It's Dolly's World, We're Just Reading in It: The Effects of an Early Childhood Literacy Program

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Abstract

High quality early childhood interventions are an integral part of the human capital model. Yet, little is known about the impact that early inputs such as parental time or resources have. This paper examines how those small capital investments affect early human capital development. Using the national roll out of a program that gives away new books for free, I assess how access to the program affects elementary academic achievement. I find that having access to the program leads to extremely small effects on both third and fourth grade English Language Art and Math standardized tests. However, when interpreting this as a precise null effect, the results suggest that capital alone is not an effective input into the early human capital model; time and attention from parents or guardians is also necessary.

Keywords: Early Childhood Education, Literacy, Human Capital Investment, Imagination Library
JEL Codes: I21, I26, J24

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1 Introduction

It is well documented that high quality preschool and other early childhood interventions are an integral part of the early human capital development model. Programs like the Perry Preschool Project (Heckman et al., 2010, 2013) and Head Start (Garces et al., 2002; Deming, 2009) can have large impacts on outcomes measured later in life. High quality preschool programs combine both time and capital inputs to produce robust returns in the model of early human capital development. For example, preschool caregivers not only spend time with children, but they also use capital (toys, books, or other stimulating resources). The combination of these inputs leads to the output of early human capital formation, which is critical for later human capital formation in formal schooling (Heckman, 2006).

However, there is less known about the effects of those same inputs at home, such as parental time, the quality of that time, and most specifically, material resources and how productive each input is individually. Both parents and policymakers have difficult decisions to make when determining how to best assist their children's development. Given time and resource constraints on parents, a simple capital investment might seem like the easiest and most efficient way to develop early human capital. Yet, time investments or quality time spent with children has already been shown to increase short-term achievement. A simple program that sends parenting tips and ideas via text messages helps boost not only engagement between parents and children, but also leads to short-term literacy achievement gains (York et al., 2019). The possibility of the effectiveness of a capital-only investment on improving early childhood human capital development has not been ruled out. If increasing cash assistance or tax rebates to families with older children improves high-school achievement and later-life human capital (Dahl & Lochner, 2012; Chetty et al., 2011b), it is plausible that early capital investments benefit children's development at the earliest stages.

In this paper, I measure the impact of a pure capital investment on early human capital development. Specifically, I estimate the effects of Dolly Parton's Imagination Library, an early childhood literacy program that mails free books to children, on third and fourth grade achievement. There are three primary mechanisms through which the books could influence achievement scores. First, having physical books in the home, as they are tangibly present, sets the stage for literacy development down the road (Feng et al., 2014; Sénéchal & LeFevre, 2002; Sénéchal et al., 1998). The sheer number of books in the home is correlated with greater levels of educational attainment (Evans et al., 2010). Second, having books around the home could encourage a more positive home learning environment, with increased non-reading engagement between parents and their children. Some examples of this could be practicing letter sounds or writing each other's names. A positive home literary environment is correlated with improved child development, seen in increased literacy and numeracy achievement (Melhuish et al., 2008; Bradley et al., 2001; Hood et al., 2008). Third, books could effect achievement by encouraging parents to read more with their children. With respect to Imagination Library, the books could serve as a tangible nudge for parents to read to their children, similar to the text message program in York et al. (2019). Additionally, access to the program could also provide necessary education resources that the family might not have had access to owning previously.

To investigate the effects of the Imagination Library program on educational achievement, I exploit the temporal and geographic variation in its national expansion. Imagination library started a national expansion program in 2000 and as of June 2018, twenty percent of school districts had access to the program. The Imagination Library data I utilize is a longitudinal panel that indicates which specific areas have access to the program. Because I measure access rather than treatment, my results represent intent-to-treat estimates, which can be interpreted as a conservative, lower bound of the true individual treatment effect.

This paper contributes to the vast literature on early childhood interventions by investigating an understudied mechanism, the effect of a pure capital investment on young children. Research suggests that other forms of pure capital investment at home, such as technology and computers, have little to no effect on educational achievement at the middle and high school level (Fairlie & Robinson, 2013). There is a lack of evidence on similar capital investments early in life. Most research on early life interventions focus on increasing the time parents spend with their children or increasing the quality of that time (Currie, 2001). The programs that are most successful at improving educational achievement, both short and long-term, are those that provide direct and adequate training for caregivers (Fryer Jr et al., 2015; Olds et al., 1998).

I find that granting free books to children has limited effects on average elementary academic achievement. A cohort with access to the program scores 0.09 standard deviations less on third grade English Language Arts (ELA) exams and 0.01 standard deviations higher on fourth grade math exams, both of which are statistically different from zero. The magnitude of the effects is likely related to the low-intensity nature of the program. Additional time actually spent reading has large educational achievement gains (Kalb & Van Ours, 2014; Figlio et al., 2018), but only increasing a capital input (i.e. giving children books) does not have an effect on the full sample of students.

Although there are no effects on the broad sample of students, there are some interesting results from the heterogeneity analysis. First, I use unconditional quantile regression Firpo09 to assess how access to the program affects students from across the achievement spectrum. Having access to the program leads lower achieving cohorts' scores to decrease and higher achieving cohorts' scores to increase. These results suggest a widening of the achievement distribution for cohorts with access. I also assess whether the results differ across race and socioeconomic status, however, the results there are similar to those from the full sample of students: a precise zero.

THe lack of evidence that pure capital inputs can impact children's development has important implications for policymakers, parents, and caregivers. Pure capital investment on its own does not affect elementary level achievement, ruling out potential policies that provide specific in-kind educational benefits to families without parental or caregiver guidance. Programs that provide both educational materials and information on best-practices for using them in the home, have the potential to have positive benefits in excess of benefits of home programs that isolate an input.

The structure of the rest of the paper is as follows. In section 2, I review the existing literature on the education production function and early childhood interventions. In Section 3, I discuss the Imagination Library program in further detail. Section 4 describes the data and Section 5 presents the empirical model. I present the results in Section 6. Section 7 concludes.

2 Related Literature

This study increases our knowledge of early childhood investments and literacy development, both in the context of the home education production function. Analysis of a low-cost, low-intensity program complements the broad field of research that shows early childhood interventions outside the home, such as preschool and full day kindergarten, can not only increase childhood achievement scores, but can have large returns over involved children's lifecycles (García et al., 2020). Early childhood interventions are important because learning skills follows a chronological process such that later skill formation builds on foundations that were established earlier in childhood. Therefore, early competencies in a broad spectrum of cognitive and social skills make learning at later ages more efficient and easier (Heckman, 2006).

Targeted interventions that isolate capital inputs can have real impacts on early human capital development. Expansive public health insurance programs increase children's primary school achievement and lead to increased high school and college completion rates (Levine & Schanzenbach, 2009; Cohodes et al., 2016). Cash assistance, whether provided through a public assistance program or tax credits, also allow families to support child development more. A $1,000 increase in income can lead to an increase in secondary school achievement anywhere from 0.04-0.06 of a standard deviation (Chetty et al., 2011a; Dahl & Lochner, 2012; Duncan et al., 2011). These results suggest there should be slight gains from giving educational materials to families, especially among those of low socioeconomic background.

Programs designed to improve the quantity of time and quality of time spent with children often have larger effects on academic achievement. For example, the Nurse-Family Partnership program was designed for low-income, first-time mothers to receive visits from a registered nurse beginning in pregnancy and lasting through the child's second birthday (a total of 50 visits). Children whose mothers had received home visits from nurses were less likely to display language delays and had higher mental development at age two (Olds et al., 1998). A less intensive program with large effects on elementary achievement was the READY4K! text messaging program. Enrolled parents received three weekly text messages containing facts about their preschooler, tips to improve engaged parenting with highly specific activities, and encouragement. Children in treated families scored 0.334 standard deviations higher on the letter sounds test and 0.204 standard deviations higher on a lowercase alphabet test (York et al., 2019). Collectively, this research base suggests that a capital-only program that is targeted at improving educational achievements could have substantial benefits, especially if the program includes some time-oriented training for the parents of enrolled children.

Although many early childhood development interventions achieve early, short-term results, many of those effects fade out as the child progresses through primary and occasionally secondary school. The impact of full day kindergarten on students who would have attended a part-time program is sizable, but often disappears by the end of first grade, only one year after kindergarten exit (DeCicca, 2007). Similarly, Currie & Thomas (1995) suggests that the large gains from participating in a Head Start preschool program fade out during elementary school. It is plausible to assume most other programs will experience similar effect degradation, but necessary to identify which skill suffer most over time. Most studies that identify fade out of skills are only assessing achievement scores.

Even though the effects tend to disappear in achievement measures, they are often steady in other contemporary skills or "reappear" in later life achievements and skills. Many of the high quality preschool programs that have been implemented in high-poverty areas achieve very large returns on investment, some reaching thirteen percent (García et al., 2020). These returns are calculated using later in life outcomes such as decreased criminal activity, improved health measures, and increased incomes for children who participated in their youth. Chetty et al. (2011a) even finds improved outcomes in homeownership rates and and retirement savings when students are enrolled in smaller kindergarten classes and have more experienced teachers, although previous studies of the same program had found a fade out of effects on achievement through elementary school Krueger (1999). One reason the effects of standardized tests might suffer from fadeout is if they fail to fully capture all relevant human capital skills that lead to a well developed adult human capital stock, such as changes in personality skills (Heckman et al., 2013).

This research is also informed by the broad field that studies literacy development and more specifically, a home environment that fosters literacy skills growth. Early family environments are influential predictors of later cognitive and non-cognitive skills of children, so it is important to understand how they affect literacy specifically (Melhuish et al., 2008; Montag et al., 2015). There are two primary areas of a home education production function that directly relate to literacy skills development. The first is financial resources as it relates to educational materials. Children who grow up in homes with many books, or extensive home libraries, are likely to spend three more years in school than their bookless peers (Evans et al., 2010). The Imagination Library program provides books to all families, inclusive of those that might have been categorized as "bookless." Thompson et al. (2017) provided an earlier study of the Imagination Library program itself. The authors found no educational achievement effects among kindergarten emergent literacy skills between those who participated and those who did not. I extend this line of research using a large range of geographic and temporal variation and assess outcomes that are farther from program exit.

In addition to the material and financial aspects, cognitive and non-cognitive stimulation is another important aspect of the home education production function. The most relevant of these activities is joint reading, which is reading between a parent and a child, regardless of the child's reading ability. Not surprisingly, these habits have large effects on children's literacy development rates (Hood et al., 2008; Bus et al., 1995). Reading to children between the ages of four and five can have positive differential effects on the reading and cognitive skills of those children at least up to ages ten or eleven, which includes the age students take their third grade standardized tests (Kalb & Van Ours, 2014). Although there is consensus regarding the effectiveness of reading to young children on developing their own literacy skills, not much is known about how a large selection of age-appropriate books affects this process. This study contributes to understanding the importance of necessary educational materials to support a rich home environment that fosters cognitive and non-cognitive stimulation.

One successful strategy that targets parents' home literacy practices uses children's consistent visits to the pediatrician. There are several pediatric based programs that either provide parents with information on not only the importance of early literacy development and reading, but also the necessary materials to implement what they have learned. Children whose families receive these treatments are often correlated with improvements in literacy practices and eventually literacy achievement. Both High et al. (2000) and Needlman et al. (2005) study the most common program, Reach out and Read, and find improvements in interaction between parents and their children in the short run, leading to higher receptive and expressive vocabulary scores.

3 Dolly Parton's Imagination Library

Dolly Parton's Imagination Library mails free, age-appropriate books to eligible children from birth to their fifth birthday on a monthly basis. If the program is provided in an area, eligibility only requires satisfying child age requirements; it does not take family type or income into account. Children enrolled for the full time period will receive 60 books by the time they graduate from the program at age five.

After beginning in 1995, the program was quick to spread to other areas. By the year 2000, a national expansion was underway and in 2004, Tennessee, the home state of the program, pledged statewide coverage, which it achieved by 2006. As of June 2018, twenty percent of all school districts nationwide had access to the program. Since the program's inception in 1995, Imagination Library has mailed over 30 million books and has spread across the US into all fifty states and internationally to Canada, the United Kingdom, Australia, and Ireland.

Imagination Library operates through partnerships with local sponsors (hereafter called *affiliates*) such as libraries, school districts, and organizations like the United Way or Lions Club. These affiliates pay a monthly cost of $2.10 per child, advertise the program, and provide support for local families. The central Imagination Library staff manages the nationwide database and selects, purchases, and ships books. To receive books, parents must enroll children individually in the program. Online enrollment is always available, but parents can also enroll their children through the mail or at some hospitals at birth, doctors offices, and many public libraries. Once enrolled, each child receives a book in the mail monthly until he or she ages out of the program.

4 Data

My analysis relies on academic achievement data that is comparable across school district, county, and state borders. I take advantage of a publicly available dataset from Stanford's Educational Opportunity Project called the Stanford Education Data Archive (SEDA), which includes a standardized achievement measurement able to withstand this comparison (Reardon et al., 2019). The SEDA dataset was built using information that was reported to the National Center for Education Statistics (NCES) under federal mandate by the No Child Left Behind Act. This act mandated that states annually test all public school students in grades 3-8 in both Math and English Language Arts (ELA) and report the number of students scoring in each proficiency level. However, states were allowed to create their own exams, previously making comparisons across state lines difficult. Using the National Assessment of Educational Progress (NAEP), SEDA provides mean test scores at the school district level on a common scale disaggregated by racial group, grade, and subject for the years 2009-2015. Average achievement is reported for student subgroups if there were more than 20 students in that subgroup tested (i.e. if there were more than 20 students in that grade, year, school district, and subject group).

In my analysis, I use estimates of school district-level average achievement that are standardized within subject and grade and measured in national student-level standard deviation units. The average achievement measurement can be interpreted as an effect size; a 1 unit increase in average achievement can be interpreted as the average student within a school-district scoring approximately one standard deviation higher than the national reference cohort in that same grade. I also include covariates from the SEDA database. There is information about the demographics of the total population that lives in the school district from the American Community Survey (ACS) that differ across time.[1] Additionally, there is information on school district characteristics from the Common Core of Data (CCD), which is an annual survey of all public schools and school districts in the United states. This data varies at the cohort-school district-year level.

The Imagination Library information comes from their affiliate database. The database includes information about each affiliate program, as well as the zip codes each covered and any status changes that affected service. To use the affiliate information with the SEDA data, I convert it from the zip code level to the school district level using the National Center for Education Statistic's Education Demographic and Geographic Estimates (EDGE) data. The change in measurement level requires two assumptions. First, I assume a whole zip code had access to the program if at least one affiliate program claimed to service it. Occasionally,

[1]SEDA found that these measures were highly correlated with estimates restricted to only include families with school-aged children (Reardon et al., 2019).

more than one affiliate program would claim to cover a single zip code; in these situations, I consider the zip code covered as long as one affiliate was providing service. The second assumption assigns a school district full coverage when at least one zip code in the school district had adopted the program. Since ninety-six percent of school districts in the country are composed of more than one zip code, this often blankets school districts when they were not actually fully covered. Of the school districts that have access to Imagination Library, an average of half of the zip codes in each district are treated. To combat measurement issues because of this discrepancy, I also present results using a population weighted indicator variable that weights the IL indicator variable using decennial census population information at the zip code level.

Summary statistics are reported in Table 1. The table presents average values of all outcome and control variables used for the whole sample of third and fourth grade observations. Column (1) represents the sample of untreated observations, column (2) represents summary statistics for the sample of treated observations, and column (3) represents all school districts. Around thirteen percent of all observations had access to the program. School districts with access to the program had it for almost four years. Asian and white students (with or without the program) scored above average. Black, Hispanic, and economically disadvantaged students scored below average.

5 Empirical Model

The basic model follows a two way fixed effects difference-in-differences strategy, where I compare elementary school achievement outcomes for those with early childhood exposure to Imagination Library to those without, either because they were born into an earlier cohort or their school district had yet to implement the program. Because of the delay between program participation and standardized tests, I assume students participated in the program and sit for exams in the same school district, or that they don't migrate to different school districts. The results are robust to varying measures of migration, as seen in Section 6.3.

To assess the effects of Imagination Library, I estimate

$$Y_{dct} = \lambda_c \ + \eta_d + \delta IL_{dc} \ + \ X_{dct}\beta_1 + Z_{dt}\beta_2 + t\theta_{dc} + \epsilon_{dc} \tag{1}$$

where the dependent variable is the achievement level for cohort c at school district d in year t.[2]

IL_{dc} represents one of two Imagination Library access measurements. The first measure is an indicator variable that equals one if the cohort living in the school district had access to the Imagination Library program for at least one month and zero otherwise. The second access measure is a population weighted treatment variable.

I include several controls in my preferred specification to ensure comparisons across treatment groups are confounded with as little outside variation as possible. The covariates, X_{dct}, include time varying cohort-by-district controls for the percent of students across race and ethnicity groups (percent non-Hispanic white, percent non-Hispanic Black, percent Hispanic, and percent Asian), the percent of students eligible for free or reduced price lunch, and the percent of students categorized as English Language Learners (ELL). In addition to those controls, I also include vector Z_{dt}, which controls for district-specific controls that are representative of the entire population that lives inside the school district's geographic bounds. These include the log of median income, educational attainment (the percent of residents that hold a Bachelor's degree or higher), the poverty level, the unemployment level, the percentage of households receiving SNAP benefits, and the percentage of households led by a single mother. In addition to the two vectors of control variables, estimates from my preferred specification include unrestricted cohort effects λ_c and unrestricted school district effects η_d to control for unobserved heterogeneity that could affect standardized test scores. Standard errors are clustered at the school district level.

I also estimate an alternate specification to assess how enrolling in the program for

[2] I assume normal kindergarten entrance based on annual kindergarten start dates set by state legislatures.

multiple years affects achievement and human capital development. One might assume that more capital (more books) directly leads to better outcomes. To do so, I replace the indicator variable with a measurement of the number of years a cohort has access to the program and a quadratic of the same variable, holding all other controls constant. The polynomial in the specification accounts for diminishing marginal returns to the books, such that the first ten books might have a different effect on the child's literacy development than the fortieth book does.

In using the differences-in-differences strategy, it is important to consider the experiment created by the national program rollout. In an ideal situation, school districts would gain access to the program at random, or at least independent of any factor that could influence student achievement scores. Additionally, school districts that adopt the program should not be different from districts that do not adopt the program in any time-varying characteristics. And finally, students in school districts with access would have experienced changes in achievement scores similar to those in districts without access in absence of the program. If these conditions are met, my main specification will provide an unbiased estimate of the average treatment effect.

Therefore, the validity of my identification strategy relies on the exogenous introduction of Imagination Library across school districts, conditional on exogenous changes in time-varying characteristics, and a parallel trends assumption. To address these concerns, I conduct a covariate balance test, assess the ability of pre-treatment characteristics of school districts to predict program adoption, and run an event study.

The covariate balance test is a placebo test that ensures that IL program adoption does not predict covariates included in the model, which should not be affected by IL program adoption. These tests use a single right hand side variable as the dependent variable in a model similar to my main specification. If IL is an insignificant predictor of these variables, the composition of a school district does not drastically change when it adopts the program. Results for the covariate balance test on the sample of third grade cohorts are displayed in Table 2.[3] Many of the coefficients presented are very small, and most are statistically insignificant for third grade exams.

Similar to Hoynes & Schanzenbach (2009), I also assess the ability of pre-treatment characteristics of school districts to predict program adoption as a means to test the exogeneity of the program. The pre-treatment characteristics I analyze come from the 2000 Census, which was the first year of Imagination Library's national expansion.[4] The outcome variable I use to assess program exogeneity is an index of the month and year a school district gained access to the program normalized to one in January 2000 (such that January 2001 is equal to 13). The Census characteristics include the percent of the 2000 population that lives in an urban area, is less than five years of age, is older than sixty-five years of age, and is Black. I also include the natural log of population served by the school district and the natural log of the median income in the school district.

Table 4 presents results from this test.[5] A negative coefficient indicates the independent variable of interest is likely to lead to earlier program adoption. I find that more populous school districts and those with a higher proportion young children are likely to access the program earlier, once unobserved state heterogeneity is accounted for. A one percent increase in the population under five years old leads to a school district gaining access almost four months earlier. However, a school district in an urban area and one with a higher proportion of Black people is likely to adopt the program later than average. Although several of these parameters are statistically significant, they fail to explain a large share of the overall variation in the timing of program adoption. The weak fit of the model suggests that many of the deciding factors to adopt Imagination Library appear to be idiosyncratic. Nonetheless, to control for differences in observable population trends that may be correlated with program adoption as well as later achievement, I include interactions of these pre-treatment values with time trends in my main specification (as in Hoynes & Schanzenbach (2009)).

[3] Although almost identical, results using the sample of fourth grade cohorts are in Table 3.

[4] Although it coincides with a few program start dates, the majority of programs started much later than 2000.

[5] Summary statistics for all variables used in the covariat balance test are in Table 5.

In addition to the exogenous adoption assumption, the canonical difference-in-differences model requires the traditional common trends assumption, which relies on the assumption that important unmeasured variables are either time invariant group attributes that are captured by the district fixed effect or time varying factors that are group invariant and thus captured by the cohort fixed effect.[6]. In other words, identification relies on the assumption that in absence of Imagination Library adoption, the outcome variables of treatment and control districts would have evolved similarly. Although it is impossible to know the counterfactual distribution of outcomes, it is more likely that school districts would have continued to trend together after the treatment date if they were trending together before, in absence of program adoption. To test pre-treatment trends, I estimate an event study with the following specification:

$$Y_{dc} = \lambda_c \ + \eta_d \ + \sum_{\tau \neq -4} \gamma_\tau ILAccess_\tau \ + \ X_{dc}\beta \ + (t \times \theta_{dc}) + \epsilon_{dc} \tag{2}$$

where all arguments are the same as in Equation 1, except the argument inside the summation term. $ILAccess_\tau$ are relative time to treatment indicators, which equal 1 for ever-treated school districts if time t is τ periods from the initial treatment year. The coefficients of interest, γ_τ, represent the average change in exam scores between time τ and the period four years prior to treatment among students ever exposed to Imagination Library relative to those who were never exposed. The results are presented in Figure 1. Overall, the figures suggest small evidence of differential group trends in the third grade sample, but little to no difference in the fourth grade sample. In the years prior to treatment in the third grade sample in Figures 1a and 1b, two coefficients reach statistical significance at the ten percent level, but are not larger than 0.025 standard deviations in magnitude. However, the pre-treatment estimates of third grade ELA exams are jointly insignificant ($F = 1.91$, $p = 0.129$). Variation in the third grade pre-treatment estimates would be troublesome if these differences

[6] I present results that acknowledge the negative weighting issues a staggered treatment design can trigger in Section 6.3 (de Chaisemartin & D'Haultfœuille, 2020)

were negative prior to treatment, suggesting that treated school districts were performing at a lower level than untreated school districts prior to program adoption. The figures suggest an opposite story, such that districts that adopted the program were performing at a higher level than untreated districts in the years immediately prior to program adoption. Adoption could still be endogenous, but the endogeneity is more likely related to factors that also predict higher average achievement scores, which I control for, and less likely caused by school districts adopting the program to increase test scores, which would be difficult to control for. Results from the fourth grade sample, presented in Figures 1c and 1d, show less variance among pre-treatment groups. Only one of the pre-treatment coefficients from the fourth grade sample between both subjects reach statistical significance, none are larger than 0.012 in magnitude, and are jointly insignificant for both subjects.

6 Results

6.1 Full Sample Results

I begin with estimates for the full sample of students and school districts, regardless of their racial or socioeconomic composition. I consider four main outcome variables: third and fourth grade English and Math average achievement levels. The outcome variables are standardized such that a 1 unit increase in the outcome achievement variable can be interpreted as an increase in the school district's average achievement by 1 standard deviation above the national reference cohort.

The basic difference-in-differences results for third and fourth grade achievement scores are presented in Tables 6 and 7, respectively. The estimates in panel A show the effects of Imagination Library access on English Language Arts (ELA) Exams and panel B shows the effects on math exams. In these tables, I define IL access equal to one if the cohort was exposed to at least one month of the program during their eligibility period. The fourth columns display the results from models that include the full panel of control variables, a district specific fixed effect, a cohort fixed effect, and 2000 Census level time trends. The estimates in the last column of Panel A in Table 6 suggests that gaining access to Imagination Library has a very small, negative effect on third grade ELA average exam scores. On average, a cohort with access scored 0.01 standard deviations lower on third grade ELA exams than a cohort without access. The estimate for fourth grade ELA exams is similarly negative, however, does not reach statistical significance. The confidence interval for the fourth grade exams rules out positive effects larger than 0.0065. These estimates imply that having access to IL for at east one month has a null effect on average school district achievement on third and fourth grade ELA exams. The effects on fourth grade mathematics exams, although still small, are positive and reach statistical significance at the fourth grade level. A cohort with access scored 0.01 standard deviations higher than average cohorts on fourth grade mathematics exams.

Tables 8 and 9 display results from a similar model but use the population weighted IL indicator. These results are similar to those presented in tables 6 and 7 in magnitude and direction of effects. Again, there is a small, negative effect on third grade ELA and Math exams and a positive effect on fourth grade Math exams with an effect size of 0.01 standard deviations.

Tables 10 and 11 display results from the alternative specification that measures a quadratic dosage effect to capture any differential trends based on the length of program enrollment. Of school districts that have access to the program, cohorts have access for an average of four years. Marginal effects at the average enrollment length conditional on being treated are also listed in the table. Panel A estimates in column (4) of Table 10 suggest that an additional year of IL access above the average has a positive effect of 0.001 of a standard deviation on third grade ELA exams. The results in Panel B of 10 suggest an additional year above average for students who have access to the program increases average standardized mathematics achievement scores by a similarly small amount of 0.004 standard deviations. The results from my preferred specification in Table 11 are very similar to the results from the third grade sample. Very few of the estimates reach statistical significance.

6.2 Heterogeneity

I also explore heterogeneity in treatment effects, as different subgroups could be more responsive to participation in the program. Specifically, I consider heterogeneous effects by achievement level, race, and socioeconomic status.

First, I examine the effects of Imagination Library participation on different points in the average achievement distribution using unconditional quantile regression as described in Firpo et al. (2009). Tables 12–17 and Figure 2 display these results. The tables present the average effect and the unconditional quantile estimates from the 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles in the average achievement score distribution. Figure 2 and Tables 12–13 present unconditional quantile estimates using the treatment indicator variable. The estimates show that access to IL widens the distribution of average achievement scores for the third grade ELA exam, such that the average score decreases in school districts with lower performing students (columns (2)–(3)) and rises in higher performing districts. The results in Panel B suggest access to the program not only shrinks the distribution for third grade mathematics exams, but the distribution is also moving leftwards. School districts in the lowest 10^{th} percentile of achievement distribution see an increase in their average standardized test scores by 1 percent of a standard deviation. Results among fourth grade achievement are similar for ELA exams. School districts in the lowest ten percent of relative achievement on fourth grade math exams see very large relative increases – close to a three and a half percentage increase in standard deviations. This increase is likely driving the large full sample results from table 7.

Tables 14 and 15 use the population weighted indicator variable as the variable of interest. These results are similar to those from the binary treatment, but if anything, are more exaggerated in magnitude and statistical significance. A key result from table 15 suggests that the lowest performing school districts on the fourth grade math exams see increases in scores by 0.04 standard deviations once they adopt the program.

Tables 16 and 17 use the linear and quadratic yearly dosage variables to measure IL access. The parameters in Panel A of Table 16 suggest a the marginal effects of one year increase in program access above average shrinks the achievement gap between high and low performing school districts. The marginal effects estimates from the other three test categories suggest a shrinking distribution.

Next, I assess how access to IL affects students of different races or ethnicity groups. The SEDA dataset includes achievement scores that differ by student characteristics. Tables 18 and 19 present the effects of the IL indicator variable, both population weighted and unweighted, on average Asian student achievement, average non-Hispanic Black student achievement, average Hispanic student achievement, and average non-Hispanic white student achievement, all still measured at the school district-cohort level. Table 18 presents results from the third grade sample and Table 19 presents results from the fourth grade sample. The estimates from panel A of both tables suggest that simply gaining access to the program leads to decreases in Asian student achievement on almost every exam, regardless if the measure was population weighted. The confidence interval from the Imagination Library access indicator variable rules out positive effects larger than 0.017 standard deviations for the sample third grade Asian students on ELA exams. Similarly, the unweighted IL indicator variable in panel B of both tables suggest a positive effect for Black students' outcomes on only one exam: fourth grade math. Having access to the program leads to a 0.02 standard deviation increase in average fourth grade mathematics exams relative to a cohort without access. The results in panels C and D show the effects of the program on Hispanic and White students, respectively. General program access of at least one month has a negative effect on most third grade exams for both groups of students, with some discrepancies between the population weighted and unweighted estimator. However, for the exams with discrepancies, both estimates are rather small and not significantly different from zero. In Table 19, the indicator variable continues to have a negative effect on fourth grade Hispanic student exam scores, but a positive effect on fourth grade White student exam scores. Gaining Access to IL for at least one month increases White students average fourth grade Math exams by 0.01 standard deviations.

Tables 20 and 21 present estimates from models using the quadratic dosage estimator. Across almost all race-grade-subject subgroups, the marginal effect of one additional treatment year for school districts that have access has a positive marginal effect on students' average exam scores. Asian students see a marginal increase of around 0.01 standard deviations on both ELA and math third grade exams after one additional year above average. An additional year above average has the same effect of a 0.01 standard deviation increase on Black student fourth third grade math exams. All other marginal effects, while positive, are less than 1 percent of a standard deviations.

I now turn to heterogeneous treatment effects across socioeconomic status. Imagination Library gives free books to all age-eligible children, regardless of family income. However, one might expect children from families of low-socioeconomic status to benefit greater from participation in the program because these families might own less books due to financial constraints. To capture these effects, I apply my preferred specification to different quantiles of data based on the distribution of a composite variable that measures economic disadvantage (a right hand side variable). These results are presented in Tables 22 and 23. In Table 22, each pair of columns represents results from a different sample of the data, where the samples are based on quantiles of the distribution of the proportion of economically disadvantaged students. For example, school districts with very high proportions of economically disadvantaged students are included in the sample used in columns (7)-(8), or the highest quantile.

The results from the effects of the IL access indicator are presented in Table 22. The results suggest that access to Imagination Library does not have a positive differential effect on academic inequality across socioeconomic status. The estimates in Panel A indicate that access to the program has a negative effect on all students, regardless of their socioeconomic status, on third grade ELA exams. Results from the model using the population weighted indicator variable in Panel B suggests treated school districts with proportions of economically disadvantaged students above the median score lower on third grade math exams relative to untreated school districts. The fourth grade exam results in Panels C and D follow a similar patter as the third grade math exams: school districts with low proportions of low-socioeconomic status see increases in scores after they gain access to the program while school districts with high proportions see decreases in average achievement scores.

Table 23 show the effects of an additional year of program access on the various exam scores using the quadratic dosage variables to measure IL access. Although the overall effect of gaining access to IL was negative for school districts with proportions of economically disadvantaged students above the median, the marginal effect of another year for these school districts once they are treated is positive on all exams studied. For school districts in the fourth quantile, or those with the highest proportion of economically disadvantaged students, an additional year of program access above the average leads to an an increase of 0.01 standard deviations on both third grade mathematics exams. Alternatively, the results from Columns 1 and 2 suggest school districts below the median of economically disadvantaged students incur some negative marginal effects.

I also use the achievement scores of economically disadvantaged students to further understand heterogeneity of treatment across socioeconomic status. Table 24 presents estimates using the average achievement scores of the economically disadvantaged students in a school district as the outcome variable. The estimates from models using the unweighted indicator suggest that simply having access to the program decreases average scores on all exams but fourth grade mathematics, as seen in the odd columns. However, the estimates from population weighted models contradict the signs of the estimates on third grade math and fourth grade ELA exams. None of the estimates in subject-grade subgroups with inconsistencies reach statistical significance. Results from models using the dosage estimator are in Table 25. Across all exams, an additional year of access to the program has a positive effect across all exams for students from low-socioeconomic status households.

6.3 Robustness Specifications

6.3.1 Migration and Private School Enrollment

Using additional data from the American Community Survey, I estimated two additional specifications, presented as robustness specifications in Tables 26 and 27. In both tables, Column 4 repeats results from the primary specification with full controls on the third grade ELA samples. This specification controls for the full vector of school district characteristics as well as unobserved heterogeneity at the school district and cohort level. Columns 1-3 use the same controls, but restrict the sample based on migration or enrollment. Column 1 of Table 26 presents results from the main specification on the sample of third grade ELA observations restricted to observations with the lowest relative migration rate. The sample used in Column 2 includes observations with migration rates below the median. Column 3 includes observations with migration rates below the 75th percentile of relative migration rates. Because there is a four year gap between students exiting the program and taking their first standardized tests, the main specifications would be biased if there were large amounts of migration, either in or out of the school district. Here, I control for rates of migration into the school district. In each column, the sign matches and magnitude roughly matches the estimates in column 4.

Columns 1-3 of Tables 27 follow the same pattern explained above, but restrict the sample based on public school enrollment. Because the federal mandatory reporting requirement only applied to public schools, private school data is not included in the SEDA dataset. If a large amount of Imagination Library participants attended private schools, the results from the main specification would not pick up on the full effects of program access. The positive coefficients in Columns 1 and 2 suggest that Imagination Library has a positive effect on average achievement scores in school districts with low public school enrollment relative to other districts.

6.3.2 Variation in Treatment Timing and Heterogeneous Effects

An additional concern with my empirical strategy is that the traditional two-way fixed effects (TWFE) difference-in-differences (DID) estimator works best when the treatment timing is the same for all treatment groups. de Chaisemartin & D'Haultfœuille (2020) shows that DID may produce biased estimates when the treatment effects differ across either fixed effect dimension. Specific to my research design, the DID estimator might be biased if treatment effects differ across time or school district. The average treatment effect (ATE) is a weighted average of the comparisons between all group-period pairs. Differences in treatment period or effects across groups could cause negative weights, leading to an ATE that is a non-convex combination of all treatment effects (de Chaisemartin & D'Haultfœuille, 2020). This is a concern in my analysis as school districts differ in their adoption of the program and effects are heterogeneous across district.

I follow de Chaisemartin & D'Haultfœuille (2020)'s prescription to assess the problem and it's potential affects on my original DID estimate and to generate new estimates of the ATE with their new estimator. This includes initially assessing the weights and calculating a test statistic to determine the extent of the issue they could cause. Using Stata code provided by the authors, I assess whether my basic specification suffers from bias due to negative weights. In the two way fixed effects (TWFE) regression of achievement on IL access and school district and cohort fixed effects, there are 13,035 total ATEs estimated. In the model, 70 percent are strictly positive and 30 percent are strictly negative. The negative weights sum to -0.094. The negative weights could cause the TWFE estimator from my primary specification may be of a different sign than the average treatment on the treated if the standard deviation of those ATEs is equal to 0.006, a plausible magnitude.

Because it is possible that the negative weights cause the sign of the two way fixed effects estimator to differ from the ATE, I estimate the model using a new estimator that corrects for the bias. Table 28 shows the estimates on the treatment variable from the primary TWFE difference-in-differences model (β_{FE}), the new estimator that corrects for the bias (DID_M), and three estimates from a pretrend analysis that also corrects for the negative weights. The estimate from the corrected model is not statistically different than the estimate from the basic model (t-statistic = 0.08), which suggests the negative weights were not an issue in this sample. The additional three coefficients DID_M^{p1}, DID_M^{p2}, and DID_M^{p3} are estimates of pretreatment trends for one, two, and three periods prior to treatment, respectively. These results slightly differ from 1a. They are all much smaller in magnitude and none reach statistical significance.

7 Discussion

In an effort to further understand how individual inputs affect the model of early human capital development, I present the effects of an early childhood intervention that gives free books to children on elementary age standardized test scores. I exploit the variation from the nationwide rollout of the program in a two way fixed effects difference-in-differences framework. My findings suggest that access to the program has small, almost null effects on aggregate test scores. A cohort with access to Imagination Library for at least one month has lower third grade English Langugae Arts scores than cohorts without access by almost one percent of a standard deviation.

Access to Imagination Library has differential effects across the achievement spectrum. While still extremely small in magnitude, results from unconditional quantile analysis analysis on English Language Arts exams suggest that low achieving cohorts in treated school districts have slightly lower achievement scores than their peers in untreated districts. However high achieving, treated cohorts see an increase in scores, causing a widening gap in achievement. This suggests that a family environment that produces low achieving students isn't going to be receptive to a small nudge like a book. Those families might require more intervention to move the needle on test scores. However, high achieving students likely already come from home environments with positive attitudes towards education and might double down on their efforts once a book arrives in the mail. In this case, a pure capital input could serve as an instrument of achievement inequality, which is the opposite effect one might expect.

The culmination of the results suggests that a pure capital input into the model of early human capital development is not effective at improving overall test scores. If the program follows a similar path of other early interventions, it is plausible that third and fourth grade are too late to pick up on effects measured in achievement scores before they fade out. If this is true, the current results are even more poignant – a pure capital investment does not make lasting effects on academic achievement.

Due to program limitations, I leave for future work the question of how complementary in-kind capital inputs and parental time are in the model of early human capital development. Understanding which features of a compound program (capital, time, or the combination of the two) would be of great value to those designing early interventions and the policymakers deciding on them. I have shown here that capital on its own fails to leave a lasting effect on academic achievement and other research suggests that time inputs are successful (York et al., 2019). However, it remains unknown whether a program that capitalizes on both inputs, like pairing parental guidance with the Imagination Library program, could be more successful at increasing early human capital development.

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Table 1: Descriptive Statistics

	School Districts without IL	School Districts with IL	All School Districts
IL Program Indicator	0	1	0.127
			[0.333]
Pop. Weighted IL Program Indicator	0	0.864	0.110
		[0.303]	[0.308]
Number of Years with IL	0	3.904	0.497
		[2.014]	[1.486]
Achievement Outcomes			
Total Student Achievement	0.0727	0.0534	0.0702
	[0.360]	[0.316]	[0.354]
Asian Student Achievement	0.461	0.400	0.453
	[0.360]	[0.316]	[0.354]
Black Student Achievement	-0.335	-0.382	-0.341
	[0.309]	[0.297]	[0.308]
Hispanic Student Achievement	-0.215	-0.226	-0.216
	[0.304]	[0.269]	[0.300]
White Student Achievement	0.321	0.323	0.322
	[0.312]	[0.267]	[0.306]
ECD Student Achievement	-0.273	-0.275	-0.273
	[0.254]	[0.225]	[0.250]
ACS Controls			
Urban Location	0.381	0.420	0.386
	[0.486]	[0.494]	[0.487]
Rural Location	0.0505	0.113	0.0585
	[0.219]	[0.317]	[0.235]
Natural Log of Median Income	11.02	10.93	11.01
	[0.302]	[0.284]	[0.301]
Rate of Bachelor's Degree	0.335	0.308	0.331
	[0.134]	[0.107]	[0.131]
Poverty Rate	0.147	0.173	0.151
	[0.0925]	[0.0867]	[0.0922]
Unemployment Rate	0.0822	0.0800	0.0819
	[0.0290]	[0.0249]	[0.0286]
Rate of Food Stamp Receipt	0.0921	0.111	0.0945
	[0.0617]	[0.0571]	[0.0614]
Female Headed Household Rate	0.190	0.190	0.190
	[0.0681]	[0.0617]	[0.0673]
CCD Controls			
Total Cohort Size	2074.3	2689.3	2152.5
	[3075.2]	[3544.3]	[3145.4]
Percent Native American Students	0.00641	0.0120	0.00712
	[0.0146]	[0.0245]	[0.0163]
Percent Asian Students	0.0847	0.0526	0.0806
	[0.0901]	[0.0634]	[0.0879]
Percent Hispanic Students	0.268	0.192	0.258
	[0.216]	[0.165]	[0.211]
Percent Black Students	0.166	0.196	0.170
	[0.162]	[0.165]	[0.163]
Percent White Students	0.475	0.547	0.484

	School Districts without IL	School Districts with IL	All School Districts
	[0.239]	[0.208]	[0.236]
Percent FRPL Eligible*	0.477	0.517	0.482
	[0.222]	[0.190]	[0.219]
Percent Economically Disadvantaged	0.488	0.524	0.493
	[0.225]	[0.193]	[0.222]
Percent English Language Learners	0.106	0.0821	0.103
	[0.102]	[0.0654]	[0.0983]

Parameters listed are mean values for all cohorts. ECD refers to economically disadvantaged students, as defined by the SEDA composite variable. Standard deviations are in brackets where applicable. * FRPL stands for Free/Reduced Price Lunch

Table 2: Covariate Balance Test: Third Grade

	(1) Imagination Library Access
Number of Students	0.422
	[1.899]
Urban Neighborhood	-0.00384
	[0.00705]
Percent Black	-0.000106
	[0.000296]
Percent Free/Reduced Price Lunch	0.000955
	[0.00156]
Percent English Language Learners	0.000717
	[0.000440]
Log Median Income	-0.00102
	[0.00134]
Unemployment Rate	0.000134
	[0.000162]
Observations	74571

Each parameter is from a separate regression of that parameter on an indicator variable that equals one when a school district gains access to Imagination Library. The sample includes all observations from third grade exams. Standard errors are in brackets and are clustered at the school district level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3: Covariate Balance Test: Fourth Grade

	(1) Imagination Library Access
Number of Students	-3.008*
	[1.739]
Urban Neighborhood	-0.00516
	[0.00639]
Percent Black	-0.000440
	[0.000306]
Percent Free/Reduced Price Lunch	0.000373
	[0.00155]
Percent English Language Learners	0.00120***
	[0.000451]
Log Median Income	-0.000917
	[0.00127]
Unemployment Rate	0.0000942
	[0.000154]
Observations	65218

Each parameter is from a separate regression of that parameter on an indicator variable that equals one when a school district gains access to Imagination Library. The sample includes all observations from fourth grade exams. Standard errors are in brackets and are clustered at the school district level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: Determinants of Imagination Library program start date using the 2000 Census

	Index	
	(1)	(2)
Percent of population urban	0.337***	0.201*
	[0.0451]	[0.102]
Percent of population age < 5	-9.221***	-3.832*
	[1.052]	[2.093]
Percent of population age > 65	-0.608**	0.776
	[0.298]	[0.492]
Percent of population Black	0.376***	0.679***
	[0.0820]	[0.204]
Log median income	8.367*	11.01
	[4.270]	[10.85]
Log population	-2.003***	-2.534*
	[0.682]	[1.410]
State Fixed Effect		X
Observations	5396	4804
R^2	0.03	0.27

The 2000 Census data are all at the school district level. The dependent variable is equal to the calendar month (normalized to one in January 2000) that the school district gained access to Imagination Library. The control variables come from the 2000 Census.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: Descriptive Statistics: 2000 Census Values

	School Districts without Imagination Library	School Districts with Imagination Library	All School Districts
Percent under 5 years old	0.0715	0.0715	0.0715
Percent over 65 years old	0.111	0.106	0.110
Percent Black	0.108	0.144	0.115
Log of Population	22.64	22.83	22.67
Log of Median Income	10.80	10.72	10.79
Percent living in Urban areas	0.923	0.845	0.909

Table 6: Effects of IL program availability on Total Average School District Achievement: Third Grade Sample

	(1)	(2)	(3)	(4)
Panel A: ELA				
IL Access Indicator	-0.0374***	0.00194	-0.0101**	-0.00970*
	[0.00323]	[0.00247]	[0.00498]	[0.00500]
Observations	80212	75662	75377	74571
Panel B: Mathematics				
IL Access Indicator	-0.0148***	0.0260***	-0.00315	-0.00629
	[0.00362]	[0.00302]	[0.00620]	[0.00622]
Observations	79878	75344	75058	74250
Control Variables		X	X	X
Cohort FE			X	X
District FE			X	X
2000 Census Time Trends				X

Each parameter is from a separate regression of the outcome variable on an indicator variable equal to one if the school district had access to Imagination Library for at least one month. The sample in panel B includes results from math exams. The outcome variable for all estimates is the average achievement score for the entire school district in the respective subject. Standard errors are in brackets and are clustered at the district level where appropriate.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: Effects of IL program availability on Total Average School District Achievement: Fourth Grade Sample

	(1)	(2)	(3)	(4)
Panel A: ELA				
IL Access Indicator	-0.0403***	0.00382	-0.00450	-0.00403
	[0.00350]	[0.00260]	[0.00539]	[0.00542]
Observations	69727	66178	65893	65218
Panel B: Mathematics				
IL Access Indicator	-0.0185***	0.0268***	0.0137**	0.0114*
	[0.00400]	[0.00324]	[0.00652]	[0.00660]
Observations	69313	65786	65496	64822
Control Variables		X	X	X
Cohort FE			X	X
District FE			X	X
2000 Census Time Trends				X

Each parameter is from a separate regression of the outcome variable on an indicator variable equal to one if the school district had access to Imagination Library for at least one month. The sample in panel B includes results from math exams. The outcome variable for all estimates is the average achievement score for the entire school district in the respective subject. Standard errors are in brackets and are clustered at the district level where appropriate.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8: Effects of Population Weighted IL Indicator Variable on Total Average School District Achievement: Third Grade Sample

	(1)	(2)	(3)	(4)
Panel A: ELA				
Population Weighted IL Indicator	-0.0394***	-0.00207	-0.00909*	-0.00811
	[0.00349]	[0.00269]	[0.00503]	[0.00505]
Observations	80212	75662	75377	74571
Panel B: Mathematics				
Population Weighted IL Indicator	-0.0131***	0.0258***	0.00219	-0.00124
	[0.00392]	[0.00325]	[0.00628]	[0.00630]
Observations	79878	75344	75058	74250
Control Variables		X	X	X
Cohort FE			X	X
District FE			X	X
2000 Census Time Trends				X

Each parameter is from a separate regression of the outcome variable on a population weighted variable that indicates access to the Imagination Library program based on zip code populations. The sample in panel B includes results from math exams. The outcome variable for all estimates is the average achievement score for the entire school district in the respective subject. Standard errors are in brackets and are clustered at the district level where appropriate.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9: Effects of Population Weighted IL Indicator Variable on Total Average School District Achievement: Fourth Grade Sample

	(1)	(2)	(3)	(4)
Panel A: ELA				
Population Weighted IL Indicator	-0.0389***	0.00328	-0.000257	0.000563
	[0.00380]	[0.00284]	[0.00551]	[0.00553]
Observations	69727	66178	65893	65218
Panel B: Mathematics				
Population Weighted IL Indicator	-0.0153***	0.0277***	0.0156**	0.0131*
	[0.00436]	[0.00353]	[0.00668]	[0.00674]
Observations	69313	65786	65496	64822
Control Variables		X	X	X
Cohort FE			X	X
District FE			X	X
2000 Census Time Trends				X

Each parameter is from a separate regression of the outcome variable on a population weighted variable that indicates access to the Imagination Library program based on zip code populations. The sample in panel B includes results from math exams. The outcome variable for all estimates is the average achievement score for the entire school district in the respective subject. Standard errors are in brackets and are clustered at the district level where appropriate.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10: Effects of additional years of access to Imagination Library on Total Average School District Achievement: Third Grade Sample

	(1)	(2)	(3)	(4)
Panel A: ELA				
Years of IL Access	-.0206987***	-.0051982**	-.0024555	-.0023871
	[0.0033676]	[0.0025335]	[0.0032563]	[0.0032584]
Years of IL Access Squared	.0024217***	.0012029***	.0004313	.0004744
	[0.0005995]	[0.0004531]	[0.0004883]	[0.0004894]
Average Years of Access†	3.895418	3.892535	3.89121	3.888919
Marginal Effects at the Mean	-.0018317	.0041664	.000901	.0013029
Observations	80212	75662	75377	74571
Panel B: Mathematics				
Years of IL Access	-.0075101*	.0102994***	.0036238	.0034802
	[0.0038905]	[0.0031558]	[0.0040006]	[0.0040064]
Years of IL Access Squared	.0009183	-.0007225	.0005	.0001423
	[0.0006878]	[0.0005587]	[0.0006082]	[0.0006064]
Average Years of Access†	3.905798	3.903249	3.901677	3.899385
Marginal Effects at the Mean	-.0003364	.0046589	.0075252	.0045898
Observations	79878	75344	75058	74250
Control Variables		X	X	X
Cohort FE			X	X
District FE			X	X
2000 Census Time Trends				X

†The average years of access used here is conditional on having access to Imagination Library.

Each parameter is from a separate regression of the outcome variable on a dosage variable that measures the length of time a school district had access to IL in years and its quadratic term. Panel A presents results from a sample of ELA exams. The sample in panel B includes results from math exams. The outcome variable for all estimates is the average achievement score for the entire school district in the respective subject. Standard errors are in brackets and are clustered at the district level where appropriate.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 11: Effects of additional years of access to Imagination Library on Total Average School District Achievement: Fourth Grade Sample

	(1)	(2)	(3)	(4)
Panel A: ELA				
Years of IL Access	-0.0211874***	-0.002717	0.0030123	0.0034939
	[0.0036137]	[0.0026435]	[0.0036339]	[0.0036584]
Years of IL Access Squared	0.0023825***	0.0008334*	-0.0002993	-0.0002742
	[0.0006521]	[0.0004791]	[0.0005146]	[0.0005156]
Average Years of Access†	3.78133	3.765212	3.763107	3.760579
Marginal Effects at the Mean	-0.0031698	0.0035586	0.0007597	0.0014314
Observations	69727	66178	65893	65218
Panel B: Mathematics				
Years of IL Access	-0.0026438	0.0175321***	0.0100088**	0.009288**
	[0.0042546]	[0.0033608]	[0.0043918]	[0.0044391]
Years of IL Access Squared	-0.0003505	-0.0022508***	-0.0005047	-0.0006415
	[0.0007647]	[0.0006048]	[0.0006452]	[0.0006476]
Average Years of Access†	3.796184	3.779517	3.777073	3.774541
Marginal Effects at the Mean	-0.0053047	0.0005184	0.0061964	0.0044452
Observations	69313	65786	65496	64822
Control Variables		X	X	X
Cohort FE			X	X
District FE			X	X
2000 Census Time Trends				X

†The average years of access used here is conditional on having access to Imagination Library.

Each parameter is from a separate regression of the outcome variable on a dosage variable that measures the length of time a school district had access to IL in years and its quadratic term. Panel A presents results from a sample of ELA exams. The sample in panel B includes results from math exams. The outcome variable for all estimates is the average achievement score for the entire school district in the respective subject. Standard errors are in brackets and are clustered at the district level where appropriate.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 12: Effects of IL program availability on achievement: Third Grade

			Quantiles of Average Achievement			
	OLS	0.10	0.25	0.50(Median)	0.75	0.90
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: ELA						
IL Access Indicator	-0.00970*	-0.0185	-0.0270**	-0.0175**	0.00548	0.00615
	[0.00500]	[0.0135]	[0.0111]	[0.00720]	[0.00843]	[0.0116]
Observations	74571	74838	74838	74838	74838	74838
Panel B: Mathematics						
IL Access Indicator	-0.00629	0.0126	-0.00323	-0.0220**	-0.0153*	-0.00765
	[0.00622]	[0.0203]	[0.0121]	[0.00879]	[0.00830]	[0.0150]
Observations	74250	74519	74519	74519	74519	74519

Results in this table come from an unconditional quantile regression that estimates the effect of having access to Imagination Library for at least one month on the school district average score on third grade exams. All estimates include the full panel of control variables, both district and cohort fixed effects, and 2000 Census level time trends. Column (1) represents the effect of an additional year of access to Imagination Library as estimated by an Ordinary Least Squares model for comparison. Standard errors are presented in brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 13: Effects of IL program availability on achievement: Fourth Grade

			Quantiles of Average Achievement			
	OLS	0.10	0.25	0.50(Median)	0.75	0.90
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: ELA						
IL Access Indicator	-0.00403	-0.0217	-0.00421	0.000827	-0.00498	0.0184
	[0.00542]	[0.0136]	[0.0112]	[0.00863]	[0.0108]	[0.0119]
Observations	65218	65483	65483	65483	65483	65483
Panel B: Mathematics						
IL Access Indicator	0.0114*	0.0343**	0.00666	-0.00404	0.0180	0.0112
	[0.00660]	[0.0146]	[0.0130]	[0.00835]	[0.0136]	[0.0162]
Observations	64822	65091	65091	65091	65091	65091

Results in this table come from an unconditional quantile regression that estimates the effect of having access to Imagination Library for at least one month on the school district average score on fourth grade exams. All estimates include the full panel of control variables, both district and cohort fixed effects, and 2000 Census level time trends. Column (1) represents the effect of an additional year of access to Imagination Library as estimated by an Ordinary Least Squares model for comparison. Standard errors are presented in brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 14: Effects of Population Weighted IL program availability on achievement: Third Grade

			Quantiles of Average Achievement			
	OLS	0.10	0.25	0.50(Median)	0.75	0.90
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: ELA						
Population Weighted IL Indicator	-0.00811	-0.0218*	-0.0252***	-0.0132*	0.0102	0.0106
	[0.00505]	[0.0125]	[0.00953]	[0.00748]	[0.00872]	[0.0111]
Observations	74571	74838	74838	74838	74838	74838
Panel B: Mathematics						
Population Weighted IL Indicator	-0.00124	0.0248*	0.00271	-0.0122	-0.00969	-0.00852
	[0.00630]	[0.0135]	[0.0126]	[0.00935]	[0.0108]	[0.0118]
Observations	74250	74519	74519	74519	74519	74519

Results in this table come from an unconditional quantile regression that estimates the effect of having access to Imagination Library for at least one month on the school district average score on third grade exams. The population weighted indicator variable is used as the main variable of interest. All estimates include the full panel of control variables, both district and cohort fixed effects, and 2000 Census level time trends. Column [1) represents the effect of an additional year of access to Imagination Library as estimated by an Ordinary Least Squares model for comparison. Standard errors are presented in brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 15: Effects of Population Weighted IL program availability on achievement: Fourth Grade

			Quantiles of Average Achievement			
	OLS	0.10	0.25	0.50(Median)	0.75	0.90
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: ELA						
Population Weighted IL Indicator	0.000563	-0.0123	-0.00621	0.00291	0.00119	0.0251**
	[0.00553]	[0.0122]	[0.0104]	[0.00859]	[0.00924]	[0.0127]
Observations	65218	65483	65483	65483	65483	65483
Panel B: Mathematics						
Population Weighted IL Indicator	0.0131*	0.0415**	0.00440	0.00406	0.0147	0.0249**
	[0.00674]	[0.0165]	[0.0129]	[0.0107]	[0.0110]	[0.0112]
Observations	64822	65091	65091	65091	65091	65091

Results in this table come from an unconditional quantile regression that estimates the effect of having access to Imagination Library for at least one month on the school district average score on fourth grade exams. The population weighted indicator variable is used as the main variable of interest. All estimates include the full panel of control variables, both district and cohort fixed effects, and 2000 Census level time trends. Column (1) represents the effect of an additional year of access to Imagination Library as estimated by an Ordinary Least Squares model for comparison. Standard errors are presented in brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 16: Effects of IL program availability on achievement: Third Grade

		Quantiles of Average Achievement				
	OLS	0.10	0.25	0.50 (Median)	0.75	0.90
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: ELA						
Years of IL Access	-0.00239	-0.0152*	-0.0157***	-0.000871	0.0130**	0.00160
	[0.00326]	[0.00850]	[0.00560]	[0.00581]	[0.00567]	[0.00756]
Years of IL Access Squared	0.000474	0.00220*	0.00295***	-0.000243	-0.00208**	-0.000669
	[0.000489]	[0.00128]	[0.000800]	[0.000879]	[0.000853]	[0.00109]
Average Years of Access†		3.890255	3.890255	3.890255	3.890255	3.890255
Marginal Effects at the Mean		.0018519	.0072373	-.0027604	-.0031652	-.0036077
Observations	74571	74838	74838	74838	74838	74838
Panel B: Mathematics						
Years of IL Access	0.00348	0.00854	0.00105	-0.00356	0.00434	0.0107
	[0.00401]	[0.00926]	[0.00672]	[0.00598]	[0.00723]	[0.00766]
Years of IL Access Squared	0.000142	0.00127	0.00170	0.000888	-0.00123	-0.00191
	[0.000606]	[0.00127]	[0.00107]	[0.000811]	[0.00100]	[0.00125]
Average Years of Access†	3.900969	3.900969	3.900969	3.900969	3.900969	
Marginal Effects at the Mean		.0184719	.0143321	.0033663	-.0052636	-.0041415
Observations	74250	74519	74519	74519	74519	74519

Results in this table come from an unconditional quantile regression that estimates the effect of having access to Imagination Library for an additional year on the school district average score on third grade exams. All estimates include the full panel of control variables, both district and cohort fixed effects, and 2000 Census level time trends. Column (1) represents the effect of an additional year of access to Imagination Library as estimated by an Ordinary Least Squares model for comparison. Standard errors are presented in brackets.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 17: Effects of IL program availability on achievement: Fourth Grade

		Quantiles of Average Achievement				
	OLS	0.10	0.25	0.50 (Median)	0.75	0.90
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: ELA						
Years of IL Access	0.00349	-0.0153**	0.00498	0.00848	0.00859	0.0114
	[0.00366]	[0.00707]	[0.00736]	[0.00739]	[0.00642]	[0.00711]
Years of IL Access Squared	-0.000274	0.00276**	-0.000321	-0.000975	-0.00116	-0.00140
	[0.000516]	[0.00114]	[0.00102]	[0.00101]	[0.000992]	[0.00112]
Average Years of Access†		3.762696	3.762696	3.762696	3.762696	3.762696
Marginal Effects at the Mean		.0184719	.0143321	.0033663	-.0052636	-.0041415
Observations	65218	65483	65483	65483	65483	65483
Panel B: Mathematics						
Years of IL Access	0.00929**	0.0163	0.00654	0.00419	0.0155*	0.0143
	[0.00444]	[0.0109]	[0.00785]	[0.00627]	[0.00858]	[0.0101]
Years of IL Access Squared	-0.000642	-0.00194	0.000604	0.000400	-0.00259**	-0.00187
	[0.000648]	[0.00148]	[0.00110]	[0.000886]	[0.00122]	[0.00130]
Average Years of Access†		3.776999	3.776999	3.776999	3.776999	3.776999
Marginal Effects at the Mean		.0184719	.0143321	.0033663	-.0052636	-.0041415
Observations	64822	65091	65091	65091	65091	65091

Results in this table come from an unconditional quantile regression that estimates the effect of having access to Imagination Library for an additional year on the school district average score on fourth grade exams. All estimates include the full panel of control variables, both district and cohort fixed effects, and 2000 Census level time trends. Column (1) represents the effect of an additional year of access to Imagination Library as estimated by an Ordinary Least Squares model for comparison. Standard errors are presented in brackets.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 18: Effects of IL program availability on average school district achievement by race: Third Grade Sample

	ELA Exams		Math Exams	
	(1)	(2)	(3)	(4)
Asian Student Average Achievement				
IL Access Indicator	-0.0254		-0.000892	
	[0.0219]		[0.0242]	
Population Weighted IL Indicator		-.0276804		-.0022861
		[.0229928]		[.0261126]
Observations	8145	8145	8671	8671
Black Student Average Achievement				
IL Access Indicator	-0.00821		-0.00431	
	[0.0115]		[0.0136]	
Population Weighted IL Indicator		.0012613		-.0044103
		[.0115007]		[.0133986]
Observations	16929	16929	16894	16894
Hispanic Student Average Achievement				
IL Access Indicator	-0.00548		-0.0118	
	[0.0106]		[0.0121]	
Population Weighted IL Indicator		.0050653		-.0034512
		[.0108567]		[.0125651]
Observations	22076	22076	22331	22331
White Student Average Achievement				
IL Access Indicator	-0.00913*		-0.00369	
	[0.00523]		[0.00643]	
Population Weighted IL Indicator		-.0057618		.0034112
		[.0052778]		[.0065677]
Observations	66619	66619	66308	66308

All results in this table regress an Imagination Library access parameter on the average school district achievement levels for a specific race. To measure access,the odd columns use an Imagination Library indicator variable and the even columns use the length of time a cohort has access. All estimates include the full panel of results, both district and cohort fixed effects, and a linear time trend of 2000 Census controls. Standard errors are presented in brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 19: Effects of IL program availability on average school district achievement by race: Fourth Grade Sample

	ELA Exams		Math Exams	
	(1)	(2)	(3)	(4)
Asian Student Average Achievement				
IL Access Indicator	0.00121		-0.00365	
	[0.0241]		[0.0237]	
Population Weighted IL Indicator		-.0022543		-.013288
		[.0261549]		[.025065]
Observations	8145	8145	8671	8671
Black Student Average Achievement				
IL Access Indicator	-0.0120		0.0262*	
	[0.0128]		[0.0154]	
Population Weighted IL Indicator		-.0018884		.0261662*
		[.0127939]		[.0149818]
Observations	14708	14708	14734	14734
Hispanic Student Average Achievement				
IL Access Indicator	-0.00681		-0.00156	
	[0.0116]		[0.0131]	
Population Weighted IL Indicator		.006609		.0074703
		[.0114772]		[.0133892]
Observations	19145	19145	19416	19416
White Student Average Achievement				
IL Access Indicator	0.000364		0.0121*	
	[0.00559]		[0.00670]	
Population Weighted IL Indicator		.0017262		.0166994**
		[.0057055]		[.0069664]
Observations	57889	57889	57641	57641

All results in this table regress an Imagination Library access parameter on the average school district achievement levels for a specific race. To measure access,the odd columns use an Imagination Library indicator variable and the even columns use the length of time a cohort has access. All estimates include the full panel of results, both district and cohort fixed effects, and a linear time trend of 2000 Census controls. Standard errors are presented in brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 20: Effects of IL program availability on average school district achievement by race: Third Grade Sample

	ELA Exams (1)	Math Exams (2)
Asian Student Average Achievement		
Years of IL Access	-0.0158	0.00337
	[0.0147]	[0.0166]
Years of IL Access Squared	0.00333	0.00108
	[0.00219]	[0.00253]
Average Years of Access†	3.835388	3.908442
Marginal Effects at the Mean	0.00974	0.011823
Observations	8145	8671
Black Student Average Achievement		
Years of IL Access	-0.00511	0.00364
	[0.00800]	[0.00895]
Years of IL Access Squared	0.00147	0.00194
	[0.00110]	[0.00131]
Average Years of Access†	3.923377	3.935787
Marginal Effects at the Mean	0.006446	0.018917
Observations	16929	16894
Hispanic Student Average Achievement		
Years of IL Access	-0.0121*	-0.00598
	[0.00689]	[0.00835]
Years of IL Access Squared	0.00183*	0.00157
	[0.00111]	[0.00133]
Average Years of Access†	3.941127	3.955647
Marginal Effects at the Mean	0.002386	0.0064146
Observations	22076	22331
White Student Average Achievement		
Years of IL Access	-0.00260	0.00486
	[0.00338]	[0.00409]
Years of IL Access Squared	0.000581	0.0000891
	[0.000510]	[0.000619]
Average Years of Access†	3.878886	3.889214
Marginal Effects at the Mean	0.001905	0.005548
Observations	66619	66308

†The average years of access used here is conditional on having access to Imagination Library

All results in this table regress an Imagination Library access parameter on the average school district achievement levels for a specific race. To measure access,the odd columns use an Imagination Library indicator variable and the even columns use the length of time a cohort has access. All estimates include the full panel of results, both district and cohort fixed effects, and a linear time trend of 2000 Census controls. Standard errors are presented in brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 21: Effects of IL program availability on average school district achievement by race: Fourth Grade Sample

	ELA Exams (1)	Math Exams (2)
Asian Student Average Achievement		
Years of IL Access	0.00102	0.0114
	[0.0141]	[0.0152]
Years of IL Access Squared	0.000163	-0.000866
	[0.00214]	[0.00242]
Average Years of Access†	3.765903	3.842254
Marginal Effects at the Mean	0.002245	0.004732
Observations	8145	8671
Black Student Average Achievement		
Years of IL Access	-0.00268	0.0167*
	[0.00841]	[0.00954]
Years of IL Access Squared	0.000633	-0.00105
	[0.00116]	[0.00135]
Average Years of Access†	3.81611	3.83176
Marginal Effects at the Mean	0.002149	0.008648
Observations	14708	14734
Hispanic Student Average Achievement		
Years of IL Access	-0.00636	-0.00173
	[0.00775]	[0.00948]
Years of IL Access Squared	0.000803	0.00126
	[0.00120]	[0.00143]
Average Years of Access†	3.883007	3.898349
Marginal Effects at the Mean	-0.000122	0.008118
Observations	19145	19416
White Student Average Achievement		
Years of IL Access	0.00307	0.0109**
	[0.00375]	[0.00455]
Years of IL Access Squared	0.0000595	-0.000631
	[0.000536]	[0.000667]
Average Years of Access†	3.748653	3.762422
Marginal Effects at the Mean	0.00351	0.00612
Observations	57889	57641

†The average years of access used here is conditional on having access to Imagination Library

All results in this table regress an Imagination Library access parameter on the average school district achievement levels for a specific race. To measure access,the odd columns use an Imagination Library indicator variable and the even columns use the length of time a cohort has access. All estimates include the full panel of results, both district and cohort fixed effects, and a linear time trend of 2000 Census controls. Standard errors are presented in brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 22: Effects of IL program availability on average school-district achievement by economic disadvantage status

	First Quantile		Second Quantile		Third Quantile		Fourth Quantile	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Third Grade ELA Exams								
IL Access Indicator	-0.00246		-0.00558		-0.0179**		-0.0105	
	[0.00999]		[0.0105]		[0.00904]		[0.0114]	
Population Weighted IL Indicator		-.0004893		-.001045		-.0238171**		-.0073247
		[.0103222]		[.010198]		[.0092473]		[.0117647]
Observations	18252	18252	16379	16379	17169	17169	18455	18455
Panel B: Third Grade Math Exams								
IL Access Indicator	-0.00549		-0.000854		-0.0160		0.00137	
	[0.0127]		[0.0123]		[0.0111]		[0.0136]	
Population Weighted IL Indicator		.0023168		.0052662		-.0137696		-.0023025
		[.0133234]		[.0119863]		[.0114924]		[.0131809]
Observations	18187	18187	16272	16272	17088	17088	18367	18367
Panel C: Fourth Grade ELA Exams								
IL Access Indicator	0.00745		-0.00443		-0.00792		-0.00240	
	[0.0117]		[0.0109]		[0.0104]		[0.0126]	
Population Weighted IL Indicator		.0023168		.0052662		-.0137696		-.0023025
		[.0133234]		[.0119863]		[.0114924]		[.0131809]
Observations	15574	15574	14515	14515	15191	15191	15903	15903
Panel D: Fourth Grade Math Exams								
IL Access Indicator	0.00591		0.00833		0.0258**		0.0136	
	[0.0144]		[0.0140]		[0.0118]		[0.0153]	
Population Weighted IL Indicator		.0113298		.0017136		.038374***		-.0018073
		[.0153468]		[.0133326]		[.0125067]		[.0153833]
Observations	15498	15498	14425	14425	15093	15093	15767	15767

Results in this table regress an Imagination Library access parameter on average school district achievement levels. To measure access,the odd columns use an Imagination Library indicator variable and the even columns use the length of time a cohort has access. Each set of two columns represents the effect size for school districts in a specific quantile based on the number of students from low socioeconomic backgrounds. For example, the models in columns (1) and (2) show results from a model run on school districts that are in the lowest quantile of low-socioeconomic students. All estimates include the full panel of results, both district and cohort fixed effects, and a linear time trend of 2000 Census controls. Standard errors are presented in brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 23: Effects of IL program availability on average school-district achievement by economic disadvantage status

	First Quantile	Second Quantile	Third Quantile	Fourth Quantile
	(1)	(2)	(3)	(4)
Panel A: Third Grade ELA Exams				
Years of IL Access	0.00301	0.00732	-0.00899	-0.000764
	[0.00654]	[0.00660]	[0.00598]	[0.00765]
Years of IL Access Squared	-0.000918	-0.00102	0.00166*	0.000558
	[0.00107]	[0.000969]	[0.000907]	[0.00107]
Average Years of Access†	3.656281	3.850243	3.879382	4.075046
Marginal Effects at the Mean	-0.003702	-0.000499	0.003879	0.003787
Observations	18252	16379	17169	18455
Panel B:Third Grade Math Exams				
Years of IL Access	0.00635	0.0102	0.000680	0.00444
	[0.00831]	[0.00801]	[0.00727]	[0.00891]
Years of IL Access Squared	-0.00137	-0.00125	0.00163	0.000712
	[0.00127]	[0.00119]	[0.00112]	[0.00132]
Average Years of Access†	3.671787	3.860271	3.893945	4.08984
Marginal Effects at the Mean	-0.003683	0.000551	0.013343	0.010267
Observations	18187	16272	17088	18367
Panel C: Fourth Grade ELA Exams				
Years of IL Access	0.0146*	0.00681	0.00398	-0.00332
	[0.00771]	[0.00750]	[0.00678]	[0.00811]
Years of IL Access Squared	-0.00255**	-0.00119	0.0000102	0.000947
	[0.00120]	[0.00107]	[0.000945]	[0.00112]
Average Years of Access†	3.67502	3.691031	3.713465	3.917126
Marginal Effects at the Mean	-0.004212	-0.001982	0.004056	0.004107
Observations	15574	14515	15191	15903
Panel D: Fourth Grade Math Exams				
Years of IL Access	0.00767	0.00759	0.0303***	-0.00856
	[0.00969]	[0.00944]	[0.00815]	[0.00977]
Years of IL Access Squared	-0.000520	-0.000807	-0.00315***	0.00195
	[0.00149]	[0.00138]	[0.00116]	[0.00143]
Average Years of Access†	3.68041	3.696484	3.728958	3.948028
Marginal Effects at the Mean	0.003842	0.001630	0.006756	0.006874
Observations	15498	14425	15093	15767

†The average years of access used here is conditional on having access to Imagination Library
Results in this table regress an Imagination Library access parameter on average school district achievement levels. To measure access,the odd columns use an Imagination Library indicator variable and the even columns use the length of time a cohort has access. Each set of two columns represents the effect size for school districts in a specific quantile based on the number of students from low socioeconomic backgrounds. For example, the models in columns (1) and (2) show results from a model run on school districts that are in the lowest quantile of low-socioeconomic students. All estimates include the full panel of results, both district and cohort fixed effects, and a linear time trend of 2000 Census controls. Standard errors are presented in brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 24: Effects of IL program availability on average school district achievement by socioeconomic status

	Third Grade ELA Exams		Third Grade Math Exams		Fourth Grade ELA Exams		Fourth Grade Math Exams	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
IL Access Indicator	-0.00752		-0.000367		-0.00204		0.0171**	
	[0.00570]		[0.00682]		[0.00643]		[0.00729]	
Population Weighted IL Indicator		-.0069476		.0010903		.0040758		.0176324**
		[.0057969]		[.0068999]		[.0063745]		[.0073136]
Observations	58194	58194	58110	58110	51067	51067	51069	51069

All results in this table regress an Imagination Library access parameter on the average achievement scores of a school district's students from low-socioeconomic backgrounds. To measure access,the odd columns use an Imagination Library indicator variable and the even columns use the length of time a cohort has access. Each set of two columns represents estimates from a different sample based on grade and subject. All estimates include the full panel of results, both district and cohort fixed effects, and a linear time trend of 2000 Census controls. Standard errors are presented in brackets.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 25: Effects of IL program availability on average school district achievement by socioeconomic status

	Third Grade ELA Exams (1)	Third Grade Math Exams (2)	Fourth Grade ELA Exams (3)	Fourth Grade Math Exams (4)
Years of IL Access	-0.00176	0.00433	0.00714*	0.0128***
	[0.00369]	[0.00435]	[0.00413]	[0.00482]
Years of IL Access Squared	0.000623	0.000547	-0.000745	-0.000895
	[0.000556]	[0.000667]	[0.000587]	[0.000707]
Average Years of Access†	3.831173	3.848056	3.699545	3.719283
Marginal Effects at the Mean	0.003015	0.008542	0.0016297	0.006113
Observations	58194	58110	51067	51069

All results in this table regress an Imagination Library access parameter on the average achievement scores of a school district's students from low-socioeconomic backgrounds. To measure access,the odd columns use an Imagination Library indicator variable and the even columns use the length of time a cohort has access. Each set of two columns represents estimates from a different sample based on grade and subject. All estimates include the full panel of results, both district and cohort fixed effects, and a linear time trend of 2000 Census controls. Standard errors are presented in brackets.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 26: Robustness Specifications: Migration

	(1)	(2)	(3)	(4)
IL Access Indicator	-0.00602	-0.0145*	-0.00680	-0.0117*
	[0.0107]	[0.00787]	[0.00702]	[0.00604]
Observations	13625	27098	40663	54439

The estimates are from the basic specification on the third grade ELA sample. Each column represents a subset of the data restricted by the relative amount of migration into the school district. Column 1 is restricted to the lowest 25 percent of migration. Each additional column adds another 25 percent, such that column 4 represents the whole sample. The outcome variable for all estimates is the average achievement score for the entire school district. Standard errors are in brackets and are clustered at the district level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

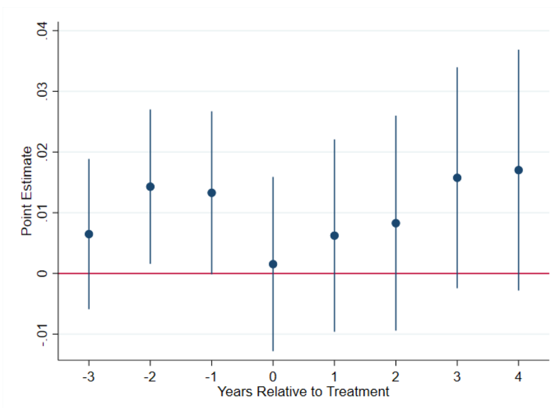
Table 27: Robustness Specifications: Public School Enrollment

	(1)	(2)	(3)	(4)
IL Access Indicator	0.00877	0.00172	-0.00924	-0.0116*
	[0.0115]	[0.00790]	[0.00642]	[0.00604]
Observations	12597	26259	40272	54424

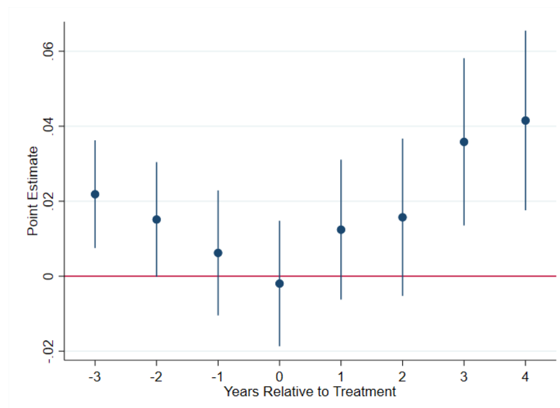
The estimates are from the basic specification on the third grade ELA sample. Each column represents a subset of the data restricted by the relative amount of public school enrollment. Column 1 is restricted to the lowest 25 percent of enrollment. Each additional column adds another 25 percent, such that column 4 represents the whole sample. The outcome variable for all estimates is the average achievement score for the entire school district. Standard errors are in brackets and are clustered at the district level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 28: Alternative Estimates on 3$^{\text{rd}}$ Grade Achievement

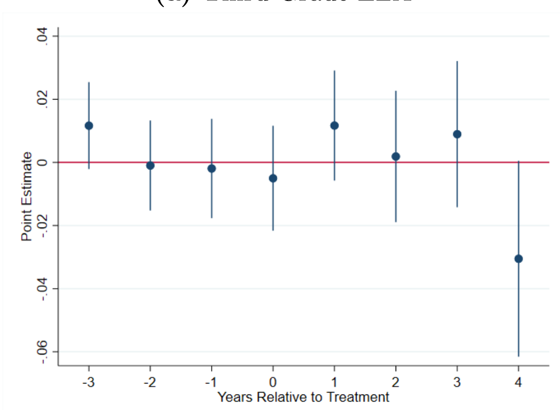
	Estimate	Standard Error	Observations
B_{fe}	-.009981**	.0049725	75378
DID_M	-.009524	.0058219	50266
DID_M^{p1}	.0027008	.006729	38587
DID_M^{p2}	.0070911	.0064246	29856
DID_M^{p3}	-.0026929	.0075401	21662



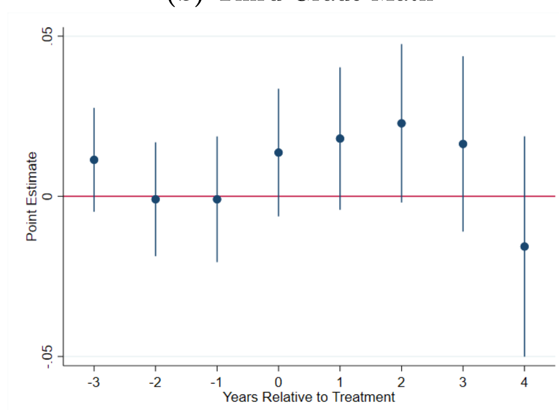
(a) Third Grade ELA



(b) Third Grade Math

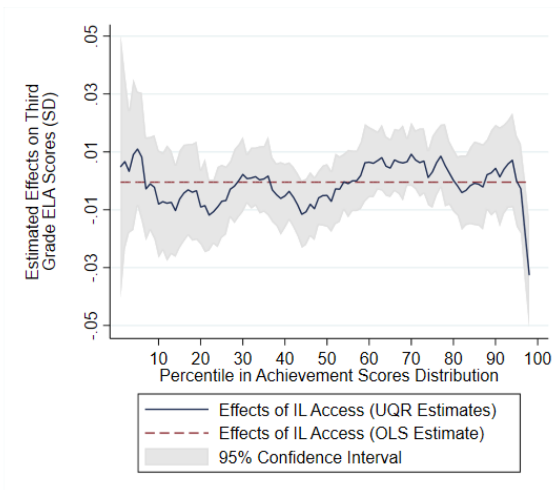


(c) Fourth Grade ELA

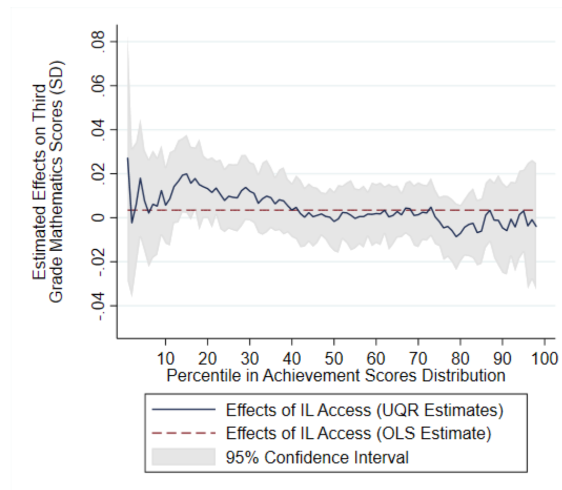


(d) Fourth Grade Math

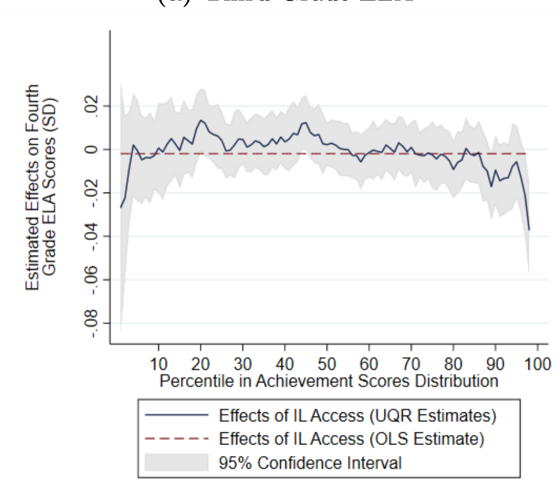
Figure 1: Event Study Estimates of the Effects on Average Achievement



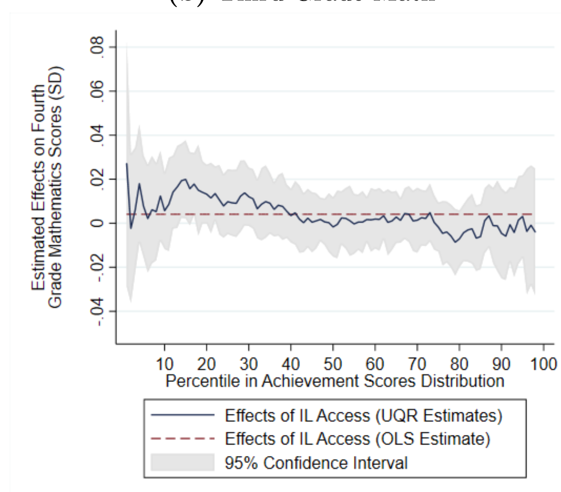
(a) Third Grade ELA



(b) Third Grade Math



(c) Fourth Grade ELA



(d) Fourth Grade Math

Figure 2: Estimated Effects on Percentiles of Average Achievement Distribution