers. To measure teacher effectiveness, we used a value-added model, a statistical approach to measure a teacher's contribution to student learning, based on students' performance on achievement tests. The study includes fourth- to eighth-grade teachers over five school years (2008-2009 to 2012-2013) in 26 school districts across the country.

The main findings are:

- **There are small differences in the effectiveness of teachers of high- and low-income students in the average study district.** In both subjects, differences in the effectiveness of teachers of high- and low-income students are one percentile point, on average. The average teacher of a low-income student is just below the 50th percentile, while the average teacher of a high-income student is at the 51st percentile. As a result, providing low-income students with at least equally effective teachers typically would not substantively reduce the student achievement gap. In addition, high- and low-income students have similar chances of being taught by the most effective teachers and the least effective teachers. In ELA, for example, 10 percent of both high- and low-income students are taught by one of the top 10 percent of teachers in a district, while 9 percent of high-income students and 10 percent of low-income students are taught by one of the bottom 10 percent of teachers.
- **Teacher hiring patterns are consistent with small differences in the effectiveness of teachers of high- and low-income students.** The teachers hired into high-poverty schools are equally effective as those hired into low-poverty schools. These new hires are less effective than the average teacher, with value added at the 39th percentile on average (-0.05 standard deviations of student achievement). High-poverty schools have more new hires than low-poverty schools, but this difference is likely to have only a small influence on equity because (1) the difference itself is small (11 percent of teachers in high-poverty schools are new hires compared to 5 percent in low-poverty schools), and (2) new hire

performance improves quickly. On average, new hires become as effective as the average teacher after one year.

- **Teacher transfer patterns are also consistent with small differences in the effectiveness of teachers of high- and low-income students.** On average, teachers who transfer to schools in a lower poverty category within a district—such as from high- to medium- or low-poverty schools—are nearly as effective as the average district teacher (with value added at the 48th percentile). Teachers who transfer to schools in a higher poverty category are significantly less effective than the average district teacher (43rd percentile). These differences are likely to have a small influence on equity since just under 4 percent of all teachers transfer to a school in a higher or lower poverty category (a little less than 2 percent from higher- to lower-poverty and less than 2 percent from lower- to higher-poverty). A little more than 4 percent of all teachers move between schools with similar poverty rates.
- **Teacher attrition patterns do not contribute to differences in the effectiveness of teachers of high- and low-income students.** The teachers who leave a district from both high- and low-poverty schools are less effective than the average district teacher. The average leaver from high-poverty schools is at the 43rd percentile and the average leaver from low-poverty schools is at the 46th percentile, but this difference is not statistically significant. More of these teachers leave high-poverty schools than low-poverty schools (10 versus 7 percent). This attrition likely does not lead to greater inequity in access to effective teachers because the teachers leaving high- and low-poverty schools are equally effective.
- **In a small subset of study districts, there is meaningful inequity in access to effective teachers in math.** In 3 of 26 study districts in math, providing high- and low-income students with equally effective teachers from grade four to eight would reduce the student achievement gap by at least a tenth of a standard deviation of student achievement, the equivalent of about 4 percentile points over a five year period. In these districts, differences between teachers of high- and low-income students are large enough to meaningfully contribute to the existing student achievement gap. We also examined the correlation of district-level measures of inequity with patterns of hiring, transfer, and attrition in a district. We found that inequity in access to effective teachers is greater in study districts where new hires in high-poverty schools are less effective than those in low-poverty schools.

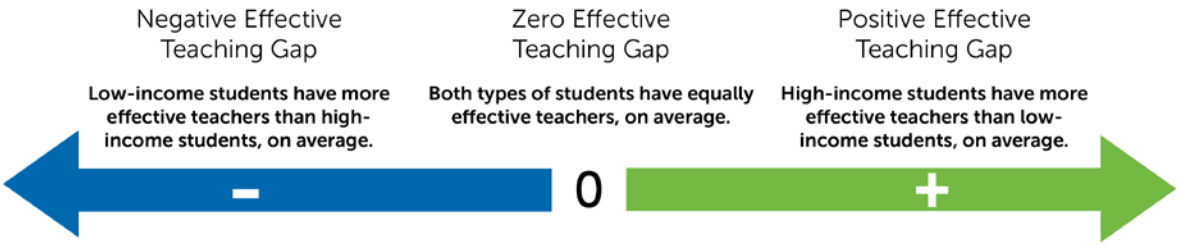
Research questions and study design

The U.S. Department of Education's Institute of Education Sciences (IES) contracted with Mathematica Policy Research to examine low-income students' access to effective teachers in a set of diverse school districts. The study addresses the following research questions:

1. Are low-income students taught by less effective teachers than high-income students? If so, to what extent would providing equal access to effective teachers reduce the student achievement gap?
2. Are there differences between high- and low-poverty schools in teacher hiring, transfer, and attrition? If so, are they consistent with inequitable access to effective teachers for low-income students?

To determine whether low-income students have equal access to effective teachers, we compare the average effectiveness of teachers of high- and low-income students, a difference known as the Effective Teaching Gap. It describes whether high-income students have more effective teachers than low-income students (a positive Effective Teaching Gap), low-income students have more effective teachers than high-income students (a negative Effective Teaching Gap), or the two types of students have equally effective teachers (a zero Effective Teaching Gap) (Figure ES.1). We defined students who are eligible for a free or reduced-price school lunch as low-income; all other students were defined as high-income. We did not compare the average characteristics or credentials of teachers of high- and low-income students because research has shown that they are not consistently related to teacher effectiveness—with the exception of teacher experience (Hanushek and Rivkin 2006; Kane et al. 2008; Constantine et al. 2009; Harris and Sass 2011). Instead, we measure teacher effectiveness using a value-added model, as described below.

Figure ES.1. Interpreting the Effective Teaching Gap



To better understand the factors that influence the Effective Teaching Gap, the study team measured the number and effectiveness of teachers (1) hired into high- and low-poverty schools, (2) transferring between high- and low-poverty schools, and (3) leaving the district from each type of school.

Study Design

Sample. We examined access to effective teachers in English/language arts (ELA) and math among students in 26 study districts, with grades four to eight in 12 districts and—due to data limitations—grades six to eight in the remaining 14 districts. We report results from the 2008–2009 through 2012–2013 school years for 21 districts, and results from the 2007–2008 through 2009–2010 school years for the other 5 districts.

Measuring Teacher Effectiveness. To measure teacher effectiveness, we used a value-added model, a statistical approach to isolate a teacher's contribution to student achievement. It measures the achievement levels of a teacher's students after accounting for students' prior achievement levels and other characteristics, as well as the characteristics of other students in the classroom. A value-added model predicts the test score each student would have achieved with the average teacher in the district, and then compares the average actual performance of a given teacher's students to the average of these students' predicted scores. The difference between the two scores is the teacher's value-added estimate. One limitation of value added is that if students in different classrooms differ on unmeasured characteristics, and those characteristics are related to student learning, that may lead to bias in the value-added estimates. The value-added scores are converted into teacher percentiles, which rank teachers from least effective (1st percentile) to most effective (99th percentile), with the average teacher at the 50th percentile.

Data. We collected standardized student test scores from state assessments in grades three to eight, a set of student characteristics (free or reduced-price lunch status, limited English proficiency, special education status, gender, race, and ethnicity), school enrollment data for students, and teacher-student-course links indicating the teacher responsible for teaching ELA and/or math to each student. We also collected information on district policies through interviews with senior district officials and staff.

Measuring Access to Effective Teaching. We measured access to effective teachers within each district using four steps to calculate the Effective Teaching Gap:

Step 1: Measure the effectiveness of each teacher in the district using a value-added model.

Step 2: Assign each student in the district the value added of his or her teacher in the relevant subject. This value-added estimate represents the effectiveness of each student's teacher for a given subject.

Step 3: Calculate average teacher value added for low-income students and for high-income students, identifying low-income students as those who are eligible for a free or reduced-price lunch.

Step 4: Subtract the average value added for low-income students from the average value added for high-income students in the district. This difference is the Effective Teaching Gap.

Measuring Patterns of Teacher Hiring, Development, Transfer, and Attrition. We defined teachers who enter a district as ***new hires***, those who move between schools as ***transfers***, and those who leave a district as ***leavers***. Teachers who do not move at all between school years are ***stayers***. We measured the percentage of teachers in each of these categories and their effectiveness, comparing patterns in schools with many low-income students (high-poverty schools) and those with fewer low-income students (medium- or low-poverty schools). For this analysis, low-poverty schools are those with less than 60 percent of students eligible for a free or reduced-price lunch, medium-poverty schools have 60 to 90 percent of students who are eligible, and high-poverty schools have more than 90 percent of students who are eligible.

District context

Although we did not use a nationally representative sample of districts, the study districts were chosen to be geographically diverse, with at least three districts from each of the four U.S. Census regions. The districts are similar to the 100 largest U.S. districts, on average. Median district enrollment is approximately 70,000 students, and there are more low-income and minority students than the typical U.S. district. In study districts, 63 percent of the students are eligible for free or reduced-price lunch, 29 percent are black, and 42 percent are Hispanic. Overall, achievement levels of students in study districts lag behind the average achievement levels of other students in their respective states by about 4 to 5 percentile points.

In two key ways, the study districts reflect national patterns. First, student achievement gaps in study districts mirror those at the national level. Among 8th grade students, the typical low-income student in the study districts performs 26 to 27 percentile points lower on state achievement tests than the typical high-income student. This achievement gap is similar to the national achievement gap on the National Assessment of Educational Progress (NAEP). Second, there is substantial variation in teacher effectiveness.

Detailed summary of findings

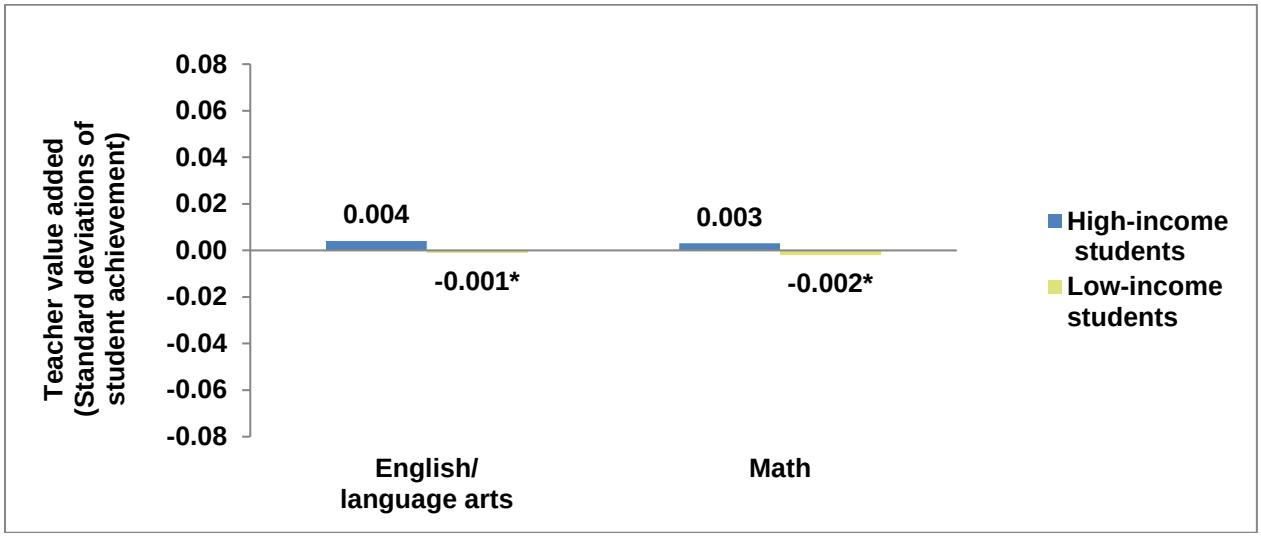
Are low-income students taught by less effective teachers than high-income students? To what extent could providing equal access to effective teachers reduce the student achievement gap?

We describe low-income students' access to effective teachers in 26 school districts for five years, from 2008–2009 to 2012–2013. We report results for the average study district to characterize the overall pattern across the 26 districts in our sample in a relatively straightforward way. Moreover, as we show below, the results for most study districts are similar to the results for the average study district. Consequently, the sample-wide average meaningfully captures low-income students' access to effective teachers in most of the districts we studied. However, because the patterns differ from the overall average in a few study districts, we also discuss low-income students' access to effective teachers for individual districts.

There are small differences in the effectiveness of teachers of high- and low-income students in the average study district

On average across study districts, high-income students have more effective teachers than low-income students, but the differences are small. In English/Language Arts (ELA), average teacher value added is 0.004 standard deviations of student achievement for high-income students and -0.001 for low-income students. This results in a statistically significant difference of 0.005—the Effective Teaching Gap in ELA (Figure ES.2). In math, the Effective Teaching Gap is 0.004 and is also statistically significant. In both subjects, the average teacher of a low-income student is just below the 50th percentile, while the average teacher of a high-income student is at the 51st percentile, indicating nearly equitable access to effective teaching in most study districts. The Effective Teaching Gap in both subjects has remained stable over time.

Figure ES.2. Average teacher effectiveness for low-income and high-income students (standard deviations of student achievement)

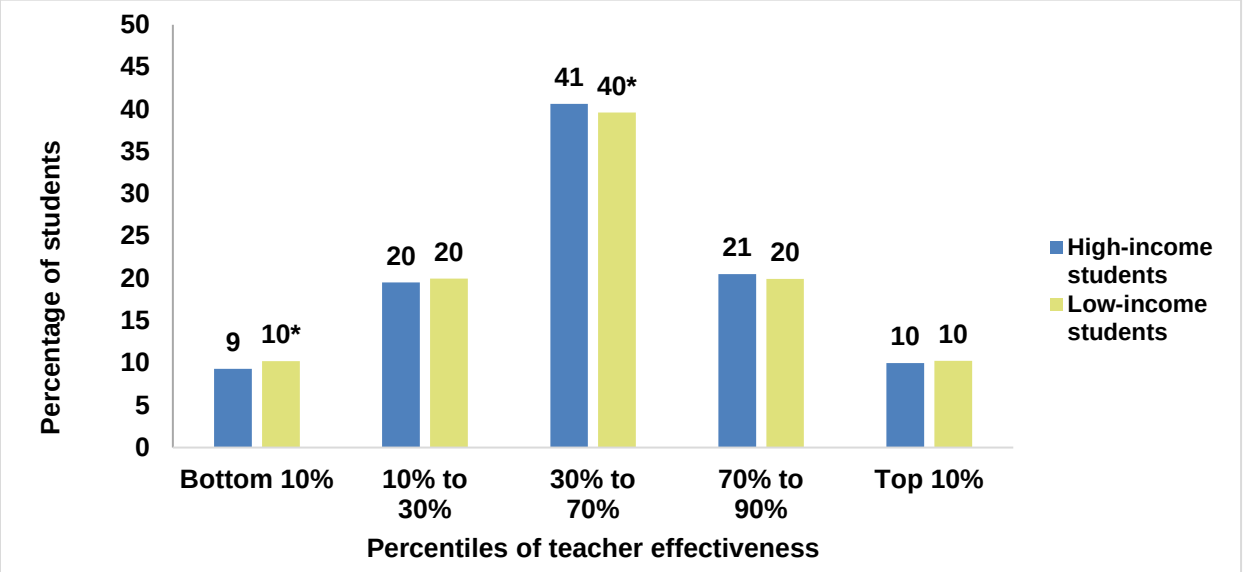


Source: Author's calculations based on district administrative data.

Note: Results are based on 26 districts for years 1 to 5, including grades 4 to 8 for 12 districts and grades 6 to 8 for 14 districts. District-level results are weighted across grades and years by the number of students. Overall results are weighted equally across districts. These results are based on a value-added model that accounts for classroom characteristics.
* Differences in the value added of the teachers of high-income and low-income students are statistically significant at the 0.05 level, two-tailed test.

High- and low-income students have similar chances of having one of the most effective teachers or one of the least effective teachers within study districts. We examined the likelihood that high- and low-income students are taught by teachers with value added in the top or bottom 10 percent of district teachers. In both subjects, 10 percent of high- and low-income students have one of the most effective teachers, on average (Figures ES.3 and ES.4). In ELA, 10 percent of low-income students have one of the least effective teachers compared with 9 percent of high-income students (this difference is statistically significant, but less than one percentage point). In math, among both groups of students, 10 percent have one of the least effective teachers. Thus, the small Effective Teaching Gap does not appear to be concealing larger differences in students' chances of having the most effective or least effective teachers in the district.

Figure ES.3. Percentage of low-income and high-income students taught by teachers at different levels of effectiveness, English/language arts

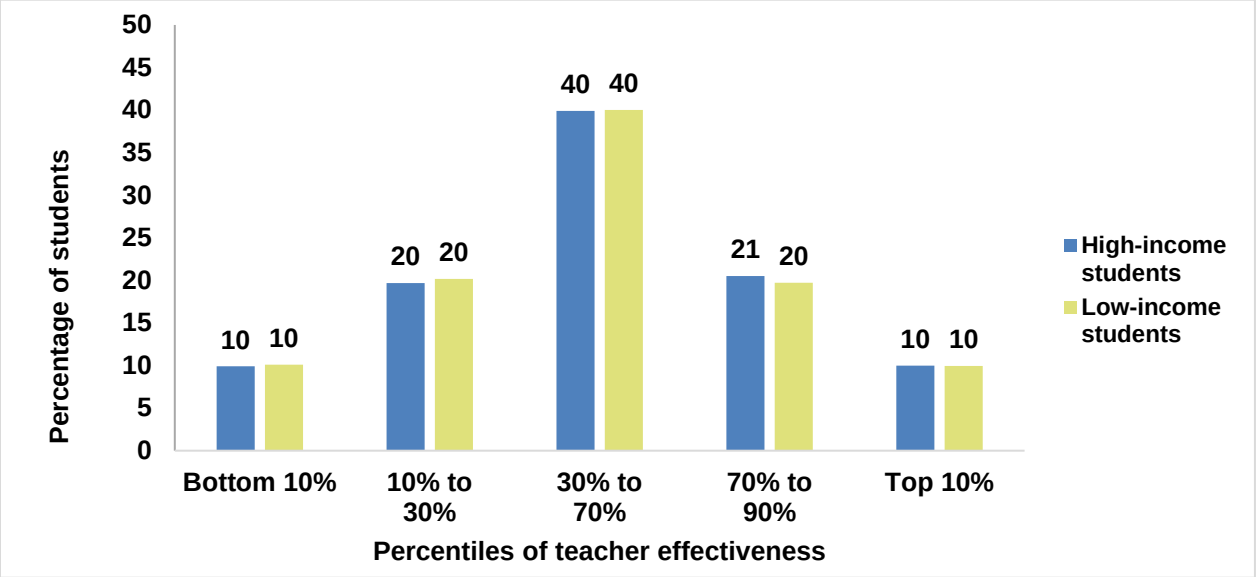


Source: Author's calculations based on district administrative data.

Note: Results are based on 26 districts for years 1 to 5, including grades 4 to 8 for 12 districts and grades 6 to 8 for 14 districts. District-level results are weighted across grades and years by the number of students. Overall results are weighted equally across districts. These results are based on a value-added model that accounts for classroom characteristics.

* Differences in the percentage of low-income and high-income students are statistically significant at the 0.05 level, two-tailed test.

Figure ES.4. Percentage of low-income and high-income students taught by teachers at different levels of effectiveness, math



Source: Author's calculations based on district administrative data.

Note: Results are based on 26 districts for years 1 to 5, including grades 4 to 8 for 12 districts and grades 6 to 8 for 14 districts. District-level results are weighted across grades and years by the number of students. Overall results are weighted equally across districts. These results are based on a value-added model that accounts for classroom characteristics.

* Differences in the percentage of low-income and high-income students are statistically significant at the 0.05 level, two-tailed test.

If low-income students had teachers at least as effective as those of high-income students, this would not substantially reduce the student achievement gap. In the average district in ELA, a typical high-income student has achievement at the 61st percentile and the typical low-income student is at the 35th percentile—a student achievement gap of 25.1 percentile points. The gap in math is 24.5 points. Providing low-income students with teachers at least as effective as those of high-income students every year from 4th through 8th grade would have relatively little effect on the student achievement gap in the average study district. We found that this would reduce the student achievement gap in 8th grade in the average district from 25.1 to 24.2 percentile points in ELA and from 24.5 to 22.3 percentile points in math.

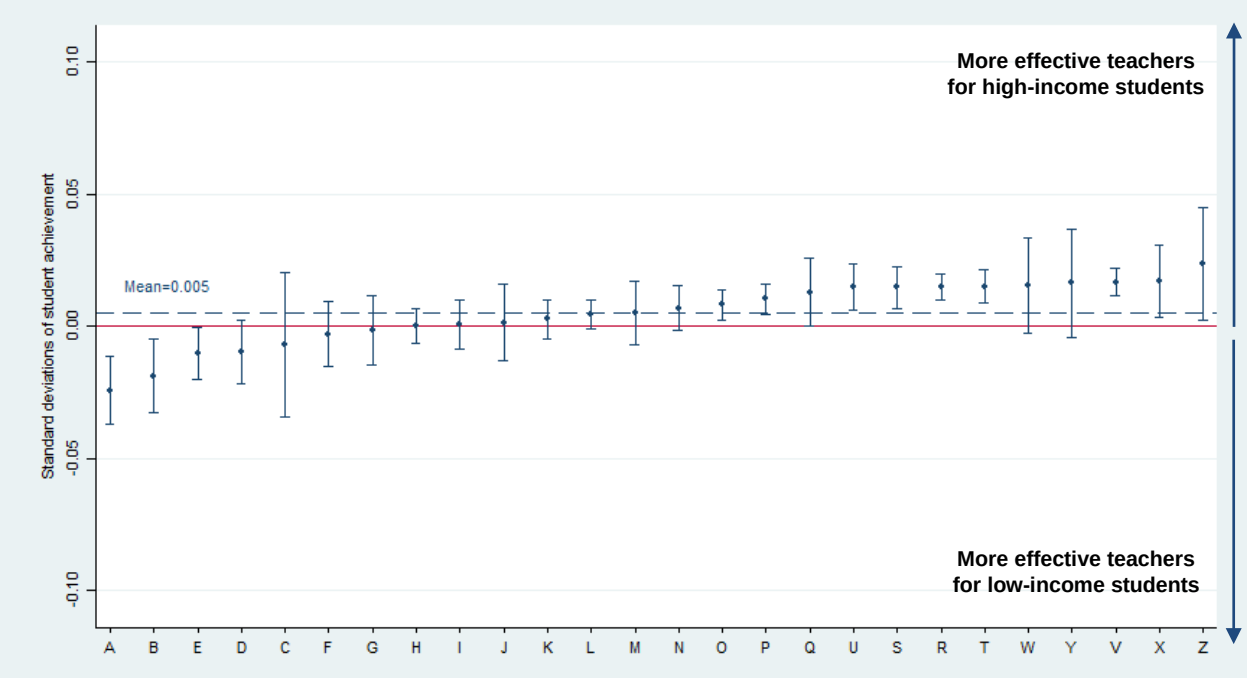
In a small subset of study districts, there is meaningful inequity in access to effective teachers in math

We characterized study districts as having meaningful inequity in access to effective teaching if eliminating this inequity for five consecutive years would reduce the student achievement gap between high- and low-income students by a tenth of a standard deviation of student achievement, or about 4 percentile points (this threshold is equivalent to an Effective Teaching Gap of 0.034 in ELA and 0.028 in math).[1] The Effective Teaching Gaps for each study district are shown in Figures ES.5 and ES.6 below.

[1] We defined a threshold for this analysis because the statistical significance of the Effective Teaching Gap is not a useful indicator of practical significance or importance of the difference between the effectiveness of teachers of

There is evidence of meaningful inequity in a few study districts in math, with low-income students receiving less effective teachers than high-income students. In a few study districts, differences between teachers of high- and low-income students are large enough to meaningfully contribute to the student achievement gap. Eliminating inequity for five consecutive years would reduce the student achievement gap by 4 or more percentile points in no study districts in ELA and 3 of the 26 districts in math. In the district with the greatest inequity among math teachers, eliminating this inequity for five consecutive years would reduce the student achievement gap by 5 percentile points.

Figure ES.5. Average Effective Teaching Gap in English/language arts, by district

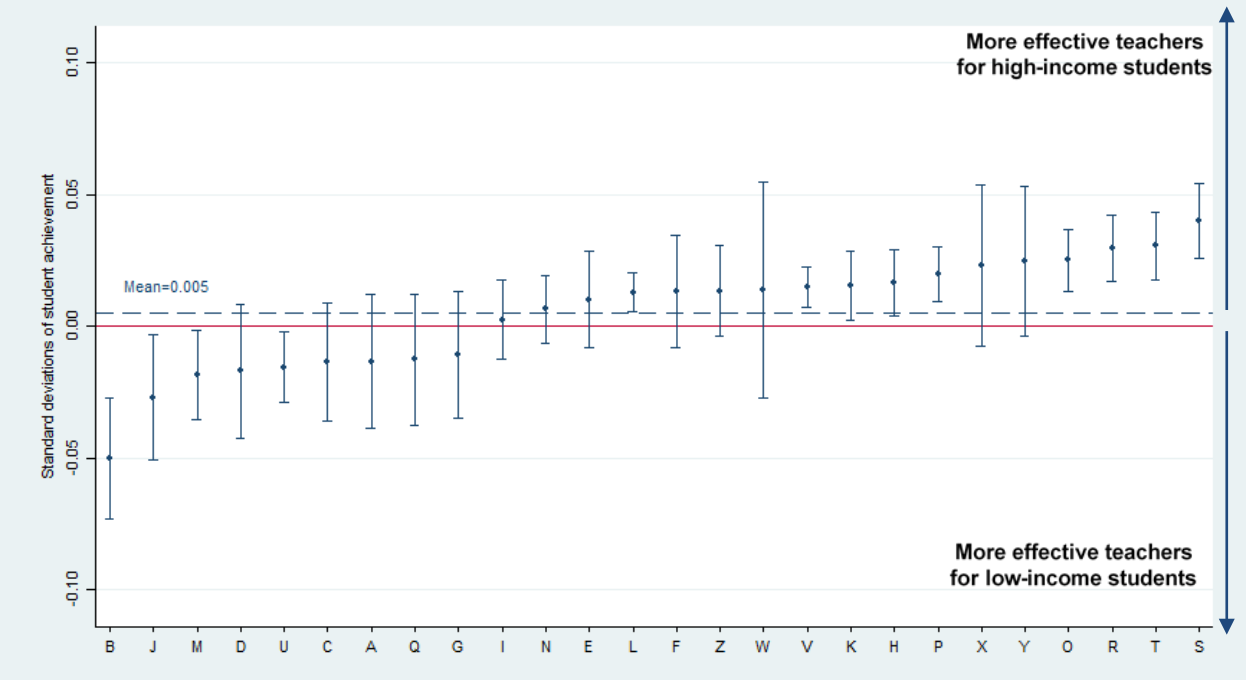


Source: Author's calculations based on district administrative data.

Note: Results are based on 26 districts for years 1 to 5, including grades 4 to 8 for 12 districts and grades 6 to 8 for 14 districts. District identifiers A to Z are assigned according to the size of each district's Effective Teaching Gap in ELA (with Z representing the largest positive gap). Effective Teaching Gaps are computed within each district-grade-year combination and averaged with equal weight across years within each district. The points represent the district-level Effective Teaching Gaps and the vertical lines show the 95-percent confidence intervals around each point. The cross-district average of 0.005 standard deviations is shown by the dashed horizontal line. To reduce the risk that districts, particularly those with relatively few teachers and students, will receive a very high or very low Effective Teaching Gaps by chance, we applied an empirical Bayes shrinkage procedure to the estimates.

high- and low-income students. In particular, the analysis relies on very large samples that yield statistically significant estimates even when they are close to zero. We did not have a specific guideline or precedent for setting a threshold for meaningful inequity, so we chose a somewhat conservative standard: a threshold effect size that corresponds to the target minimal detectable effect size of 0.10 often used in studies of education interventions.

Figure ES.6. Average Effective Teaching Gap in math, by district



Source: Author's calculations based on district administrative data.

Note: Results are based on 26 districts for years 1 to 5, including grades 4 to 8 for 12 districts and grades 6 to 8 for 14 districts. District identifiers A to Z are assigned according to the size of each district's Effective Teaching Gap in ELA (with Z representing the largest positive gap). Effective Teaching Gaps are computed within each district-grade-year combination and averaged with equal weight across years within each district. The points represent the district-level Effective Teaching Gaps and the vertical lines show the 95-percent confidence intervals around each point. The cross-district average of 0.004 standard deviations is shown by the dashed horizontal line. To reduce the risk that districts, particularly those with relatively few teachers and students, will receive a very high or very low Effective Teaching Gaps by chance, we applied an empirical Bayes shrinkage procedure to the estimates.

Are there differences between high- and low-poverty schools in teacher hiring, transfer, and attrition? Are these differences consistent with inequitable access to effective teachers for low-income students?

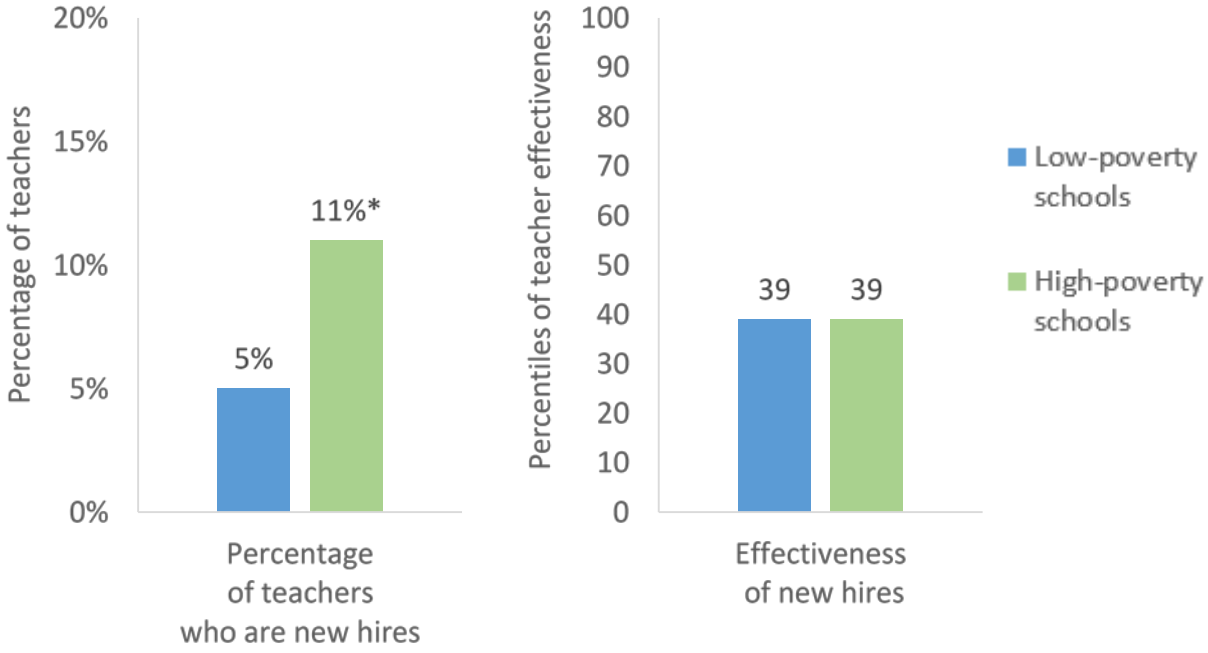
To understand how teacher hiring, transfer, and attrition patterns might contribute to inequitable access for low-income students, we measured average differences between high- and low-poverty schools in (1) the percentage of teachers who experience each type of career transition, and (2) the effectiveness of these teachers. Both of these factors may influence teacher equity. We first focus on average patterns across the full sample. These average patterns reflect hiring, transfer, and attrition in most study districts. We then examine whether district-specific patterns of hiring, transfer, and attrition are related to inequity in access to effective teachers at the district level. In particular, we present the results from a correlational analysis examining whether certain hiring, transfer, or attrition patterns tend to occur in districts with greater (or lesser) inequity in access to effective teachers.

Hiring patterns are consistent with small differences in the effectiveness of teachers of high- and low-income students

High- and low-poverty schools hire teachers who are similarly effective in their first year in study districts. These new hires (defined as novice or experienced teachers who are new to a district) are less effective than the average teacher, with value added at the 39th percentile on average (-0.05 standard deviations of student achievement) in both high- and low-poverty schools (Figure ES.7).

The presence of more new hires in high-poverty schools is consistent with a small amount of inequity for two reasons. First, although high-poverty schools have more new hires than low-poverty schools, the difference is small (11 percent of teachers in high-poverty schools are new hires compared to 5 percent in low-poverty schools). In addition, most teachers in both high- and low-poverty schools in study districts (89 and 95 percent, respectively) are not new hires. Second, while new hires tend to be less effective than the average district teacher in their first year, they improve substantially by their second year, when they are nearly as effective as the average teacher. New hires at high- and low-poverty schools improve at similar rates in study districts, on average.

Figure ES.7. Percentage and effectiveness of new hires for low- and high-poverty schools



Source: Authors' calculations based on district administrative data.

Note: The results are for teachers in grades 4 to 8 in 12 districts and in grades 6 to 8 in 13 districts, for years 2 through 5.

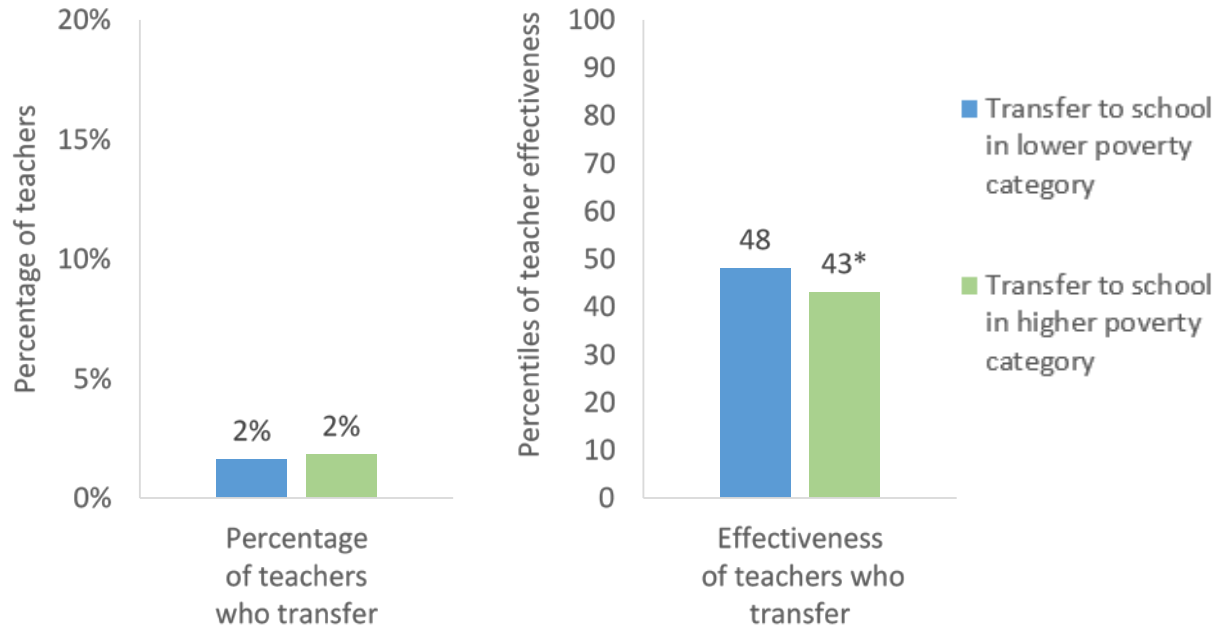
* Differences between low- and high-poverty schools are statistically significant at the 0.05 level, two-tailed test.

Teachers' transfer patterns are consistent with small differences in the effectiveness of teachers of high- and low-income students

Teachers who transfer to schools in a lower poverty category are more effective than those who transfer to a higher poverty category. On average, teachers who transfer to schools in a lower poverty category within a district have value added at the 48th percentile. Teachers who transfer to schools in a higher poverty category have value added at the 43rd percentile, on average (Figure ES.8).

Overall, transfer patterns are consistent with a small amount of inequity because a small percentage of teachers transfer to schools with poverty levels different from their former schools. Although teachers transferring to schools in lower poverty categories are more effective than those transferring to schools in higher poverty categories, this difference is likely to have a small influence on inequity. This is because just under 4 percent of teachers transfer to a school in a higher or lower poverty category (a little less than 2 percent from higher- to lower-poverty and less than 2 percent from lower- to higher-poverty). A little more than 4 percent of teachers move between schools with similar poverty rates.

Figure ES.8. Percentage and effectiveness of teachers transferring to schools in lower and higher poverty categories



Source: Authors' calculations based on district administrative data.

Note: The results are for teachers in grades 4 to 8 in 12 districts and in grades 6 to 8 in 13 districts, for years 1 through 4.

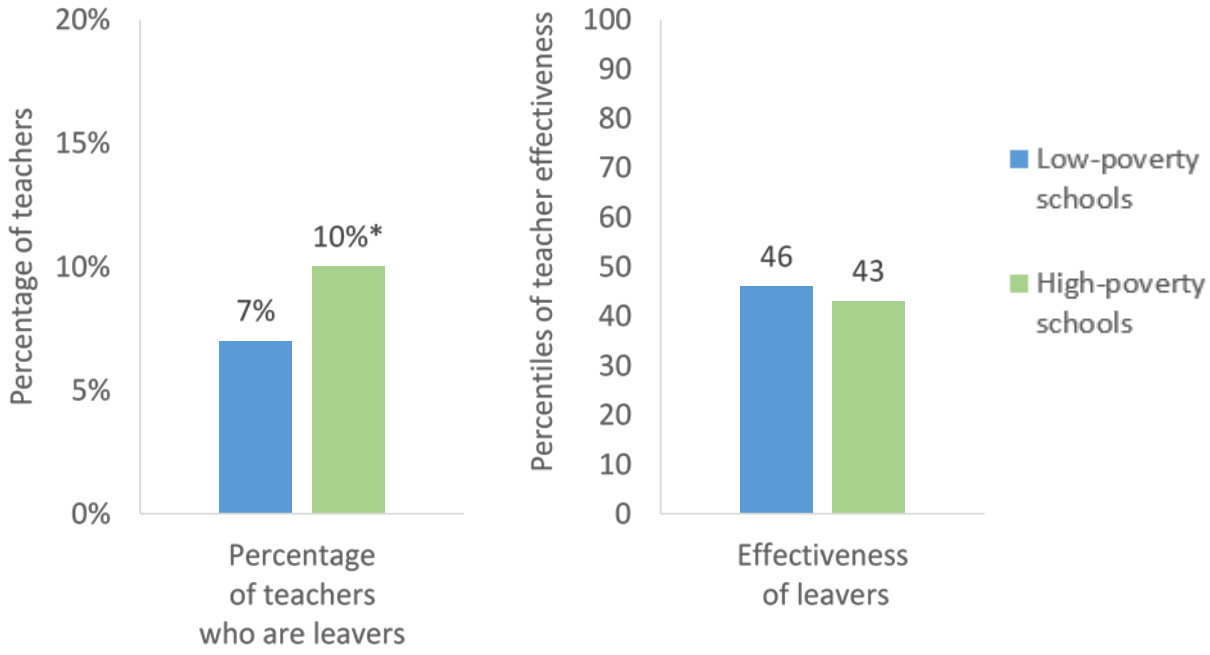
* Differences between teachers who transfer to schools in a lower poverty category and those who transfer to schools in a higher poverty category are statistically significant at the 0.05 level, two-tailed test.

Teacher attrition patterns do not contribute to low-income students having less effective teachers than high-income students, on average

Teachers in high-poverty schools are more likely than those in low-poverty schools to leave study districts. On average, 10 percent of teachers in high-poverty schools and 7 percent of teachers in low-poverty schools leave study districts at the end of a school year to teach in another district or leave the profession (Figure ES.9).

Leavers are less effective than stayers in both high- and low-poverty schools. Teacher attrition could either benefit or harm students, because schools may lose their more or less effective teachers. In study districts, teachers who leave the district are less effective than those who stay, on average. This is true in both high- and low-poverty schools, as the average leaver from a high-poverty school is at the 43rd percentile of effectiveness and the average leaver from a low-poverty school is at the 46th percentile. This difference in the effectiveness of leavers at high- and low-poverty schools is not statistically significant.

Figure ES.9. Percentage and effectiveness of leavers from low- and high-poverty schools



Source: Authors' calculations based on district administrative data.

Note: The results are for teachers in grades 4 to 8 in 12 districts and in grades 6 to 8 in 13 districts, for years 1 through 4.

* Differences between low- and high-poverty schools are statistically significant at the 0.05 level,

Hiring patterns in individual study districts are correlated with low-income students' access to effective teachers in those districts

Districts where high-poverty schools hire less effective teachers than low-poverty schools tend to have greater inequity. Just as some districts have greater inequity than the average district, some have patterns of teacher hiring, development, transfer, and attrition that

differ from the average district. Thus, we examined patterns of hiring, transfer, and attrition in individual districts and measured the relationships between these patterns and the districts' measures of low-income students' access to effective teachers. We found that district-level patterns of teacher hiring are associated with greater inequity in study districts. In particular, districts tend to have greater inequity (a larger Effective Teaching Gap) when high-poverty schools hire less effective teachers than low-poverty schools; that is, when new hires in high-poverty schools are less effective than new hires in low-poverty school. By contrast, district-level teacher transfer or attrition patterns are not associated with greater inequity. Nor are differences in the prevalence of new hires, transfers, or leavers related to greater inequity.

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