Annenberg Institute
BROWN UNIVERSITY

EdWorkingPaper No. 25-1155

How Does Early Achievement Predict Within-Year Student Mobility? Longitudinal Evidence from Missouri

Margaret K. Wallace
Washington University in St. Louis

Jason Jabbari
Washington University in St. Louis

Yung Chun
Washington University in St. Louis

Takeshi Terada
Washington University in St. Louis

Somalis Chy
Washington University in St. Louis

Student mobility that occurs within a school year may be especially disruptive for student outcomes, yet little is known regarding the predictors of within-year mobility. In particular, research has yet to comprehensively examine the role of student achievement in predicting within-year student mobility. Thus, we sought to understand this link by examining longitudinal 3rd – 8th grade student- and school-level data. We conducted (1) random effect panel regression models to consider the ways in which student achievement in math and English and language arts (ELA) predict within-year student mobility and (2) survival models to examine these mobility patterns over time. We found that achievement levels were significantly associated with student mobility and that low achievement in 3rd grade had lasting effects on student mobility. We close with implications for policy and practice.

VERSION: March 2025

Suggested citation: Wallace, Margaret K., Jason Jabbari, Yung Chun, Takeshi Terada, and Somalis Chy. (2025). How Does Early Achievement Predict Within-Year Student Mobility? Longitudinal Evidence from Missouri. (EdWorkingPaper: 25 -1155). Retrieved from Annenberg Institute at Brown University: https://doi.org/10.26300/a1ae-jj25

How Does Early Achievement Predict Within-Year Student Mobility? Longitudinal Evidence from Missouri

Margaret K. Wallace[1], Jason Jabbari[2], Yung Chun[2], Takeshi Terada[2] and Somalis Chy[2]

[1]Department of Education, Washington University in St. Louis

[2]Social Policy Institute, Washington University in St. Louis

Author Note

Margaret K. Wallace, Ph.D., https://orcid.org/0000-0001-7577-9950

Jason Jabbari, Ph.D., https://orcid.org/0000-0002-0196-4966

Yung Chun, Ph.D., https://orcid.org/0000-0003-4042-7984

Somalis Chy, Ph.D., https://orcid.org/0000-0002-8503-6664

Work for this project was funded by the James S. McDonnell Foundation. We would like to thank the St. Louis School Research-Practice Collaborative for their partnership and feedback, as well the Missouri Department of Elementary & Secondary Education for their data and technical support. We have no known conflicts of interest. Correspondence concerning this article should be addressed to Margaret Wallace, Washington University in St. Louis. Email: margaretw@wustl.edu.

Abstract

Student mobility that occurs within a school year may be especially disruptive for student outcomes, yet little is known regarding the predictors of within-year mobility. In particular, research has yet to comprehensively examine the role of student achievement in predicting within-year student mobility. Thus, we sought to understand this link by examining longitudinal 3rd – 8th grade student- and school-level data. We conducted (1) random effect panel regression models to consider the ways in which student achievement in math and English and language arts (ELA) predict within-year student mobility and (2) survival models to examine these mobility patterns over time. We found that achievement levels were significantly associated with student mobility and that low achievement in 3rd grade had lasting effects on student mobility. We close with implications for policy and practice.

Keywords: Student Mobility, achievement, predictors of mobility, survival analysis

How Does Early Achievement Predict Within-Year Student Mobility?

Unstructured student mobility is the movement of students from one school to another for reasons outside of typical grade promotion (e.g. advancing from elementary to middle school). Unstructured student mobility is widespread across the U.S., with the majority of students making at least one non-promotional move before high school (Rumberger, 2015). Unstructured student mobility can lead to both positive and negative impacts on academic outcomes, often depending on when the transfer occurs and where the student transfers to (Hanushek et al., 2004; Reynolds et al., 2009; Rumberger; 2015; Welsh, 2017). Existing research demonstrates that student mobility that occurs during the school year, or *within-year mobility,* generally leads to poorer student performance (Hanushek et al., 2004; Engec, 2006; Min, 2021; Grigg, 2012). Despite this particularly negative impact of within-year mobility on performance, research often groups student mobility that occurs both between- and within-school years together as unstructured mobility. As a result, limited research exists on specific predictors of within-year mobility (Welsh, 2017). Further, although the impact of unstructured mobility can differ across school and neighborhood contexts (Hanushek et al., 2004), research often focuses on a specific geographic area (e.g., urban), which limits our ability to understand role of school context in predicting mobility. Moreover, the role of student achievement as a predictor of student mobility is seldom examined in the literature (Maroulis et al., 2019; Welsh et al., 2016; Wright, 1999), which further limits our understanding of the predictors of student mobility. Given the prevalence of student mobility in the earlier years of school (Rumberger, 2015) and the detrimental impacts of within-year mobility, we sought to identify how student achievement, in addition to a host of student and school characteristics predicts within-year mobility in grades 3-8, as well as how student achievement in grade 3 can have lasting effects. Additionally, given the

importance of geographic context, we examined and how this relationship varies across urban and suburban/rural contexts. Doing so can help to identify students at risk of transferring during the school year and tailor interventions accordingly. We asked the following research questions:

1. What school- and student-level characteristics in early education predict within-year student mobility?
    a. How does this impact differ across urban, rural, and suburban contexts?
2. What is the impact of students' early performance on student mobility over time?
    a. How does this impact differ across urban, rural, and suburban contexts?

Using longitudinal student- and school-level data across nine years and five counties, our study disentangled the drivers of unstructured mobility by focusing on how student achievement predicts within-year mobility over time and how this relationship varies across urban and suburban/rural contexts. We did so by first using random effect panel regression models to consider the ways in which student achievement in math and English and language arts (ELA) predict within-year student mobility. Next, we used survival models to examine these mobility patterns over time. Finally, we compared these patterns across a unique urban environment in Saint Louis City and the surrounding rural and suburban counties. In the following section, we first review the literature on the impacts of student mobility to demonstrate its importance as an area of study. We then review the literature on the predictors of student mobility to situate our current study. This paper is part of a larger project and paper series on student mobility. Thus, research summarized in the following review have also been summarized in other papers in our series on student mobility (Cohen et al., 2024; Jabbari et al., 2024; Terada, 2024; Wallace et al., 2024).

Review of the Literature

Impact of Student Mobility

Considerable research has demonstrated the impact of student mobility on students' academic outcomes (Goldhaber et al., 2022; Hanushek et al., 2004; Reynolds et al., 2009; Rumberger, 2003; Schwartz et al., 2009; for a review see Reynolds et al., 2009 and Welsh, 2017). For example, in a meta-analysis of 16 articles on this topic, student mobility was linked to lower math and reading achievement as well as lower rates of graduation (Reynolds et al., 2009). More recent analyses have confirmed this finding, revealing an association between unstructured mobility and lower academic achievement and graduation rates (Goldhaber et al., 2022). Several other scholars have also identified a negative relationship between student mobility and high school graduation rates (Reynolds et al., 2009; Gasper et al., 2012; Rumberger & Larson, 1998; South et al., 2007; Stamp et al., 2022). In a more recent review of the literature, Welsh (2017), found that while generally student mobility has negative impacts on student achievement, this can be offset overtime when moving to a higher quality school. For instance, Schwartz and colleagues (2009) identified that student mobility can even improve student performance overtime, particularly when families are making intentional moves to improve student outcomes.

Impact of Within-Year Mobility

Student mobility may be especially disruptive for students' learning when it occurs during the school year. However, much of the research on student mobility does not distinguish the timing of mobility (within- or between-school years) (Welsh, 2017). The research that does examine within-year mobility reports predominantly negative outcomes. For example, within-year mobility has been linked to lower academic performance (Hanushek et al., 2004; Engec, 2006; Min, 2021; Grigg, 2012), higher suspension rates (Engec, 2006), negative impacts on overall school quality (Hanushek et al., 2004), and increased instances of dropping out when

compared to between-year transfers (Stamp et al., 2022). For example, Min (2021) found within-year mobility had a more significant negative impact on academic achievement relative to between-year mobility. Furthermore, these negative effects of within-year mobility on achievement are especially pronounced for low-income, Black, and Latine students (De la Torre & Gwynne, 2009; Hanushek et al., 2004) as well as Asian students (Min, 2021). These scholars also found that Black students are more likely to experience both within-year and between-year mobility (Min, 2021) and are more likely to attend schools with higher rates of mobility (Hanushek et al., 2004). Given the harmful consequences of within-year mobility, more work is needed to examine the predictors of within-year mobility specifically. Furthermore, given the disproportionate experiences of mobility and its impacts on marginalized student groups, more work is needed to examine which students are at risk of within-year mobility as well as the role of school context.

Predictors of Mobility

In recent years, researchers have identified several predictors of unstructured mobility. For instance, residential mobility has been identified as a common predictor for student mobility (De la Torre & Gwynne, 2009; Rumberger & Larson 1998; Rumberger, 2015). This can include voluntary residential mobility, such as moving homes or neighborhoods for job promotions or other intentional reasons, or involuntary mobility due to circumstances like evictions, homelessness, or divorce (Rumberger, 2015). Residential mobility played a large part in student mobility in Chicago Public Schools as identified by a review of over two million student records on enrollment data between 1995 and 2007. These records showed that roughly 80% of students who transferred during the school year also changed residences. The same study found a growing gap between African American students and their peers' mobility rates, noting that much of the

gap can be explained by residential mobility. These findings suggest that African American students may be experiencing disproportionate levels of student and residential mobility due to inequitable housing access, demolition of affordable housing units, and disproportionate economic impacts on households that can lead to housing instability (e.g., eviction) (De la Torre and Gwynn, 2009).

In addition to residential mobility, school-level and student-level factors can impact unstructured mobility. For example, changes in the school district, such as school closures due to overcrowding, can lead to increased student mobility (De la Torre and Gwynn, 2009). Additionally, data from the National Center for Education Statistics, which included 247 school and over 7,000 students, showed that schools with higher concentrations of Black and Brown students and of students who had repeated a grade experienced greater levels of turnover (including student mobility and/or dropout) (Rumberger & Thomas, 2000). These student factors may stem from schools' policies and practices of pushing out "unwanted" students (Bowditch, 1993; Rumberger & Thomas, 2000). These findings were expanded by an assessment of over 130,000 4th, 8th, and 12th grade students in the United States that showed higher mobility rates in urban districts predominantly composed of Black students (Rumberger, 2003). Specifically, Black and Hispanic 4th graders exhibited higher rates of unstructured mobility compared to their White and Asian American peers. Additionally, 4th grade students from low socioeconomic status (SES) backgrounds were more likely to experience student mobility compared to those from middle- and high-SES backgrounds. Students from single-parent households were also more likely to experience student mobility (Rumberger, 2003). Finally, an analysis of student mobility predictors in New Orleans public schools found that students receiving special education were more likely to experience unstructured mobility (Welsh et al., 2016). In sum, the

current body of literature has linked several school-level factors and student characteristics that lead to student mobility; however, more work is needed to identify factors that predict within-year mobility specifically.

Achievement as a Predictor

Researchers have also linked school and student academic performance to student mobility. For example, families may move to a higher performing school to try to improve their child's academic performance (Rumberger, 2015). For 3rd and 4th graders in a Midwest district, low achievement in math and reading was related to later mobility, particularly for moves within the school district (Wright, 1999). In another study, Welsh and colleagues (2016) examined unstructured student mobility using student-level data from over 22,000 students across the 2006-07 to 2010-11 school years for all public schools (including public charter) in New Orleans. Using linear probability modeling, the authors found that high-achieving students were more likely to switch to high-quality schools while low-achieving students were more likely to transfer to low-quality schools. This pattern likely further perpetuates disparities for students of color and low-income students who disproportionately experience lower levels of achievement due to inequitable access to educational resources. A more recent examination of unstructured mobility in New Orleans public schools examined factors that "push" and "pull" students from one school to another (Maroulis et al., 2019). This study used hierarchical linear modeling with data from over 2,000 students across the 2010-11 and 2011-12 school years and found academic performance was s a strong predictor of unstructured student mobility. Specifically, for low-achieving students, low academic performance at their current schools served as a stronger "push" factor than the "pull" of high performance at a potential new school. The "pull" factors of academic performance were more strongly associated with medium to high-achieving students

(Maroulis et al., 2019). While this body of work builds our understanding of how achievement impacts student mobility (Maroulis et al., 2019; Welsh, 2016; Wright, 1999), it is not clear how achievement predicts within-year mobility specifically.

Student Mobility in Early Education

Finally, special attention should be paid to predictors of student mobility in the earlier years. National data from the Early Childhood Longitudinal Survey showed that roughly 42% of students in elementary school make at least one school change, and over 20% make two or more school changes (Rumberger, 2015). Additionally, national data from the National Assessment of Education Progress surveyed 4th, 8th, and 12th grade students' reports of school changes over their last two years of schooling. They found that 35% of 4th grade students, 21% of 8th grade students, and 9% of 12th grade students made at least one or more moves. However, due to limitations of the national data sets each of these have grouped between- and within-year transfers. While unstructured student mobility in elementary schools can often be attributed to residential mobility (Rumberger, 2015), less is known about the predictors of within-year mobility in elementary school. Further, given the established link between achievement and student mobility, more work is needed to examine how early achievement predicts within-year mobility specifically.

Methods[1]

Data and Sample

Student- and school-level data for our empirical analysis comes from the Missouri Department of Elementary and Secondary Education (DESE). The student-level enrollment and

[1] Given that this study is part of a larger project, the description of data collection, sample, and variables are methods section in this study is similar to another paper by our team (Terada et al., 2024) and the analytical approach is nearly identical to Wallace et al., (2024.) which explores the relationship between punishment and mobility among high school students.

core demographic data were collected from the 2009-2010 school year through the 2018-2019 school year. Complete records were collected for any student from 3rd through 8th grades who attended a public school (including a public charter school) in one of the five St. Louis area counties throughout the study period: St. Louis City, St. Louis County, St. Charles County, Franklin County, and Jefferson County. Student-level data was then merged with publicly available school-level assessment and discipline data from the DESE. The school assessment file included the number of students in each achievement level at each school in state-level ELA and math assessments, while the school discipline file included average incidents in student discipline.

Due to our focus on within-year student mobility from 3rd to 8th grades, a small proportion of observations were removed through listwise deletion. Specifically, we removed summer school records, records in which entry dates are the same as the exit dates ("no shows"), records in which the exit code is stop-out, drop-out, or deceased, or records that we were not able to match with school-level (e.g., for students that attended a school that was closed in 2018-2019). We also removed students who repeated any of the same grades for two or more years or who did not have test scores in any of the 3rd through 8th grades. A visual depiction of our data cleaning process can be found in Appendix A. The final analytical sample includes 70,603 students (423,618 student-level records), consisting of 7,283 students (43,698 records) for St. Louis City County and 56,767 students (340,602 records) for four counties across 9 school years. While our five-county analysis allows us to understand student mobility across an entire metropolitan region, we also include subsample analyses of St. Louis City and the surrounding four counties to explore how mobility dynamics may vary across urban and suburban contexts.

Analytical Approach

Regression Modeling

To better understand how student-level characteristics including, student achievement, predict within-year student mobility, we first used random-effect logistic regression models for dichotomous outcomes. Unlike fixed-effect models, random effect models allow us to estimate the effects of time-invariant characteristics, like student race, ethnicity, and poverty. Given the prior literature, these variables are meaningful in understanding the relationship between achievement and mobility. To ensure temporality, we leverage student- and school-level variables in a specific school year to examine whether a student transfers to a different school in the following school year. For example, when we predict whether a student transfers in 4th grade, we use student- and school-level characteristics of the student in 3rd grade. Because our datasets include 3rd through 8th grades, student- and school-level predictors in the 8th grade are not included in the analysis; only the outcome variable in 8th grade is included. For our examination of whether or not students transfer, we apply the following logistic regression models:

$$\ln\left(\frac{p_{i\in s,t}}{1-p_{i\in s,t}}\right) = X_{i,t-1}^{ind}\mathrm{B} + X_{s,t-1}^{sch}\mathrm{B} + \varepsilon_{i,t} \quad (1)$$

where $p_{i\in s,t}$ is the probability of transferring for student i in school s at time t, $X_{i,t-1}^{ind}$ is a vector of individual student i's variables at a school year before the transfer $(t-1)$, $\mathrm{X}_{\mathrm{s,t-1}}^{\mathrm{sch}}$ is a vector of school-level variables of student i's school s at a year before the transfer $(t-1)$, and $\varepsilon_{i,t}$ is the error term. To aid interpretation, our results are reported in odds ratios.

Survival Modeling

Our second analysis focuses on when a student transfers to a different school. We utilized the Cox proportional-hazard regression model (Cox, 1972). The Cox proportional-hazard model

can be used to examine whether the hazard or survival functions (i.e., time-to-event) differ within and between individuals, as well as the time related to these differences. Our Cox proportional hazard model can be estimated as follows:

$$h_{ij}(t) = h_0(t)\, exp(X_{i,t=3}^{ind}\mathrm{B} + X_{s,t=3}^{sch}\mathrm{B}) \quad (2)$$

where *t* represents the survival time, $h_{ij}(t)$ is the hazard function of the *j*th event at time interval *t* in individual student *i*, $X_{i,t=3}^{ind}$ is a vector of individual student *i*'s characteristics in the 3rd grade, $X_{s,t=3}^{sch}$ is a vector of school characteristics of student *i*'s school *s*, the coefficients B, represent the impact of student- and school level characteristics in the 3rd grade, and $h_0(t)$ is the baseline hazard that corresponds to the value of the hazard if all the predictors are zero.

We examined the association between student- and school-level characteristics in the 3rd grade (i.e., student records and school information when a student was in the 3rd grade) and their likelihood of transferring in subsequent years.

Measures

Dependent Variables

For both the first and second analyses, we constructed a dichotomous outcome variable by dividing students' exit status into two categories (0 = remain in the school during a school year; and 1 = transfer to another school once or more during a school year). In particular, our survival analysis focused on the first event of transfers. Once a student transferred to a different school, the student was removed from our survival analytic pool. For example, when a student transferred to a different school in their first year, the student was removed from the survival analytic pool; their second transfer was not analyzed.

Independent Variables

We examined the associations between student- and school-level demographic characteristics and unstructured transfers occurring during the school year. The first analysis focuses on whether students transfer to another school during the school year, while the second concentrates on when these students transfer. Student-level characteristics include school year, grade level (ranging from 3rd through 8th grades), race/ethnicity (White, Black, Hispanic, Asian, and others), gender (female and male), lunch status (free, reduced-, and regular-priced), special education status (student with or without an individualized education plan; IEP), English language status (English language learner; ELL or non-ELL), homeless status (homeless and not homeless), residency status (resident in the attending school district, not a resident in the attending school district), charter school status (charter school student and not a charter school student), and achievement levels in state-level assessment in math and ELL (below basic, basic, proficient, and advanced). Additionally, school-level characteristics include the numbers of enrolled students, percentages of each race/ethnicity group (White, Black, and Hispanic), percentages of free/reduced lunch students, percentages of special education students, rates of out-of-school suspension[2][3], percentages of students with proficient or advanced levels in state-level math and ELA assessments. In some cases, we re-scaled school-level variables to obtain more manageable coefficients for ease of interpretation. Specifically, we divided the numbers of enrolled students by one hundred and the rest of the variables by ten. By re-scaling them, the coefficients were small enough to be interpretable.

[2] Rates are calculated as the total number of suspension occurrence per 100 students.
[3] Here, it is important to note that some school-level variables were subject to "blinding" due to very low numbers. For example, if a statistic was derived from less than 10 students, the Missouri Department of Elementary and Secondary Education coded it as missing. Not wanting to further limit the sample, we recoded these statistics as 0, due to their small size.

Results

Sample Description

For this study, we examined student- and school-level variables (see Table 1 for sample descriptive statistics). On average, over 94.53% of students remained in their respective schools and 5.47% of students transferred to another school. For math achievement levels in the state assessments, 18.24% of students were performing at below basic levels, 42.90% of students were performing at basic levels, 29.51% of students were performing at proficient levels, and 9.35% of students were performing at advanced levels. For ELA achievement levels in the state assessments, 14.80% of students were performing at below basic levels, 38.44% of students were performing at basic levels, 32.64% of students were performing at proficient levels, and 14.12% of students were performing at advanced levels. In regards to gender, 51.16% were male students and 48.84% were female students. As for race/ethnicity, 60.45% were White students, 31.62% were Black students, 3.57% were Hispanic students, and 1.77% were Asian students. For lunch status, 47.83% of students did not qualify for free or reduced-price lunch, 46.86% of students qualified for free lunch, and 5.31% of students qualified for reduced-price lunch. Related to special education status, 17.25% of students qualified for special education services, and about 11% of students were designated as English language learners (ELL). In terms of housing status, 96.64% of students were not homeless and 3.36% of students were homeless. The vast majority of students resided in their school's catchment area (97.45%) and did not attend charter schools (97.13%). For school-level characteristics, we included many of the same variables included at the student level, such as achievement levels, race/ethnicity, lunch status, ELL status, and special education status. We also included the number of enrolled students and out-of-school suspension.

Descriptive statistics for St. Louis City and the other four counties can be found in Appendix B. Here, it is important to note that some of the sample characteristics in St. Louis City were notably different from the surrounding counties. For example, the percentages of students with below basic or basic levels in the state assessments were much higher in both math (81.06%) and ELA (73.20%) than the percentages for math (57.25%) and ELA (49.37%) in the other four counties. Additionally, the percentage of Black students (79.01%) and students who qualified for free lunch (88.35%) was also much higher than the percentage of Black students (24.92%) and the percentage of students who qualified for free lunch (38.55%)[4] in the other four counties.

Logistic Regression

In our first research question, we asked whether there is an association between student transfers and student-level characteristics (Models 1 and 2), as well as between student- and school-level characteristics (Models 3 and 4). Models 1 and 3 used achievement levels in the math assessments and Models 2 and 4 used achievement levels in the ELA assessments.

Almost all student-level variables, including achievement levels in the state assessments, school year, grade level, race/ethnicity, lunch status, homeless status, residency status, ELL status, and charter school, were significantly associated with student transfers (Table 2). Starting with school years in Models 3 (math performance), when compared to the school year of 2009-2010, all other school years were significantly associated with a moderate decrease in the odds of transfers. For all other variables, we use a coefficient plot to visualize the odds of being associated with transfers (Figures 1 and 2). Beginning with student variables, performing at a basic level (OR=0.823***), a proficient level (OR=0.643***), and an advanced level

[4] This estimate could be inflated due to Community Eligibility Provisions, which categorizes all students in a given school as FRPL-eligible after a certain threshold of students are directly eligible.

(OR=0.572***)—when compared to students with a below basic level in the math assessment, being Hispanic (OR=0.821***) or Asian students (OR=0.807*)—when compared to white students, ELL students (OR=0.887***)—when compared to non-ELL students, students not residing in their school's catchment area (OR=0.652***)—when compared to students residing in their school's catchment area, and attending a charter school students (OR=0.604***)—when compared to not attending a charter school, were significantly associated with decreased odds of transferring. Conversely, Black students (OR=1.347***) and other racial/ethnic students (OR=1.131*)—when compared to white students, students who qualify for free (OR=3.622***) and reduced-price lunch (OR=2.004***)—when compared to students who don't qualify for either, homeless students (OR=1.446***)—when compared to non-homeless students, and special education students (OR=1.072***)—when compared non-special education students, were significantly associated with increased odds of transferring. Model 4, which focuses on ELA performance, demonstrated similar results as Model 3 (math performance).

We then examined school-level variables in Model 3. We found that a one-unit increase in the percent of ELL students (OR=0.936***), and the percent of students who reached proficient or advanced levels in the math assessments (OR=0.558***) was significantly associated with decreased odds of transfers, while a one-unit increase in the percent of Black students (OR=1.105***), the percent of Hispanic students (OR=1.156***), the percent of White students (OR=1.217***), the percent of students who qualify for free or reduced lunch (OR=1.176***), and the percent of special education students (OR=1.045**) was significantly associated with increased odds of transfers. Similar results in school-level variables were seen in Model 4, which focuses on ELA performance, and Model 3, which focuses on math performance.

Subsample analyses for St. Louis City and the other four counties can be found in Appendix C. We observe both similarities and differences between St. Louis City (Table C1, Figures C1 and C2) the surrounding four counties (Tables C2 and Figures C3 and C4). For instance, associations with academic performance were largely similar across St. Louis city and the surrounding counties. However, in Model 3 in St. Louis City, students who qualify for free lunch (St. Louis City: OR=1.491***; Surrounding Counties: OR=3.776***) were less likely to transfer compared to their peers who did not qualify. In addition, in St. Louis City, there was no correlation between transferring rates with grade levels, Asian students, students who qualified for reduced lunch status, or special education students. At the school level in St. Louis City, a one-unit increase in the number of enrolled students (St. Louis City: 0.955***; Surrounding Counties: 1.010) was significantly associated with decreased odds of transferring. Conversely, a one-unit increase in the percent of ELL students (St. Louis City: OR=1.108***; Surrounding Counties: OR=1.064) was significantly associated with increased odds of transferring.

Survival Analysis

Table 3 presents the results of the Cox proportional hazards estimates of student transfers. Models 1 and 2 assess student-level characteristics, while Models 3 and 4 include both student- and school-level characteristics. Similar to our regression analyses, Models 1 and 3 included achievement levels in math assessments, and Models 2 and 4 included achievement levels in ELA assessments.

Starting with math performance (Model 3), we found that students performing at basic, proficient, and advanced levels in 3rd grade experience a significantly lower risk of transferring to a different school when compared to students performing at below basic levels ($p < 0.001$, Figure 3). Moreover, the risk accumulates each year, such that by 8th grade roughly 74% of the

students who performed at a below basic level in 3rd grade math remained in their school of origin, whereas roughly 84% of students who performed at an advanced level in 3rd grade math remained in their school of origin. Similar results were observed when analyzing ELA performance (Model 4; Figure 4). In both models, the largest differences occurred in 8th year, representing an accumulation effect.

Subsample analyses for St. Louis City and the other four counties can be found in Appendix D (St. Louis City: Table D1, Figures D1 and D2; Surrounding Counties: Table D2, Figures D3 and D4). For both math and ELA, the differences between low- and high-performing students were largest in the context of St. Louis City. For example, in St. Louis City roughly 57% of the students who performed at a below basic level in 3rd grade math remained in their school of origin, whereas roughly 73% of students who performed at an advanced level in 3rd grade math remained in their school of origin. However, in the surrounding four counties roughly 79% of the students who performed at a below basic level in 3rd grade math remained in their school of origin, whereas roughly 88% of students who performed at an advanced level in 3rd grade math remained in their school of origin. Similar results were observed for ELA performance. In either case, the largest differences occurred in 8th year, representing an accumulation effect.

Discussion

Within-year mobility remains an enduring educational problem that disproportionately impacts Black students, low-income students, and students from other marginalized groups, yet limited research exists related to predictors of within-year mobility (Welsh, 2017). Additionally, although the impact of within-year mobility can differ across school and neighborhood contexts (Hanushek et al., 2004), limited research exists on how these predictors vary across these

contexts. Without knowing the predictors of student mobility and the role of school and neighborhood contexts, our ability to intervene proactively is severely limited.

Using longitudinal student- and school-level data across five large counties over a nine-year timespan, we examined the association between student achievement and within-year mobility over time and assessed variation across urban and suburban/rural contexts. While we explore a variety of predictors of within-year mobility, our main focus is on student achievement. First, student achievement is a reliably collected measure every year for all students; second, it is a measure that is often known by teachers and administrators; and third, it is a measure that is often communicated to families. Altogether, these factors allow for student achievement to operate as a key "risk factor" that can be used to identify students for potential intervention.

Findings

We first performed random effect panel regression analyses, and found that when compared to students performing at a below basic level in math, students performing at a basic level showed a 18% decrease in the odds of transferring. Further, students performing at a proficient or advanced level were associated with a 36% or 43% decrease in the odds of transferring, respectively. Similar findings were observed for ELA performance, which together suggest sequential decreases in the risk of transferring with improved academic performance. While the year lag between academic performance and transferring ensures temporality, it can also be seen as a conservative estimate, as performance continues to influence transferring during the following year.

Our random effect panel regression analyses also allowed us to understand the influence of a variety of student and school characteristics beyond academic achievement. In line with the previous research, we found large disparities in terms of race and social class when accounting

for academic performance: Black students experienced a 35% increase in the odds of transferring, and students who qualified for free lunch experienced a 262% increase in the odds of transferring. While these findings align with Wallace et al.'s (2024) work on transferring during the high school years, it is important to note that these disparities are much larger in elementary and middle school grades.

Given that we account for race and social class as well as a variety of school characteristics, yet still find significant effects stemming from academic performance, we are left with a few compelling explanations. For instance, it is possible that parents of higher performing students may feel satisfied with the school that their child attends and, thus, may be less likely to transfer during the school year. Alternatively, it is possible that lower performing students are more prone to certain labels that cause schools to "push" them out (Bradley & Renzulli, 2011). As noted by Wallace et al. (2024.), while the pushout process often examines leaving school without graduating high school, it can also be conceptualized as leaving school without finishing the school year. Unsurprisingly, unhoused students were also more likely to transfer. We also found that students with IEPs and students who were suspended were more likely to transfer, which may lend further support to the labeling and pushout perspectives (Shifrer, 2013; Cruz & Myers, 2024; Jabbari & Johnson, 2022; 2024).

While certain policies may make it easier for students to transfer, it is also possible that families use these policies to find a school of choice, which ultimately may make them less likely to transfer during the school year. This hypothesis is supported by our finding that students that did not reside in one's catchment area were actually less likely to transfer. Moreover, students who attended charter schools were less likely to transfer. In both cases, parents can

often be seen as “choosing” a particular school and thus may be more satisfied with this school and less likely to transfer during the school year.

Our assessment of school-level characteristics allowed us to see if schools play a mediating role in explaining the influence of academic performance on transferring. Similar to Wallace et al. (2024.), we only observe small decreases in the influence of academic performance on transferring. Moreover, the variation explained does not substantially increase when we include school characteristics, suggesting that school characteristics are less important in transferring relative to student characteristics.

Next, we turn to our findings from our survival models. While our random effect regression models examined the effect of academic performance each year on transferring, our survival models examined the effect of academic performance in 3rd grade on transferring over time, representing a long-term, enduring effect. Overall, we found substantial differences in transferring based on 3rd grade academic performance that accumulated over time. By 8th grade, students who performed at a below basic level in 3rd grade math had roughly a 74% chance of not transferring mid-year up to this point, while students who performed at an advanced level in 3rd grade math had roughly an 84% chance of not transferring mid-year. Furthermore, these differences grew over time, representing an accumulation affect.

Finally, while we did not observe large differences between St. Louis City and the surrounding counties in our random effect regression models in terms of academic performance, we did observe large differences in our survival models. In St. Louis City roughly 57% of the students who performed at a below basic level in 3rd grade math did not experience a within-year transfer, whereas roughly 73% of students who performed at an advanced level in 3rd grade math did not experience a within-year transfer. However, in the surrounding four counties, roughly

79% of the students who performed at a below basic level in 3rd grade math did not experience a within-year transfer, whereas roughly 88% of students who performed at an advanced level in 3rd grade math did not experience a within-year transfer. Here, the consequences of low academic performance are far greater in St. Louis City. Urban educational dynamics appear to intensify this phenomenon for students, placing already vulnerable students at greater risk of within-year transfer. As noted by Wallace et al. (2024.), while labeling and other stigma may manifest in particularly salient ways in urban areas, it is also possible that urban schools may be less equipped to support students with low academic performance, which may make transferring to another school—even in the middle of the school year—a more viable option.

Implications

Our findings have implications for policy-makers, school administrators, and researchers. First, our findings demonstrate the importance of early academic performance. In this regard, while early warning systems are often used in high school to identify students at risk of dropping out (Balfanz & Byrnes, 2019), our study suggests that early warning systems should also be implemented in the early grades—especially when considering the outsized proportion of students who transfer in elementary schools. Indeed, our study lends support to the idea that academic investments are best when made early in a child's life (Heckman, 2012). In this regard, policy-makers should consider effective strategies at boosting early academic performance, such as universal pre-kindergarten (pre-K). Indeed, there is a strong body of research demonstrating pre-K's effectiveness on early academic performance (Gormley et al., 2005). Given that high quality pre-K can be inequitably distributed across racial geographies, policy-makers should work to ensure that Black and low-income students have equal access to high quality pre-K (Latham et al., 2021).

Our findings also highlight a variety of risk factors across contexts that can be used to identify and support students most in need. Given the prominence of poverty in predicting transfers in our models, policy-makers should consider broader efforts to provide low-income families with financial resources to reduce the effect of certain housing "shocks", such as eviction. In this regard, expanded Child Tax Credits not only lead to a marginal reduction in evictions (Hamilton et al., 2022) but also an increase in tutoring access (Jabbari et al., 2023). Furthermore, schools should consider strategies that reduce instances of homelessness. As noted by Wallace et al. (2024.), Maplewood Richmond Heights—one of the schools included in our sample—established "Joe's Place" in 2006 to "offer unhoused students in the [district] a caring home environment that supports them for high school graduation, self-sufficiency, and positive transitions into their adult lives" (Joe's Place, 2024).

Finally, our findings demonstrate that it is important to examine both longevity and heterogeneity together when studying transferring. While there were few differences between St. Louis City and surrounding counties in our random effect panel regression models, there were striking differences between St. Louis City and surrounding counties in our survival models. Although survival modeling strategies are more prevalent in public health research (e.g., in studies of mortality), we demonstrate that survival strategies can be a useful tool in examining risk factors in education.

Limitations

While this study has important contributions, it also has some limitations both in terms of internal and external validity. Starting with internal validity, our random effect panel regression models leverage repeated observations and a host of observed characteristics at both the student and the school level, however, we cannot rule out the possibility of selection bias associated with

academic achievement. Indeed, there are likely some unobserved characteristics that are influencing academic achievement and transferring that may introduce some bias in our results. Future research should consider exogenous sources of variation related to academic performance, such as policy changes in instructional practices, that can help limit selection bias. Moving onto external validity, despite leveraging data from over five large, diverse counties across nine years, the relationship between academic performance and transferring may differ in other parts of Missouri and other parts of the country. As noted by Wallace et al. (2024.), future research should explore these dynamics nationally, potentially by leveraging federal survey data from the National Center for Education Statistics.

Conclusion

Students who transfer to other schools, especially in the middle of a school year, often experience lower achievement levels, greater rates of punishment, and frequently exit the education system prematurely (Wallace et al., 2024). These instances of "School Hopscotch" (Welsh, 2017), in turn, can erode a sense of community in a given school and neighborhood. While students who transfer may be viewed as "someone else's problem", given the deleterious individual and communal effects of transferring schools, a collective sense of responsibility is needed (Wallace et al., 2024).

Stemming from this collective sense of responsibility, this study emerged from a research-practice-partnership in St. Louis, Missouri, where a diverse set of school leaders, practitioners, researchers, and community leaders came together to attempt to both reduce the rates of within-year transfers, while also providing supports for students who do transfer. As part of this collective action, we were charged with identifying some of the major predictors of school mobility that could be used to tailor resources and support for students who may be most at-risk

of transferring. In doing so, we demonstrate the effects of low academic performance on within-year transfers. We also demonstrate the enduring effects of early academic performance to further motivate collective action. However, this is only the first step. Indeed, the identification of risk factors is only valuable if leaders and practitioners use these risk factors to intervene appropriately. We anticipate that future efforts both in St. Louis and elsewhere will leverage risk factors to test new strategies that can both reduce the rates of within-year mobility and improve the outcomes for students who transfer.

References

Amorim, L. D. A. F., & Cai, J. (2015). Modelling recurrent events: a tutorial for analysis in epidemiology. *International Journal of Epidemiology*, *44*(1), 324–333. https://doi.org/10.1093/ije/dyu222

Bahr, P. R. (2009). Educational attainment as process: Using hierarchical discrete-time event history analysis to model rate of progress. *Research in Higher Education*, *50*, 691-714. https://doi.org/10.1007/s11162-009-9135-x.

Balfanz, R., & Byrnes, V. (2019). Early warning indicators and intervention systems: State of the field. *Handbook of student engagement interventions*, 45-55.

Bowditch, C. (1993). Getting Rid of Troublemakers: High School Disciplinary Procedures and the Production of Dropouts. *Social Problems (Berkeley, Calif.), 40*(4), 493–509. https://doi.org/10.1525/sp.1993.40.4.03x0094p

Chung, S., & Delaney, R. (2024). *Where, when, and what happens after students transfer before year-end?* PRiME Center. Saint Louis University. https://www.sluprime.org/policy-brief-database/where-when-and-what-happens-after-students-transfer-before-year-end-8bbwp

Cohen, P., Jabbari, J., Chun, Y., Terada, T., Wallace, M. K., & Chy S. (2024). *Does School Context Moderate the Relationship between Student Mobility and Academic Performance? Longitudinal Evidence from Missouri.* [Unpublished manuscript]. Social Policy Institute, Washington University in St. Louis.

Cox, D. R. (1972). Regression Models and Life-Tables. *Journal of the Royal Statistical Society. Series B, Methodological*, *34*(2), 187–220. https://doi.org/10.1111/j.25176161.1972.tb00899.x

De La Torre, M., & Gwynne, J. (2009). Changing Schools: A Look at Student Mobility Trends in Chicago Public Schools Since 1995. Consortium on Chicago School Research. 1313 East 60th Street, Chicago, IL 60637.

Engec, N., (2006) Relationship Between Mobility and Student Performance and Behavior, The *Journal of Educational Research, 99*:3, 167-178, https://doi.org/10.3200/JOER.99.3.167-178

Gasper, J., DeLuca, S., & Estacion, A. (2012). Switching Schools: Revisiting the Relationship Between School Mobility and High School Dropout. *American Educational Research Journal, 49*(3), 487–519. https://doi.org/10.3102/0002831211415250

Goldhaber, D., Koedel, C., Özek, U., & Parsons, E. (2022). Using longitudinal student mobility to identify at-risk students. *AERA Open, 8*. https://doi.org/10.1177/23328584211071090

Gormley Jr, W. T., & Phillips, D. (2005). The effects of universal pre-k in Oklahoma: Research highlights and policy implications. *Policy Studies Journal, 33*(1), 65-82.

Grigg, J. (2012). School Enrollment changes and Student Achievement Growth: A Case Study in Educational Disruption and Continuity. *Sociology of Education, 85*(4), 388–404. https://doi.org/10.1177/0038040712441374

Hanushek, E. A., Kain, J. F., & Rivkin, S. G. (2004). Disruption versus Tiebout improvement: The costs and benefits of switching schools. *Journal of public Economics*, *88*(9-10), 1721-1746.

Heckman, J. J. (2012). Invest in early childhood development: Reduce deficits, strengthen the economy. *The Heckman Equation, 7*(1-2).

Kleinbaum, D. G., & Klein, M. (2012). Survival analysis: a self-learning text. Springer.

Jabbari, J., Cohen, P., Terada, T., Chun, Y., Wallace, M. K., & Chy S. (2024). *What are the Outcomes of Transfer?* [Unpublished manuscript]. Social Policy Institute, Washington University in St. Louis.

Jabbari, Jason, Cameron Anglum, Stephen Roll, and Leah Hamilton. "The Child Tax Credit, Educational Investments, and the American Dream: A Moderated Mediation Analysis." *Socius 9* (2023): 23780231231181899.

Latham, S., Corcoran, S. P., Sattin-Bajaj, C., & Jennings, J. L. (2021). Racial disparities in pre-K quality: Evidence from New York City's universal pre-K program. *Educational Researcher, 50*(9), 607-617.

Lougheed, J. P., Benson, L., Cole, P. M., & Ram, N. (2019). Multilevel survival analysis: Studying the timing of children's recurring behaviors. Developmental Psychology, 55(1), 53. https://doi.org/10.1037/dev0000619

Mills, M. (2010). *Introducing survival and event history analysis*. Sage Publications

Maroulis, S., Santillano, R., Jabbar, H., & Harris, D. N. (2019). The Push and Pull of School Performance: Evidence from Student Mobility in New Orleans. *American Journal of Education*, *125*(3), 345–380. https://doi.org/10.1086/702734

Min, J. (2021). Between-Year and Within-Year School Mobility: Different Effects by Race/Ethnicity. *Education and Urban Society*, *54*(3), 288–311. https://doi.org/10.1177/00131245211004563

Reynolds, A. J., Chen, C. C., & Herbers, J. E. (2009). School mobility and educational success: A research synthesis and evidence on prevention. In *Workshop on the impact of mobility and change on the lives of young children, schools, and neighborhoods, June* (pp. 29-30).

Rumberger, R. W. (2003). The Causes and Consequences of Student Mobility. The Journal of *Negro Education, 72*(1), 6–21. https://doi.org/10.2307/3211287

Rumberger, R. W. (2015). *Student Mobility: Causes, Consequences, and Solutions.* Boulder, CO: National Education Policy Center. Retrieved from http://nepc.colorado.edu/publication/student-mobility

Rumberger, R. W., & Larson, K. A. (1998). Student mobility and the increased risk of High School dropout. *American Journal of Education, 107*(1), 1–35. https://doi.org/10.1086/444201

Rumberger, R. W., & Thomas, S. L. (2000). The Distribution of Dropout and Turnover Rates among Urban and Suburban High Schools. *Sociology of Education*, *73*(1), 39–67. https://doi.org/10.2307/2673198

Schwartz, A. E., Stiefel, L., & Chalico, L. (2009). The multiple dimensions of student mobility and implications for academic performance: Evidence from New York City elementary and middle school students. Available at SSRN 1508603.

South, S. J., Haynie, D. L., & Bose, S. (2007). Student mobility and school dropout. Social *Science Research, 36*(1), 68–94. https://doi.org/10.1016/j.ssresearch.2005.10.001

Stamp, J., Frigon, C., Dupéré, V., Dion, E., Olivier, E., & Archambault, I. (2022). School Mobility and High School Dropout: Seasonal and Developmental Timing Matters. *Frontiers in Education (Lausanne)*, 7. https://doi.org/10.3389/feduc.2022.887617

Statistical tools for high-throughput data analysis (n.d.). Cox Proportional-Hazards Model. http://www.sthda.com/english/wiki/cox-proportional-hazards-model#google_vignette

Terada, T., Jabbari, J., Chun, Y., Hall, R., Greenstein, E., Wallace, M. K., & Chy S. (2024). *Who Transfers and Where Do They Go? Identifying Risk Factors Across Student, School, And*

Neighborhood Characteristics. [Unpublished manuscript]. Social Policy Institute, Washington University in St. Louis.

Wallace M.K., Jabbari, J., Chun, Y., Terada, T., Chy, S. (2024) *Are School Discipline Practices Pushing Students Out…to Another School? A Longitudinal Analysis of School Transfers in Five Midwest Counties* [Unpublished manuscript]. Department of Education, Washington University in St. Louis.

Welsh, R. O., Duque, M., & McEachin, A. (2016). School Choice, Student Mobility, and School Quality: Evidence from post-Katrina New Orleans. *Education Finance and Policy*, *11*(2), 150–176. https://doi.org/10.1162/EDFP_a_00183

Welsh, R. O. (2017). School hopscotch: A comprehensive review of K–12 student mobility in the United States. *Review of Educational Research, 87*(3), 475–511.

Wright, D. (1999). Student Mobility: A Negligible and Confounded Influence on Student Achievement. *The Journal of Educational Research (Washington, D.C.)*, *92*(6), 347–353. https://doi.org/10.1080/00220679909597618

Table 1

Results of descriptive statistics for five counties

		3rd grade		4th grade		5th grade		6th grade		7th grade		8th grade		Total (423,618)	
Student-level variables	**Category**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Transfer	Non-transfer	66184	93.74%	66195	93.76%	66640	94.39%	66972	94.86%	67229	95.22%	67241	95.24%	400461	94.53%
	Transfer	4419	6.26%	4408	6.24%	3963	5.61%	3631	5.14%	3374	4.78%	3362	4.76%	23157	5.47%
School year	2010	13906	19.70%											13906	3.28%
	2011	13954	19.76%	13906	19.70%									27860	6.58%
	2012	13901	19.69%	13954	19.76%	13906	19.70%							41761	9.86%
	2013	14529	20.58%	13901	19.69%	13954	19.76%	13906	19.70%					56290	13.29%
	2014	14313	20.27%	14529	20.58%	13901	19.69%	13954	19.76%	13906	19.70%			70603	16.67%
	2015			14313	20.27%	14529	20.58%	13901	19.69%	13954	19.76%	13906	19.70%	70603	16.67%
	2016					14313	20.27%	14529	20.58%	13901	19.69%	13954	19.76%	56697	13.38%
	2017							14313	20.27%	14529	20.58%	13901	19.69%	42743	10.09%
	2018									14313	20.27%	14529	20.58%	28842	6.81%
	2019											14313	20.27%	14313	3.38%
Achievement - MA	Below basic	4885	6.92%	6852	9.70%	10956	15.52%	14243	20.17%	18196	25.77%	22151	31.37%	77283	18.24%
	Basic	35454	50.22%	35104	49.72%	29372	41.60%	28935	40.98%	26657	37.76%	26219	37.14%	181741	42.90%
	Proficient	24970	35.37%	23761	33.65%	21700	30.74%	20999	29.74%	18559	26.29%	15008	21.26%	124997	29.51%
	Advanced	5294	7.50%	4886	6.92%	8575	12.15%	6426	9.10%	7191	10.19%	7225	10.23%	39597	9.35%
Achievement - ELA	Below basic	6635	9.40%	8639	12.24%	8399	11.90%	11937	16.91%	14147	20.04%	12949	18.34%	62706	14.80%
	Basic	36711	52.00%	29106	41.22%	26652	37.75%	25058	35.49%	22126	31.34%	23193	32.85%	162846	38.44%
	Proficient	17966	25.45%	20933	29.65%	24835	35.18%	25592	36.25%	24297	34.41%	24642	34.90%	138265	32.64%
	Advanced	9291	13.16%	11925	16.89%	10717	15.18%	8016	11.35%	10033	14.21%	9819	13.91%	59801	14.12%
Gender	Female	34504	48.87%	34486	48.84%	34480	48.84%	34474	48.83%	34466	48.82%	34473	48.83%	206883	48.84%
	Male	36099	51.13%	36117	51.16%	36123	51.16%	36129	51.17%	36137	51.18%	36130	51.17%	216735	51.16%
Race/Ethnicity	White	42926	60.80%	42781	60.59%	42698	60.48%	42619	60.36%	42569	60.29%	42478	60.16%	256071	60.45%
	Asian	1301	1.84%	1276	1.81%	1251	1.77%	1240	1.76%	1222	1.73%	1217	1.72%	7507	1.77%
	Black	22572	31.97%	22424	31.76%	22371	31.69%	22259	31.53%	22202	31.45%	22134	31.35%	133962	31.62%
	Hispanic	2413	3.42%	2463	3.49%	2496	3.54%	2543	3.60%	2580	3.65%	2623	3.72%	15118	3.57%
	Others	1391	1.97%	1659	2.35%	1787	2.53%	1942	2.75%	2030	2.88%	2151	3.05%	10960	2.59%
Lunch status	Unreduced lunch	33430	47.35%	33181	47.00%	33239	47.08%	33658	47.67%	34193	48.43%	34911	49.45%	202612	47.83%
	Free lunch	33073	46.84%	33552	47.52%	33469	47.40%	33146	46.95%	32813	46.48%	32446	45.96%	198499	46.86%
	Reduced lunch	4100	5.81%	3870	5.48%	3895	5.52%	3799	5.38%	3597	5.09%	3246	4.60%	22507	5.31%

Homelessness	Not Homeless	68593	97.15%	68455	96.96%	68276	96.70%	68194	96.59%	68042	96.37%	67838	96.08%	409398	96.64%
	Homeless	2010	2.85%	2148	3.04%	2327	3.30%	2409	3.41%	2561	3.63%	2765	3.92%	14220	3.36%
ELL status	Not ELL	58165	82.38%	61262	86.77%	63706	90.23%	64664	91.59%	64971	92.02%	65408	92.64%	378176	89.27%
	ELL	12438	17.62%	9341	13.23%	6897	9.77%	5939	8.41%	5632	7.98%	5195	7.36%	45442	10.73%
IEP	Not IEP	58456	82.80%	57961	82.09%	58054	82.23%	58600	83.00%	58701	83.14%	58757	83.22%	350529	82.75%
	IEP	12147	17.20%	12642	17.91%	12549	17.77%	12003	17.00%	11902	16.86%	11846	16.78%	73089	17.25%
Residency	Resident in the attending district	69062	97.82%	68946	97.65%	68846	97.51%	68663	97.25%	68599	97.16%	68692	97.29%	412808	97.45%
	Others	1541	2.18%	1657	2.35%	1757	2.49%	1940	2.75%	2004	2.84%	1911	2.71%	10810	2.55%
Charter school	Not charter school	68693	97.29%	68753	97.38%	68597	97.16%	68417	96.90%	68489	97.01%	68525	97.06%	411474	97.13%
	Charter school	1910	2.71%	1850	2.62%	2006	2.84%	2186	3.10%	2114	2.99%	2078	2.94%	12144	2.87%
School-level variables		**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Number of enrolled students		493.80	191.79	489.11	178.7	495.28	177.76	663.31	276.1	674.05	263.05	669.09	262.77	580.78	245.42
Percentage of Black students		30.02	35.99	29.5	35.77	29.19	35.68	29.48	35.02	29.24	34.86	28.97	34.85	29.4	35.37
Percentage of Hispanic students		3.33	4.31	3.57	4.43	3.68	4.34	3.5	4.03	3.66	4.06	3.9	4.18	3.6	4.23
Percentage of White students		61.57	34.83	61.23	34.48	61.06	34.25	61.51	33.82	61.25	33.65	60.89	33.54	61.25	34.1
Percentage of free/reduced lunch		48.82	28.16	49.19	28.65	49.37	29.05	47.77	29.23	47.11	29.92	47.08	30.93	48.22	29.35
Percentage of ELL students		3.62	6.53	3.94	6.73	4.05	6.66	2.12	4.22	2.07	4.11	2.15	4.19	2.99	5.62
Percentage of special education students		13.65	4.39	13.61	4.5	13.63	4.72	14.34	4.89	14.64	5.49	14.94	6.23	14.14	5.11
Rate of out-of-school suspension		0.37	1.26	0.33	1.22	0.33	1.22	1.46	2.47	2.07	3.2	2.18	3.5	1.12	2.49
Percentage of students with proficient/advanced levels in math		42.61	19.52	42.21	19.49	42.12	20.41	39.07	19.51	35.5	19.19	31.63	18.13	38.85	19.81
Percentage of students with proficient/advanced levels in ELA		41.51	17.85	45.25	18.46	48.85	19.61	48.94	18.43	48.41	18.02	47.56	18.66	46.76	18.7

Table 2

Results of panel regression for five counties

	Model 1	Model 2	Model 3	Model 4
Achievement level in math (reference=Below basic)				
Basic	0.776***		0.823***	
	(0.0184)		(0.0196)	
Proficient	0.563***		0.643***	
	(0.0167)		(0.0197)	
Advanced	0.472***		0.572***	
	(0.0228)		(0.0284)	
Achievement level in ELA (reference=Below basic)				
Basic		0.772***		0.819***
		(0.0190)		(0.0202)
Proficient		0.626***		0.716***
		(0.0179)		(0.0209)
Advanced		0.494***		0.600***
		(0.0200)		(0.0248)
Grade (reference=3rd grade)				
4th grade	0.897***	0.913***	0.901***	0.913***
	(0.0238)	(0.0243)	(0.0239)	(0.0243)
5th grade	0.846***	0.866***	0.853***	0.869***
	(0.0251)	(0.0257)	(0.0253)	(0.0258)
6th grade	0.802***	0.814***	0.816***	0.823***
	(0.0268)	(0.0271)	(0.0281)	(0.0283)
7th grade	0.828***	0.849***	0.847***	0.870***
	(0.0311)	(0.0319)	(0.0335)	(0.0344)
Gender (reference=Female)				
Male	1.051*	1.006	1.044*	1.010
	(0.0207)	(0.0199)	(0.0205)	(0.0199)
Ethnicity (reference=White)				
Asian	0.642***	0.623***	0.807*	0.792*
	(0.0657)	(0.0638)	(0.0838)	(0.0822)
Black	1.328***	1.355***	1.347***	1.367***
	(0.0305)	(0.0311)	(0.0463)	(0.0470)
Hispanic	0.727***	0.731***	0.821**	0.829**

	(0.0428)	(0.0431)	(0.0494)	(0.0500)
Others	1.014	1.024	1.131*	1.138*
	(0.0620)	(0.0626)	(0.0700)	(0.0704)
Lunch (reference=Unreduced lunch)				
Free lunch	4.972***	4.990***	3.622***	3.637***
	(0.127)	(0.128)	(0.0985)	(0.0990)
Reduced lunch	2.475***	2.479***	2.004***	2.012***
	(0.113)	(0.113)	(0.0919)	(0.0923)
Homeless (reference=Not homeless)				
Homeless	1.551***	1.545***	1.446***	1.434***
	(0.0538)	(0.0537)	(0.0503)	(0.0499)
ELL (reference=Not ELL)				
ELL	0.917**	0.915**	0.887***	0.873***
	(0.0281)	(0.0280)	(0.0290)	(0.0286)
Resident (reference=Resident in the attending school)				
Others	0.379***	0.379***	0.652***	0.655***
	(0.0255)	(0.0255)	(0.0470)	(0.0472)
Special Education (reference=Not Special Ed.)				
IEP	1.015	1.006	1.072**	1.066*
	(0.0254)	(0.0255)	(0.0270)	(0.0272)
Charter school (reference=Not charter school)				
Charter school	0.625***	0.617***	0.604***	0.601***
	(0.0335)	(0.0331)	(0.0347)	(0.0345)
Number of enrolled students			0.998	0.995
			(0.00448)	(0.00447)
Percentage of Black students			1.105***	1.086**
			(0.0323)	(0.0317)
Percentage of Hispanic students			1.156***	1.142**
			(0.0491)	(0.0485)
Percentage of White students			1.217***	1.198***
			(0.0351)	(0.0345)
Percentage of free/reduced lunch			1.176***	1.164***
			(0.00805)	(0.00817)
Percentage of ELL students			0.936***	0.930***
			(0.0186)	(0.0185)
Percentage of special education students			1.045**	1.034*
			(0.0153)	(0.0152)
Rate of out-of-school suspension			0.969	0.953

			(0.0390)	(0.0384)
Percentage of proficiency or advanced levels in math			0.558***	
			(0.0376)	
Percentage of proficiency or advanced levels in ELA				0.422***
				(0.0320)
School year (reference=2010)				
2011	1.040	1.036	1.059	1.086+
	(0.0504)	(0.0502)	(0.0515)	(0.0529)
2012	0.965	0.952	0.979	0.997
	(0.0462)	(0.0456)	(0.0473)	(0.0483)
2013	0.902*	0.892*	0.928	0.951
	(0.0435)	(0.0430)	(0.0452)	(0.0466)
2014	0.895*	0.878**	0.921+	0.919+
	(0.0437)	(0.0429)	(0.0455)	(0.0454)
2015	0.768***	0.818***	0.727***	0.898+
	(0.0417)	(0.0443)	(0.0400)	(0.0504)
2016	0.778***	0.806***	0.752***	0.913
	(0.0449)	(0.0467)	(0.0440)	(0.0550)
2017	0.736***	0.764***	0.712***	0.872*
	(0.0466)	(0.0485)	(0.0456)	(0.0574)
2018	0.643***	0.682***	0.616***	0.696***
	(0.0483)	(0.0511)	(0.0468)	(0.0528)
Pseudo r-squared	0.0637	0.0631	0.0722	0.0720
lnsig2u	1.219***	1.230***	1.161***	1.164***
	(0.0335)	(0.0336)	(0.0329)	(0.0330)
Observations	353015	353015	353015	353015

Exponentiated coefficients; Standard errors in parentheses
+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Model 1: Student-level variables and a math achievement level are included.
Model 2: Student-level variables and an ELA achievement level are included.
Model 3: Student- and school-level variables and a math achievement level are included.
Model 4: Student- and school-level variables and an ELA achievement level are included.

Table 3

Results of survival analysis for five counties

	Model 1	Model 2	Model 3	Model 4
Achievement level in 3rd grade, math (reference=Below basic)				
Basic	0.791***		0.834***	
	(0.0163)		(0.0174)	
Proficient	0.613***		0.675***	
	(0.0147)		(0.0169)	
Advanced	0.499***		0.552***	
	(0.0201)		(0.0229)	
Achievement level in 3rd grade, ELA (reference=Below basic)				
Basic		0.787***		0.837***
		(0.0149)		(0.0161)
Proficient		0.661***		0.745***
		(0.0158)		(0.0184)
Advanced		0.535***		0.621***
		(0.0172)		(0.0205)
Homeless in 3rd grade (reference=Not homeless)				
Homeless	1.583***	1.580***	1.491***	1.493***
	(0.0399)	(0.0398)	(0.0377)	(0.0378)
Gender (reference=Female)				
Male	1.057***	1.019	1.055***	1.025+
	(0.0141)	(0.0136)	(0.0140)	(0.0137)
Ethnicity (reference=White)				
Asian	0.673***	0.654***	0.885	0.867+
	(0.0519)	(0.0505)	(0.0691)	(0.0677)
Black	1.228***	1.245***	1.447***	1.474***
	(0.0193)	(0.0195)	(0.0361)	(0.0367)
Hispanic	0.784***	0.782***	0.916*	0.920+
	(0.0331)	(0.0330)	(0.0396)	(0.0398)
Others	1.163***	1.169***	1.321***	1.326***
	(0.0471)	(0.0474)	(0.0544)	(0.0545)
Lunch in 3rd grade (reference=Unreduced lunch)				
Free lunch	4.265***	4.241***	3.055***	3.062***
	(0.0832)	(0.0830)	(0.0637)	(0.0639)
Reduced lunch	2.126***	2.116***	1.670***	1.672***
	(0.0753)	(0.0750)	(0.0598)	(0.0599)
ELL in 3rd grade (reference=Not ELL)				
ELL	0.855***	0.853***	0.858***	0.852***
	(0.0176)	(0.0176)	(0.0189)	(0.0188)
Resident in 3rd grade (reference=Resident in the attending school)				
Others	0.322***	0.323***	0.481***	0.476***

	(0.0194)	(0.0194)	(0.0304)	(0.0301)
Special Education in 3rd grade (reference=Not Special Ed.)				
IEP	0.915***	0.905***	0.944**	0.940**
	(0.0169)	(0.0170)	(0.0176)	(0.0178)
Charter school in 3rd grade (reference=Not charter school)				
Charter school	0.606***	0.596***	0.604***	0.601***
	(0.0258)	(0.0253)	(0.0289)	(0.0288)
Number of enrolled 3rd grade students			1.000***	1.000***
			(0.0000385)	(0.0000386)
Percentage of 3rd grade Black students			0.997	0.996+
			(0.00217)	(0.00217)
Percentage of 3rd grade Hispanic students			1.005+	1.004
			(0.00307)	(0.00306)
Percentage of 3rd grade White students			1.010***	1.008***
			(0.00216)	(0.00215)
Percentage of free/reduced lunch in 3rd grade			1.019***	1.018***
			(0.000525)	(0.000543)
Percentage of ELL students in 3rd grade			0.989***	0.989***
			(0.00128)	(0.00128)
Percentage of special education students in 3rd grade			1.005***	1.005***
			(0.00149)	(0.00147)
Percentage of out-of-school suspension in 3rd grade			1.023***	1.024***
			(0.00493)	(0.00493)
Percentage of 3rd grade students with proficient/advanced levels in math			0.802***	
			(0.0389)	
Percentage of 3rd grade students with proficient/advanced levels in ELA				0.642***
				(0.0362)
Observations	423,618	423,618	423,618	423,618
R^2				
Pseudo R^2	0.027	0.026	0.031	0.031

Exponentiated coefficients; Standard errors in parentheses
+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 1

Results of panel regression with math achievement levels, five counties

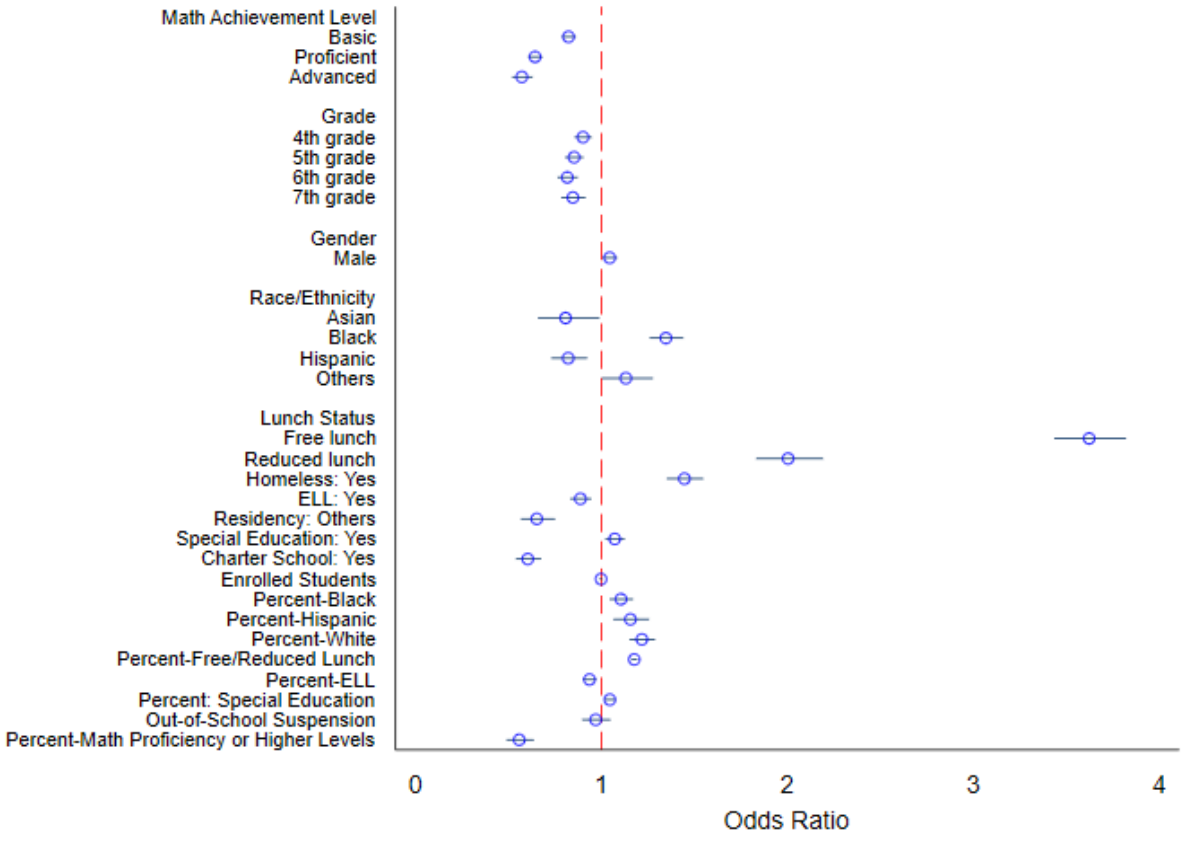


Figure 2

Results of panel regression with ELA achievement levels, five counties

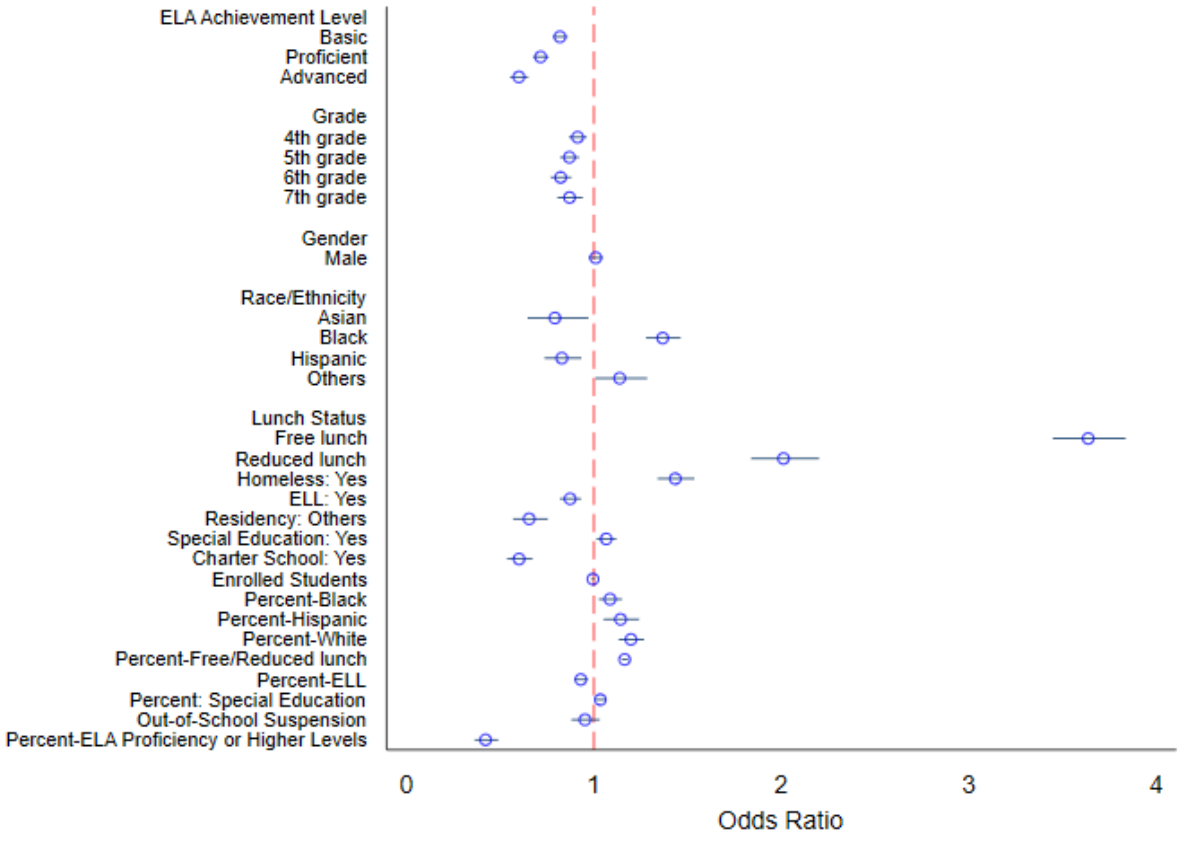


Figure 3

Results of survival analysis by math performance level, five counties

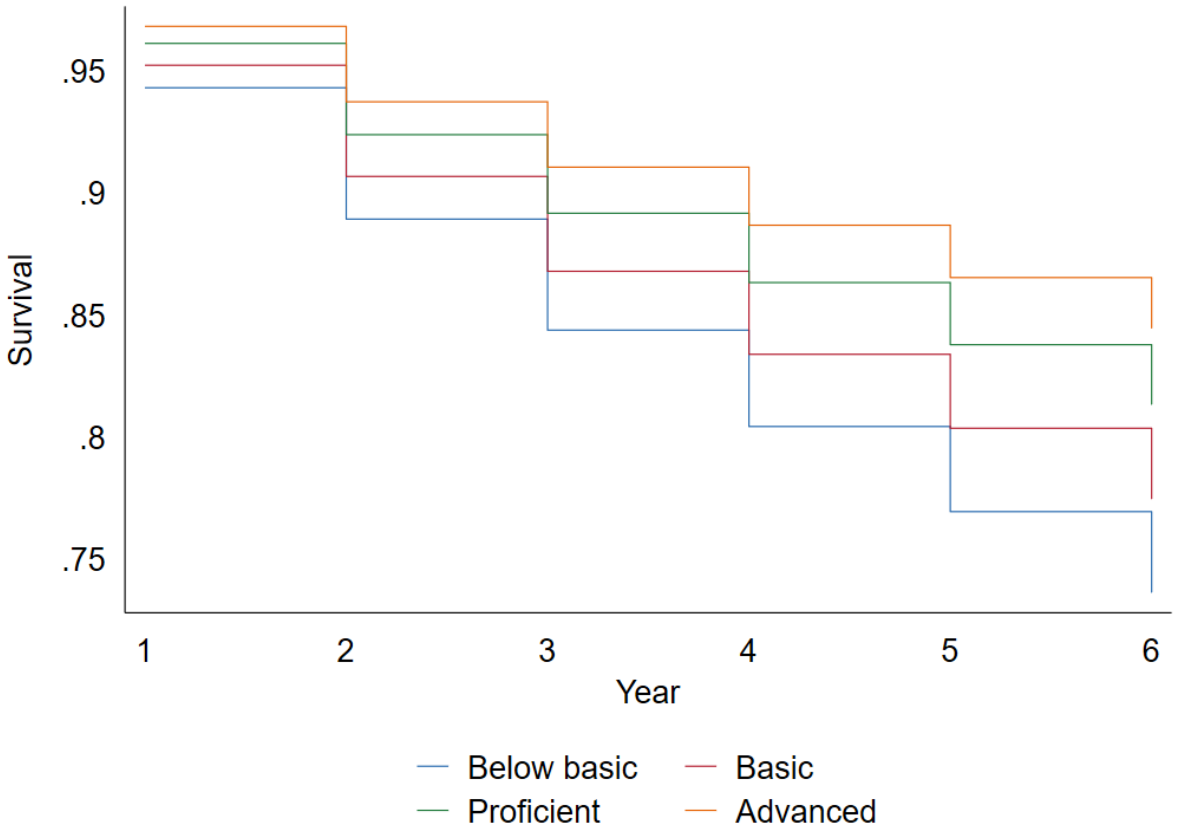
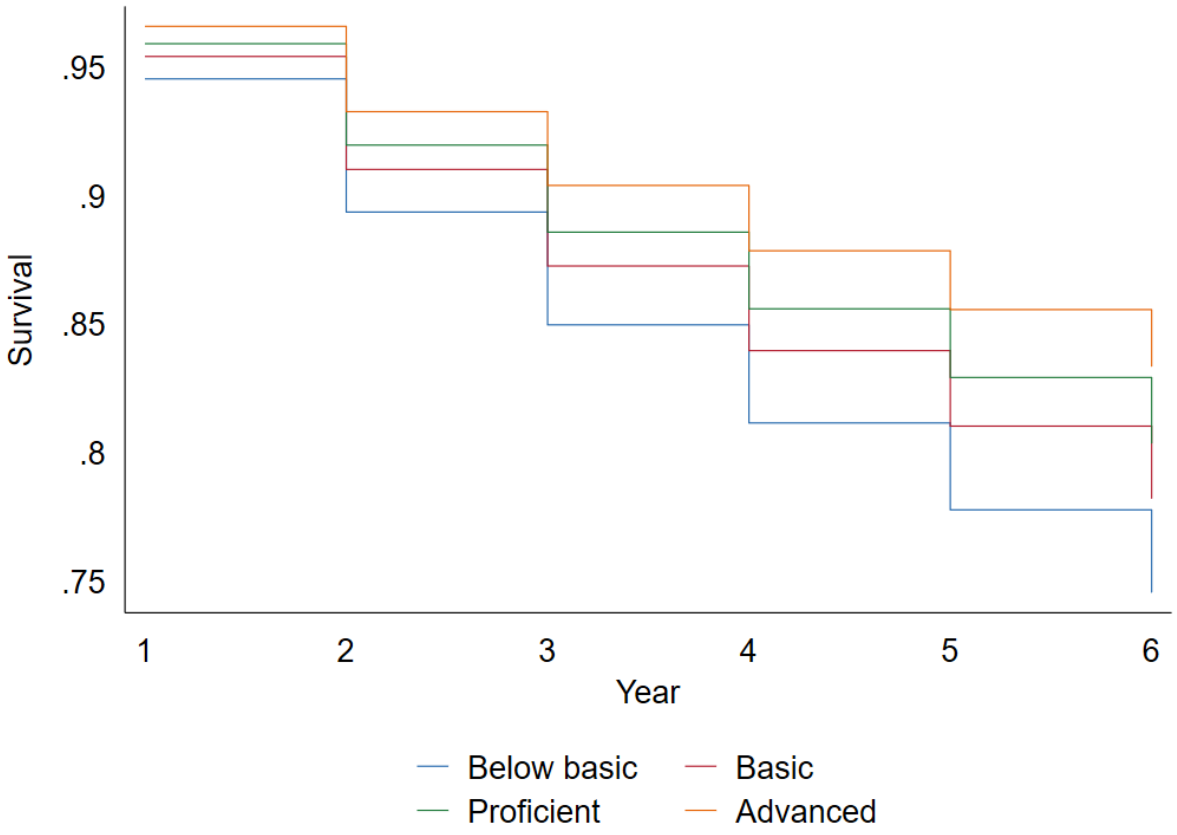


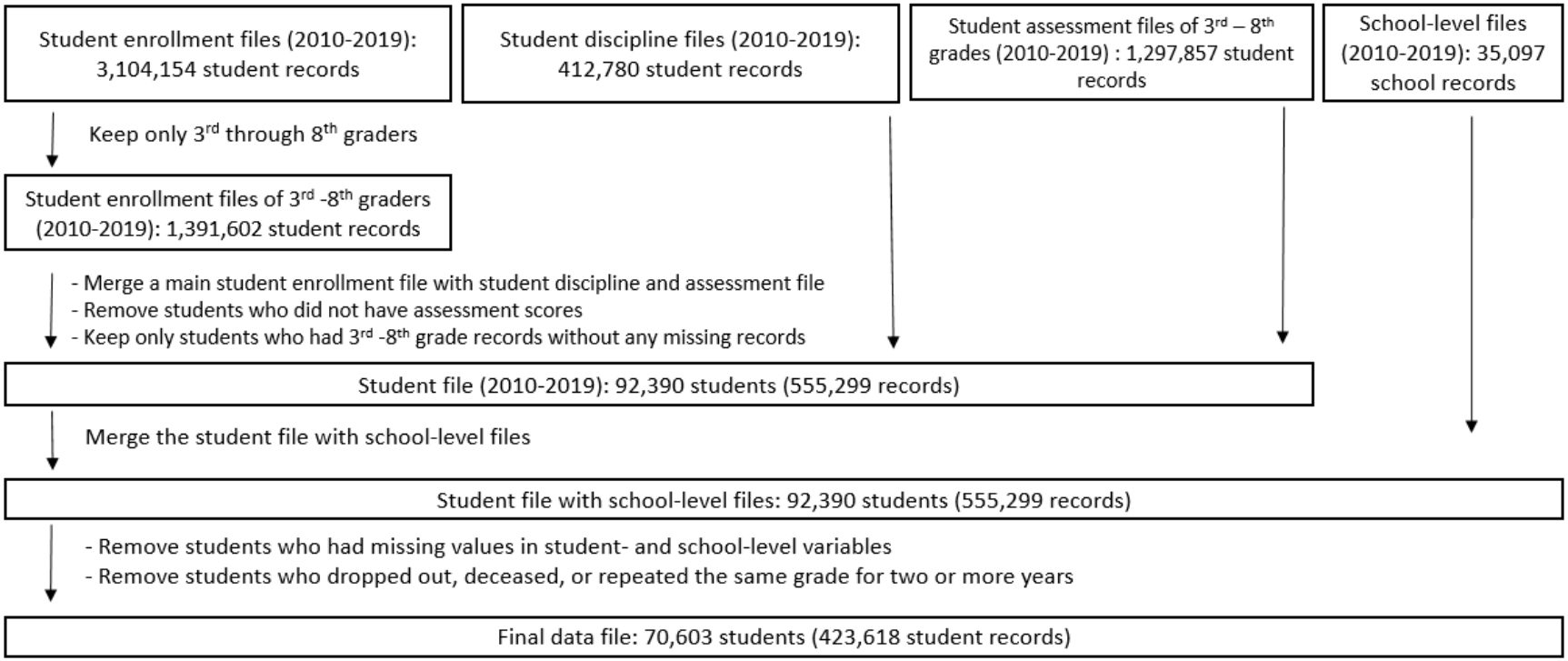
Figure 4

Results of survival analysis by ELA performance level, five counties



Appendix A

Data Cleaning Process



Appendix B

Descriptive Statistics for St. Louis City and Surrounding Counties

Table B1

Results of descriptive statistics, St. Louis City only

		3rd grade		4th grade		5th grade		6th grade		7th grade		8th grade		Total (43,698)	
Student-level variables	**Category**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Transfer	Non-transfer	6592	90.51%	6554	89.99%	6629	91.02%	6608	90.73%	6681	91.73%	6716	92.21%	39780	91.03%
	Transfer	691	9.49%	729	10.01%	654	8.98%	675	9.27%	602	8.27%	567	7.79%	3918	8.97%
School year	2010	1435	19.70%											1435	3.28%
	2011	1424	19.55%	1435	19.70%									2859	6.54%
	2012	1318	18.10%	1424	19.55%	1435	19.70%							4177	9.56%
	2013	1559	21.41%	1318	18.10%	1424	19.55%	1435	19.70%					5736	13.13%
	2014	1547	21.24%	1559	21.41%	1318	18.10%	1424	19.55%	1435	19.70%			7283	16.67%
	2015			1547	21.24%	1559	21.41%	1318	18.10%	1424	19.55%	1435	19.70%	7283	16.67%
	2016					1547	21.24%	1559	21.41%	1318	18.10%	1424	19.55%	5848	13.38%
	2017							1547	21.24%	1559	21.41%	1318	18.10%	4424	10.12%
	2018									1547	21.24%	1559	21.41%	3106	7.11%
	2019											1547	21.24%	1547	3.54%
Achievement level - MA	Below basic	1291	17.73%	1699	23.33%	2189	30.06%	2590	35.56%	3311	45.46%	3927	53.92%	15007	34.34%
	Basic	4246	58.30%	4154	57.04%	3562	48.91%	3230	44.35%	2854	39.19%	2368	32.51%	20414	46.72%
	Proficient	1487	20.42%	1258	17.27%	1208	16.59%	1209	16.60%	888	12.19%	708	9.72%	6758	15.47%
	Advanced	259	3.56%	172	2.36%	324	4.45%	254	3.49%	230	3.16%	280	3.84%	1519	3.48%
Achievement level - ELA	Below basic	1662	22.82%	1894	26.01%	1860	25.54%	2296	31.53%	2676	36.74%	2524	34.66%	12912	29.55%
	Basic	4090	56.16%	3429	47.08%	3242	44.51%	3017	41.43%	2567	35.25%	2731	37.50%	19076	43.65%
	Proficient	1051	14.43%	1384	19.00%	1717	23.58%	1639	22.50%	1596	21.91%	1595	21.90%	8982	20.55%
	Advanced	480	6.59%	576	7.91%	464	6.37%	331	4.54%	444	6.10%	433	5.95%	2728	6.24%
Gender	Female	3635	49.91%	3631	49.86%	3626	49.79%	3614	49.62%	3613	49.61%	3614	49.62%	21733	49.73%
	Male	3648	50.09%	3652	50.14%	3657	50.21%	3669	50.38%	3670	50.39%	3669	50.38%	21965	50.27%
Race/Ethnicity	White	975	13.39%	954	13.10%	947	13.00%	934	12.82%	931	12.78%	916	12.58%	5657	12.95%
	Asian	132	1.81%	130	1.78%	130	1.78%	132	1.81%	133	1.83%	131	1.80%	788	1.80%
	Black	5780	79.36%	5779	79.35%	5770	79.23%	5744	78.87%	5727	78.64%	5724	78.59%	34524	79.01%
	Hispanic	350	4.81%	357	4.90%	360	4.94%	367	5.04%	368	5.05%	375	5.15%	2177	4.98%
	Others	46	0.63%	63	0.87%	76	1.04%	106	1.46%	124	1.70%	137	1.88%	552	1.26%
Lunch status	Unreduced lunch	729	10.01%	667	9.16%	625	8.58%	619	8.50%	601	8.25%	592	8.13%	3833	8.77%

	Free lunch	6265	86.02%	6390	87.74%	6445	88.49%	6465	88.77%	6497	89.21%	6547	89.89%	38609	88.35%
	Reduced lunch	289	3.97%	226	3.10%	213	2.92%	199	2.73%	185	2.54%	144	1.98%	1256	2.87%
Homelessness	Not Homeless	6604	90.68%	6447	88.52%	6397	87.83%	6417	88.11%	6387	87.70%	6332	86.94%	38584	88.30%
	Homeless	679	9.32%	836	11.48%	886	12.17%	866	11.89%	896	12.30%	951	13.06%	5114	11.70%
ELL status	Not ELL	6150	84.44%	6439	88.41%	6390	87.74%	6417	88.11%	6384	87.66%	6413	88.05%	38193	87.40%
	ELL	1133	15.56%	844	11.59%	893	12.26%	866	11.89%	899	12.34%	870	11.95%	5505	12.60%
IEP	Not IEP	6417	88.11%	6345	87.12%	6297	86.46%	6300	86.50%	6258	85.93%	6247	85.78%	37864	86.65%
	IEP	866	11.89%	938	12.88%	986	13.54%	983	13.50%	1025	14.07%	1036	14.22%	5834	13.35%
Residency	Resident in the attending district	7263	99.73%	7183	98.63%	7119	97.75%	7015	96.32%	6974	95.76%	6954	95.48%	42508	97.28%
	Others	20	0.27%	100	1.37%	164	2.25%	268	3.68%	309	4.24%	329	4.52%	1190	2.72%
Charter school	Not charter school	5454	74.89%	5593	76.80%	5586	76.70%	5530	75.93%	5612	77.06%	5667	77.81%	33442	76.53%
	Charter school	1829	25.11%	1690	23.20%	1697	23.30%	1753	24.07%	1671	22.94%	1616	22.19%	10256	23.47%
School-level variables		**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Number of enrolled students		439.94	250.02	440.39	237.69	431.21	224.93	493.16	230.14	510.75	218.9	509.2	221.57	470.77	233.29
Percentage of Black students		77.43	25.63	75.29	28.44	74.36	30.27	71.75	30.53	70.57	31.17	69.89	31.84	73.21	29.84
Percentage of Hispanic students		4.83	7.58	4.98	8.08	4.91	8.37	5	8.36	5.17	8.63	5.24	8.64	5.02	8.28
Percentage of White students		14.66	20.54	16.36	23.3	17.14	24.87	19.14	25.36	19.94	26.04	20.44	26.52	17.95	24.61
Percentage of free/reduced lunch		88.52	15.19	87.99	18.47	87.88	20.3	85.54	22.87	85.19	24.28	85.44	25.58	86.76	21.46
Percentage of ELL students		8.9	13.54	8.49	13.23	7.88	12.68	5.84	9.31	5.73	8.88	5.69	8.98	7.09	11.37
Percentage of special education students		12.06	4.84	12.09	4.88	12.2	4.57	13.84	5.41	15	6.37	15.6	7.54	13.46	5.88
Rate of out-of-school suspension		1.26	2.49	1.16	2.42	1.22	2.67	3.24	3.87	4.5	4.79	4.6	4.94	2.66	3.98
Percentage of students with proficient/advanced levels in math		22.45	14.69	22.75	15.47	23.72	16.87	20.96	16.84	18.42	16.32	16.55	16.18	20.81	16.28
Percentage of students with proficient/advanced levels in ELA		23.23	14.83	26.82	16.42	30.86	18.57	30.89	18.4	30.44	18.44	30.55	19.06	28.8	17.91

Table B2

Results of descriptive statistics, four counties only

		3rd grade		4th grade		5th grade		6th grade		7th grade		8th grade		Total (340,602)	
Student-level variables	**Category**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Transfer	Non-transfer	53816	94.80%	54065	95.24%	54387	95.81%	54630	96.24%	54735	96.42%	54739	96.43%	326372	95.82%
	Transfer	2951	5.20%	2702	4.76%	2380	4.19%	2137	3.76%	2032	3.58%	2028	3.57%	14230	4.18%
School year	2010	11097	19.55%											11097	3.26%
	2011	10989	19.36%	11097	19.55%									22086	6.48%
	2012	11233	19.79%	10989	19.36%	11097	19.55%							33319	9.78%
	2013	11814	20.81%	11233	19.79%	10989	19.36%	11097	19.55%					45133	13.25%
	2014	11634	20.49%	11814	20.81%	11233	19.79%	10989	19.36%	11097	19.55%			56767	16.67%
	2015			11634	20.49%	11814	20.81%	11233	19.79%	10989	19.36%	11097	19.55%	56767	16.67%
	2016					11634	20.49%	11814	20.81%	11233	19.79%	10989	19.36%	45670	13.41%
	2017							11634	20.49%	11814	20.81%	11233	19.79%	34681	10.18%
	2018									11634	20.49%	11814	20.81%	23448	6.88%
	2019											11634	20.49%	11634	3.42%
Achievement level - MA	Below basic	2845	5.01%	4212	7.42%	7403	13.04%	9918	17.47%	12545	22.10%	15366	27.07%	52289	15.35%
	Basic	27533	48.50%	27302	48.09%	22543	39.71%	22743	40.06%	21146	37.25%	21457	37.80%	142724	41.90%
	Proficient	21662	38.16%	20794	36.63%	18953	33.39%	18241	32.13%	16427	28.94%	13335	23.49%	109412	32.12%
	Advanced	4727	8.33%	4459	7.85%	7868	13.86%	5865	10.33%	6649	11.71%	6609	11.64%	36177	10.62%
Achievement level - ELA	Below basic	4018	7.08%	5604	9.87%	5403	9.52%	8164	14.38%	9641	16.98%	8633	15.21%	41463	12.17%
	Basic	28872	50.86%	22584	39.78%	20421	35.97%	19367	34.12%	17285	30.45%	18181	32.03%	126710	37.20%
	Proficient	15591	27.46%	17858	31.46%	21199	37.34%	21971	38.70%	20777	36.60%	21081	37.14%	118477	34.78%
	Advanced	8286	14.60%	10721	18.89%	9744	17.16%	7265	12.80%	9064	15.97%	8872	15.63%	53952	15.84%
Gender	Female	27605	48.63%	27599	48.62%	27594	48.61%	27596	48.61%	27590	48.60%	27595	48.61%	165579	48.61%
	Male	29162	51.37%	29168	51.38%	29173	51.39%	29171	51.39%	29177	51.40%	29172	51.39%	175023	51.39%
Race/Ethnicity	White	38223	67.33%	38120	67.15%	38061	67.05%	38002	66.94%	37953	66.86%	37885	66.74%	228244	67.01%
	Asian	1118	1.97%	1096	1.93%	1071	1.89%	1056	1.86%	1038	1.83%	1038	1.83%	6417	1.88%
	Black	14346	25.27%	14215	25.04%	14169	24.96%	14091	24.82%	14054	24.76%	13995	24.65%	84870	24.92%
	Hispanic	1915	3.37%	1953	3.44%	1972	3.47%	2015	3.55%	2049	3.61%	2082	3.67%	11986	3.52%
	Others	1165	2.05%	1383	2.44%	1494	2.63%	1603	2.82%	1673	2.95%	1767	3.11%	9085	2.67%
Lunch status	Unreduced lunch	31271	55.09%	31153	54.88%	31247	55.04%	31631	55.72%	32118	56.58%	32758	57.71%	190178	55.84%
	Free lunch	22066	38.87%	22342	39.36%	22231	39.16%	21881	38.55%	21555	37.97%	21239	37.41%	131314	38.55%
	Reduced lunch	3430	6.04%	3272	5.76%	3289	5.79%	3255	5.73%	3094	5.45%	2770	4.88%	19110	5.61%

Homelessness	Not Homeless	55732	98.18%	55790	98.28%	55699	98.12%	55625	97.99%	55541	97.84%	55432	97.65%	333819	98.01%
	Homeless	1035	1.82%	977	1.72%	1068	1.88%	1142	2.01%	1226	2.16%	1335	2.35%	6783	1.99%
ELL status	Not ELL	46086	81.18%	48891	86.13%	51392	90.53%	52315	92.16%	52657	92.76%	53047	93.45%	304388	89.37%
	ELL	10681	18.82%	7876	13.87%	5375	9.47%	4452	7.84%	4110	7.24%	3720	6.55%	36214	10.63%
IEP	Not IEP	46582	82.06%	46184	81.36%	46344	81.64%	46871	82.57%	47022	82.83%	47082	82.94%	280085	82.23%
	IEP	10185	17.94%	10583	18.64%	10423	18.36%	9896	17.43%	9745	17.17%	9685	17.06%	60517	17.77%
Residency	Resident in the attending district	55285	97.39%	55262	97.35%	55236	97.30%	55181	97.21%	55168	97.18%	55275	97.37%	331407	97.30%
	Others	1482	2.61%	1505	2.65%	1531	2.70%	1586	2.79%	1599	2.82%	1492	2.63%	9195	2.70%
Charter school	Not charter school	56767	100.00%	56717	99.91%	56628	99.76%	56536	99.59%	56521	99.57%	56505	99.54%	339674	99.73%
	Charter school	0	0.00%	50	0.09%	139	0.24%	231	0.41%	246	0.43%	262	0.46%	928	0.27%
School-level variables		**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Number of enrolled students		507.67	171.43	501.68	161.49	509.55	164.57	699.03	264.94	708.45	253.69	703.08	254.82	604.91	238.21
Percentage of Black students		23.54	31.65	23.24	31.47	23.02	31.32	23.76	31.07	23.65	31	23.39	30.97	23.43	31.25
Percentage of Hispanic students		3.18	3.6	3.42	3.61	3.56	3.42	3.33	2.95	3.51	2.97	3.77	3.16	3.46	3.3
Percentage of White students		67.78	30.84	67.17	30.63	66.87	30.44	67.08	30.18	66.63	30.14	66.19	30.1	66.95	30.39
Percentage of free/reduced lunch		41.37	24.62	42.03	25.25	42.38	25.69	41.06	25.8	40.42	26.44	40.4	27.52	41.28	25.91
Percentage of ELL students		3.12	4.78	3.49	5.17	3.69	5.28	1.69	2.7	1.65	2.76	1.75	2.87	2.56	4.19
Percentage of special education students		13.91	4.3	13.84	4.41	13.84	4.7	14.42	4.8	14.6	5.37	14.85	6.11	14.25	5
Rate of out-of-school suspension		0.21	0.81	0.2	0.86	0.2	0.76	1.18	2.01	1.69	2.67	1.82	3.08	0.88	2.07
Percentage of students with proficient/advanced levels in math		46.44	17.33	45.88	17.61	45.65	18.92	42.42	18.01	38.75	17.93	34.57	17.02	42.29	18.34
Percentage of students with proficient/advanced levels in ELA		45.16	15.46	48.8	16.3	52.4	17.57	52.34	16.16	51.7	15.79	50.66	16.75	50.18	16.55

Appendix C

Subsample Analyses for Panel Regression Models

Table C1

Results of panel regression for St. Louis City only

	Model 1	Model 2	Model 3	Model 4
Achievement level in math (reference=Below basic)				
Basic	0.776***		0.810***	
	(0.0390)		(0.0414)	
Proficient	0.585***		0.654***	
	(0.0438)		(0.0511)	
Advanced	0.649**		0.760+	
	(0.0932)		(0.112)	
Achievement level in ELA (reference=Below basic)				
Basic		0.816***		0.860**
		(0.0423)		(0.0451)
Proficient		0.635***		0.714***
		(0.0435)		(0.0506)
Advanced		0.472***		0.565***
		(0.0569)		(0.0701)
Grade (reference=3rd grade)				
4th grade	0.905	0.923	0.937	0.944
	(0.0594)	(0.0607)	(0.0618)	(0.0622)
5th grade	1.049	1.083	1.099	1.118
	(0.0757)	(0.0782)	(0.0800)	(0.0812)
6th grade	1.000	1.023	1.067	1.070
	(0.0813)	(0.0831)	(0.0921)	(0.0923)
7th grade	0.949	0.992	1.014	1.045
	(0.0874)	(0.0912)	(0.102)	(0.105)
Gender (reference=Female)				
Male	1.120*	1.085+	1.113*	1.086+
	(0.0531)	(0.0516)	(0.0532)	(0.0520)
Ethnicity (reference=White)				
Asian	0.728	0.704	0.706	0.693
	(0.169)	(0.164)	(0.167)	(0.164)
Black	1.350***	1.322***	1.260*	1.231*

	(0.114)	(0.112)	(0.121)	(0.119)
Hispanic	0.597**	0.572***	0.668*	0.648*
	(0.0991)	(0.0952)	(0.116)	(0.112)
Others	0.677	0.655	0.802	0.767
	(0.190)	(0.185)	(0.227)	(0.217)
Lunch (reference=Unreduced lunch)				
Free lunch	1.754***	1.706***	1.491***	1.463***
	(0.177)	(0.173)	(0.158)	(0.155)
Reduced lunch	0.982	0.973	0.911	0.908
	(0.178)	(0.177)	(0.167)	(0.166)
Homeless (reference=Not homeless)				
Homeless	1.574***	1.554***	1.488***	1.464***
	(0.0951)	(0.0941)	(0.0911)	(0.0896)
ELL (reference=Not ELL)				
ELL	0.893	0.875	0.825*	0.803*
	(0.0748)	(0.0734)	(0.0712)	(0.0693)
Resident (reference=Resident in the attending school)				
Others	0.386***	0.388***	0.719	0.696
	(0.0788)	(0.0793)	(0.164)	(0.159)
Special Education (reference=Not Special Ed.)				
IEP	0.943	0.923	0.959	0.946
	(0.0639)	(0.0632)	(0.0656)	(0.0654)
Charter school (reference=Not charter school)				
Charter school	0.561***	0.553***	0.701***	0.679***
	(0.0352)	(0.0346)	(0.0577)	(0.0556)
Number of enrolled students			0.955***	0.953***
			(0.0121)	(0.0121)
Percentage of Black students			1.084	1.036
			(0.0899)	(0.0855)
Percentage of Hispanic students			0.894	0.878
			(0.0844)	(0.0824)
Percentage of White students			1.098	1.054
			(0.0959)	(0.0913)
Percentage of free/reduced lunch			1.049+	1.040
			(0.0283)	(0.0286)
Percentage of ELL students			1.108**	1.078*
			(0.0414)	(0.0407)
Percentage of special education students			0.993	0.971

			(0.0446)	(0.0445)
Rate of out-of-school suspension			1.126^{+}	1.110
			(0.0796)	(0.0788)
Percentage of proficiency or advanced levels in math			0.502***	
			(0.101)	
Percentage of proficiency or advanced levels in ELA				0.403***
				(0.0817)
School year (reference=2010)				
2011	1.091	1.088	1.065	1.091
	(0.128)	(0.128)	(0.126)	(0.129)
2012	0.953	0.944	0.910	0.934
	(0.112)	(0.111)	(0.107)	(0.110)
2013	0.731**	0.722**	0.725**	0.738*
	(0.0867)	(0.0857)	(0.0868)	(0.0883)
2014	0.689**	0.676**	0.684**	0.679**
	(0.0830)	(0.0814)	(0.0831)	(0.0824)
2015	0.635***	0.677**	0.594***	0.726*
	(0.0841)	(0.0894)	(0.0803)	(0.0990)
2016	0.605***	0.620***	0.568***	0.671**
	(0.0850)	(0.0874)	(0.0813)	(0.0978)
2017	0.608**	0.626**	0.564***	0.679*
	(0.0928)	(0.0959)	(0.0878)	(0.107)
2018	0.526***	0.544***	0.480***	0.534***
	(0.0953)	(0.0987)	(0.0883)	(0.0978)
Pseudo r-squared	0.0269	0.0273	0.0310	0.0317
lnsig2u	0.943	0.946	0.970	0.958
	(0.0706)	(0.0707)	(0.0730)	(0.0725)
Observations	36415	36415	36415	36415

Exponentiated coefficients; Standard errors in parentheses
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table C2

Results of panel regression for four counties

	Model 1	Model 2	Model 3	Model 4
Achievement level in math (reference=Below basic)				
Basic	0.777***		0.824***	
	(0.0243)		(0.0259)	
Proficient	0.548***		0.616***	
	(0.0209)		(0.0240)	
Advanced	0.463***		0.551***	
	(0.0272)		(0.0333)	
Achievement level in ELA (reference=Below basic)				
Basic		0.760***		0.804***
		(0.0247)		(0.0262)
Proficient		0.629***		0.709***
		(0.0231)		(0.0264)
Advanced		0.496***		0.596***
		(0.0247)		(0.0302)
Grade (reference=3rd grade)				
4th grade	0.888***	0.903**	0.883***	0.894***
	(0.0298)	(0.0304)	(0.0296)	(0.0301)
5th grade	0.812***	0.828***	0.806***	0.820***
	(0.0306)	(0.0312)	(0.0304)	(0.0309)
6th grade	0.789***	0.798***	0.781***	0.782***
	(0.0332)	(0.0335)	(0.0342)	(0.0342)
7th grade	0.821***	0.834***	0.818***	0.834***
	(0.0388)	(0.0394)	(0.0410)	(0.0418)
Gender (reference=Female)				
Male	1.051*	1.004	1.042+	1.005
	(0.0259)	(0.0249)	(0.0256)	(0.0248)
Ethnicity (reference=White)				
Asian	0.758*	0.734*	0.928	0.910
	(0.0915)	(0.0886)	(0.113)	(0.111)
Black	1.576***	1.616***	1.359***	1.391***
	(0.0452)	(0.0463)	(0.0577)	(0.0590)
Hispanic	0.804**	0.813**	0.845*	0.855*

	(0.0574)	(0.0582)	(0.0613)	(0.0620)
Others	1.009	1.022	1.074	1.088
	(0.0759)	(0.0769)	(0.0817)	(0.0827)
Lunch (reference=Unreduced lunch)				
Free lunch	4.766***	4.806***	3.776***	3.805***
	(0.142)	(0.143)	(0.118)	(0.119)
Reduced lunch	2.458***	2.464***	2.089***	2.100***
	(0.129)	(0.130)	(0.111)	(0.111)
Homeless (reference=Not homeless)				
Homeless	1.516***	1.517***	1.460***	1.451***
	(0.0773)	(0.0775)	(0.0744)	(0.0741)
ELL (reference=Not ELL)				
ELL	0.928*	0.928+	0.891**	0.878**
	(0.0352)	(0.0353)	(0.0385)	(0.0381)
Resident (reference=Resident in the attending school)				
Others	0.379***	0.378***	0.669***	0.673***
	(0.0285)	(0.0285)	(0.0544)	(0.0548)
Special Education (reference=Not Special Ed.)				
IEP	1.074*	1.074*	1.133***	1.137***
	(0.0329)	(0.0333)	(0.0349)	(0.0354)
Charter school (reference=Not charter school)				
Charter school	0.830	0.813	0.755+	0.729+
	(0.139)	(0.136)	(0.128)	(0.124)
Number of enrolled students			1.010+	1.005
			(0.00602)	(0.00600)
Percentage of Black students			1.277***	1.249***
			(0.0485)	(0.0476)
Percentage of Hispanic students			1.307***	1.271***
			(0.0807)	(0.0785)
Percentage of White students			1.340***	1.315***
			(0.0496)	(0.0487)
Percentage of free/reduced lunch			1.130***	1.107***
			(0.00991)	(0.0102)
Percentage of ELL students			1.064+	1.067+
			(0.0357)	(0.0358)
Percentage of special education students			1.082***	1.063***
			(0.0177)	(0.0176)
Rate of out-of-school suspension			0.922	0.923

			(0.0552)	(0.0552)
Percentage of proficiency or advanced levels in math			0.587***	
			(0.0546)	
Percentage of proficiency or advanced levels in ELA				0.338***
				(0.0392)
School year (reference=2010)				
2011	0.977	0.970	1.026	1.060
	(0.0597)	(0.0593)	(0.0629)	(0.0653)
2012	0.919	0.904+	0.963	0.996
	(0.0552)	(0.0543)	(0.0586)	(0.0610)
2013	0.849**	0.837**	0.903+	0.943
	(0.0512)	(0.0506)	(0.0554)	(0.0583)
2014	0.897+	0.879*	0.954	0.959
	(0.0545)	(0.0535)	(0.0590)	(0.0594)
2015	0.746***	0.796***	0.740***	0.955
	(0.0506)	(0.0538)	(0.0512)	(0.0684)
2016	0.766***	0.796**	0.778***	0.993
	(0.0552)	(0.0575)	(0.0571)	(0.0762)
2017	0.700***	0.728***	0.711***	0.916
	(0.0553)	(0.0577)	(0.0573)	(0.0766)
2018	0.600***	0.644***	0.602***	0.692***
	(0.0565)	(0.0606)	(0.0578)	(0.0662)
Pseudo r-squared	0.0689	0.0679	0.0759	0.0756
lnsig2u	1.271***	1.285***	1.213***	1.218***
	(0.0442)	(0.0444)	(0.0435)	(0.0436)
Observations	283835	283835	283835	283835

Exponentiated coefficients; Standard errors in parentheses
+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure C1

Results of panel regression with math achievement levels, St. Louis City only

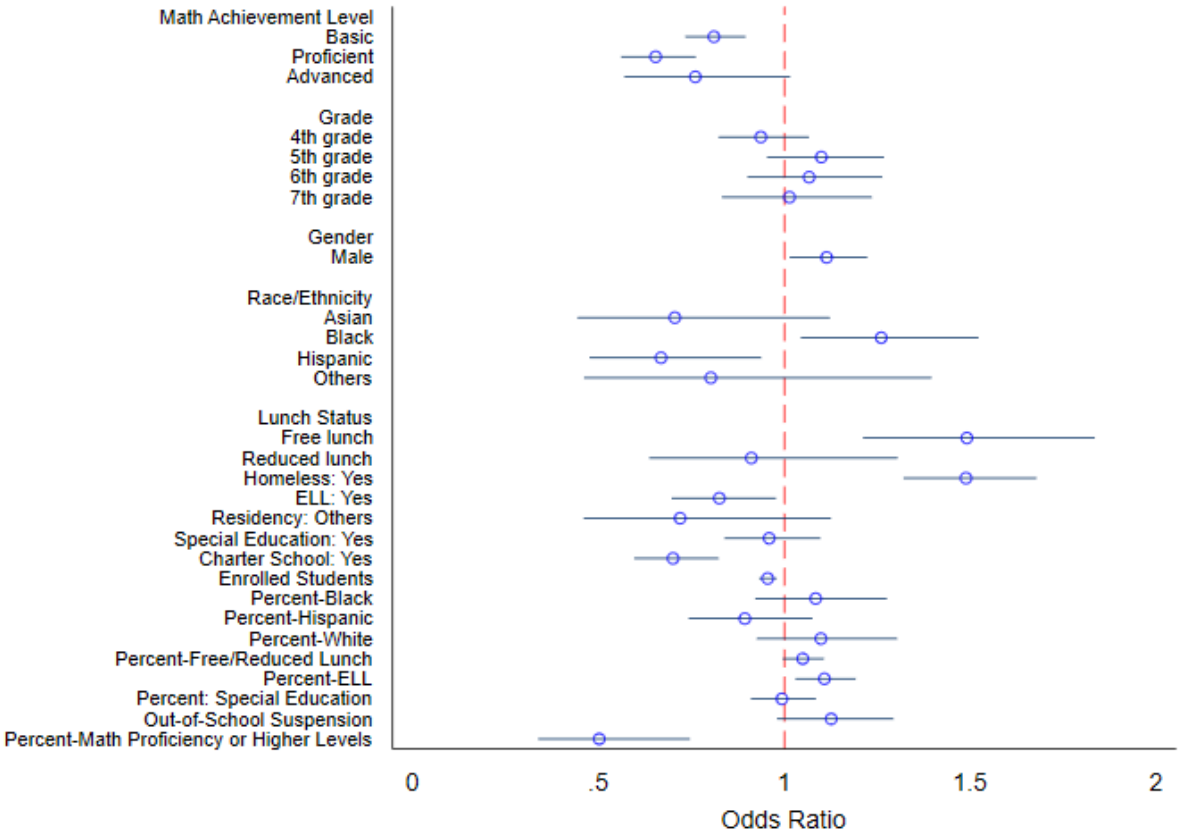


Figure C2

Results of panel regression with ELA achievement levels, St. Louis City only

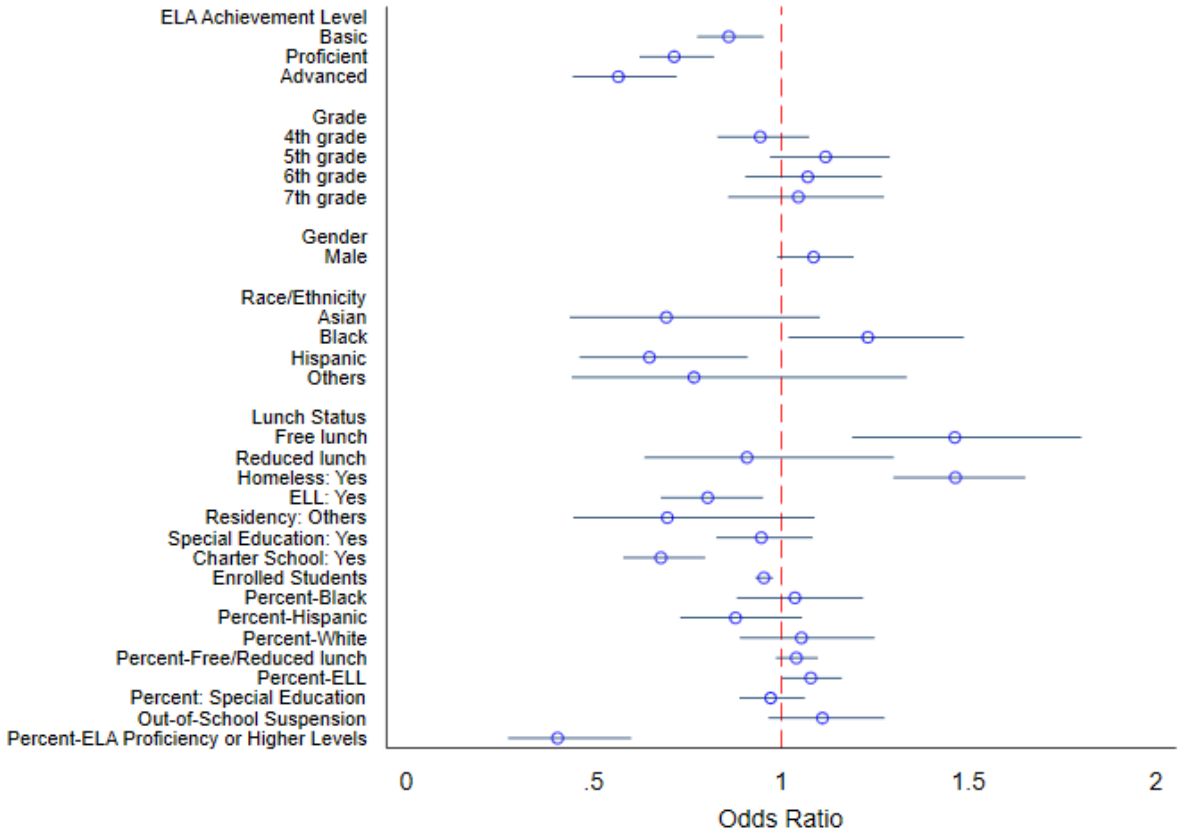


Figure C3

Results of panel regression with math achievement levels, four counties

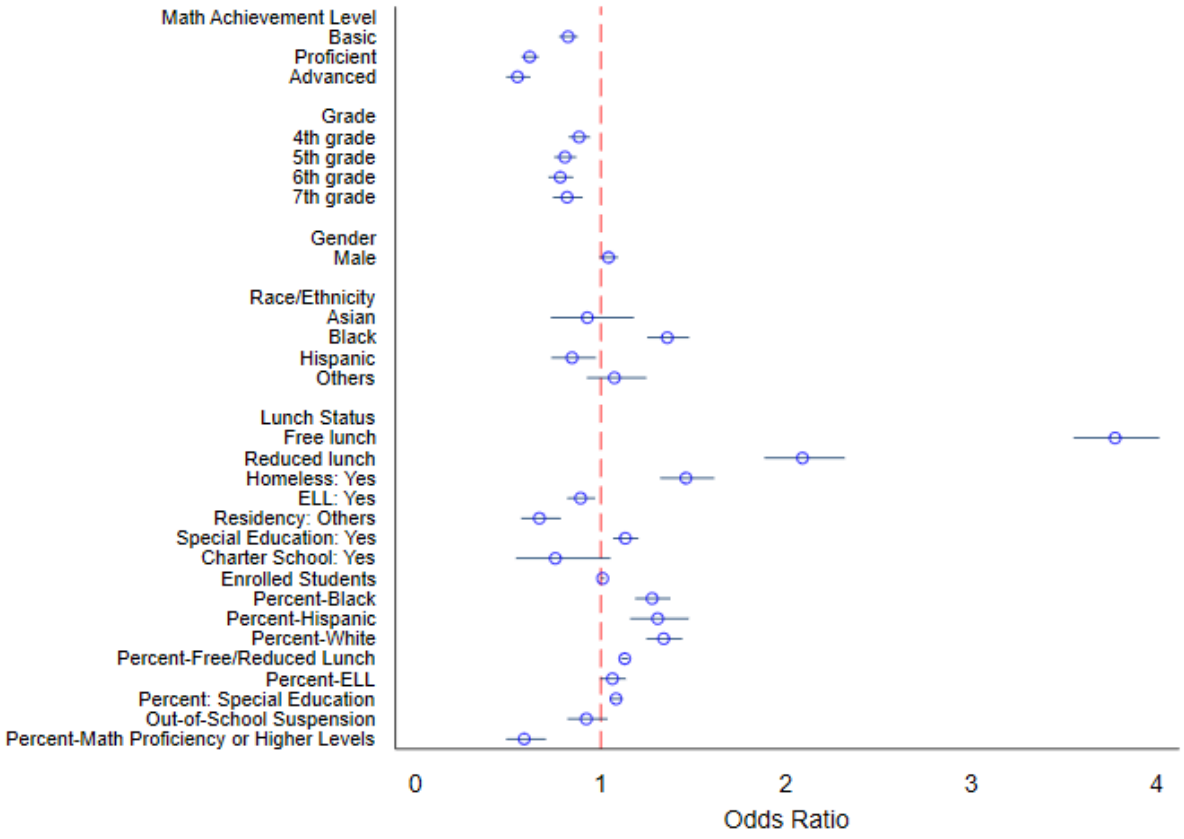
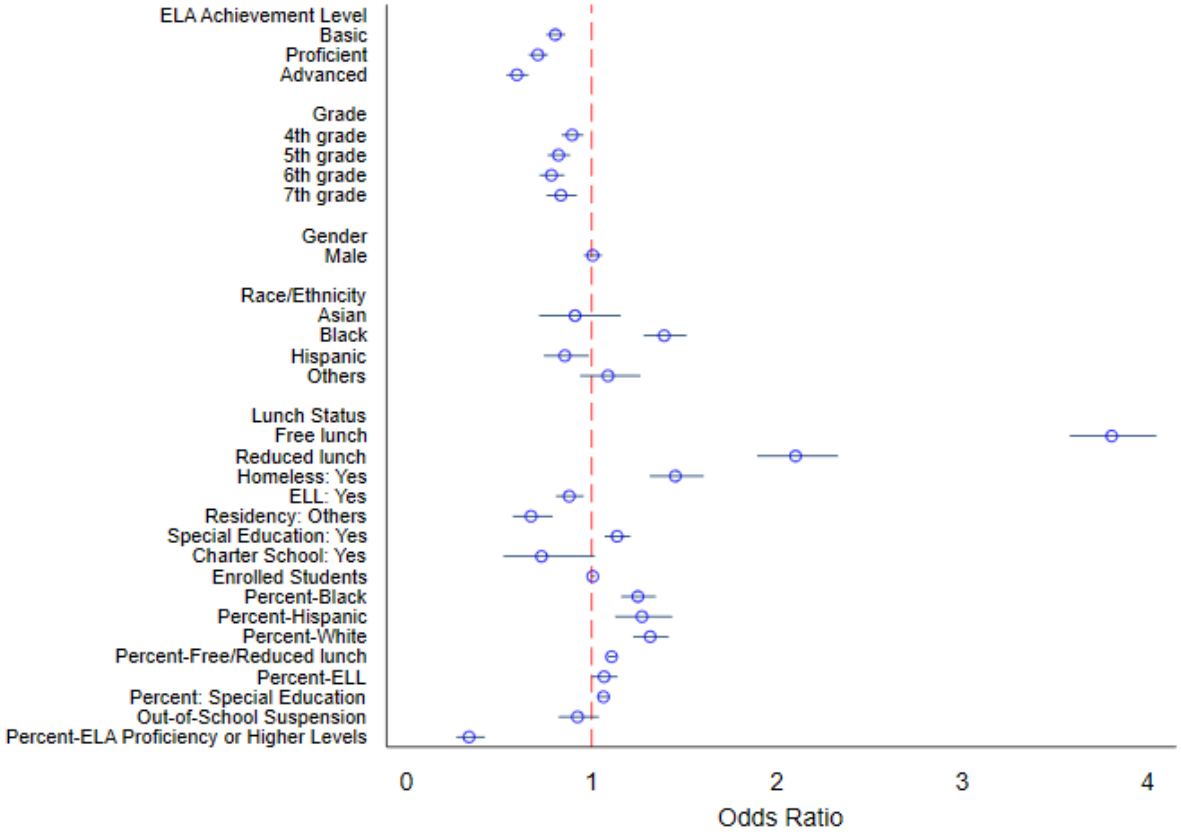


Figure C4

Results of panel regression with ELA achievement levels, four counties



Appendix D

Subsample Analyses for Survival Analysis Models

Table D1

Results of survival analysis, St. Louis City only

	Model 1	Model 2	Model 3	Model 4
Achievement level in 3rd grade, math (reference=Below basic)				
Basic	0.843***		0.905*	
	(0.0336)		(0.0365)	
Proficient	0.625***		0.702***	
	(0.0344)		(0.0403)	
Advanced	0.487***		0.570***	
	(0.0601)		(0.0714)	
Achievement level in 3rd grade, ELA (reference=Below basic)				
Basic		0.793***		0.849***
		(0.0300)		(0.0326)
Proficient		0.615***		0.702***
		(0.0365)		(0.0431)
Advanced		0.592***		0.710***
		(0.0497)		(0.0617)
Homeless in 3rd grade (reference=Not homeless)				
Homeless	1.416***	1.398***	1.330***	1.322***
	(0.0648)	(0.0640)	(0.0613)	(0.0609)
Gender (reference=Female)				
Male	1.107**	1.073*	1.097**	1.071*
	(0.0358)	(0.0349)	(0.0355)	(0.0348)
Ethnicity (reference=White)				
Asian	0.826	0.799	0.699*	0.682*
	(0.148)	(0.143)	(0.127)	(0.124)
Black	1.331***	1.352***	1.170*	1.189*
	(0.0861)	(0.0875)	(0.0866)	(0.0883)
Hispanic	0.754*	0.757*	0.825	0.828
	(0.0946)	(0.0951)	(0.107)	(0.108)
Others	1.300	1.329+	1.309	1.340+
	(0.216)	(0.220)	(0.219)	(0.224)
Lunch in 3rd grade (reference=Unreduced lunch)				
Free lunch	1.380***	1.362***	1.021	1.014
	(0.0981)	(0.0974)	(0.0745)	(0.0744)
Reduced lunch	0.774+	0.771*	0.640***	0.640***
	(0.102)	(0.102)	(0.0846)	(0.0846)
ELL in 3rd grade (reference=Not ELL)				
ELL	0.784***	0.770***	0.725***	0.717***
	(0.0534)	(0.0524)	(0.0515)	(0.0510)
Resident in 3rd grade (reference=Resident in the attending school)				

Others	1.353	1.309	1.843	1.795
	(0.557)	(0.539)	(0.764)	(0.744)
Special Education in 3rd grade (reference=Not Special Ed.)				
IEP	0.859**	0.830***	0.886*	0.862**
	(0.0443)	(0.0433)	(0.0459)	(0.0453)
Charter school	0.599***	0.592***	0.912	0.919
	(0.0288)	(0.0283)	(0.0748)	(0.0747)
Number of enrolled 3rd grade students			0.999***	0.999***
			(0.000135)	(0.000135)
Percentage of 3rd grade Black students			0.989	0.988+
			(0.00719)	(0.00717)
Percentage of 3rd grade Hispanic students			0.962***	0.962***
			(0.00730)	(0.00729)
Percentage of 3rd grade White students			0.988+	0.987+
			(0.00694)	(0.00694)
Percentage of free/reduced lunch in 3rd grade			1.023***	1.022***
			(0.00338)	(0.00343)
Percentage of ELL students in 3rd grade			1.011**	1.010**
			(0.00367)	(0.00366)
Percentage of special education students in 3rd grade			1.000	1.000
			(0.00438)	(0.00437)
Percentage of out-of-school suspension in 3rd grade			1.065***	1.063***
			(0.00851)	(0.00848)
Proficiency_MA_3rd			1.165	
			(0.172)	
Proficiency_ELA_3rd				0.895
				(0.142)
Observations	43,698	43,698	43,698	43,698
R^2				
Pseudo R^2	0.010	0.010	0.015	0.015

Exponentiated coefficients; Standard errors in parentheses
+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table D2

Results of survival analysis, four counties only

	Model 1	Model 2	Model 3	Model 4
Achievement level in 3rd grade, math (reference=Below basic)				
Basic	0.769***		0.802***	
	(0.0220)		(0.0231)	
Proficient	0.575***		0.620***	
	(0.0187)		(0.0206)	
Advanced	0.466***		0.511***	
	(0.0238)		(0.0267)	
Achievement level in 3rd grade, ELA (reference=Below basic)				
Basic		0.769***		0.806***
		(0.0201)		(0.0212)
Proficient		0.644***		0.705***
		(0.0204)		(0.0227)
Advanced		0.501***		0.565***
		(0.0207)		(0.0238)
Homeless in 3rd grade (reference=Not homeless)				
Homeless	1.701***	1.705***	1.655***	1.659***
	(0.0615)	(0.0616)	(0.0599)	(0.0601)
Gender (reference=Female)				
Male	1.058***	1.015	1.051**	1.015
	(0.0180)	(0.0173)	(0.0179)	(0.0173)
Ethnicity (reference=White)				
Asian	0.748**	0.726***	0.924	0.902
	(0.0693)	(0.0673)	(0.0865)	(0.0845)
Black	1.485***	1.509***	1.461***	1.496***
	(0.0293)	(0.0297)	(0.0449)	(0.0459)
Hispanic	0.843***	0.839***	0.894*	0.893*
	(0.0432)	(0.0431)	(0.0468)	(0.0468)
Others	1.198***	1.206***	1.295***	1.304***
	(0.0604)	(0.0608)	(0.0663)	(0.0667)
Lunch in 3rd grade (reference=Unreduced lunch)				
Free lunch	4.141***	4.124***	3.352***	3.367***
	(0.0945)	(0.0944)	(0.0809)	(0.0814)
Reduced lunch	2.176***	2.164***	1.850***	1.851***
	(0.0891)	(0.0886)	(0.0766)	(0.0767)
ELL in 3rd grade (reference=Not ELL)				
ELL	0.917***	0.919***	0.920**	0.916**
	(0.0222)	(0.0223)	(0.0256)	(0.0256)
Resident in 3rd grade (reference=Resident in the attending school)				
Others	0.312***	0.313***	0.463***	0.456***
	(0.0197)	(0.0197)	(0.0312)	(0.0307)
Special Education in 3rd grade (reference=Not Special Ed.)				

IEP	0.934**	0.930**	0.961+	0.960+
	(0.0214)	(0.0217)	(0.0223)	(0.0226)
Number of enrolled 3rd grade students			1.000	1.000
			(0.0000555)	(0.0000554)
Percentage of 3rd grade Black students			1.014***	1.013***
			(0.00290)	(0.00291)
Percentage of 3rd grade Hispanic students			1.016***	1.015***
			(0.00435)	(0.00435)
Percentage of 3rd grade White students			1.020***	1.019***
			(0.00283)	(0.00283)
Percentage of free/reduced lunch in 3rd grade			1.013***	1.012***
			(0.000681)	(0.000719)
Percentage of ELL students in 3rd grade			1.001	1.001
			(0.00257)	(0.00256)
Percentage of special education students in 3rd grade			1.014***	1.014***
			(0.00152)	(0.00152)
Percentage of out-of-school suspension in 3rd grade			1.012	1.014+
			(0.00802)	(0.00807)
Percentage of 3rd grade students with proficient/advanced levels in math			0.798**	
			(0.0554)	
Percentage of 3rd grade students with proficient/advanced levels in ELA				0.674***
				(0.0596)
Observations	340,602	340,602	340,602	340,602
R^2				
Pseudo R^2	0.032	0.031	0.034	0.034

Exponentiated coefficients; Standard errors in parentheses
+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure D1

Results of survival analysis by math performance level, St. Louis City only

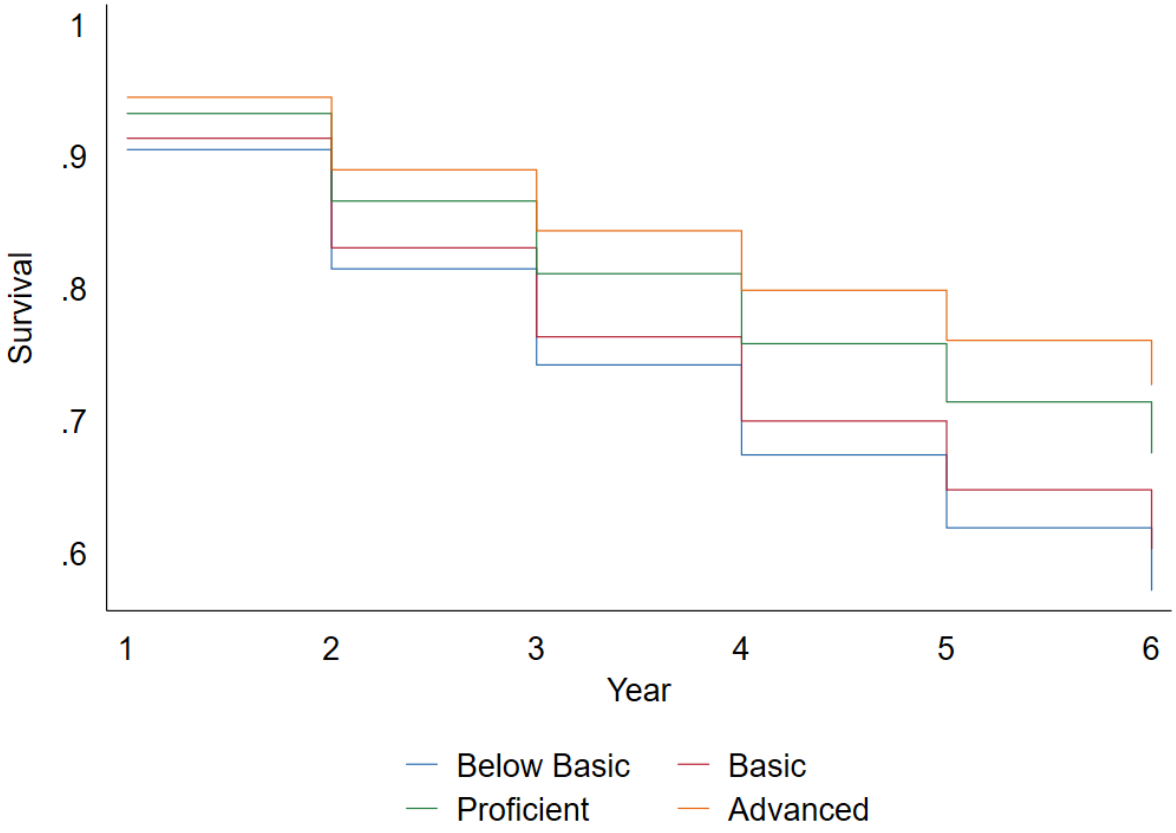


Figure D2

Results of survival analysis by ELA performance level, St. Louis City only

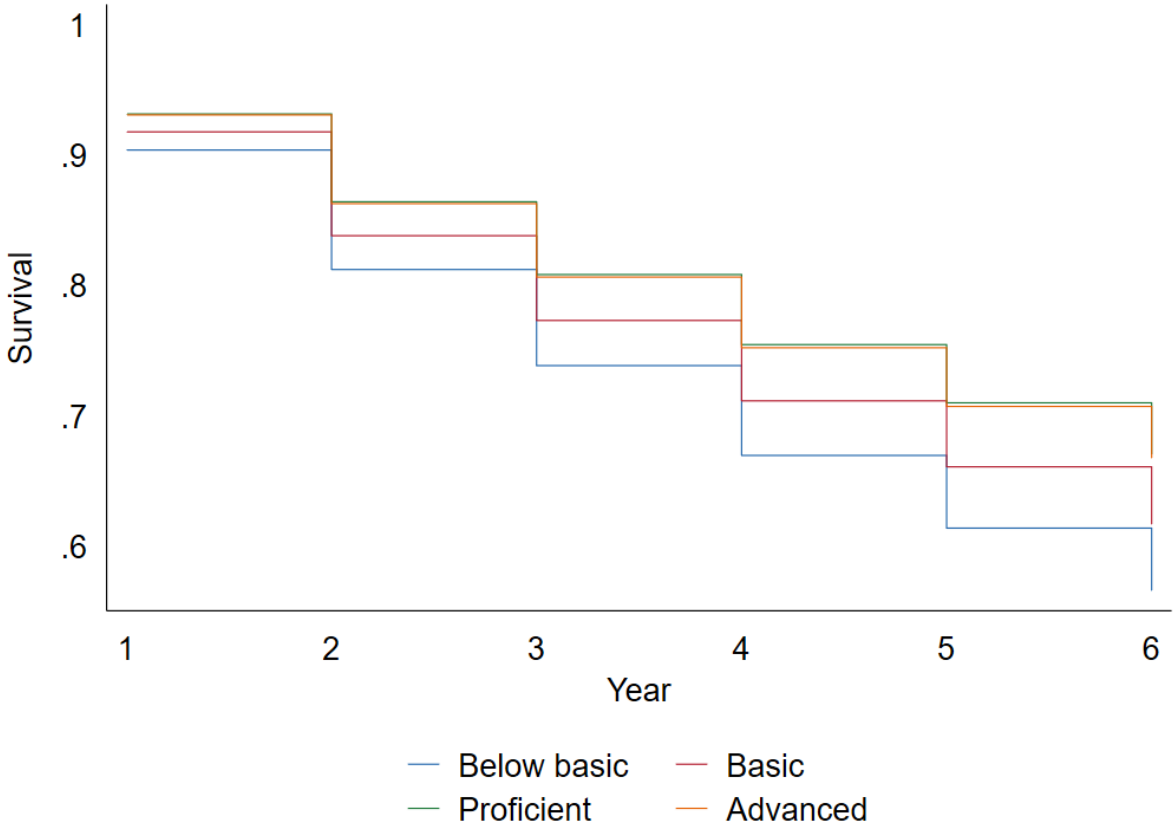


Figure D3

Results of survival analysis by math performance level, four counties

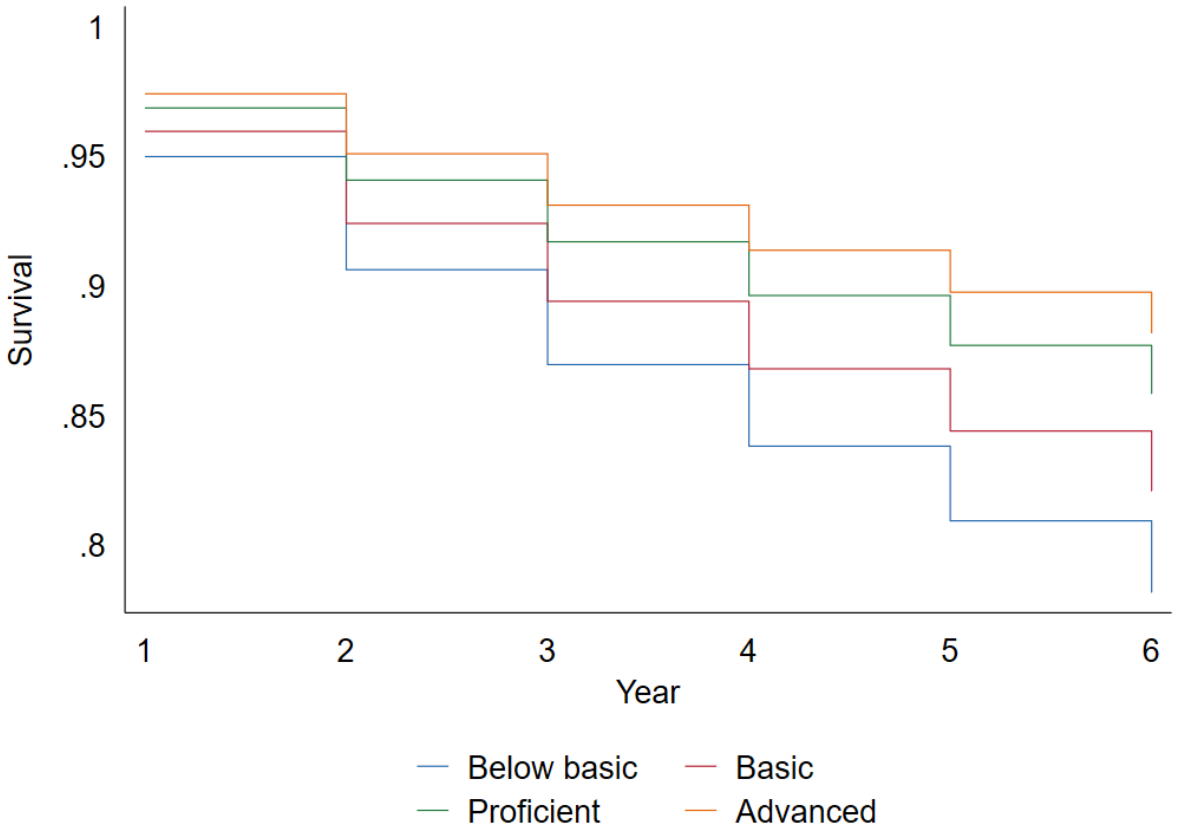


Figure D4

Results of survival analysis by ELA performance level, four counties