Early Grade Retention Harms Adult Earnings

Jiee Zhong *
Miami University

Abstract

This paper presents the first causal evidence of the effects of grade retention on labor market outcomes and post-secondary educational attainment, analyzing a reading test-based retention policy in Texas. Employing a fuzzy regression discontinuity design, the study finds that third-grade retention significantly reduces the average earnings between ages 23 and 25 by $3,512 (22%). While retention initially increases test scores, these gains diminish over time. Moreover, retention increases school absence, violence, and crime. It further reduces the likelihood of high school graduation but does not affect college enrollment, graduation, the timing of these outcomes, or the selectivity of college attended.

Keywords: Grade Retention, Educational Attainment, Labor Market Outcomes

*Zhong: Department of Economics, Miami University (email: jieezhong@gmail.com). I am grateful to Andrew Barr and Jason Lindo for their invaluable guidance and insightful advice during the development of this paper. I extend my sincere appreciation to Joanna Lahey, Yonghong An, and the attendees of the 2022 Midwest Economics Association, 2022 Western Economic Association International, 2022 Association for Public Policy Analysis and Management, 2022 Southern Economics Association conferences, 2023 Eastern Economic Association Conferences, and 2023 LBJ School Policy Research Workshop, for their constructive comments and helpful suggestions. The views expressed in this paper are solely those of the author and do not necessarily represent the views of the affiliated institution.

1 Introduction

One in ten public school students in the United States has been retained at least once between kindergarten and twelfth grade, with retention rates climbing to 21% among Black students and 12% among Hispanic students (National Center for Education Statistics, 2010). The implementation of grade retention has been the subject of debate, with proponents citing its potential to improve the academic performance of low-achieving students through additional time to acquire essential knowledge. Conversely, opponents argue that grade retention can negatively impact student outcomes by creating a sense of punishment and stigma. Given the prevalence and growth of grade retention practices and their unequal impacts on disadvantaged populations, it is imperative to examine the effects of this policy.

The existing literature on grade retention presents a mixed view of its intermediate effects. Research focusing on third-grade retention policy shows improvements in reading and math scores (Jacob and Lefgren, 2004; Schwerdt et al., 2017; Figlio and Özek, 2020). These gains, however, tend to diminish in the subsequent years and do not persistently enhance longer-term educational achievement outcomes such as high school graduation or college enrollment rates (Schwerdt et al., 2017). Moreover, Özek (2015) finds detrimental effects of the third-grade retention policy, including increased disciplinary incidents among economically disadvantaged students. In contrast, retention policies implemented in later grades tend to result in more deleterious outcomes. Studies (Jacob and Lefgren, 2009; Manacorda, 2012; Eren et al., 2022) indicate that eighth-grade retention substantially increases the risk of school dropout and the conviction of violent crime. Despite these conflicted results, the impacts of grade retention on long-term outcomes remain insufficiently examined.

This study fills this gap by providing new causal evidence of the long-term effects of early grade retention on post-secondary attainment and long-term labor market outcomes, employing the reading test-based third-grade retention policy in Texas. This policy requires third graders to pass the promotion cutoff on the state standardized reading test within three attempts to advance to fourth grade. This cutoff varies by the test difficulty and is undisclosed to students prior to

assessment, creating a quasi-experimental environment. That is, students whose reading scores close to this cutoff are comparable in their characteristics, differing primarily in their likelihood of retention in third grade. By leveraging the variation in retention probability at the cutoff on the third reading test, combined with Texas ERC data that links students' educational records to earnings outcomes, this study employs a fuzzy regression discontinuity design to estimate the causal effects of retention in third grade on educational attainment and labor market outcomes.

The results demonstrate that third-grade retention decreases average earnings between ages 23 and 25 by $3,512, a 22% reduction compared to peers who barely pass the cutoff. This negative effect on earnings outcomes is pronounced at higher income levels rather than at the entry level. Furthermore, retention in third grade decreases the initial earnings received after turning 18. However, it does not affect the age at which individuals earn their first wages, nor does it impact the likelihood of maintaining positive wages from ages 23 to 26, indicating that retention in third grade does not reduce earnings by disproportionately delaying entry into the labor market.

Additionally, third-grade retention shows no detectable effects on college enrollment, graduation, the timing of these events, or the selectivity of the college attended. This absence of effect on college outcomes could be linked to the generally lower academic performance of retained students, who are less likely to pursue higher education. This finding also indicates that the observed reduction in earnings is not attributable to delays in entering the labor market due to prolonged post-secondary education.

Analysis of intermediate outcomes shows that third-grade retention temporarily boosts test scores and decreases the likelihood of repeating later grades, yet these improvements fade over time. These results align with the findings in Schwerdt et al. (2017). In contrast to Schwerdt et al. (2017), which reports no impact on high school graduation when third-grade retention is combined with summer school, this study reveals that retention alone significantly reduces the likelihood of high school graduation by 15% compared to peers just above the promotion cutoff. Additionally, this study highlights negative impacts on non-cognitive skills development, evidenced by increased school absence, violence, and crime, further differentiating it from the outcomes reported by Schw-

erdt et al. (2017).

Furthermore, the subgroup analysis reveals significantly higher retention rates for Hispanic, female, and low-income students compared to their counterparts. However, the differences are not statistically significant when examining the impacts of third-grade retention on earnings outcomes across different races, genders, and income levels.

This study contributes to the literature on grade retention policies by providing the first causal analysis of the effect of grade retention on post-secondary attainment and labor market outcomes.[1] Previous studies on early grade retention policies have documented its improvement in test scores by combining summer school with repeating a grade (Figlio and Özek, 2020; Schwerdt et al., 2017; Greene and Winters, 2007; Jacob and Lefgren, 2004). Building on these findings, this research delves deeper into the long-term impacts of repeating third grade alone, particularly focusing on the critical yet under-explored areas of post-secondary attainment and labor market success. Contrary to the short-term positive effects documented in this and earlier research, this study further reveals significant adverse long-term effects of retaining low-achieving third graders for an additional year, particularly on high school graduation and labor market outcomes. The adverse behavioral effects observed in this study also align with studies (Jacob and Lefgren, 2009; Eren et al., 2022) showing negative consequences of retention in later grades—such as increased dropout rates and criminal behavior.

This study also complements a growing body of literature on education intervention (Chetty et al., 2011; Lindqvist and Vestman, 2011; Deming, 2011; Heckman et al., 2006; Heckman and Rubinstein, 2001), which demonstrates lasting impacts on adult outcomes despite fade-out gain in test scores. This study shows the case with the early grade retention policy. These findings underscore the important role of non-cognitive skills rather than test scores in predicting long-term life and career success, especially for low-achieving students.

[1] Schwerdt et al. (2017) provide suggested evidence of the effect of third-grade retention policies in Florida on college enrollment; however, the validity of their findings is limited by data constraints. Their research only includes college enrollment data for a subset of students in the first cohort instead of all cohorts and does not account for enrollments in colleges outside of Florida. Additionally, they lack information on college graduation outcomes. Conversely, this study encompasses nationwide college enrollment data across the United States for all cohorts in the main sample and detailed college graduation data from Texas.

The policy implications of this study are particularly relevant to students who are marginally affected by the third-grade retention policy. These students are also more likely to rank at the lower end of the ability distribution and are predominantly from low-income and racial minority groups. The results of this study reveal that instead of aiding struggling students academically, third-grade retention exacerbates behavioral problems, reduces educational attainment, and lowers adult earnings, further disadvantaging them as they enter the labor market. The observed high retention rates among disadvantaged groups, coupled with the negative impact on earnings outcomes, suggest that retaining low-achieving students in third grade may exacerbate social inequalities.

2 Background

Following the No Child Left Behind Act of 2001, Texas implemented a reading test-based retention policy for third graders in the 2002-03 school year, replacing its prior policy of social promotion. This change aimed to improve student educational performance through standardized testing and minimum performance standards because third grade marks a crucial transition from learning to read to reading to learn. Policymakers establish the reading test-based grade retention policy to ensure students have a solid foundation in reading before moving forward to more advanced academic subjects.

The implementation of this policy in Texas has sparked a highly debated topic among educators, policymakers, and parents, as opinions are divided on its effectiveness. Supporters of the policy believe that repeating the third grade would give additional time to develop the necessary reading skills for success in later grades. On the other hand, opponents argue that grade retention negatively impacts students, including decreased academic achievement, increased dropout rates, and behavioral issues. Despite the ongoing debate, the third-grade retention policy remains in place.

Under the new policy, third-grade students must pass the Texas Assessment of Knowledge and Skills (TAKS) reading test to advance to the fourth grade. The TAKS test is a standardized assess-

ment used to measure student performance in Texas public schools. Students have three chances to pass the reading test. The TAKS reading tests are typically administered in either February or March, again in April, and then in either June or July.[2] If the students fail the first reading test, schools offer accelerated instruction to help them catch up. In an accelerated instruction group, each teacher is assigned a maximum of ten students.

If a student struggles and fails twice, the district must establish a grade placement committee (GPC), made up of the school principal, the student's parent, and their English teacher, to determine the accelerated instruction the student will receive before the third attempt reading test. If a student fails the reading test on their third attempt, they would be subject to automatic retention in the same grade for the following academic year, regardless of their performance in other subjects.

Nevertheless, there exist exceptions to the standard procedure. After a student fails the third try of the reading test, the school will formally notify the student's parent or guardian regarding the retention decision. Parents or guardians can then appeal this decision by submitting a written request to the grade placement committee. If the student's retention is appealed and the GPC members unanimously agree on promotion, the student will be promoted to the fourth grade. The GPC's decision takes into account various academic indicators, including teacher recommendations and previous academic performance. However, these criteria are not standardized across school districts.

3 Data

The Texas Education Research Center (ERC), maintains the administrative data for each student attending the Texas public schools. Specifically, the Texas ERC compiles pre-kindergarten through the twelfth grade (PK-12) educational records from the Texas Education Agency (TEA), the post-secondary education records within Texas from the Texas Higher Education Coordinating Board (THECB), the post-secondary education records from other states via the National Stu-

[2]The mathematics tests are administered in April and June or July.

dent Clearinghouse (NSC), and the Texas employment earnings data from the Texas Workforce Commission (TWC). Each dataset incorporates a uniquely generated identifier, denoted as ID2. This ID2 serves as a unique substitute for Social Security Numbers (SSNs), enabling longitudinal tracking of a student across these diverse datasets. To test the accuracy of the longitudinal tracking across datasets using ID2, I merge the main sample from the TEA data with the community college enrollment file in 2014. I then examine the match rates for gender from these two datasets. The matching rate for gender using ID2 is 99%. The remaining 1% discrepancy may be due to manual errors. The introduction of each dataset and the definitions for key outcome variables used in this study are documented below. More details about the data, data linkages, and definitions or attrition for each outcome variable are available in the Appendix section A.1.

TEA 1994-2022

One of the key variables from TEA is the student's performance on state standardized assessment, the Texas Assessment of Knowledge and Skills (TAKS). The TAKS had been administered from 2003 to 2011. It is required for students in grades 3 to 11 to assess reading and math skills, with the raw scores reflecting the number of correctly answered multiple-choice questions. I can observe the TAKS reading and mathematics scores up to six years after grade three or eighth grade for the third-graders between the 2002-2003 and 2004-2005 school years. I use the raw reading score subtracting the promotion cutoff as the running variable. The TEA files also contain a scale score, which quantifies a student's performance relative to the passing standards or proficiency levels, allowing direct comparisons of student performance between specific sets of test questions from different test administrations (Texas Education Agency). In this study, I use both the raw scores and scale scores as outcome variables to show the robustness of the impacts of third-grade retention on test scores. Additionally, the test scores are standardized with zero mean and one standard deviation by subject-grade/year-cohort.

High school graduation is another critical measure of educational achievement. In this analysis, I define "ever graduating from high school" as obtaining a high school diploma (excluding a GED) within an eight-year window post-grade nine. Additionally, I categorize high school graduation

based on its timing relative to the expected schedule. For example, graduating on time refers to graduating from a high school by the ninth year following grade three. I also measure delayed graduation outcomes, indicating graduating at least one more year, at least two more years, at least three more years, and at least four more years, relative to on-time graduation.

Dropout is closely related to high school graduation. Since the 2005-06 school year, Texas has adopted the National Center for Education Statistics (NCES) definition of a dropout: a student in grades 7-12 who leaves school and does not re-enroll the following fall, without being expelled, graduating, earning a GED, transferring to non-Texas public schools, starting college, or passing away. According to this definition, graduating from high school and dropping out are not mutually exclusive. TEA also documents the details of the reasons that a student leaves the public school, including attending a private school, out-of-state school, and others. These details enable this study to track the impacts of third-grade retention on attrition of the outcome variables.

The TEA also covers details about the reasons and actions for student disciplinary incidents. Particularly, there are variables that document whether a disciplinary incident belongs to crime or violent behavior. The disciplinary incidents classified as violent behavior or crime are listed in Table A4 and A5, respectively. This study uses the violence and crime variables to estimate the impacts of retention on severe behavior outcomes.

THECB 2010-2021 and NSC 2011-2019

The post-secondary outcomes are combined from THECB and NSC, focusing on college enrollment, graduation, and the types of institutions attended. I have developed two metrics for college enrollment: one tracking any enrollment from 2010 to 2021, and another assessing on-time enrollment, which I define as enrollment in college by the ninth year post-grade three. As for college graduation outcomes, these are limited to graduations from Texas colleges, as NSC data from 2011 to 2016 lacks specific graduation dates and statuses. Furthermore, I explore the effects on the types of institutions where students enroll or from which they graduate, categorizing these as community colleges in Texas, public universities in Texas, or out-of-state institutions.

TWC Wages Data 2007-2022

The main outcome variables are earnings outcomes from the TWC. The TWC dataset covers wages paid within Texas, while earnings obtained from other states are not documented in the TWC data.[3] A lack of positive earnings in the dataset might reflect unemployment within Texas or employment outside the state. Missing wage records are coded as zero in this study. The outcomes of interest are annual earnings at each age from 23 to 26 as well as the average earnings between ages 23 to 25 and 23 to 26. I also generate variables indicating having positive earnings at each age from 23 through 26 and over these years to estimate the impacts of third-grade retention on having positive earnings in Texas. Another set of earnings outcomes is measured as the annual wages earned from the 8^{th} to the 11^{th} year post-grade nine and the average earnings during this period. Utilizing data on earnings outcomes post-grade nine—rather than age-specific earnings—helps to circumvent the timing discrepancies in labor market entry attributable to the extra year for repeating third grade.

This study's main sample consists of third-graders from the 2002-2003 to the 2004-2005 school years, whose third-attempt reading scores are within eight points of the cutoff. The 2002-2003 group of third-graders represents the initial cohort impacted by Texas's test-based third-grade retention policy. As of 2022, when I observe their latest earnings, the 2002-2003 cohorts are approximately 27 years old. Details for the calendar year corresponding to the age for each cohort are available in Appendix Table A1. The final cohort under consideration, those in the third grade in 2004-2005, would be around 25 years old in 2022. These three cohorts were selected to ensure a sufficient sample size for conducting fuzzy regression discontinuity analysis and to enable the observation of earnings data up to the age of 25.

Table 1 provides summary statistics that compare the main study sample to two specific groups: all third-graders from the 2002-2003 to 2004-2005 school years and those who failed the initial reading test. Relative to the general third-grade population during these years, the main study sample has a higher proportion of older Hispanic or Black male students with limited English

[3] TWC requires all employers to report Unemployment Insurance (UI) wages and to pay their quarterly UI taxes electronically. Employers that do not file and pay electronically may be subject to penalties as prescribed in Sections 213.023 and 213.024 of the Texas Unemployment Compensation Act (TUCA).

Table 1: Summary statistics

	(1) Full cohorts 2003-5	(2) Main sample	(3) Fail 1st test	(4) Diff.(2)-(1)	(5) t-stat (4)	(6) Diff. (2)-(3)	(7) t-stat(6)
Student Characteristics							
Age	8.16	8.26	8.35	0.10	35.5	-0.09	-25.8
Eligible for Free Meals	0.34	0.62	0.57	0.28	88.5	0.05	14.5
Male	0.51	0.54	0.59	0.03	7.9	-0.06	-16.9
Limited English Proficiency	0.27	0.38	0.28	0.11	36.3	0.09	29.6
Bilingual Program	0.07	0.17	0.13	0.10	56.5	0.05	19.0
Migrant	0.02	0.04	0.03	0.02	18.5	0.00	1.7
Special Education	0.12	0.07	0.46	-0.06	-26.4	-0.39	-118.6
Hispanic	0.45	0.60	0.50	0.15	44.7	0.10	28.1
Black	0.14	0.26	0.21	0.12	50.8	0.05	16.4
White	0.37	0.12	0.27	-0.25	-79.1	-0.14	-47.6
Education Outcomes							
Reading Score	5.18	-6.64	-13.76	-11.82	-175.6	7.12	123.6
Math Scores	7.02	-3.20	-1.36	-10.22	-214.2	-1.84	-30.0
Total absence 1-9 years later	64.43	78.63	80.09	14.20	39.7	-1.46	-3.3
Dropout	0.07	0.16	0.13	0.10	57.9	0.04	14.9
High School Graduation	0.74	0.61	0.64	-0.12	-43.1	-0.03	-9.0
Any College Enrollment	0.57	0.37	0.34	-0.19	-59.7	0.03	8.5
Public University Enrollment	0.26	0.08	0.07	-0.18	-63.8	0.00	0.8
Community College Enrollment	0.48	0.32	0.30	-0.17	-50.6	0.02	5.4
Labor Market Outcomes							
Av.wages btw Ages 23 to 25	19270.56	15367.70	13980.31	-3902.86	-25.0	1387.39	10.9

Notes: This table provides the summary statistics for three groups of sample: all third-graders from the 2002-2003 to 2004-2005 school years, the main sample used in this study (first-time third-graders from the 2002-03 to the 2004-05 school years with scores zero to eighth points to the promotion cutoff of the third attempt reading test), and those who failed the initial reading test. The sample includes three cohorts of first-time third-grade students who took the third-attempt reading test between the 2002-03 and 2004-05 school years and scored 0-8 points to the promotion cutoff.

proficiency, lower family income, and poorer performance on third-grade reading and math tests. This group also exhibits more behavioral issues, lower educational achievement, and reduced adult incomes.

Similarly, when compared to those who failed the initial reading test, the main study sample primarily consists of Hispanic or Black female students from low-income backgrounds with limited English proficiency. In contrast, they show better reading performance but worse math performance in third grade. Longitudinally, this group has lower high school graduation rates but higher college enrollment rates and earns more in adulthood.

4 Empirical Strategy

The existing exemption in the retention process allows students who fail their third-attempt reading test to advance to the next grade upon successful parental appeal and approval by the grade placement committee members. This introduces a selection bias complicating the estimation of retention's causal impacts, as exemption decisions are likely influenced by factors such as parental involvement and socioeconomic status, which vary across the retained and promoted students.

To circumvent this issue, this study exploits the variation generated at the promotion cutoff of the third-attempt reading test as a tool for causal identification. Texas' test-based retention policy mandates that third graders must surpass a specified reading score cutoff to progress to the fourth grade. This cutoff, determined annually by educational experts based on test difficulty and undisclosed to students prior to assessment, creates a quasi-experimental environment. Students near the cutoff are comparable in their characteristics except for their probability of being retained in third grade. Despite the potential for exemptions, the probability of retention increases discontinuously for students just below the cutoff. This provides a clear division for employing a fuzzy regression discontinuity design, leveraging the quasi-random variation at the cutoff to estimate the short-term and long-term causal effects of third-grade retention.

The sample comprises three cohorts of third-graders spanning from the 2002-2003 to the 2004-2005 school years. Given that the promotion cutoff for the reading test may vary annually, the analysis utilizes the difference between students' raw reading scores and the corresponding yearly cutoff as the running variable. Under the validity of the continuity assumption, the fuzzy RDD estimates the local average treatment effect of repeating third grade.

For identification, I employ the local linear regression within a bandwidth defined around the promotion cutoff, adhering to the recommended practices from Gelman and Imbens (2019) and Imbens and Lemieux (2008). The model controls for the running variable (reading scores minus cutoff) and accommodates different slopes on either side of the cutoff. Additionally, a triangular kernel is employed, which places the highest weight on students close to the promotion cutoff. The optimal bandwidth is selected by optimizing the mean squared error based on the method in

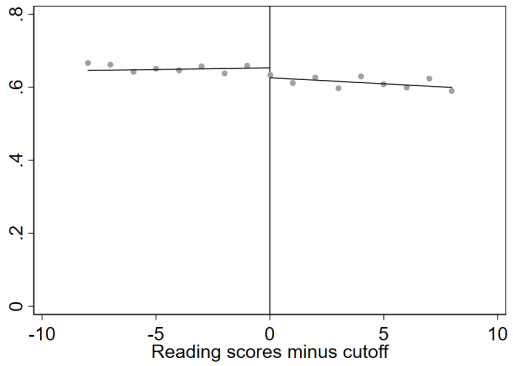
Calonico et al. (2017). Specifically, the analysis is implemented through a two-stage instrumental variables framework, detailed as follows:

$$Retention_i = \theta_0 + \theta_1 I\{score_i < C\} + \theta_2(score_i - C) + \theta_3 I\{score_i < C\} * (score_i - C) + \gamma X_i + \varepsilon_i \quad (1)$$

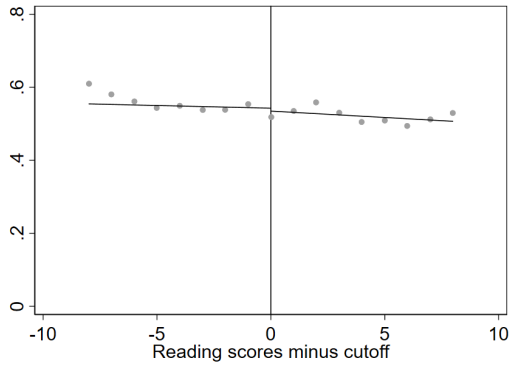
$$Y_i = \beta_0 + \beta_1 Retention_i + \beta_2(score_i - C) + \beta_3 I\{score_i < C\} * (score_i - C) + \eta X_i + \mu_i \quad (2)$$

where Y_i denotes the outcomes of interest for student i, including educational achievement, behavior, and earnings outcomes; $Retention_i$ is an indicator that takes the value one if a student was retained in third grade; $score_i$ is the reading raw score, representing the number of questions answered correctly; C is the promotion cutoff of the reading test score; $I\{score_i < C\}$ is an indicator, indicating scoring below the promotion cutoff, which is also the instrumental variable for third-grade retention; X_i is a vector of control variables, including demographic characteristics like gender, eligibility for free meals, and cohort fixed effects. This study uses the robust standard error, but the results align closely with those clustering the standard error by school. The parameter of interest, β_1, measures the effect of third-grade retention on earnings, educational, and behavioral outcomes. The regression discontinuity estimate of β_1 can be interpreted causally if the baseline characteristics and the distribution of the running variable are smooth across the promotion cutoff.

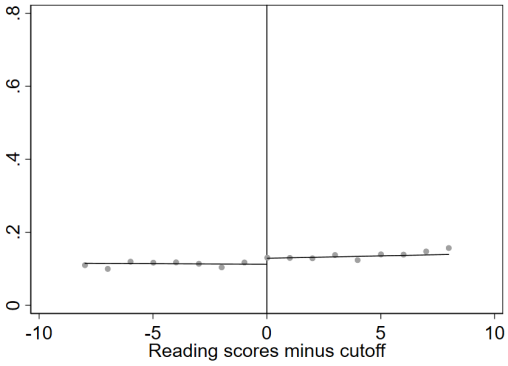
Figure 1: Balance Test



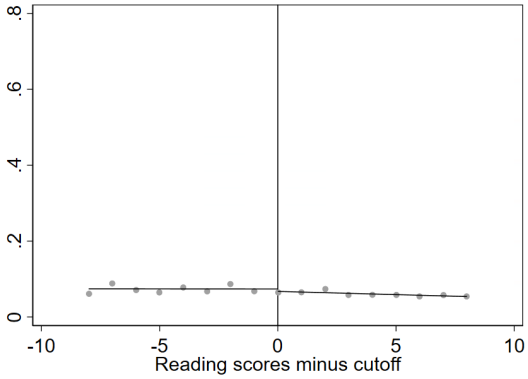
(a) Free meals



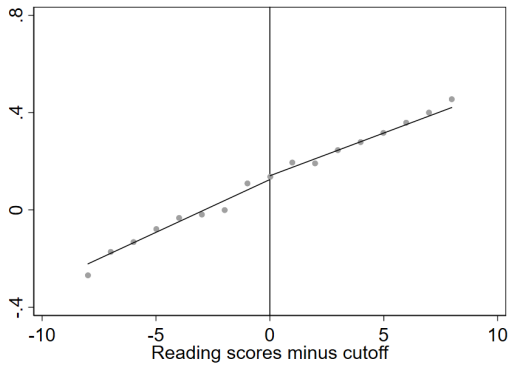
(b) Male



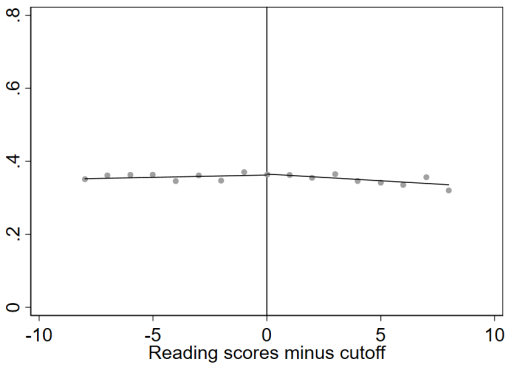
(c) White students



(d) Special Education



(e) Math Scores



(f) Limited English Proficiency

Notes: These figures show the reduced-form estimate of failing the third-attempt reading test on students' characteristics recorded before the third-attempt reading test in third grade.

Figure 1 visually illustrates the balance test by plotting baseline characteristics—such as eli-

gibility for free meals, gender, race, participation in special education, and limited English proficiency—against reading scores around the promotion cutoff. This graphical evidence confirms that these baseline characteristics are smooth across the cutoff, suggesting no systematic differences between students on either side of the threshold.

Complementing the graphical analysis, Table 2 offers statistical evidence, estimating the impact of scoring just below the cutoff on the same set of baseline characteristics prior to taking the third-attempt reading test. The results indicate that scoring below the cutoff does not significantly affect math scores, eligibility for free meals, racial composition, special education participation, or English proficiency levels. Nevertheless, there is a marginally significant effect on gender at the 10% level. To ensure robustness, the main analyses include gender as a control variable to mitigate any potential bias from this slight imbalance.

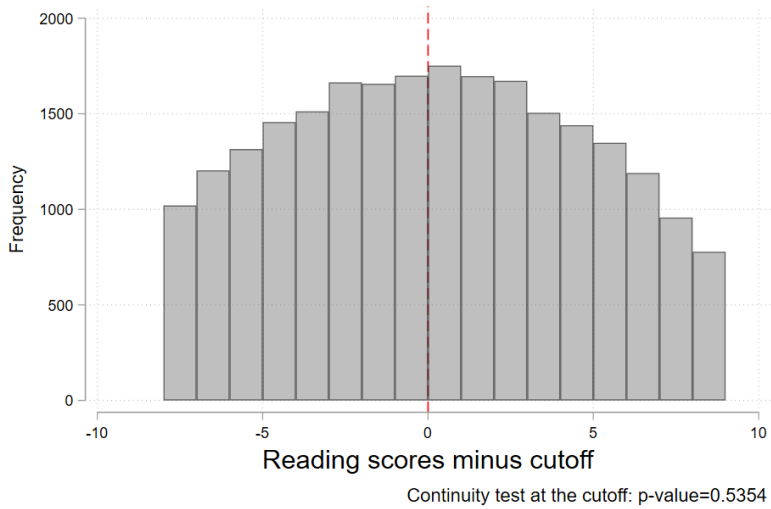
Table 2: Balance Test

Variable	(1) Free meals	(2) Male	(3) White	(4) Special Education	(5) Math Scores	(6) Limited English Proficiency
Below Cutoff	0.029	0.049	-0.016	0.003	-0.007	0.008
	(0.018)	(0.026)	(0.012)	(0.010)	(0.032)	(0.018)
Above cutoff mean	0.615	0.523	0.135	0.062	0.263	0.352
Effect size	4.72%	9.37%	-11.85%	4.84%	-2.66%	2.27%
Observations	14599	11646	17404	14536	17253	17404

Notes: This table shows the estimates of scoring below the reading scores cutoff on characteristics observed before the retention. Math scores are standardized to have zero mean and one standard deviation by cohorts.

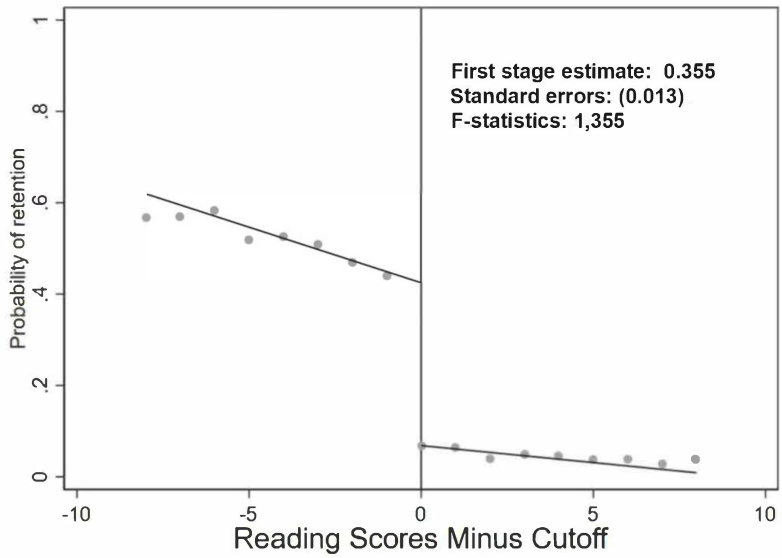
Further supporting the validity of the continuity assumption, Figure 2 shows that the distribution of the third attempt reading scores is continuous at the cutoff, with the P-value of 0.5354 from the continuity test in Cattaneo et al. (2020). Moreover, failing the third-attempt reading test significantly increases the likelihood of retention in third grade. As illustrated in Figure 3, students who score below the promotion cutoff have a 35.5 percentage points higher probability of repeating third grade, a strong relationship underscored by the F-statistic with the value of 1,355.

Figure 2: The distribution of the third-attempt reading test scores



Notes: This figure displays the distribution of the third-attempt reading test scores within a bandwidth of zero to eight points to the cutoff. This is the maximum bandwidth from all regression in the main results. The P-values of the continuity test come from the method in Cattaneo et al. (2020).

Figure 3: Failing the third-attempt reading test increases the probability of third-grade retention



Notes: This figure displays the likelihood of repeating grade three as a function of the third-attempt reading scores subtracting the promotion cutoff. The bandwidth is eight points to the cutoff, which is the maximum bandwidth from all the regressions in the main results. Each regression controls for gender, eligibility for free meals, and cohort fixed effect.

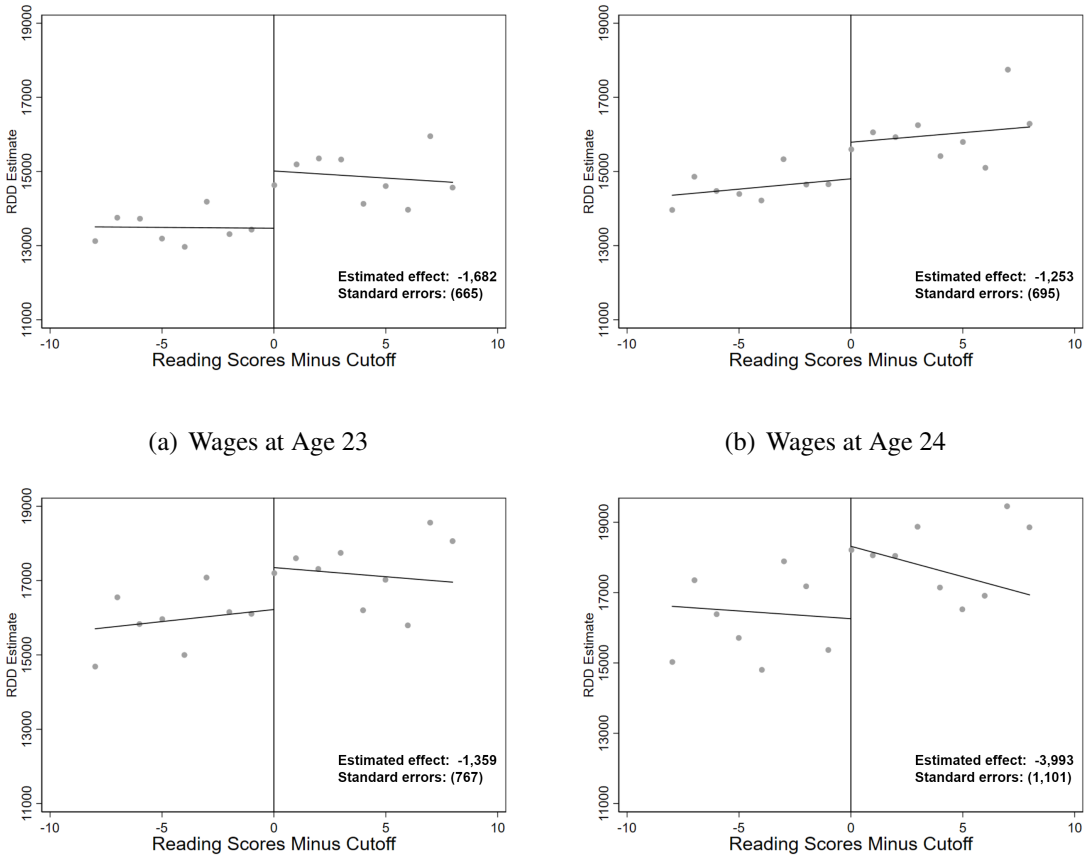
5 Results

5.1 Effects on Earnings Outcomes

Failing the third-attempt reading test reduces adult earnings. Figure 4 visually demonstrates this decline, showing notable earnings reductions for individuals below the cutoff at each age from 23 to 26. Table 3 shows the reduced form estimates of failing the third-attempt reading test on earnings outcomes. The reduced form estimates can be obtained through θ_1 by replacing "Retention" on the left of the equation (1) with earnings outcomes. Specifically, students who barely fail the third-attempt reading test earn $1,682 less at age 23 compared to those who barely pass the test. This negative impact persists, with reductions of $1,253 and $1,359 in earnings at ages 24 and 25, respectively. These effect sizes at ages 24 and 25 are slightly smaller than that at age 23. This disparity is likely because the wages at these ages for the 2002-2003 and 2003-2004 cohorts were earned in 2020, a year of heightened unemployment due to the COVID-19 pandemic.[4]The pandemic's impact on the job market appears to have moderated the wage differences between those who barely failed and those who passed the test. However, the adverse effect intensifies at age 26, although these findings are less precise due to incomplete wage data at age 26 for the third-graders of 2004-2005. Despite variations observed in earnings at a single age, the adverse effects of failing the third-attempt reading test on the average earnings during these ages are statistically significant and stable. Specifically, scoring below the cutoff reduces average earnings between ages 23 to 25 and ages 23 to 26 by $1,468 (9.30%) and $1,560 (9.48%), respectively. Both effects are statistically significant at the 5% level. Figure 5 provides graphical evidence for the effect of scoring below the reading test on the average earnings between ages 23 and 25.

[4]Appendix Table A1 shows the corresponding calendar year for earnings at each age by cohort. The 2002-2003 and 2003-2004 cohorts obtain their wages at age 25 and 24 in the year 2020, respectively.

Figure 4: Failing the 3^{rd} Reading Test Reduces Annual Earnings at Each Age from 23 to 26



(a) Wages at Age 23

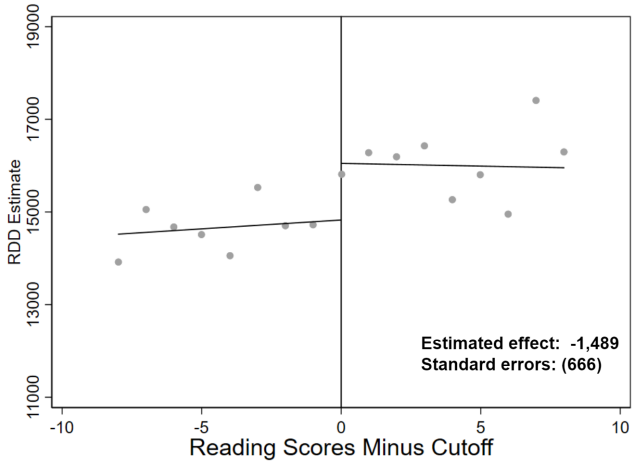
(b) Wages at Age 24

(c) Wages at Age 25

(d) Wages at Age 26

Notes: This figure shows the reduced-form estimated effects of failing the third-attempt reading test on earnings at each age from 23 to 26 after controlling for gender, free meals, and cohort fixed effect. These estimates are derived by substituting "Retention" with earnings outcomes in equation (1), identified by θ_1. The dots are cell means, and the lines are fitted using a first-order polynomial regression and triangular weight. The bandwidth is eight points to the cutoff.

Figure 5: Failing the 3^{rd} Reading Test Reduces Average Earnings between Ages 23 and 25



Notes: This figure shows the reduced-form estimated effects of failing the third-attempt reading test on the average earnings between ages 23 to 25 after controlling for gender, free meals, and cohort fixed effect. The dots are cell means and the lines are fitted using a first-order polynomial regression and triangular weight. The bandwidth is eight points to the cutoff.

Table 3: Effect of Failing the Reading Test on Earnings between Ages 23 and 26

	(1)	(2)	(3)	(4)	(5)	(6)
	Annual Earnings at Each Age from 23 to 26				Average Earnings	
	Age23	Age24	Age25	Age26	Ages23-25	Ages23-26
Below cutoff	-1,682	-1,253	-1,359	-3,993	-1,489	-1,560
	(665)	(695)	(767)	(1101)	(666)	(677)
Above cutoff mean	14,864	15,948	17,226	17,950	16,011	16,454
Effect size	-11.32%	-7.86%	-7.89%	-22.25%	-9.30%	-9.48%
Observations	14509	14507	14468	7750	14509	14509

Notes: This table displays the reduced form estimates, obtained by replacing Retention on the left of equation (1) with earnings outcomes, of the effect of failing the third-attempt reading test on annual earnings at each age from 23 to 26 and the average earnings between 23 to 25 and 23 to 26. The sample includes the 2002-03 to 2004-05 cohorts of first-time third-grade students who took the third-attempt reading test. The "Above cutoff mean" indicates the average earnings outcome for students whose reading scores are zero to eight points above the cutoff.

Next, I employ the fuzzy RDD to estimate the impacts of retention in the third grade on earnings outcomes. Holding low-achieving students back in third grade for one more year reduces adult earnings. The results come from Table 4, demonstrating that retention in third grade substantially decreases annual earnings at each age from 23 to 26. Particularly, it decreases earnings at age 23 by \$4,325. The adverse effects persist at ages 24 (-\$2,942) and 25 (-\$3,198), though their magnitudes

Table 4: Effect of Third-Grade Retention on Earnings between Ages 23 and 26

	(1)	(2)	(3)	(4)	(5)	(6)
	Annual Earnings at Each Age from 23 to 26				Average Earnings	
	Age23	Age24	Age25	Age26	Ages23-25	Ages23-26
Retention	-4,324	-2,942	-3,198	-6,869	-3,512	-3,653
	(1,535)	(1,583)	(1,758)	(2,534)	(1,472)	(1,485)
Above cutoff mean	14,864	15,948	17,226	17,950	16,011	16,454
Effect size	-29.09%	-18.45%	-18.56%	-38.27%	-21.93%	-22.20%
Observations	19784	19782	19731	11728	19784	19784

Notes: This table displays the fuzzy RDD estimate of the effect of third-grade retention on annual earnings at each age from 23 to 26 and the average earnings between 23 to 25 and 23 to 26. The sample includes the 2002-03 to 2004-05 cohorts of first-time third-grade students who took the third-attempt reading test. The earnings data comes from the Texas Workforce Commission(TWC), which covers quarterly wages from employment in Texas. Zero positive earnings in the dataset could indicate either unemployment within Texas or unobserved wages from employment outside the state. The "Above cutoff mean" indicates the average earnings outcome of students whose reading scores are zero to eight points above the cutoff. The bandwidth for each outcome is determined by minimizing the mean squared error, following the approach outlined in Calonico et al. (2017). Variations in bandwidth across outcomes account for differences in observations.

are slightly attenuated. The adverse impact becomes more pronounced at age 26, leading to a decrease in annual wages by $6,869. However, the precision of this estimate is compromised by incomplete wage data for the 2004-2005 third-grade cohort at this age. To address this limitation, Table A6 presents a robustness check with the 2002-2003 and 2003-2004 cohorts, which are not affected by these data issues. For these cohorts, the estimated reduction in annual wages at age 26 is $5,597. While slightly smaller, this effect is more precise and statistically significant at the 5% level.

Despite minor annual variations, similar negative effects are observed on the average earnings. Specifically, retention results in an average earnings decline between ages 23 and 25 by $3,512, representing a 22% reduction relative to the mean, $16,011, of those whose reading scores are zero to eight points above the cutoff .[5]This effect closely aligns with the $3,653 decreases in the average earnings observed between ages 23 to 26.

Table 5 further shows that third-grade retention has no effect on earning positive income at all ages from 23 to 26. Nor does it impact the probability of having positive earnings at each age

[5]From now on, above cutoff mean has the same meaning as control group mean, indicating the mean of those whose reading scores are zero to eight points above the cutoff.

Table 5: Effect of Grade Retention on Having Positive Earnings by Age

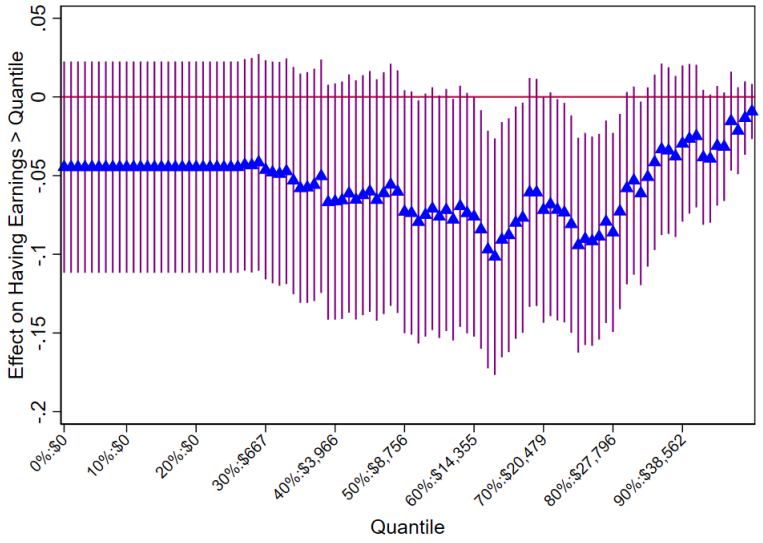
	(1) Age 23	(2) Age 24	(3) Age 25	(4) Age 26	(5) All ages 23-26
Having positive wages	-0.111	-0.013	-0.066	-0.062	-0.025
	(0.042)	(0.043)	(0.042)	(0.064)	(0.037)
Above cutoff mean	0.68	0.67	0.66	0.65	0.37
Effect size	-16.32%	-1.94%	-10.00%	-9.54%	-6.76%
Observations	19784	19782	19731	11728	22070

Notes: This table displays the fuzzy RDD estimate of the effect of third-grade retention on having positive earnings at each age from 23 to 26 and all ages during this period. The sample includes the 2002-03 to 2004-05 cohorts of first-time third-grade students who took the third-attempt reading test. The earnings data comes from the Texas Workforce Commission(TWC), which covers quarterly wages from employment in Texas. Zero positive earnings in the dataset could indicate either unemployment within Texas or unobserved wages from employment outside the state.

from 24 to 26. However, retention reduces the likelihood of having a positive income at age 23 by 11.1 percentage points, representing a 16.32% decrease compared to the mean of 68% among students slightly above the cutoff. This specific reduction in earnings at age 23 could suggest that retained students complete college later than their promoted peers, potentially affecting their early earnings. However, the point estimate provided in the subsequent section demonstrates that third-grade retention does not influence the timing of college completion. This finding confirms that differences in the timing of completing college are not the cause of the observed earnings reduction at age 23.

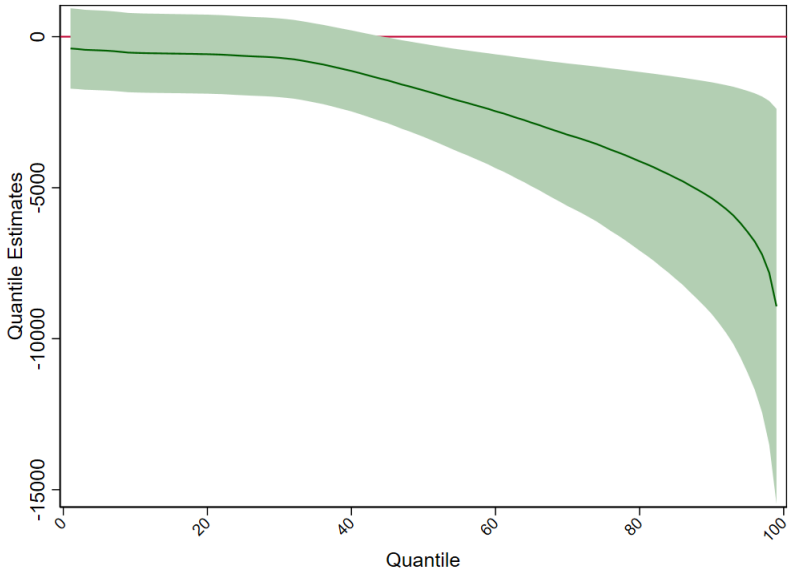
To further understand how retention in third grade reduces adult earnings, I investigate the distributional effects of third-grade retention on earnings outcomes. Figure 6 depicts how third-grade retention affects the likelihood of earning more than each percentile from zero to ninety-nine of the average earnings between ages 23 and 25. This graphical analysis indicates that third-grade retention does not significantly decrease the probability of earning low income. Instead, it notably reduces the likelihood of attaining incomes at the higher percentiles. Further, the quantile regression results, illustrated in Figure 7, reinforce that the adverse impact of third-grade retention on earnings intensifies at higher income levels rather than at the entry level.

Figure 6: The Effects of Retention on the Average Earnings between Ages 23-25



Notes: This figure displays the impacts of third-grade retention on the likelihood of earning more than each percentile from zero to ninety-nine of the average earnings between ages 23 and 25. The blue triangles are the estimate of the effect of third-grade retention on the likelihood of earning more than each percentile. The purple lines represent the 95 confidence interval.

Figure 7: The Quantile Regression Estimate of Retention's Effect on Earnings Outcomes



Notes: This figure displays the quantile regression estimated effects of third-grade retention on the average earnings between ages 23 and 25. The green solid line indicates the estimates of the quantile regression of the effect of retention on earnings. The green saddle represents the 95 confidence interval.

5.2 Effects on Educational Attainment

Third-grade retention shows no significant effects on overall college enrollment outcomes. Table 6 examines the effect of third-grade retention on the likelihood of ever enrolling in any college from 2010 through 2021 and on enrolling in college on time (by the ninth year after grade three). Column (1) indicates that third-grade retention leads to a negligible and statistically insignificant increase in overall college enrollment by 1.6 percentage points, a 3.95% rise compared to the 40.5% baseline enrollment rate among students slightly above the cutoff.

Further analysis shows that retention in third grade does not disproportionately impact the selectivity of college attended. Third-grade retention leads to a small increase in the likelihood of enrolling in Texas community colleges (1.5 percentage points or a 4.31% increase) but a small decline in the probability of enrolling in Texas public universities (-1.4 percentage points or a 15.05% decline). Both estimates, however, lack statistical significance at the 10% level. Additionally, retention in third grade results in an increase of out-of-Texas college enrollment by 0.9 percentage points, a 75% increase relative to the above cutoff mean of 1.2%, though this estimate also fails to reach statistical significance.

Additionally, third-grade retention appears to have no impact on on-time college enrollment. Column (2) reveals negative and statistically insignificant effects on on-time enrollment across different types of institutions: a reduction of 10 percentage points (-27.93%) for any college, 9.6 percentage points (-27.75%) for community colleges in Texas, and 9 percentage points (-43.27%) for public universities in Texas. Conversely, there is a positive but statistically insignificant increase of 48.1 percentage points (858.93%) for on-time enrollment in colleges outside Texas, relative to a very small baseline rate of 0.056 among students who barely pass the promotion cutoff.

Third-grade retention also has no detectable effects on overall college graduation outcomes in Texas. As shown in Panel A of Table 7, retention in third grade leads to 1.7 percentage points or a 16.04% increase in the likelihood of graduating from any college in Texas, but the estimate is not statistically significant.[6]Notably, this positive effect is primarily observed in community colleges

[6]Any college graduation is defined as graduating from any college or university in Texas from 2010 to 2021 due

Table 6: Effect of Retention on College Enrollment and Timing

	(1) Ever enrolled	(2) On-time enrollment: by the 9^{th} year after grade 3
Any College	0.016	-0.100
	(0.041)	(0.071)
Above cutoff mean	0.405	0.358
Effect size	3.95%	-27.93%
Observations	19909	7435
Community College in Texas	0.015	-0.096
	(0.041)	(0.083)
Above cutoff mean	0.348	0.346
Effect size	4.31%	-27.75%
Observations	19909	5554
Public University in Texas	-0.014	-0.090
	(0.022)	(0.155)
Above cutoff mean	0.093	0.208
Effect size	-15.05%	-43.27%
Observations	22070	1514
College Outside Texas	0.009	0.481
	(0.009)	(0.476)
Above cutoff mean	0.012	0.056
Effect size	75%	858.93%
Observations	22070	192

Notes: This table shows the fuzzy RDD estimates of the effects of third-grade retention on ever and on-time college enrollment. The ever college enrollment indicates enrollment in any college at any point between 2010 and 2021. The college outcome data come from the Texas Higher Education Coordinating Board (THECB) and the National Student Clearinghouse (NSC).

in Texas. Conversely, retention results in 0.3 percentage points or a 6.52% decline in the likelihood of graduating from public universities in Texas. The estimate is not statistically significant at the conventional level.

Moreover, third-grade retention does not affect on-time college graduation. The results in panel B indicate that the point estimate of the effect of retention on on-time (by age 22) graduation from any college is positive but negligible and statistically insignificant. Analysis based on the college type reveals that retention leads to an increase of 0.8 percentage points (28.57%) in on-time community college graduation (by age 20) but a decline of 0.9 percentage points (-31.25%) in on-time public university graduation (by age 22). Both estimates are not statistically significant

to lacking graduation information in NSC files for colleges outside Texas.

at the 10% level. These observed null effects on the overall college enrollment and graduation outcomes can be attributed to the lower baseline educational performance and subsequent lower college enrollment rates of retained students compared to their promoted peers.

Table 7: Effect of Retention on College Graduation and Timing

	(1) Texas college	(2) Community	(3) Public	(4) Health	(5) Private
Panel A: Ever graduated					
Retention	0.017	0.010	-0.003	0.002	0.004
	(0.025)	(0.022)	(0.015)	(0.002)	(0.004)
Above cutoff mean	0.106	0.076	0.046	0.001	0.005
Effect size	16.04%	13.16%	-6.52%	200%	80%
Observations	19909	19909	19909	19909	22070
Panel B: On-time graduation					
Retention	0.003	0.008	-0.009	0.002	-0.000
	(0.020)	(0.014)	(0.011)	(0.002)	(0.004)
Above cutoff mean	0.067	0.028	0.0288	0.0002	0.003
Effect size	4.48%	28.57%	-31.25%	1000%	-0%
Observations	19909	19909	19909	17404	22070

Notes: This table presents the fuzzy RDD estimates of the effects of third-grade retention on ever graduating and on-time graduation from colleges or universities in Texas. On-time graduation from any college is defined as graduating by age 22. For public universities, on-time graduation is also by age 22, while for community and other colleges, it is by age 20. The Texas Higher Education Coordinating Board (THECB) has not had graduation information for career institutions in Texas since 2010. Additionally, the National Student Clearinghouse (NSC) files located at the Texas ERC do not cover graduation information from 2011 and 2016.

Building on the results for college enrollment and graduation, the following analysis explores the impact of third-grade retention on dropout and high school graduation rates. Notably, in the 2005-06 school year, Texas adopted the National Center for Education Statistics (NCES) definition of a dropout. According to this definition, a dropout is a student from grades 7-12 who does not return to public school the following fall, is not expelled, does not graduate, does not receive a GED, does not continue schooling outside the public system, does not start college, and does not die. The study categorizes any student who leaves a Texas public school from 2004 through 2018 under this criterion as having ever dropped out. Moreover, high school graduation is defined as attaining a diploma within an eight-year period post-grade nine (2009 through 2022), excluding

those who only receive a GED.

Table 8: Effect of Grade Retention on Dropout and High School Graduation Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		High School Graduation					
	Ever dropout	Ever graduated	On time	1+ years	2+ years	3+ years	4+ years
Retention	0.021	-0.091	-0.505	0.505	0.012	-0.019	-0.015
	(0.033)	(0.043)	(0.045)	(0.046)	(0.023)	(0.010)	(0.006)
Above cutoff mean	0.150	0.642	0.712	0.288	0.032	0.008	0.005
Effect size	14.00%	-14.17%	-70.93%	175.35%	37.50%	-237.50%	-300.00%
Observations	19909	19909	12218	12218	12218	13548	12218

Notes: This table presents the effects of third-grade retention on dropout and high school graduation outcomes. A dropout is a student from grades 7-12 who does not return to public school the following fall, is not expelled, and does not graduate, receive a GED, continue schooling outside the public system, start college, or pass away. Ever high school graduation is defined as attaining a high school diploma within at least an eight-year period starting from the ninth grade or any time between 2009 and 2022. Notable, high school graduation does not include students who obtain general educational development (GED) certification. Column(3) shows the effect of retention on graduating from high school on time (by the ninth year following grade three), conditional on graduating from high school at any time between 2009 and 2022. Columns (4) to (7) measure the impacts of third-grade retention on graduating from high school 1+, 2+, 3+, and 4+ years later relative to on-time graduation, conditional on graduating from high school any time between 2009 and 2022.

Table 8 presents the detailed impacts of third-grade retention on dropout and high school graduation outcomes. Column (1) shows that third-grade retention increases the probability of ever dropping out by 2.1 percentage points—a 14% increase relative to the average for students just above the cutoff, though this effect is not statistically significant at the 10% level. Additionally, column (2) of Table 8 reveals that third-grade retention significantly reduces the likelihood of graduating from high school by 9.1 percentage points, a 14.17% decrease relative to their peers just above the cutoff, with this effect being statistically significant at the 5% level. Column (3) indicates a 50.5 percentage points decrease in on-time high school graduation by the ninth year post-grade three, equating to a 70.93% reduction relative to the above cutoff mean and statistically significant at the 1% level. Notably, most retained students still manage to graduate within a year of their expected graduation date, as shown in column (4). Further, results in columns (5) to (7) confirm that retention does not extend the time to high school graduation by two or more years.

These differing impacts of third-grade retention on dropout and graduation rates are influenced by several factors. Firstly, the minimal effect on dropout rates may be attributed to Texas's high

legal dropout age, which mandates students to stay in school until they graduate or reach 19, although exceptions are made for 17-year-olds enrolled in high school equivalency courses with parental consent. Secondly, students leaving the public school system for reasons such as obtaining a GED, or continuing education in private, home, or out-of-state schools are neither classified as dropouts nor graduates, thereby widening the gap between dropout and graduation rates.

5.3 Effects on Short-Term Outcomes

In this section, I investigate the impacts of third-grade retention on intermediate outcomes, including test scores and behavioral outcomes, and track these impacts in the subsequent years following grade three. I begin with estimating the impacts on test scores. Estimating the causal effects of retention on test scores presents challenges due to the different tests post-grade three administered to retained students and their promoted peers. To address this, I analyze the impacts of third-grade retention on the reading and math scores administered within the same academic year or the same grade level after the third grade.

While third-grade retention initially increases test scores, this improvement fades out gradually. Figure 8 shows the impact of third-grade retention on the reading scale scores from the first to the fifth year after third grade.[7]The test scores are standardized to have a mean of zero and a standard deviation of one by cohort and the test year. The results indicate that while retention initially boosts reading scores, this advantage diminishes by the fifth year. A similar trend is observed in the standardized mathematics scores, with initial improvements fading in the subsequent years.

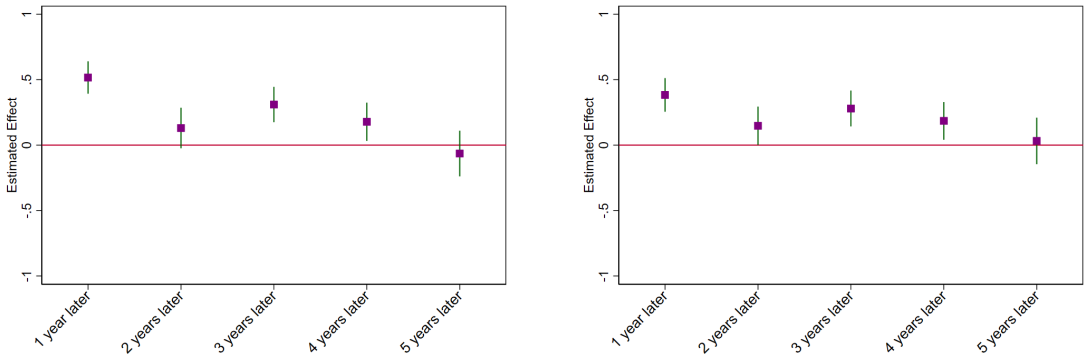
The results depicted in Figure 9, which trace the impact of retention on test scores across subsequent grades, corroborate that the initial gain of third-grade retention on test scores is transient.[8]Although retention appears to enhance reading and math scores in the fourth grade, these gains are not sustained, dissipating by the eighth grade. This finding aligns with Schwerdt et al. (2017), who document similar fading effects of third-grade retention policy in Florida on test

[7]The effects of retention on raw test scores by year are shown in Appendix Figure A1.
[8]The effect of retention on raw scores by grades is available in Appendix Figure A2.

scores. Literature on other human capital development topics also finds the existence of fade out of test score gains.

The initial improvements in test scores lead to a lower likelihood of repeating a later grade post-grade three, where reading and math scores are important criteria in retention decisions in later grades. The results in Table 9 show that reduction is particularly notable in grades four, five, eight, and nine. Mirroring the test score fade-out pattern, the effect of third-grade retention on the likelihood of retention post-grade three diminishes and even becomes positive by grade ten.

Figure 8: Effects of Grade Retention on Test Scores by Years

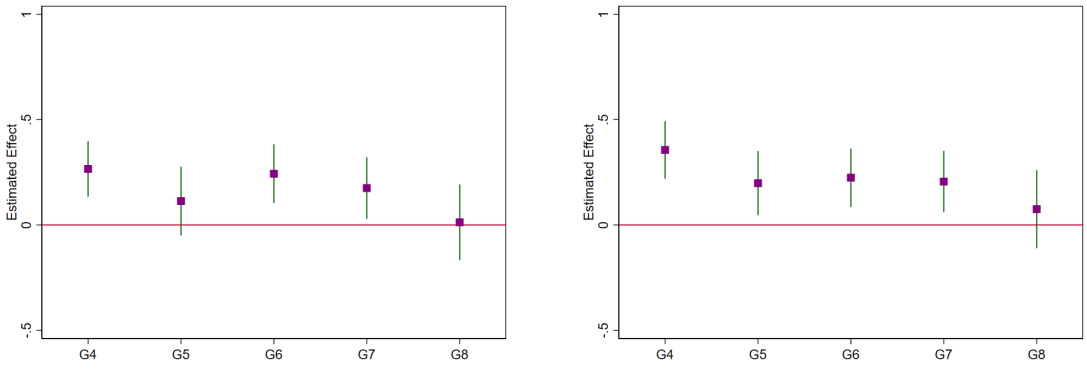


(a) Reading Scores

(b) Math Scores

Notes: These figures display the effects of third-grade retention on reading and math scale scores from the first to the fifth year after grade three. The scale score quantifies a student's performance relative to the passing standards or proficiency levels, allowing direct comparisons of student performance between specific sets of test questions from different test administrations. The scale score is further standardized with a zero mean and one standard deviation by subject-year-cohort.

Figure 9: Effects of Grade Retention on Test Scores by Grades



(a) Reading Scores

(b) Math Scores

Notes: These figures display the effects of third-grade retention on reading and math scale scores from the fourth through the eighth grade. The scale score quantifies a student's performance relative to the passing standards or proficiency levels, allowing direct comparisons of student performance between specific sets of test questions from different test administrations. The scale score is further standardized with zero mean and one standard deviation by subject-grade-cohort.

Table 9: Effect of Third-Grade Retention on Retention in Later Grades

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Retention in Each Grade Post-Grade Three								
	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11	Grade 12
Third-grade Retention	-0.124	-0.206	-0.012	-0.019	-0.042	-0.064	0.040	-0.009	-0.015
	(0.022)	(0.025)	(0.012)	(0.012)	(0.013)	(0.030)	(0.021)	(0.015)	(0.013)
Above cutoff mean	0.075	0.125	0.020	0.024	0.029	0.140	0.050	0.030	0.028
Effect size	-165.33%	-164.8%	-60%	-79.17%	-144.83%	-45.71%	80%	-30%	-53.57%
Observations	37201	37201	37201	37201	37201	37201	37201	37201	37201

Notes: This table provides fuzzy RDD estimates of the impact of third-grade retention on the frequency of grade retention beyond third grade. Column (1) illustrates the effect of third-grade retention on the total instances of retention after third grade. Columns (2) and subsequent detail the impact on the likelihood of repeating each subsequent grade.

However, the initial gain in test scores does not necessarily lead to improvements in long-term educational outcomes. As shown in Appendix Table A7, the analysis of the predictive effects of reading scores from the first to the fifth year post-grade three on high school graduation rates indicates that scores from the initial three years post-grade three do not predict high school graduation outcomes. In contrast, reading scores from the fourth and fifth years post-grade three positively correlate with high school graduation. However, the improvement in reading scores due to repeat-

ing third grade becomes smaller or statistically insignificant during these years. These findings reveal that the fade-out gain in test scores does not lead to improvements in long-term educational outcomes, underscoring the importance of estimating the effect of retention on the outcomes beyond test scores.

Table 10: Total and Average Incidents of Behavior Outcomes 1-9 Years Post-grade 3

	(1)	**(2)**	**(3)**	**(4)**
	Outcome not Scaled		Outcome Scaled by the Mean	
	Total	Average	Total	Average
Panel A: Effects on school absence				
Days absent	6.907	1.330	0.860	0.150
	(5.909)	(0.713)	(0.583)	(0.074)
Mean: above cutoff 0-8 points	79.187	9.395	7.902	0.955
Effect size	8.72%	14.16%	10.88%	15.71%
Observations	17404	17164	17404	17164
Panel B: Effects on Violent Behaviors				
Violence	0.598	0.066	6.714	0.746
	(0.184)	(0.020)	(2.116)	(0.235)
Mean: above cutoff 0-8 points	0.907	0.085	9.443	0.881
Effect size	65.93%	77.65%	71.10%	84.68%
Observations	17404	17404	17404	17404
Panel C: Effects on Crime				
Crime	0.237	0.026	7.268	0.808
	(0.113)	(0.013)	(4.157)	(0.462)
Mean: above cutoff 0-8 points	0.375	0.038	8.946	0.913
Effect size	63.20%	68.42%	81.24%	88.50%
Observations	17404	17404	17404	17404

Notes: This table displays the fuzzy RDD estimate of the effect of third-grade retention on total and average incidents of school absence, violence, and crime from one to nine years following grade three. Columns (3) and (4) display the results after scaling the outcome variable by the mean. Additionally, in Panel A, days absent from school are treated as missing for students who leave Texas public schools. In Panel B and C, violence and crime are coded as zero for students who leave the Texas public school.

Conversely, retaining low-achieving students in the third grade increases behavioral issues. Table 10 details the impacts of third-grade retention on various behavioral outcomes, including school absences, violent incidents, and criminal behaviors. Specifically, Panel A shows that retention in third grade leads to an increase of 6.9 days in total days of school absences over the subsequent one

to nine years following grade three, although this effect is not statistically significant at the 10% confidence level. There is, however, a marginally significant increase of 1.3 days in average school absences during this period, at the 10% confidence level. Further analysis, as depicted in columns (1) to (2) of Appendix Table A19, reveals that retention increases school absences in the first two years post-grade three by 1.4 and 1.5 days, respectively, at the 5% and 1% confidence levels. These effect sizes are 25% and 26% increase compared to the mean of students with reading scores zero to eight points above the cutoff.

Moreover, third-grade retention increases violent behavior, which is classified as the behavior listed in Table A4. Panel B outlines that retention increases the total number of violent incidents from the first through the ninth year following grade three by 0.598 and the average number of violent behaviors during this period by 0.066. Both effects are statistically significant at the 1% confidence level, representing a 66% and 78% increase relative to the mean among students slightly above the cutoff. Moreover, the result in column (1) of Appendix Table A19 indicates that retention in third grade increases violent behaviors in the first year post-grade three by 0.043. This effect is statistically significant at the 5% level, representing a 154% increase compared to the mean of 0.028 among their initial peers slightly above the promotion cutoff. The adverse effect on the number of violent behaviors committed is also observed in the fourth and fifth years following grade three, with increases of 0.159 (137%) and 0.138 (109%), respectively. Both estimates are statistically significant at the 1% confidence level.

Third-grade retention also increases severe behavior issues, such as crime listed in Table A5. Results are shown in Panel C, revealing that retention significantly increases the total incidents of crime committed within nine years post-grade three by 0.237 and the average number of crimes committed during this period by 0.026. Both estimates are statistically significant at the 5% confidence level, representing a 63% and 68% increase relative to the control group mean. Exploring the impacts following grade three annually in Appendix Table A19, I find that the adverse effect on crime is particularly pronounced in the fourth and fifth years post-grade three, though these effects are marginally significant at the 10% level. Moreover, columns (3) and (4) of Table 10 show

similar effect sizes of the adverse impacts of retention in third grade on behavioral outcomes after scaling these outcomes with the mean.

5.4 Effects on Subgroup

Research on grade retention reveals varying effects across different student backgrounds. Jacob and Lefgren (2009) indicates that the adverse effect of eighth-grade retention on dropout rates is more pronounced among African American students. Özek (2015) demonstrates that Florida's third-grade promotion policy disproportionately increases disciplinary incidents and suspensions among economically disadvantaged male students. Furthermore, Figlio and Özek (2020) find that third-grade retention in Florida enhances English proficiency for English learners more than for non-English learners. Inspired by the diverse impacts observed across student backgrounds in existing research, this study explores how third-grade retention policy impacts students across demographic groups.

I begin by analyzing the impact of failing the third-attempt reading test on retention rates in third grade. Retention rates are substantially higher among Hispanic, female, and low-income students compared to their respective counterparts. As shown in Table 11, failing the reading test increases the likelihood of retention in third grade by 40 percentage points (74%) for Hispanic students, 29.4 percentage points (59%) for Black students, and 25 percentage points (61%) for White students, with all effects being statistically significant. Moreover, these differences across racial groups are statistically significant (p-values < 0.01). Additionally, retention rates are significantly higher for female (38.4 percentage points) and low-income (39.2 percentage points) students compared to their male and higher-income counterparts, respectively.

Table 12 further examines the effects of third-grade retention on crucial outcomes, categorized by race, gender, and income levels. Third-grade retention adversely impacts adult earnings across various demographic groups. As shown in column (1) of Panel A in Table 12, the effects on average earnings between ages 23 and 25 are negative for Black (-$6,051), Hispanic (-$2,593), and White (-$3,624) students. Notably, the reduction in earnings for Black students is larger and

Table 11: Effect of Failing the Third Attempt Reading Test on Retention Rates by Subgroup

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Outcome: Retention in Third Grade							
	All	Black	Hispanic	White	Female	Male	Not Free meal	Free meal
Below cutoff	0.355	0.294	0.400	0.250	0.384	0.329	0.392	0.311
	(0.013)	(0.028)	(0.016)	(0.035)	(0.023)	(0.017)	(0.018)	(0.022)
Below cutoff mean	0.52	0.50	0.54	0.41	0.53	0.51	0.51	0.52
P-values			By race: 0.000		By gender: 0.007		By income: 0.067	
Observations	19,784	4,382	13,243	2,712	8,042	11,753	10,184	7,781

Notes: This table shows the first-stage result of failing the third attempt reading test on the likelihood of being retained in grade three overall and by demographic groups. Each regression in columns (1) through (4) controls for gender, eligibility for free school meals, and cohort fixed effects. Columns (5)-(6) control for free meals and cohort fixed effects. Columns (7)-(8) control for gender and cohort fixed effects. The bandwidths are 0–8 test-score points to the cutoff. This study uses robust standard errors, which are reported in parentheses.

reaches statistical significance at the 5% level, although the differences among racial groups are not statistically significant (p-value=0.535). Panel B of the table further illustrates that retention diminishes earnings for both genders, with women experiencing a larger negative impact of -$4,134 compared to -$3,022 for men. This effect is statistically significant at the 1% level for females, though the gender difference itself is not statistically significant. Additionally, Panel C reports the effects of retention on earnings based on family income, as measured by eligibility for free meals. The earnings for students eligible for free meals decrease by $3,120, significant at the 5% level. For those not eligible, the decrease is slightly larger at -$3,628, though it does not reach statistical significance. Despite these substantial negative impacts on earnings outcomes, third-grade retention has no detectable effects on college enrollment, as shown in column (2). Additionally, the differences in the effects on college enrollment are not statistically detectable by race, gender, and income.

However, third-grade retention reduces the likelihood of high school graduation, with effects varying across racial groups. As detailed in column (3), White students experience a pronounced decline in the likelihood of high school graduation by 43.8 percentage points, higher than the reductions for Black (17.6 percentage points) and Hispanic students (0.6 percentage points). This variation across racial groups is statistically significant (p-value=0.019). Retention also has negative and statistically significant effects on high school graduation for female (-10 percentage points) and low-income (-9.2 percentage points) students, although no significant differences are observed

by gender or family income.

Furthermore, columns (4) and (5) suggest that third-grade retention results in an increase in the likelihood of dropping out (21.3 percentage points) and attending out-of-state school (14.2 percentage points) for White students. Both effects are marginally significant at the 10% level, explaining the large negative effect observed on the likelihood of high school graduation among White students. Nevertheless, this pattern is not observed for other students. Moreover, the differences in these effects by race, gender, and income are not statistically distinguishable from zero.

Retention in third grade increases total school absences within nine years post-grade three, with Black students experiencing an additional 22 days and female students 11 days. Both effects are marginally significant at the 10% level. However, the variations in this effect across race, gender, and income groups are not statistically significant. Furthermore, the impact of retention on total criminal offenses committed within the same period does not differ significantly across demographic groups.

Table 12: Effect of Third-Grade Retention on Various Outcomes by Demographic Group

	(1) Av.Wage2325	(2) College Enroll.	(3) HS Grad.	(4) Ever Dropout	(5) Ever Out State	(6) Absence	(7) Crime
Panel A: By Race							
Black	-6,051	-0.087	-0.176	0.007	-0.017	22.189	0.037
	(2,648)	(0.090)	(0.091)	(0.069)	(0.035)	(12.123)	(0.210)
Observations	5574	5620	5620	5620	5620	5620	5620
Hispanic	-2,593	0.020	-0.006	-0.010	0.022	-1.726	0.135
	(1,607)	(0.044)	(0.044)	(0.034)	(0.024)	(5.765)	(0.117)
Observations	13243	13315	13315	13315	13315	13315	13315
White	-3,624	0.195	-0.438	0.213	0.142	18.298	0.103
	(6,850)	(0.157)	(0.170)	(0.109)	(0.083)	(20.911)	(0.251)
P-value for equal effects	0.535	0.266	0.019	0.180	0.195	0.168	0.921
Observations	2712	2727	2727	2727	2727	2727	2727
Panel B: By Gender							
Male	-3,022	0.001	-0.074	0.007	0.047	1.232	0.126
	(2,327)	(0.056)	(0.057)	(0.044)	(0.029)	(7.619)	(0.169)
Observations	11753	11827	11827	11827	11827	11827	11827
Female	-4,134	0.013	-0.100	0.035	-0.000	11.305	0.122
	(1,416)	(0.052)	(0.052)	(0.038)	(0.025)	(6.724)	(0.081)
P-value for equal effects	0.662	0.869	0.728	0.632	0.217	0.316	0.996
Observations	10184	10243	10243	10243	10243	10243	10243
Panel C: By Free Meal							
Free	-3,120	0.011	-0.092	0.040	0.026	7.880	0.116
	(1,580)	(0.045)	(0.047)	(0.036)	(0.023)	(6.185)	(0.114)
Observations	13883	13971	13971	13971	13971	13971	13971
Not Free	-3,628	0.014	-0.059	-0.026	0.019	-0.142	0.145
	(2,674)	(0.071)	(0.069)	(0.049)	(0.034)	(8.810)	(0.170)
P-value for equal effects	0.901	0.971	0.670	0.267	0.866	0.437	0.878
Observations	8054	8099	8099	8099	8099	8099	8099

Notes: This table displays the fuzzy RDD estimates of the effects of third-grade retention on students' outcomes by demographic groups. The sample includes the 2002-03 to 2004-05 cohorts of first-time third-grade students who took the third-attempt reading test. All the regressions control for cohort fixed effects.

6 Robustness Checks

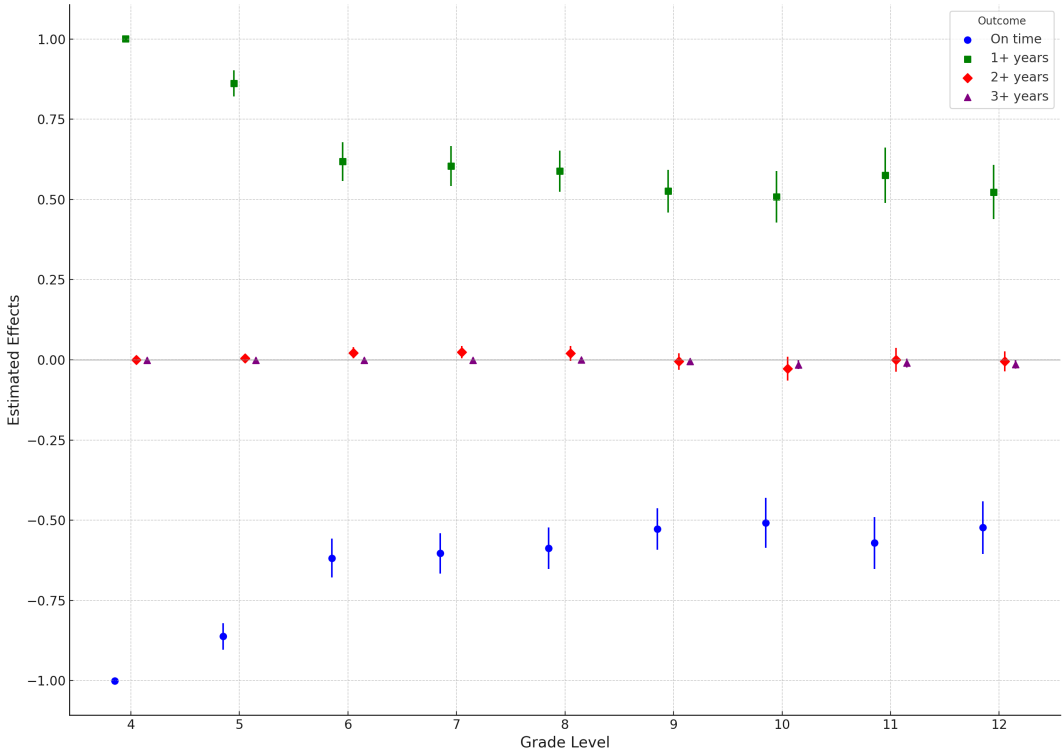
6.1 Timing Analyses

Holding students back in third grade for one more year naturally delays educational progression in the subsequent grades, raising concerns about its potential impact on the estimates of retention's effects on educational and labor market outcomes. To address this, I analyze the effects of third-grade retention on the likelihood of timely progression to each subsequent grade from four through twelve. The graphical results in Figure 10 indicate that repeating third grade indeed reduces the likelihood of progressing to grades 4-12 on time relative to their initially promoted peers, with this negative effect diminishing and stabilizing at a reduction of about 50 percentage points from grade nine onwards. Despite these initial delays, repeating third grade does not postpone progression to subsequent grades by two or more years beyond the expected schedule. Further details are provided in Appendix Table A10.

Similarly, although retention initially reduces the on-time high school graduation rate, as detailed in Table 8, this timing disparity narrows by the following year, around age 18. Additionally, the high school graduation data span at least eight years after grade nine, ensuring comprehensive coverage of graduation records for analysis and mitigating any potential impacts from timing disparities. Moreover, retention is unlikely to bias the estimate of the effect of retention on earnings outcomes by keeping students in high school up to age 23.

Additional findings from Table 6 and Table 7 indicate that retention in third grade does not affect the likelihood of ever and on-time college enrollment and graduation. Neither does it affect the status of being enrolled in a college at each age from 18 to 26, as revealed in Table A9. Furthermore, among students who scored within eight points of the promotion cutoff, only 37% enrolled in any form of college. Of these, 32% (out of 37%) attended community college—a typically two-year program. These students are expected to complete community college by age 20. These findings suggest that any negative impact on earnings is unlikely due to prolonged enrollment in post-secondary education.

Figure 10: Effects of Retention on Timing of Reaching Each Grade



Notes: This figure displays the impacts of third-grade retention on the likelihood of reaching each grade from four to twelve on time, 1+, 2+, 3+, and 4+ more years relative to the expected time.

Notably, no evidence indicates that retention delays the entry into the labor market. Instead, retained students might enter the labor market earlier than their promoted peers, as suggested by the negative and statistically insignificant effect of retention on the age at which students first earn a positive wage (-13.6 percentage points), as shown in Table 17.[9]

To further differentiate the negative effects on earnings from the potential timing discrepancies in labor market entry attributable to the extra year spent on repeating third grade, I examine the impact of third-grade retention on income earned each year from the 8^{th} to the 11^{th} years following grade nine, as well as on the average earnings across these years.[10]The results presented in Table 13 show that retention reduces the average earnings during this period by $3,460, a 23.32%

[9]Given that Texas law allows students to drop out at least 17 years old under certain conditions, I measure first positive earnings from age 18 and onward.

[10]Selecting grade nine as the baseline offers distinct advantages. Primarily, third-grade retention does not significantly influence the likelihood of attending grade nine. Secondly, in the main sample, fewer than 1.5% of third-graders fail to attend grade nine in a Texas public school compared to their initially promoted peers.

decrease relative to peers slightly above the cutoff. This reduction is consistent with the 22.20% decrease observed in average earnings between ages 23 and 26, reinforcing the stability of retention's negative impact on earnings outcomes across different measures.

Table 13: Effect of Retention on Earnings from the 8_{th} to 11_{th} Year after Grade Nine

	(1)	(2)	(3)	(4)	(5)
	Annual Earnings from the 8^{th} to the 11^{th} Year Post-Grade Nine				Average Earnings
	Grade 9+8^{th}	Grade 9+9^{th}	Grade 9+10^{th}	Grade 9+11^{th}	Grade 9+8^{th} to 11^{th}
Retention	-2,644	-2,698	-1,963	-6,530	-3,460
	(1,486)	(1,613)	(1,700)	(1,706)	(1,443)
Above cutoff mean	13,733	14,743	15,703	15, 165	14, 836
Effect size	-19.25%	-18.30%	-12.50%	-43.06%	-23.32%
Observations	19909	19909	19909	19909	19909

Notes: This table displays the fuzzy RDD estimate of the effect of third-grade retention on Earnings from the 8^{th} to 11^{th} years following grade Nine and the average earnings during this period. The sample includes the 2002-03 to 2004-05 cohorts of first-time third-grade students who took the third-attempt reading test. The earnings data comes from the Texas Workforce Commission(TWC), which covers quarterly wages from employment in Texas. Zero positive earnings in the dataset could indicate either unemployment within Texas or unobserved wages from employment outside the state. The bandwidth for each outcome is determined by minimizing the mean squared error, following the approach outlined in Calonico et al. (2017). Variations in bandwidth across outcomes account for differences in observations.

6.2 Attrition Analyses

The Texas ERC data includes only the educational records of students enrolled in public schools. This may introduce bias in the estimated effects on educational outcomes if third-grade retention disproportionately leads to students leaving public schools and achieving higher educational attainment elsewhere. Similarly, the TWC data excludes income from students working outside Texas. If retention significantly increases the likelihood of retained students earning higher wages outside Texas, this could lead to an overestimation of the negative effects on earnings outcomes reported in this study. To address these concerns, I first analyze the attrition rates for students with third-grade reading scores slightly above and below the promotion cutoff. Subsequently, I examine the impact of third-grade retention on the likelihood of students leaving the Texas public school system and assess how these attrition issues affect the estimated impacts on high school

graduation rates and earnings outcomes.[11]

In Appendix Table A11, I compare the attrition rates among students slightly above and below the promotion cutoff. On average, students below the cutoff are more likely to leave the public school for private or home school than those above the cutoff. However, there is no statistically significant difference in attending school outside Texas, and retained students are less likely to attend college outside Texas. Since the Texas ERC data does not include high school graduation information outside the public school system, I define high school graduation attrition as leaving the public school without graduation to attend school elsewhere. It is important to note that this definition likely represents an upper limit of high school graduation attrition, as not all students who leave will obtain a high school diploma elsewhere. The results indicate that students scoring below the cutoff are more likely to leave the public school system without graduating and attend school elsewhere, with pronounced differences evident from grade ten onward, while no statistically significant differences are observed before grade nine.

Table 14: Effect of Retention on Attending School Outside the Texas Public School System

	(1) Attending Out-of-State School	(2) Attending Private or Home School
Retention	0.042	-0.003
	(0.024)	(0.025)
Above cutoff mean	0.059	0.099
Effect size	71.19%	-3.03%
Observations	17404	22070

Notes: This table presents the effects of third-grade retention on leaving Texas public school without graduation to attend private or home schools and out-of-state schools using the fuzzy RDD method. Out-of-State School indicates as ever continuing school outside Texas between 2004 and 2018. Private or home School is defined as ever attending a private or home school between 2004 and 2018.

I further analyze whether third-grade retention disproportionately increases attrition. Table 14 presents the results of third-grade retention on enrolling in private or home schools and out-of-state schools. The results in column (1) show that third-grade retention has a positive and

[11] Attrition should not exist for college outcomes since the Texas ERC data covers nationwide college enrollment records.

marginally significant effect on the likelihood of attending schools outside Texas by 4.2 percentage points at the 10% confidence level. This effect is a 71% increase relative to the above cutoff mean of 5.9%. The subgroup analyses, shown in Table 12, suggest that this effect is particularly pronounced among White students. Conversely, column (2) demonstrates that third-grade retention has a negligible negative and statistically insignificant effect on the likelihood of attending private or home schools.

To address concerns that third-grade retention may lead students to complete their high school education outside the Texas public school system, I examine the potential impact of retention on high school graduation attrition, as shown in Appendix Table A12. The findings indicate that third-grade retention has a minimal and statistically insignificant effect on the likelihood of students leaving the public school system without graduating and enrolling in schools outside of Texas. Additionally, the results show that this effect is consistent across different grades at which students leave the public school.

Table 15: Effect of Retention on Earnings Attrition and Imputed Earnings

	(1)	(2)	(3)	(4)	(5)
	Attrition	Av.Wages at ages 23-26	Imputed Wages		
			mean	mean-one sd	mean+one sd
Retention	0.009	-3,653	-3,611	-3,627	-3,591
	(0.014)	(1,485)	(1,530)	(1,518)	(1,563)
Above cutoff mean	0.022	16,454	16,882	16,514	17,249
Effect size	40.91%	-22.20%	-21.39%	-21.96%	-20.82%
Observations	19909	19784	19784	19784	19784

Notes: This table displays the fuzzy RDD estimates of the effects of third-grade retention on earnings attrition and imputed earnings outcomes. Earnings attrition is defined as ever attending schools or colleges outside Texas and not having any wage records in the TWC data between ages 23 and 26. In columns (3) to (5), zero wage records for students ever attending educational institutions outside of Texas are replaced with three scenarios: the average positive earnings of their peers who are initially promoted and have the same reading scores, this average minus one standard deviation, and this average plus one standard deviation.

Next, I explore how the increase in the likelihood of attending school or college outside of Texas affects the estimated effects on labor market outcomes. Particularly, if third-grade retention increases the likelihood of having higher wages outside of Texas, the negative effect of retention on earnings would be overestimated. To address this issue, I estimate the impact of third-grade reten-

tion on earnings attrition and imputed earnings outcomes in Table 15. Earnings attrition, as shown in column (1) of Table 15, is defined as attending school or college outside Texas and subsequently having missing wage records for all ages from 23 through 26 in the Texas Workforce Commission (TWC) data. The results indicate that third-grade retention has a negligible and insignificant impact on the likelihood of attending out-of-state educational institutions and having zero wages in Texas during the specified ages.

To further refine the analysis, columns (3) to (5) of Table 15 incorporate imputed earnings for those who attended schools or colleges outside Texas. Here, zero wage records are replaced with three scenarios: the average positive earnings of peers who are initially promoted and have the same reading scores, this average minus one standard deviation, and this average plus one standard deviation. The results from these imputed earnings scenarios align closely with those observed without imputation, as detailed in column (2). These consistent findings, alongside the negligible effect of third-grade retention on earnings attrition, indicate that attrition does not alter the estimated impacts on earnings outcomes.

6.3 Additional Analyses

To further validate the main findings, I conduct additional robustness checks using the minimum standard cutoff from the first math test in third grade as a quasi-experimental threshold. Administered in April—two months before the third-attempt reading test and not a direct criterion for the reading test-based retention policy—this math test provides a counterfactual to assess the specificity of the retention's impact on earnings through failing the third-attempt reading test in third grade.

The reduced form estimates shown in Appendix Table A13 reveal that scoring below the math cutoff has no significant impact on earnings at each age from 23 to 26 for those marginally failing the math test. This outcome suggests that the math test threshold itself does not inherently influence earnings potential. Furthermore, fuzzy RDD estimates, which use scoring below the math cutoff as an instrument for third-grade retention, indicate retention caused by failing the math cutoff

does not lead to statistically significant changes in earnings outcomes. These results reinforce the conclusion that the negative earnings impacts are specifically linked to retention resulting from failing the third-attempt reading test.

The robustness of the negative impact of retention on earnings is further corroborated by employing various identification strategies. Appendix Table A14 displays local linear regression estimates from the primary analysis along with two additional estimates from (Calonico et al., 2017): the bias-corrected and the robust estimates. All three estimations provide consistent and similar results, reinforcing the reliability of the main results regarding the detrimental effects of retention on earnings.

7 Discussion

7.1 Comparison Across Literature

The existing literature on grade retention primarily examines its intermediate-term effects, with fewer addressing long-term effects. In contrast, this study offers comprehensive estimates across a spectrum of outcomes, ranging from short-term to long-term outcomes and spanning both academic and behavioral dimensions. This section compares the findings of this study to those from prestigious research across multiple settings including Texas, Louisiana, Chicago, Florida, and the Netherlands. Appendix Table A15 summarizes these results.

This fade-out gains of test scores observed in this study align with those reported in Schwerdt et al. (2017). However, unlike the latter study which examines the combined effects of summer school and third-grade repetition in Florida, this analysis specifically isolates the impact of third-grade repetition alone. Furthermore, this study shows that third-grade retention leads to a 15% reduction in the likelihood of high school graduation—a stark contrast to the negligible effect reported by Schwerdt et al. (2017), where the adverse impact of repetition may be mitigated by the benefits of summer school (Özek, 2021). Nonetheless, similar to Schwerdt et al. (2017), neither study observes a significant effect on college enrollment.

This study finds that third-grade retention has a positive but statistically insignificant 14% increase in school dropout. This effect size closely mirrors the 16% and 11% increases reported by Eren et al. (2022) and Eren et al. (2017), respectively, under NCES dropout criteria.[12]Moreover, Jacob and Lefgren (2009) report a higher effect size, a 21% increase, on dropout, but the dropout definition is different. [13]

On behavioral outcomes, this study shows a 25% increase in days absent from school in one year after grade three compared to the 6% increase displayed in Eren et al. (2022). Moreover, this study finds a 63% increase in the likelihood of committing a crime, aligning with the 58% increase in adult violent crime noted by Eren et al. (2022), though the latter find no effect on juvenile conviction. Eren et al. (2017) estimate the net effect of summer school and the grade repetition, revealing a negligible, positive, and statistically insignificant effect on juvenile crime rates for the fourth-graders but a negative and insignificant effect for the eighth-graders.

Extending the analysis to labor market outcomes, this study demonstrates a 22% decrease in average earnings between ages 23 and 25 for students held back in third grade. This adverse effect on earnings outcomes is larger than that shown in a working paper by Meulen (2023), who report repeating the twelfth grade leads to a 9% earnings reduction at age 28 due to failing the exit exam. Notably, the larger effect size of 22% observed in this study, compared to the 9% reported by Meulen (2023), suggests that retention at an earlier grade exerts a more detrimental impact on long-term labor market outcomes than retention at a later stage.

In broader human capital development, Angrist and Krueger (1991) find that an additional year of education increases annual earnings by 7.5%. Additionally, Barr and Gibbs (2022) demonstrate that children of mothers who participated in Head Start see a 6% to 11% increase in discounted wages through age 50. Further, Chetty et al. (2011) show that a kindergarten teacher with one standard deviation higher value-added can raise a student's income at age 25 by 1.3%, and a higher-

[12]Under the NCES definition, dropout is a student who is enrolled in a school in grades 7-12, does not return to the school the following fall, is not expelled, and does not graduate, does not receive a GED, does not continue other schools, does not begin college, or does not die.

[13]The dropout takes on a value of one if the student dropped out of the Chicago public school and a value of zero if the student graduated. For the relatively small percent of students who left the CPS prior to graduating or dropping out, the authors have set this outcome to missing (Jacob and Lefgren, 2009).

quality kindergarten leads to roughly 3% higher earnings at age 27. The pronounced effect size of 22% observed in this study, compared to other educational interventions, may reflect the unique characteristics of the sample group—third graders from income- and racially-disadvantaged backgrounds with low academic performance. This group differs significantly from the more general populations examined in other studies.

7.2 Quantify the Intermediate Effects to the Reduction in Earnings

To what extent do the intermediate effects of third-grade retention on test scores, high school graduation, school absence, and criminal activity contribute to the reduction in earnings caused by retention in third grade? In this section, I provide a simple benchmark to answer this question. First, I predict the association between educational and behavioral outcomes and earnings using the data from third-graders scoring zero to eight points above the cutoff on their third-attempt reading scores. It is crucial to note that these estimated effects on earnings, while predictive, are not causal. Subsequently, these associations are applied to the causal effects of third-grade retention on intermediate outcomes to suggest how retention might reduce earnings through these channels.

The predictive model described below incorporates controls for demographic variables including gender, race, and eligibility for free meals. It also accounts for school fixed effects to control for time-invariant characteristics unique to each school. Furthermore, third-grade reading scores are included to adjust for baseline reading performance.

$$Earnings_i = \alpha + \beta_1 \text{Intermediate Outcomes}_i + \beta_2 X_i + \gamma_{\text{school}} + \theta_{\text{reading scores}} + \varepsilon_i \tag{3}$$

Where the earnings refer to the average wages between ages 23 and 25; the intermediate outcomes include reading and math scores in the 5^{th} year after grade three[14], crime, absence, and high school graduation.

Table 16 reports the results of this analysis. Columns (1) to (5) present the OLS estimates of

[14]Fifth-year scores are used because they show stronger predictive power than earlier year scores, and scores beyond this year become less precise due to data limitations.

the predicted effect of each of the intermediate variables listed on the left on the average wages earned between ages 23 and 25, separately. The results indicate that these intermediate variables are strongly associated with earnings. Column (6) shows the pooled effects of all intermediate variables on earnings, revealing that reading and math scores lose predictive power when high school graduation and behavioral outcomes are considered. Committing a juvenile crime is associated with a reduction of $1,198 in average wages, while each additional day of school absence reduces earnings by $24. High school graduation correlates with an increase in earnings of $5,385, a 33% increase compared to the mean of students slightly above the cutoff, aligning with findings from Deming (2009) and Lochner and Moretti (2004), who report increases of 27% and 42%, respectively.

Column (7) displays the causal effect of third-grade retention on these intermediate outcomes. I focus on the intermediate outcomes that have significant prediction power on earnings and those that retention has a significant effect on, including crime, absence, and high school graduation. Subsequently, column (8) estimates the contribution of third-grade retention's adverse effect on earnings through these pathways, by multiplying the predicted relationship between intermediate outcomes and earnings (column (6)) with retention's effect on these intermediate outcomes (column (7)). For example, retention in third grade reduces earnings through increased crime by $284. Similarly, third-grade retention reduces earnings through increased school absence and reduced high school graduation by $70 and $512, respectively. Finally, column (9) quantifies the these effects as a percentage of the total negative effect of retention on earnings, revealing that these pathways account for 24.7% of the overall earnings reduction.

Further analysis, employing literature-derived causal effects of intermediate outcomes on earnings rather than predicted correlations, substantiates a comparable effect size. Specifically, the analysis reveals a 39.2% reduction in earnings attributed to increased absences, heightened crime rates, and lower high school graduation rates. Results are presented in Appendix Table A16, with Panel A detailing the causal effects of retention on intermediate outcomes, Panel B displaying the causal impacts of these intermediate outcomes on earnings from literature, and Panel C demonstrat-

ing how retention indirectly affects earnings through these channels. The findings underscore that third-grade retention predominantly lowers earnings by decreasing high school graduation rates, increasing absences, and heightening criminal behavior by 6.5%, 2.7%, and 30%, respectively, according to the estimates in Panel C.

Table 16: Third-grade Retention, Intermediate Outcomes, and Earnings

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Dependent Var.: Average wages between ages 23 and 25						Retention's effect	Effect (6)x(7)	Effect size:(8)/$3,512
Reading Scores	846.030					-467.533	-0.065		
	(246.796)					(374.807)	(0.089)		
Math Scores		1361.438				574.406	0.172		
		(235.468)				(358.767)	(0.077)		
Crime			-1482.654			-1197.662	0.237	-284	-8.1%
			(157.146)			(210.688)	(0.113)		
Absence				-41.939		-23.994	2.921	-70	-2%
				(3.895)		(4.256)	(0.560)[15]		
High School Grad.					9956.185	5384.689	-0.095	-512	-14.6%
					(375.430)	(645.673)	(0.043)		
Total Effect								-866	-24.7%
Observations	10475	10442	11571	8276	11571	8208			

Notes: Columns (1) to (5) of this table display the predicted effects of the intermediate outcomes listed on the left on average wages earned between ages 23 and 25. Column (6) provides regression results for all intermediate outcomes on the earnings outcome. Column (7) shows the effect of third-grade retention on each intermediate outcome. By multiplying the coefficients from column (7) by the predicted effects in column (6), I calculate the contribution of these affected intermediate outcomes to the reduction in earnings, presented in column (8). Column (9) expresses these effect sizes as a proportion of $3,512, the total earnings reduction attributable to third-grade retention.

7.3 Other Potential Channels

7.3.1 Effect on the First Income Outcomes and Work Experience

The decrease in earnings attributed to third-grade retention is partially explained by increased school absences, criminal behavior, and a reduced likelihood of graduating high school, accounting for less than half of the total earnings decline. This section further investigates whether the first income and total work experience might also contribute to the observed reductions in adult earnings.

A working paper by Meulen (2023) demonstrates that retaining twelfth graders who fail the exit exam significantly lowers their earnings at age 28 by reducing their work experience. However, the dynamics may differ for early grade retention. Table 17 examines the impact of third-grade

retention on the age at which students earn their first positive wage, starting from age 18, their first wages, and their total years of work experience between ages 21 and 26. The results in column (1) show that third-grade retention leads to a small and statistically insignificant decline on the age at which students earn their first wages. This finding may be attributed to the reduced likelihood of repeating later grades post-grade three, as shown in Table 9, potentially narrowing gaps in subsequent educational advancement and labor market entry.

Table 17: Effect of Retention on the Age of First Wages, First Wages, and Total Work Experience

	(1) Age of First Wages	(2) First Positive Wages	(3) Total Work Experience btw Ages 21 to 26
Retention	-0.136	-1,885	-0.319
	(0.211)	(857)	(0.202)
Above cutoff mean	18.876	7,458	3.822
Effect size	-0.7%	-25.3%	-8.4%
Observations	15667	16504	19909

Notes: This table displays the fuzzy RDD estimates of the effects of third-grade retention on the age at which students earn their first positive wage, starting from age 18, their first wages, and their total years of work experience between ages 21 and 26.

Rather than delaying entry into the labor market, retention in third grade appears to adversely affect the earning potential of retained students once they enter the workforce. The results in column (2) indicate that third-grade retention decreases the first positive wages by $1,885, representing a significant 25% reduction compared to the average among students slightly above the cutoff, with statistical significance at the 5% level. Additionally, third-grade retention results in a 0.319 decline in the total years of work experience accumulated between ages 21 and 26, while the estimate is not statistically significant at the conventional level.

7.3.2 School Quality

Retention in third grade could harm long-term earnings outcomes if retained students are more likely to be assigned to schools with lower quality. To measure school quality, I use the Texas school accountability ratings. These ratings are derived from a variety of performance metrics, including state standardized test scores, graduation rates, and readiness for college, careers, and the military. Additionally, the ratings assess student achievement, school progress, and efforts to

close achievement gaps among different student groups (Texas Education Agency). Specifically, schools are categorized into six ratings: Exemplary (E), Recognized (R), Academically Acceptable (A), Academically Unacceptable (L), Not Rated: Other (X), and Not Rated: Data Integrity Issues (I). Numerical values are assigned as follows: 3 for E, 2 for R, 1 for A, and 0 for L, with X and I treated as missing.

Third-grade retention has no impact on school ratings. The results come from Table 18, showing that retention in third grade has a negative but insignificant effect on the school ratings in the fifth year after grade three and the average school ratings between 2008 and 2010. The findings indicate that the impact of third-grade retention on long-term earnings does not operate through changes in middle school quality.

Table 18: Effect of Third-Grade Retention on Middle School Ratings

	(1) School rating in the 5^{th} years after grade 3	(2) Av.School rating btw 2008-2010
Retention	-0.012	-0.009
	(0.026)	(0.021)
Above cutoff mean	1.972	1.941
Effect size	0.61%	0.46%
Observations	35757	36168

Notes: This table displays the fuzzy RDD estimate of the effect of third-grade retention on school ratings in the fifth year after grade three and the average ratings between 2008 and 2010. Schools are categorized into six ratings: Exemplary (E), Recognized (R), Academically Acceptable (A), Academically Unacceptable (L), Not Rated: Other (X), and Not Rated: Data Integrity Issues (I). Numerical values are assigned as follows: 3 for E, 2 for R, 1 for A, and 0 for L, with X and I treated as missing.

8 Conclusion

While there is ongoing debate over the policy of grade retention, its use has been increasing over the years. The literature presents mixed results; some studies indicate improvements in educational performance, such as test scores, while others highlight negative consequences, including increased dropout rates, disciplinary issues, and even criminal behavior. However, the long-term impacts of grade retention remain less explored, leaving open questions about its ultimate effects

on students.

This study contributes new insights by providing the first causal evidence of the long-term effects of grade retention on post-secondary educational attainment and labor market outcomes, specifically examining the reading test-based retention policy in Texas. This policy mandates that third graders pass a state-standardized reading test within three attempts to progress to the fourth grade. Employing a fuzzy regression discontinuity design, this study leverages a quasi-random variation at the promotion cutoff of the third-attempt reading test in third grade to determine the causal impacts on both intermediate and long-term outcomes.

The results in this study show that retention of low-achieving third graders significantly reduces their earnings between ages 23 to 25 by $3,512, marking a 22% decrease compared to their peers who barely pass the cutoff. While retention in third grade initially improves test scores, these gains quickly fade, and it exacerbates issues such as increased school absences, violence, and crime. Importantly, it also reduces the likelihood of graduating from high school by 15%, with no discernible benefits for college enrollment or graduation.

These long-term effects observed in this study differ from the findings of Schwerdt et al. (2017), which does not observe significant impacts on high school graduation. This discrepancy might be explained by the positive effects of accompanying summer school programs, which can offset the negative impacts of retention. Additionally, the sample in this study, primarily consisting of low-income and racial minority students with lower educational performance, likely faces more severe negative consequences.

The observations of test score gains fading over time and the detrimental long-term effects observed in this study are consistent with emerging research on educational interventions, which demonstrate that the fade-out improvements in test scores do not necessarily translate into long-term adult success. This body of work highlights the greater predictive power of non-cognitive skills over cognitive test scores for long-term life and career success, especially among low-achieving students. Complementing this line of literature, this study demonstrates similar fade-out improvements in test scores within the context of grade retention policies. Although grade

retention temporarily boosts test scores by reiterating the same material, it might adversely exacerbate non-cognitive deficits by imposing emotional burdens and a sense of stigma, which, in turn, increase behavioral issues and ultimately lead to poorer adult outcomes.

The findings of this study indicate that third-grade retention does not support struggling students academically; instead, it exacerbates behavioral issues and lowers educational attainment, further disadvantaging them as they transition into the labor market. The policy implications of these results are particularly relevant for students who are marginally affected by the reading test-based retention policy—typically those with lower reading performance and from disadvantaged backgrounds. The outcomes could potentially vary with different promotion cutoffs[16] or with the addition of support services such as summer school remediation in the year following retention.

[16]I find no effect of scoring below the cutoff of the first attempt reading test on earnings outcomes. This result is available as requested.

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Online Appendix for "Early Grade Retention Harms Adult Earnings" by Jiee Zhong

A Appendix

A.1 Data and Definitions for Outcome Variables

A.1.1 Texas ERC Data

The Texas Education Research Center (ERC) compiles administrative data from various sources for students in Texas public schools. The Texas ERC dataset encompasses Pre-Kindergarten to twelfth grade (PK-12) educational records from the Texas Education Agency (TEA), post-secondary outcomes from Texas institutions via the Texas Higher Education Coordinating Board (THECB), national post-secondary outcomes from the National Student Clearinghouse (NSC), and employment and earnings records from the Texas Workforce Commission (TWC). This section details each dataset's specific contributions to this study.

TEA Data (1994-2022)

The TEA provides comprehensive student-level PK-12 educational records from Texas public schools. In this study, the TEA data span from the 1994-1995 to the 2022-2023 school year. This study utilizes demographic information such as age, gender, race, limited English proficiency, free meal eligibility, special education participation, and annual school attendance. Attendance records are particularly used to identify grade retention, defined as a student repeating the same grade in the subsequent year. Absenteeism data is also used to assess the impact of retention on school absences. The dataset further includes high school graduation statuses and other exit information, such as dropout rates, private or home school attendance, out-of-state schooling, expulsions, or death.

The TEA provides student-level test scores from the Texas Assessment of Knowledge and Skills (TAKS), which was administered annually from 2002-2003 to 2011-2012. This study analyzes the effects of third-grade retention on reading and math test scores for students from third

to eighth grade, or one to five years post-grade three. The TEA data includes both raw scores, reflecting the number of correct responses, and scale scores, which facilitate direct comparisons across different test administrations. In this analysis, raw reading scores adjusted by the promotion cutoff serve as the running variable. Both raw scores and scale scores are standardized across subject-grade/year-cohort to have a mean of zero and a standard deviation of one, separately.

THECB Data (2010-2021)

The THECB data used in this study spans from 2010 through 2021, including detailed records on post-secondary education in Texas. The data further categorizes institutions into five types: Public University, Community College, Independent College/University, Health Institutions, and Career School/College. This study examines the impact of third-grade retention on college outcomes across these institution types.

NSC Data (2011-2019)

The NSC data from 2011 through 2019 supplements THECB by providing enrollment records for Texas students attending out-of-state colleges, covering about 96% of U.S. higher education enrollment. However, the NSC data from 2011 through 2016 do not include graduation dates or completion statuses.

TWC Wages Data (2007-2022)

The wage data come from the TWC spanning from 2007 through 2022, which reports quarterly wages for people who work in Texas. TWC requires all employers to report Unemployment Insurance (UI) wages and to pay their quarterly UI taxes electronically. Employers that do not file and pay electronically may be subject to penalties as prescribed in Sections 213.023 and 213.024 of the Texas Unemployment Compensation Act (TUCA). This study aggregates the quarterly wages into annual wages and adjusts for inflation to the 2020 value. Notably, the TWC data do not include wages for workers outside of Texas. As a researcher, I can not identify whether the missing wages come from unemployment in Texas or employment outside Texas. In this study, I code missing wages as zero. However, I explore the impacts of retention on the likelihood of working outside Texas and conduct a series of analyses to test the robustness of the main results by replacing the

missing wages with the average positive wages from peers who share the same reading scores. The definitions of earnings outcomes are listed in Table A3.

A.1.2 Data Linkage and Cleaning

Each dataset has a unique identifier (ID2) for each student, which serves as a substitute for social security numbers (SSNs), facilitating longitudinal tracking across datasets. A student without a valid SSNs would obtain a state-assigned ID2. Moreover, the ID2 is regularly verified and updated across the TEA, THECB, and TWC to reflect changes such as the acquisition of a valid SSN. Details for the matching process and crosswalk can be found here. To test the preciseness of the longitudinal tracking across datasets using ID2, I merge the main sample from the TEA data with the community college enrollment in 2014 and examine the match rates for gender from these two datasets. The corrected matching rate for gender is 99% using ID2.

The main analysis sample includes three cohorts of first-time third-graders from the 2002-2003 through 2004-2005 school years. Third-graders in the 2002-2003 school year were the first cohort that was affected by the Texas test-based third-grade retention policy. They are around age 27 in 2022. The last cohort, third-graders in the 2004-2005 school year, will have an age of around 25 in 2022. The timeline for each cohort is detailed in Table A1. I pick these three cohorts to have enough sample size for the fuzzy regression discontinuity estimation and to be able to observe earnings up to age 25. Additionally, I focus on third-graders whose ID2 is not empty in the TEA test scores files.[17]This is because the employment earnings data can only be matched through ID2. In addition, almost all records from TWC files contain valid ID2 due to the fact that SSNs are required for employment.

A.1.3 Outcomes Definition and Attrition

Earnings outcomes: This study employs two types of measures for earnings outcomes. The first category defines earnings by age, including annual earnings from ages 23 to 26 and average

[17]Only a small fraction of students in the TEA files miss ID2.

Table A1: Cohorts 2003 to 2005 Timeline Without Retention

	Cohort 2002-2003		Cohort 2003-2004		Cohort 2004-2005	
Calendar Year	Grade	Age	Grade	Age	Grade	Age
2003	3	8	2	7	1	6
2004	4	9	3	8	2	7
2005	5	10	4	9	3	8
2006	6	11	5	10	4	9
2007	7	12	6	11	5	10
2008	8	13	7	12	6	11
2009	9	14	8	13	7	12
2010	10	15	9	14	8	13
2011	11	16	10	15	9	14
2012	12	17	11	16	10	15
2013		18	12	17	11	16
2014		19		18	12	17
2015		20		19		18
2016		21		20		19
2017	The 8^{th} year post-grade 9	22		21		20
2018	The 9^{th} year post-grade 9	23	The 8^{th} year post-grade 9	22		21
2019	The 10^{th} year post-grade 9	24	The 9^{th} year post-grade 9	23	The 8^{th} year post-grade 9	22
2020	The 11^{th} year post-grade 9	25	The 10^{th} year post-grade 9	24	The 9^{th} year post-grade 9	23
2021	The 12^{th} year post-grade 9	26	The 11^{th} year post-grade 9	25	The 10^{th} year post-grade 9	24
2022	The 13^{th} year post-grade 9	27	The 12^{th} year post-grade 9	26	The 11^{th} year post-grade 9	25
Ever Dropout	2004 to 2018		2004 to 2018		2004 to 2018	
Ever HG Grad.	2009 to 2022		2009 to 2022		2009 to 2022	
On-Time HG Grad.	By 2013		By 2014		By 2015	
On-Time College Enroll.	By 2013		By 2014		By 2015	
Ever College Enroll.	2010 to 2021		2010 to 2021		2010 to 2021	

earnings across these years. Additionally, this category assesses the presence of positive earnings at each age from 23 to 26 and cumulatively over these years. The second category measures annual earnings from the 8^{th} to the 11^{th} year post-ninth grade and calculates average earnings across this period. This category also includes indicators for positive earnings each year and overall during this period.

Importantly, missing wage data are recorded as zero, which may represent either unemployment within Texas or employment outside Texas not reported to the TWC. Attrition in earnings data primarily involves wages from students who work outside of Texas. Thus, I measure earnings attrition as attending an educational institution outside Texas and having zero wages in Texas for a specific age or period.

College enrollment outcomes: College enrollment outcomes are classified into two categories: "ever enrolling" in a college and "on-time" college enrollment. The ever enrolling category tracks any college enrollment from 2010 through 2021, while on-time enrollment specifically refers to enrolling in college by the ninth year post-grade three. These outcomes are further differentiated

by the selectivity and type of institution, including community colleges in Texas, public universities in Texas, and colleges outside Texas. Additionally, I define variables to track college enrollment status annually for each age from 18 to 26, providing a detailed view of the impact of third-grade retention on college enrollment.

College graduation outcomes: The NSC files within the Texas ERC lack detailed information on graduation status and dates. Therefore, this study focuses solely on college graduations within Texas. Graduation outcomes are categorized similarly to college enrollment outcomes, differentiated as "ever graduated" and "on-time graduation" from either a community college or a public university in Texas. Ever graduated tracks students who graduated at any time between 2010 and 2021. On-time graduation from a community college is defined as graduating by age 20, while for a public university, it is defined as graduating by age 22. Additionally, on-time graduation from any type of college is also set at graduation by age 22.

High school graduation: High school graduation is defined as obtaining a high school diploma between 2009 and 2022, or within an eight to ten-year period starting from the ninth grade, excluding individuals who only attain a GED. The term "high school graduation attrition" is used to describe students graduating from schools outside the Texas public school system, which could include private schools or schools outside of Texas. However, I do not observe high school graduation outside Texas public schools. In my analysis, I categorize high school graduation attrition as one if a student leaves the Texas public schools without graduating to attend school elsewhere, and zero otherwise. This approach provides an upper-bound estimate of high school graduation attrition. It acknowledges that not all students who transfer to other schools necessarily complete their high school education.

Dropout: Texas public schools follow the U.S. Department of Education's National Center for Education Statistics (NCES) definition for dropout beginning from the 2005-06 school year. By this definition, a dropout is a student who is enrolled in a Texas public school in grades 7-12, does not return to public school the following fall, is not expelled, and does not graduate, does not receive a GED, does not continue school outside the Texas public school system, does not begin

college, or does not die (Secondary School Completion and Dropouts, 2008-09). In this study, dropout indicates ever dropping out of Texas public school based on the NCES definition from 2004 through 2018.

Test scores: I conduct same-grade and same-year comparisons when analyzing the effects on reading and math scores. First, I estimate the impact of retention on test scores when both retained and promoted students reach the same grade, spanning from grades four to eight. Second, I compare the test scores by year from the first to the fifth year following grade three. Reading and math scores are standardized by subject-cohort-grade/year, with a mean of zero and a standard deviation of one.

Behavioral Outcomes: The TEA disciplinary reasons and actions files identify incidents of violence and crime, which are detailed in Tables A4 and A5, respectively. I define the outcome variables for violence and crime as the annual counts of these incidents recorded each year from one to nine years following grade three. Furthermore, for these outcome variables, I calculate both the cumulative total and the annual average number of incidents over the entire nine-year period. Similarly, I define the school absence variables as the number of days a student is absent from school each year, spanning from one to nine years following grade three. Additionally, I calculate both the cumulative total and the annual average of days absent over this nine-year period.

Table A2: Definition and Attrition of Educational and Behavioral Outcome

Outcomes	Definition	Attrition
Panel A: Educational Outcomes		
Same-year test scores	First-attempt reading or math scores from the first through the fifth year post-grade three	Have test scores outside public schools
Same-grade test scores	First-attempt reading/math scores in grades four to eight	Have test scores outside of public schools
High school graduation	Graduated from a public high school from 2009 through 2022, excluding GED	Graduated outside of the Texas public school
Any college enrollment	Enrolled in any college or university nationwide in the U.S. between 2010 and 2021	N/A
Community college enrollment	Enrolled in a community college in Texas between 2010 and 2021	N/A
Public University enrollment	Enrolled in a public university in Texas between 2010 and 2021	N/A
College enrollment outside Texas	Enrolled in any college outside Texas between 2011 and 2019	N/A
Any college graduation in Texas	Graduated from any college in Texas between 2010 and 2021	N/A
Community college graduation	Graduated from a community college in Texas between 2010 and 2021	N/A
Public University graduation	Graduated from a Public University in Texas between 2010 and 2021	N/A
Panel B: Behavioral Outcomes		
School absence	Total/average/annual days absent from school	Days absent outside of the Texas public schools
Crime	Total/average/annual criminal activities defined in Table A5	Crime committed outside of Texas public schools
Violent behaviors	Total/average/annual violent behaviors defined in Table A4	Violence committed outside Texas public schools

Notes: This table summarizes the definition and attrition of educational and behavioral outcomes.

Table A3: Labor Market Outcomes Definition and Attrition

Outcomes	Definition	Attrition
Panel A: earnings by age		
Wages 26 [a]	Annual wages at age 26	Have wages at age 26 earned outside of Texas
Wages 25	Annual wages at age 25	Have wages at age 25 earned outside of Texas
Wages 24	Annual wages at age 24	Have wages at age 24 earned outside of Texas
Wages 23	Annual wages at age 23	Have wages at age 23 earned outside of Texas
Av. Wages 23-25	Average wages btw ages 23 and 25	Have earnings in this period outside of Texas
Av. Wages 23-26	Average earnings btw ages 23 and 26	Have earnings in this period outside of Texas
Pos.wages2325	Have positive earnings btw ages 23 & 25	Have positive earnings btw ages 23 & 25 outside Texas
Pos.2326	Have positive earnings btw ages 23 & 26	Have positive earnings btw ages 23 & 26 outside Texas
Panel B: earnings from the 8^{th} to the 11^{th} years post-grade nine		
Earnings grade 9+8^{th}	Annual earnings in the 8^{th} year post-grade nine	Have earnings in the 8^{th} year post-grade nine earned outside of Texas
Earnings grade 9+9^{th}	Annual earnings in the 9^{th} year post-grade nine	Have earnings in the 9^{th} year post-grade nine earned outside of Texas
Earnings grade 9+10^{th}	Annual earnings in the 10^{th} year post-grade nine	Have earnings in the 10^{th} year post-grade nine earned outside of Texas
Earnings grade 9+11^{th}	Annual earnings in the 11^{th} year post-grade nine	Have earnings in the 11^{th} year post-grade nine earned outside of Texas
Av.Earnings grade 9+$(8-11)^{th}$	Average earnings btw the 8^{th} to 11^{th} years post-grade nine	Have earnings btw the 8^{th} to 11^{th} years post-grade nine earned outside of Texas

Notes: This table summarizes the definition and attrition of earnings outcome variable.

[a] The earnings at age 26, which equals the wages in 2023, are not available for the 2005 third-graders. However, third-grade retention has no significant effect on having missing earnings at age 26.

Table A4: Definition of Violent Behavior

CODE	TRANSLATION
2	CONDUCT PUNISHABLE AS A FELONY 37.006(A)(2)(A)
4	POSSESSED, SOLD, USED OR WAS UNDER THE INFLUENCE OF MARIHUANA OR OTHER CONTROLLED SUBSTANCE
5	POSSESSED, SOLD, USED OR WAS UNDER THE INFLUENCE OF AN ALCOHOLIC BEVERAGE
6	ABUSE OF A VOLATILE CHEMICAL
7	PUBLIC LEWDNESS OR INDECENT EXPOSURE
8	RETALIATION AGAINST SCHOOL EMPLOYEE
9	TITLE 5 FELONY - OFF CAMPUS AND NOT AT SCHOOL SPONSORED ACTIVITY
10	NON TITLE 5 FELONY CONDUCT-NOT ON CAMPUS OR AT SCHOOL SPONSORED ACTIVITY
11	BROUGHT FIREARM TO SCHOOL - TEC37.007(e) OR UNLAWFUL CARRY OF A HANDGUN
12	UNLAWFUL CARRY OF AN ILLEGAL KNIFE UNDER PENAL CODE 46.02-TEC 37.007(a)(1)
13	UNLAWFUL CARRYING OF A CLUB UNDER PENAL CODE 46.02 - TEC 37.007(a)(1)
14	CONDUCT CONTAINING THE ELEMENTS OF AN OFFENSE RELATING TO PROHIBITED WEAPONS
16	ARSON
17	MURDER, CAPITAL MURDER, CRIMINAL ATTEMPT TO COMMIT MURDER OR CAPITAL MURDER
18	INDECENCY WITH A CHILD
19	AGGRAVATED KIDNAPPING
22	CRIMINAL MISCHIEF
26	TERRORISTIC THREAT - TEC SECTION 37.006(A)(1) OR 37.007(B)
27	ASSAULT UNDER PENAL CODE SECT. 22.01(A)(1) AGAINST A DISTRICT EMPLOYEE/VOLUNTEER
28	ASSAULT UNDER PENAL CODE SECT 22.01(A)(1) OTHER THAN SCHOOL DISTRICT EMPLOYEE/VOLUNTEER
29	AGGRAVATED ASSAULT (PC SECT 22.02) AGAINST SCHOOL DISTRICT EMPLOYEE/VOLUNTEER
30	AGGRAVATED ASSAULT (PC SECT 22.02) AGAINST SOMEONE OTHER THAN DISTRICT EMPLOYEE
31	SEXUAL OR AGGRAVATED ASSAULT AGAINST A SCHOOL DISTRICT EMPLOYEE/VOLUNTEER
32	SEXUAL OR AGGRAVATED SEXUAL ASSAULT AGAINST SOMEONE O/T DISTRICT EMPLOYEE/VOLUNTEER
34	SCHOOL-RELATED GANG VIOLENCE
35	FALSE ALARM/FALSE REPORT - TEC SECTION 37.006(A)(1) AND 37.007(B)
36	FELONY CONTROLLED SUBSTANCE VIOLATION - TEC SECTION 37.007(A)(3)
37	FELONY ALCOHOL VIOLATION - TEC SECTION 37.007(A)(3)
41	FIGHTING/MUTUAL COMBAT
46	AGGRAVATED ROBBERY - TEC 37.007(a)(2)(F), TEC 37.006 (c)-(d)
47	MANSLAUGHTER
48	CRIMINALLY NEGLIGENT HOMICIDE
49	ENGAGES IN DEADLY CONDUCT
53	ENGAGED IN CONDUCT THAT OFFENSES ARE SPEC IN TEC OFF-CAMPUS BUT W/IN 300FT

Notes: This table lists the incidents that are categorized as violence.

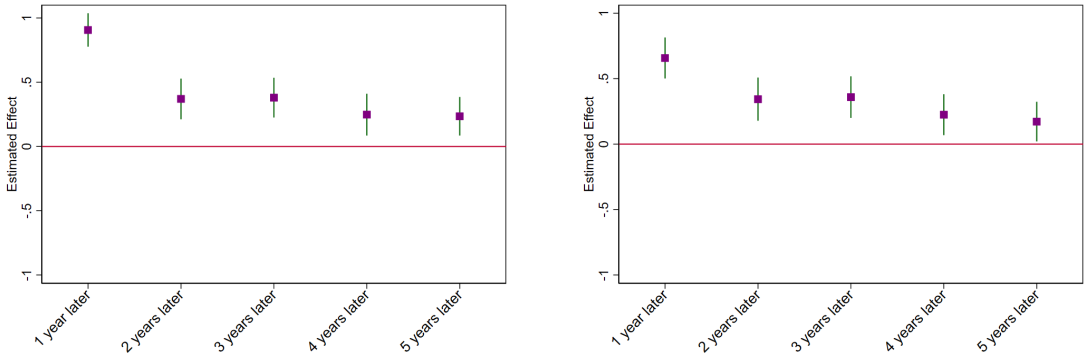
Table A5: Definition of Criminal Behavior

CODE	TRANSLATION
1	PERMANENT REMOVAL BY TEACHER FROM CLASS
2	CONDUCT PUNISHABLE AS A FELONY 37.006(A)(2)(A)
4	POSSESSED, SOLD, USED OR WAS UNDER THE INFLUENCE OF MARIHUANA OR OTHER CONTROLLED SUBSTANCE
5	POSSESSED, SOLD, USED OR WAS UNDER THE INFLUENCE OF AN ALCOHOLIC BEVERAGE
6	ABUSE OF A VOLATILE CHEMICAL
7	PUBLIC LEWDNESS OR INDECENT EXPOSURE
8	RETALIATION AGAINST SCHOOL EMPLOYEE
9	TITLE 5 FELONY - OFF CAMPUS AND NOT AT SCHOOL SPONSORED ACTIVITY
10	NON TITLE 5 FELONY CONDUCT-NOT ON CAMPUS OR AT SCHOOL SPONSORED ACTIVITY
11	BROUGHT FIREARM TO SCHOOL - TEC37.007(e) OR UNLAWFUL CARRY OF A HANDGUN
12	UNLAWFUL CARRY OF AN ILLEGAL KNIFE UNDER PENAL CODE 46.02-TEC 37.007(a)(1)
13	UNLAWFUL CARRYING OF A CLUB UNDER PENAL CODE 46.02 - TEC 37.007(a)(1)
14	CONDUCT CONTAINING THE ELEMENTS OF AN OFFENSE RELATING TO PROHIBITED WEAPONS
16	ARSON
17	MURDER, CAPITAL MURDER, CRIMINAL ATTEMPT TO COMMIT MURDER OR CAPITAL MURDER
18	INDECENCY WITH A CHILD
19	AGGRAVATED KIDNAPPING
22	CRIMINAL MISCHIEF
26	TERRORISTIC THREAT - TEC SECTION 37.006(A)(1) OR 37.007(B)
27	ASSAULT UNDER PENAL CODE SECT. 22.01(A)(1) AGAINST A DISTRICT EMPLOYEE/VOLUNTEER
28	ASSAULT UNDER PENAL CODE SECT 22.01(A)(1) OTHER THAN SCHOOL DISTRICT EMPLOYEE/VOLUNTEER
29	AGGRAVATED ASSAULT (PC SECT 22.02) AGAINST SCHOOL DISTRICT EMPLOYEE/VOLUNTEER
30	AGGRAVATED ASSAULT (PC SECT 22.02) AGAINST SOMEONE OTHER THAN DISTRICT EMPLOYEE
31	SEXUAL OR AGGRAVATED ASSAULT AGAINST A SCHOOL DISTRICT EMPLOYEE/VOLUNTEER
32	SEXUAL OR AGGRAVATED SEXUAL ASSAULT AGAINST SOMEONE O/T DISTRICT EMPLOYEE/VOLUNTEER
35	FALSE ALARM/FALSE REPORT - TEC SECTION 37.006(A)(1) AND 37.007(B)
36	FELONY CONTROLLED SUBSTANCE VIOLATION - TEC SECTION 37.007(A)(3)
37	FELONY ALCOHOL VIOLATION - TEC SECTION 37.007(A)(3)
46	AGGRAVATED ROBBERY - TEC 37.007(a)(2)(F), TEC 37.006 (c)-(d)
47	MANSLAUGHTER
48	CRIMINALLY NEGLIGENT HOMICIDE
49	ENGAGES IN DEADLY CONDUCT
50/52	USED, EXHIBITED OR POSSESSED A NON-ILLEGAL KNIFE PER STUDENT CODE CONDUCT
51	USED, EXHIBITED, OR POSSESSED A FIREARM OFF-CAMPUS BUT W/IN 300FT OF SCHOOL
53	ENGAGED IN CONDUCT THAT OFFENSES ARE SPEC IN TEC OFF-CAMPUS BUT W/IN 300FT
54	ENGAGE IN CONDUCT PUNISH AS FELONY OFF-CAMPUS BUT W/IN 300FT

Notes: This table lists the incidents that are categorized as crimes.

A.2 Tables and Figures of Main Results

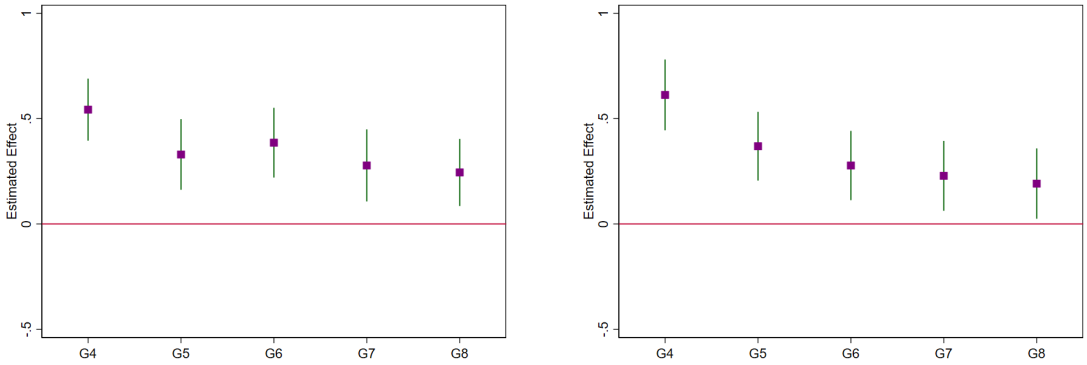
Figure A1: Effects of Grade Retention on Raw Scores by Years



(a) Reading Scores (b) Math Scores

Notes: These figures display the effects of third-grade retention on reading and math raw scores from one to five years after grade three. The raw scores measure the number of questions answered correctly. The raw score is further standardized with zero mean and one standard deviation by subject-year-cohort.

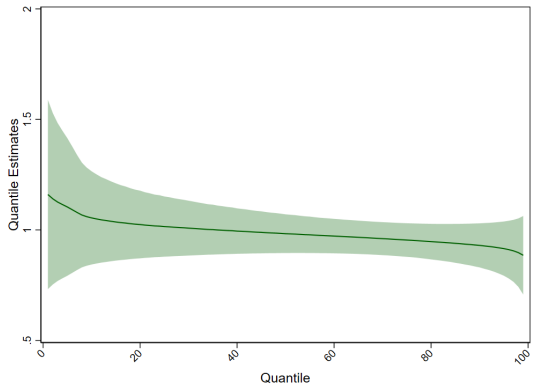
Figure A2: Effects of Grade Retention on Raw Scores by Grades



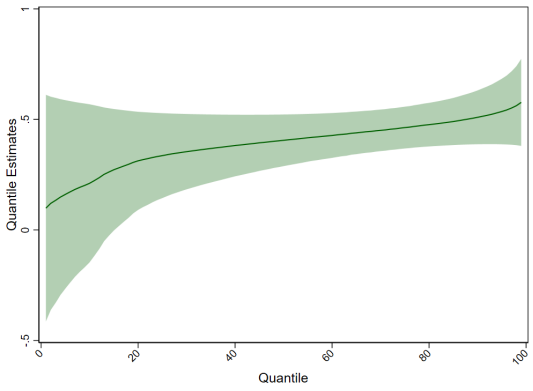
(a) Reading Scores (b) Math Scores

Notes: These figures display the effects of third-grade retention on reading and math raw scores from the fourth through the eighth grades. The raw scores measure the number of questions answered correctly. The raw score is further standardized with zero mean and one standard deviation by subject-year-cohort.

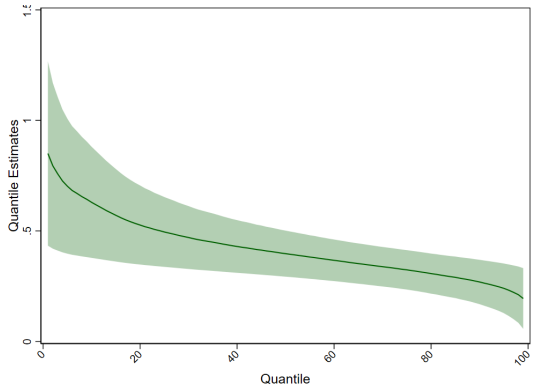
Figure A3: Quantile Regression Estimates of Retention's Effects on Reading Raw Scores by Years



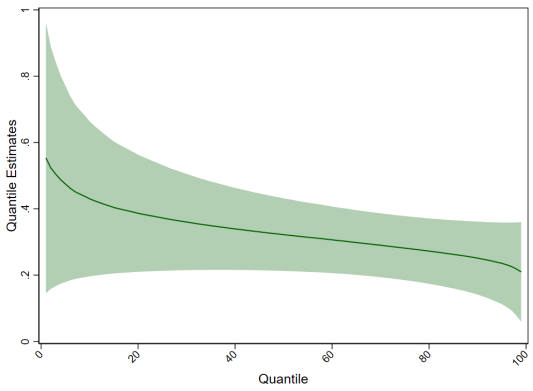
(a) The First Year Post-Grade 3



(b) The Second Year Post-Grade 3



(c) The Third Year Post-Grade 3



(d) The Fourth Year Post-Grade 3

Notes: These figures display the quantile regression estimates of the effects of third-grade retention on reading raw scores from the first to the fourth year after grade three. The raw scores measure the number of questions answered correctly. The raw score is further standardized with zero mean and one standard deviation by subject-year-cohort.

Table A6: Effect of Grade Retention on Earnings Outcomes by Cohorts

	(1)	(2)	(3)	(4)	(5)	(6)
	Annual Earnings at Each Age from 23 to 26				Average Earnings	
	Age23	Age24	Age25	Age26	Ages23-25	Ages23-26
Cohorts 2003 to 2005	-4,324	-2,942	-3,198	-6,686	-3,512	-3,653
	(1,535)	(1,583)	(1,758)	(2,534)	(1,472)	(1485)
Observations	19784	19782	19731	11728	19784	19784
Cohorts 2003 to 2004	-5,691	-3,221	-4,364	-5,597	-4,495	-4,889
	(2,153)	(2,138)	(2,261)	(2,443)	(2,047)	(2085)
Observations	9792	9791	9789	9754	9792	9792
Cohort 2003	-6,352	-4,226	-2,501	-2,166	-4,564	-4,161
	(3,566)	(3,538)	(3,627)	(4,292)	(3,401)	(3496)
Observations	3786	4593	4591	3783	3786	3786
Cohort 2004	-5,088	-1,603	-4,754	-8,082	-3,861	-4,967
	(2,364)	(2,382)	(2,635)	(2,699)	(2,276)	(2293)
Observations	5958	6575	5958	6575	5958	5958
Cohort 2005	-3,201	-3,829	-2,040	-22,801	-3,132	-2,871
	(2,922)	(3,058)	(3,412)	(18,034)	(2,859)	(2877)
Observations	7502	8469	8420	8470	7502	7502

Notes: This table displays the fuzzy RDD estimate of the effect of third-grade retention on annual earnings at each age from 23 to 26 by cohort. The sample includes the 2003 to 2005 cohorts of first-time third-grade students who took the third-attempt reading test.

Table A7: Predicted Effect of Reading Scores on High School Graduation

	High School Graduation					
	(1)	(2)	(3)	(4)	(5)	(6)
1 year later	0.013					0.001
	(0.008)					(0.012)
2 years later		0.008				0.016
		(0.007)				(0.011)
3 years later			0.007			-0.028
			(0.007)			(0.009)
4 years later				0.072		0.067
				(0.007)		(0.009)
5 years later					0.088	0.079
					(0.006)	(0.007)
Constant	0.851	0.901	0.893	0.922	0.947	0.984
	(0.040)	(0.039)	(0.041)	(0.040)	(0.039)	(0.043)
Observations	10736	10860	10032	10168	10488	8850

Notes: This table displays the predicted effects of reading scale scores one to five years following grade three on high school graduation. The reading scale scores are standardized with zero mean and one standard deviation by subject-year-cohort.

Table A8: Effect of Third-Grade Retention on Risky Behavior

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Yearly Behavioral Incidents								
	1 year later	2 year later	3 year later	4 year later	5 year later	6 year later	7 year later	8 year later	9 year later
Panel A: Effects on school absence									
Days absent scaled by mean	0.230	0.239	0.063	0.112	0.166	0.144	0.131	-0.029	0.002
	(0.091)	(0.088)	(0.092)	(0.101)	(0.101)	(0.113)	(0.100)	(0.099)	(0.110)
Mean: above cutoff 0-8 points	0.906	0.910	0.934	0.915	0.915	0.928	0.923	0.950	0.973
Effect size	25.39%	26.26%	6.75%	12.24%	18.14%	15.52%	14.19%	-3.05%	0.21%
Observations	17040	19095	18801	16267	18471	16004	17931	16931	13103
Panel B: Effects on Violent Behaviors									
Violence scaled by mean	1.346	0.629	0.600	1.217	0.942	0.283	0.260	0.410	0.718
	(0.664)	(0.483)	(0.436)	(0.397)	(0.345)	(0.338)	(0.397)	(0.498)	(0.737)
Mean: above cutoff 0-8 points	0.877	0.962	0.851	0.885	0.866	0.833	0.900	0.921	0.830
Effect size	153.48%	65.38%	70.51%	137.51%	108.78%	33.97%	28.89%	44.52%	86.51%
Observations	19909	19909	19909	19909	19909	19909	19909	19909	19909
Panel C: Effects on Crime									
Crime scaled by mean	0.915	1.425	0.508	1.425	0.950	0.026	0.486	0.200	0.235
	(2.268)	(1.427)	(0.965)	(0.731)	(0.557)	(0.479)	(0.552)	(0.647)	(0.843)
Mean: above cutoff 0-8 points	0.912	1.083	0.870	0.946	0.935	0.827	0.917	0.922	0.808
Effect size	100.33%	131.58%	58.39%	150.63%	101.60%	3.14%	53.00%	21.69%	29.08%
Observations	19909	19909	19909	19909	19909	19909	19909	19909	19909

Notes: This table displays the fuzzy RDD estimate of the effect of third-grade retention on yearly incidents of school absence, violent behavior, and crime. These behavioral outcomes are scaled by the mean of the outcome variables in each year.

Table A9: Effect of Grade Retention on the Timing of College Enrollment

	(1) Age 18	(2) Age 19	(3) Age 20	(4) Age 21	(5) Age 22	(6) Age 23	(7) Age 24	(8) Age 25	(9) Age 26
College Enrollment	-0.041	-0.006	0.028	-0.028	0.011	-0.007	0.012	0.011	0.000
	(0.031)	(0.034)	(0.031)	(0.027)	(0.025)	(0.020)	(0.019)	(0.013)	(0.007)
Observations	22070	19909	19909	19909	19909	22070	19909	19909	19909

Notes: This table presents the impact of third-grade retention on the status of being enrolled in a college at each age from 18 to 26, analyzed using a fuzzy RDD approach. Data on college outcomes are sourced from the Texas Higher Education Coordinating Board (THECB) and the National Student Clearinghouse (NSC). College enrollment is defined as enrolling in any college in Texas or other states.

Table A10: Effect of Retention on Grade Progression

	(1) On time attendance	(2) 1+ years	(3) 2+ years	(4) 3+ years	(5) Do not attend
Grade 4	-1.001	1.001	-0.001	-0.001	0.065
	(0.003)	(0.003)	(0.002)	(0.001)	(0.016)
Observations	19308	19308	19308	19308	19909
Grade 5	-0.862	0.862	0.005	-0.001	0.036
	(0.021)	(0.021)	(0.006)	(0.001)	(0.019)
Observations	20936	18882	20936	16522	22070
Grade 6	-0.618	0.618	0.022	-0.001	0.032
	(0.031)	(0.031)	(0.009)	(0.001)	(0.021)
Observations	18495	18495	20496	18495	22070
Grade 7	-0.603	0.604	0.024	-0.001	0.014
	(0.032)	(0.032)	(0.010)	(0.001)	(0.022)
Observations	18328	18328	20323	18328	22070
Grade 8	-0.587	0.588	0.020	0.000	0.018
	(0.033)	(0.033)	(0.012)	(0.002)	(0.025)
Observations	18076	18076	20029	18076	19909
Grade 9	-0.527	0.526	-0.005	-0.005	0.014
	(0.033)	(0.034)	(0.013)	(0.003)	(0.024)
Observations	20065	18104	20065	20065	22070
Grade 10	-0.508	0.508	-0.027	-0.015	0.030
	(0.040)	(0.041)	(0.019)	(0.007)	(0.036)
Observations	15278	15278	16898	16898	22070
Grade 11	-0.571	0.575	-0.000	-0.010	0.131
	(0.041)	(0.044)	(0.019)	(0.007)	(0.042)
Observations	13680	11965	13680	13680	19909
Grade 12	-0.523	0.523	-0.005	-0.014	0.112
	(0.042)	(0.043)	(0.016)	(0.007)	(0.045)
Observations	13223	13223	13223	13223	17404

Notes: This table shows the fuzzy RDD estimates of retention in third grade on on-time enrollment in each grade following grade three.

Table A11: Attrition Rates Among Students Above and Below the Cutoff

	(1) Above Cutoff Mean	(2) Below Cutoff Mean	(3) Difference	(4) t-statistic
Attend private or home school	0.099	0.114	-0.015	-3.7
Attend out-of-state school	0.059	0.061	-0.002	-0.7
Attend out-of-state college	0.012	0.008	0.004	3.0
Attrition Rate of High School Graduation				
Leave and attend school elsewhere before grade 9	0.016	0.018	-0.002	-1.3
Leave and attend school elsewhere before grade 10	0.051	0.066	-0.014	-4.7
Leave and attend school elsewhere before grade 11	0.083	0.105	-0.021	-5.7
Leave and attend school elsewhere before grade 12	0.112	0.133	-0.021	-4.9
Ever leave and attend school elsewhere	0.131	0.151	-0.020	-4.4
Attrition Rate of Earnings Outcome				
Attend school/college outside Texas with zero wages at age 23	0.028	0.031	-0.004	-1.6
Attend school/college outside Texas with zero wages at age 24	0.028	0.031	-0.003	-1.3
Attend school/college outside Texas with zero wages at age 25	0.029	0.031	-0.002	-0.8
Attend school/college outside Texas with zero wages at age 26	0.021	0.023	-0.002	-0.9
Attend school/college outside Texas with zero wages btw ages 23-25	0.022	0.025	-0.003	-1.3
Attend school/college outside Texas with zero wages btw ages 23-26	0.022	0.024	-0.002	-1.1

Notes: This table compares attrition rates for students whose third-grade reading scores fall within eight points above or below the promotion cutoff. High school graduation attrition is defined as leaving the public school system without graduating and enrolling elsewhere, including private, home, or out-of-state schools. Attrition for earnings outcomes refers to attending an educational institution outside Texas and having zero wages in the Texas TWC data during the corresponding age period.

Table A12: Effects of Retention on High School Graduation Attrition

	(1)	(2)	(3)	(4)	(5)
	High School Graduation Attrition				
	Exit before Grade 9	Exit before Grade 10	Exit before Grade 11	Exit before Grade 12	Ever exit
Retention	-0.010	-0.004	0.031	0.027	0.030
	(0.010)	(0.020)	(0.027)	(0.031)	(0.032)
Above cutoff mean	0.016	0.051	0.083	0.112	0.131
Effect size	-62.50%	-7.84%	37.35%	24.11%	22.90%
Observations	19909	19909	19909	17404	19909

Notes: This table shows the fuzzy RDD estimates of the effects of retention on high school graduation attrition. In this context, attrition refers to students who leave for other schools and do not obtain a high school graduation diploma from the Texas public school system. This includes scenarios where students transferred to schools outside of Texas, switched to private or homeschooling, enrolled in the Texas University high school diploma program, or completed high school through alternative pathways such as enrolling in college without a high school diploma.

Table A13: Effect of Grade Retention on Earnings using Math Cutoff

	(1) Wages at Age 23	(2) Wages at Age 24	(3) Wages at Age 25	(4) Wages at Age 26	(5) Av.Wages 23-25	(6) Av.Wages 23-26
Reduced Form Estimates	-439	-582	-446	-733	-468	-451
	(732)	(781)	(866)	(1032)	(740)	(752)
Observations	12496	12495	12475	9118	12496	12496
Fuzzy RDD Estimates	-7966	-12316	-11064	-17669	-12422	-12537
	(14762)	(15333)	(15458)	(26478)	(13870)	(14080)
Observations	12496	15758	15731	9118	15759	15759

Notes: The top panel of this table shows the reduced form estimates of the effect of failing the minimum standard cutoff of the first math test in third grade on earnings outcomes. The bottom panel of this table displays the fuzzy RDD estimate of the effect of third-grade retention due to failing the math test on earnings at each age from 23 through 26 and the average earnings between ages 23 to 25 and ages 23 to 26.

Table A14: Effect of Grade Retention on Earnings by Methods

	(1) Wages at Age 23	(2) Wages at Age 24	(3) Wages at Age 25	(4) Wages at Age 26	(5) Av.Wages 23-25	(6) Av.Wages 23-26
Local linear regression	-4324	-2942	-3198	-6869	-3512	-3653
	(1536)	(1583)	(1757)	(2532)	(1472)	(1485)
Bias-corrected	-4737	-3780	-4057	-10799	-4330	-4485
	(1536)	(1583)	(1757)	(2532)	(1472)	(1485)
Robust	-4737	-3780	-4057	-10799	-4330	-4485
	(2076)	(2108)	(2408)	(3691)	(1953)	(1964)
Observations	36970	36966	36874	26196	36970	36970

Notes: The estimates presented in this table are obtained using rdrobust introduced in (Calonico et al., 2017) and represent the impacts of retention on earnings outcomes. Three estimation procedures are employed: (i) conventional RD estimates, local linear regression with heteroskedasticity-robust standard errors, (ii) bias-corrected estimates with heteroskedasticity-robust standard errors, and (iii) bias-corrected estimates with robust standard errors.

Table A15: Comparison across papers

Policy	Papers	Grade	Reading scores one year later	Dropout	Absence	Crime	High school grad.	College enroll.	Wages
Texas	This paper	3	0.52δ	0.025(17%)	1.41(25%)	0.237(63%)	-0.095(-15%)	0.016(4%)	-$3500(-22%)
Louisiana	Eren et al. (2022)	8		0.072(16%)	0.76 (6%)	0.010(58%)			
	Eren et al. (2017)	4		0.048(11%)		0.0007(1.5%)			
	Eren et al. (2017)	8		0.048(10%)		-0.0034(-4.4%)			
Chicago	Jacob and Lefgren (2009)	8		0.112 (21%)			-0.099(-24%)		
Florida	Schwerdt et al. (2017)	3	0.23δ				-0.003(0.4%)	0.004(0.9%)	
	Figlio and Özek (2020)	3	0.085δ						
	Özek (2015)	3							
Netherlands	Meulen (2023)	12							€3000 (-9%)

Notes: This table compares the results observed in this study with those from literature studying grade retention policy.

Table A16: Effect of Intermediate Outcomes on Reduced Earnings through Retention

	(1) High school graduation	(2) Days Absent	(3) Juvenile crime
Panel A:Retention's Effect on Intermediate Outcomes	-0.095	2.921	0.237
	Angrist and Krueger (1991) Extra two years edu	Cattan et al. (2023) One day absent	Aizer and Doyle Jr (2015) Juvenile incarceration
Panel B: Causal Effect of Intermediate Outcome on Earnings	15%	-0.2%	-0.276 [18]
Panel C: Contribution of Intermediate Effects to Reduced Earnings(Panel AxB)	$-228	$-94	$-1,047
Effect size: Panel C Values /$3,512	-6.5%	-2.7%	-30%

Notes: This table presents a back-of-envelope calculation illustrating the contribution of intermediate outcomes, affected by third-grade retention, to the reduction in average earnings between ages 23 and 25. Panel A reports the causal effects of retention on these intermediate outcomes shown in this study. Panel B provides the impacts of these outcomes on earnings, derived from existing literature. Panel C demonstrates how retention indirectly affects earnings through these channels by multiplying Pane A with B.

Table A17: Summary Statistics between Compliers and Noncompliers

	Below Cutoff				Above Cutoff			
	Retained	Promoted	Diff.	t-stat	Promoted	Retained	Diff.	t-stat
Age	8.15	8.44	-0.29	-32.5	8.25	8.15	0.10	4.8
Eligible for Free Meals	0.65	0.65	0.01	0.6	0.61	0.63	-0.01	-0.5
Male	0.55	0.57	-0.02	-2.0	0.52	0.53	-0.01	-0.4
Limited English Proficiency	0.38	0.33	0.05	5.9	0.35	0.31	0.04	2.0
Bilingual Program	0.20	0.15	0.04	6.3	0.17	0.14	0.03	1.7
Migrant	0.04	0.04	0.01	2.3	0.04	0.03	0.01	0.8
Special Education	0.05	0.09	-0.04	-8.1	0.06	0.05	0.01	1.4
Hispanic	0.63	0.57	0.06	6.8	0.60	0.60	-0.00	-0.0
Black	0.26	0.28	-0.02	-2.1	0.24	0.27	-0.03	-1.6
White	0.09	0.14	-0.05	-8.2	0.14	0.11	0.03	2.1
Third Grade Reading Score	-4.34	-3.94	-0.39	-9.5	3.44	2.87	0.57	5.5
High school graduation	0.58	0.58	-0.01	-0.7	0.65	0.57	0.08	3.8
Any College Enrollment	0.34	0.34	-0.00	-0.2	0.41	0.37	0.04	1.8
Average Wages btw Ages 23 to 25	14467	14913	-446	-1.4	16076	14717	1359	1.8

Notes: This table presents summary statistics for students who were retained versus those who were promoted, further categorized by whether their reading scores fell below or above the cutoff.

Table A18: Effect of Failing the Third Test on Earnings Outcomes Using the First Test as IV

	(1)	(2)
	First stage	**IV**
Outcome variables	Below 3^{rd} test cutoff	Av.wages at ages 23 to 25
Below 1^{st} cutoff	-0.189	
	(0.078)	
Below 3^{rd} cutoff		-44,593
		(19,331)
Below 1^{st} cutoff *First test scores	0.110	6,213
	(0.020)	(2,972)
First test scores	-0.066	-4,414
	(0.020)	(2,162)
Constant	0.525	31,045
	(0.078)	(6,573)
Cragg-Donald Wald F statistic	10	
Kleibergen-Paap rk Wald F statistic	7.8	
Observations	20,094	20,094

Notes: Column (1) presents the first-stage result, detailing the impact of failing the first reading test on failing the third test. Column (2) provides the instrumental variable (IV) estimate of the effect of failing the third reading test on average earnings between ages 23 and 25, using failing the first test as the IV.

Table A19: Effect of Third-Grade Retention on Yearly Incidents of Risky Behavior

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Yearly Behavioral Incidents								
	1 year later	2 year later	3 year later	4 year later	5 year later	6 year later	7 year later	8 year later	9 year later
Panel A: Effects on school absence									
Days absent	1.410	1.511	0.461	0.984	1.723	1.680	1.722	-0.394	0.027
	(0.555)	(0.560)	(0.668)	(0.891)	(1.052)	(1.316)	(1.313)	(1.360)	(1.517)
Mean: above cutoff 0-8 points	5.555	5.763	6.804	8.039	9.509	10.847	12.099	13.003	13.465
Effect size	25.38%	26.22%	6.78%	12.24%	18.12%	15.49%	14.23%	-3.03%	0.20%
Observations	17040	19095	18801	16267	18471	16004	17931	16931	13103
Panel B: Effects on Violent Behaviors									
Violence	0.043	0.037	0.060	0.159	0.138	0.044	0.033	0.034	0.026
	(0.021)	(0.028)	(0.044)	(0.052)	(0.051)	(0.052)	(0.050)	(0.042)	(0.027)
Mean: above cutoff 0-8 points	0.028	0.056	0.085	0.116	0.127	0.129	0.114	0.077	0.030
Effect size	153.57%	66.07%	70.59%	137.07%	108.66%	34.11%	28.95%	44.16%	86.67%
Observations	19909	19909	19909	19909	19909	19909	19909	19909	19909
Panel C: Effects on Crime									
Crime	0.003	0.013	0.013	0.062	0.062	0.002	0.036	0.011	0.006
	(0.007)	(0.013)	(0.025)	(0.032)	(0.036)	(0.037)	(0.041)	(0.035)	(0.021)
Mean: above cutoff 0-8 points	0.003	0.010	0.022	0.041	0.061	0.064	0.068	0.049	0.020
Effect size	100.00%	130.00%	59.09%	151.22%	101.64%	3.13%	52.94%	22.45%	30.00%
Observations	19909	19909	19909	19909	19909	19909	19909	19909	19909

Notes: This table displays the fuzzy RDD estimate of the effect of third-grade retention on yearly incidents of school absence, violence, and crime from one to nine years following grade three. Additionally, in Panel A, days absent from school are treated as missing for students who leave Texas public schools. In Panel B and C, violence and crime are coded as zero for students who leave the Texas public school. This table would provide the lower-bound estimates of the effects of retention on crime or violence if retention disproportionately increases these behaviors among retained students who left the public school.