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## The effects of grade retention on human capital accumulation

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*Department of Economics*

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*The Effects of Grade Retention on Human  
Capital Accumulation*

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## THE EFFECTS OF GRADE RETENTION ON HUMAN CAPITAL ACCUMULATION

ALEX SOLIS

# THE EFFECTS OF GRADE RETENTION ON HUMAN CAPITAL ACCUMULATION \*

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## Abstract

Grade retention is a widely used educational policy promoting human capital. However, its benefits and costs are still under debate. Retention may affect learning, cognitive and psychological capacities, educational attainment and the lifetime income (through the timing of entry to the labor market). This paper estimates the causal effects of grade retention on all these outcomes exploiting a retention rule based on the school GPA that enables a regression discontinuity design. I use administrative data from a 15-years panel on the universe of students in the educational system in Chile. The findings are fourfold. First, (marginally) retained students achieve the same amount of education than (marginally) promoted (i.e., high school graduation, higher education enrollment, etc.). Second, they improve their cognitive ability (measured by test scores) in the short and the long run. Third, induces parents to increase parental time investments and expectations. Fourth, enhances student psychological traits, and overall learning experience.

JEL Codes: I21, I26, I3, J24

Keywords: Grade retention, attainment, cognitive achievement, high school graduation, parental investment, self-esteem, learning.

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# 1 INTRODUCTION

Grade retention is a world-wide used educational policy to promote the acquisition of human capital. It adjusts the timing of the learning process by forcing the student to repeat a school grade. The objective is to allow students to develop cognitive and psychological capacities to improve learning on a vertically integrated curriculum. Additionally, retention acts as an incentive device, requiring students exert higher effort to avoid the high cost of retention. Some of the consequences of retention are immediate, students break social ties, suffer from stigma and low self-esteem, while others may appear in the future in the form of lower income or lower education. Retention may delay the entry to the labor market leading to lower lifetime income. In the educational dimension, may increases dropout rates implying lower education. On the aggregate level, retention implies a higher number of students in the educational system and therefore more demand for educational inputs. Given the potential costs, the debate has been highly controversial.

The estimation of the causal effects is challenging because retained and promoted students differ in observable and unobservable ways. The process of retention involve actions and decisions from teachers and parents and as a consequence, there is selection into treatment. Those who receive the retention treatment differ in several characteristics, and some of them that are unobserved by the researcher, for example, student ability and family involvement. Given that educational outcomes also depend on these features the estimations suffer from omitted variable bias. Most of the earlier literature, going back to the beginning of the twentieth century,<sup>1</sup> conclude that grade retention is an unjustifiable (see, for example, Abidin et al. [1971] and Jimerson [2001]). However, these conclusions rely on comparisons that do not address the selection problem. Recent papers, however, have used exogenous variation produced by cutoffs on retention policies in different context, e.g., Eide and Showalter [2001] using data from the US, Jacob and Lefgren [2009, 2004] in Chicago, Manacorda [2010] in Uruguay, and Schwerdt et al. [2017] in

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<sup>1</sup>To the best of my knowledge, the first paper discussing the consequences of grade retention is Cornman [1908]

Florida.<sup>2</sup>

This paper estimates the causal effects of retention on a wide variety of measures of attainment, cognitive ability, parental responses and psychological aspects at four different educational levels. I address the endogeneity problems exploiting a retention rule based on the annual grade point average (GPA) that enables a regression discontinuity design. Students failing at most one subject are required to have a GPA equal to 4.5 or higher<sup>3</sup> to be promoted. In the absence of manipulation, students scoring in a narrow window around this GPA-cutoff are as good as randomly assigned to retention (as in Lee [2008]). Therefore, the comparison between students scoring barely above and barely below 4.5 gives the causal effect of retention on educational outcomes.

The analysis exploits a 15-year long panel of administrative data, including all the students in the educational system of Chile. For the older cohorts, the whole educational history is available, from first-grade enrollment until high school graduation. The panel can be linked to several national standardized tests at fourth-, sixth-, eighth- and tenth-grade, allowing to measure cognitive ability on mathematics and language and its evolution over time. These national tests include survey information from most parents and students about expectations, self-beliefs, and parental involvement. Finally, test scores from the higher education admission system allows estimating the effects on long-run cognitive ability and higher education enrollment.

At all levels of retention, I find that marginally retained students attain the same level of school than marginally promoted. In contrast to previous literature, the probability of entering high school is not affected by retention in all levels. In the longer run, I estimate zero effects in the graduation rate from high school for all levels of repetition. However, the highest grade level achieved in the educational process decreases by 0.4 years, when they repeat in the first- and the third-grade, while the difference is not significant for second- and fourth-grade repeaters. This evidence indicates that among those who do not graduate from high school, repeaters dropout

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<sup>2</sup>Additionally, some paper use matching methods such as Goos et al. [2013] in Belgium and Im et al. [2013] in Texas.

<sup>3</sup>GPA range from 2 to 7 on intervals of 0.1 points

at earlier grade level.

For the grades where the highest level attained is the same (second and fourth), students stay longer in the educational system (about 0.4 years), and therefore they enter the labor market later. For first- and third-graders, repetition does not imply entering the labor market later, since they stay in the educational system for the same number of years than promoted.

The performance while studying improves for repeaters. Repeaters life-time GPA increases in 0.2 and 0.4 points from a baseline GPA of 5, and is not due to changes in the quality of the school they attend after repetition. Overall attendance also increases for retained students, but the effects are economically irrelevant (increases by 0.5 to 1.5 percentage points from a baseline attendance of 95-98%, one to three days).

The second set of outcomes shows the effects on cognitive achievement using standardized tests at the national level. Marginally retained students score better on the standardized test in the fourth-grade by 0.36-0.42 standard deviations in math, by 0.29-0.46 standard deviations in language, and by 0.31-0.42 in science, regardless the retention level.<sup>4</sup>

These gains are persistent over time up to the tenth grade, between six to nine years after retention. However, the effects depend on the level of repetition. Marginal first-grade repeaters score 0.51, 0.51 and 0.36 standard deviations higher in math in the tests taken at sixth-, eighth- and tenth-grade respectively (the gains are 0.3, 0.38 and 0.34 in language in the respective grades).

A similar situation appears for second-grade repeaters, while the effect in math is close to zero in sixth-grade, it is strong at the eighth- and tenth-grade (0.58 and 0.22). In language, the effects are slightly weaker (0.14, 0.25, and 0.16 in sixth-, eighth- and tenth-grade respectively) and only significantly different from zero in the sixth-grade test.

For repeaters in third-grade, the only significant effect, in the long-run, appears in math in the tenth-grade (0.22 standard deviations). For fourth-grade repeaters, gains in math are positive and sizable in sixth and eighth but turn to be negative in the tenth-grade. In language, they are

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<sup>4</sup>Scores in science were also analyzed with very similar results.

never statistically different from zero.

College admission test scores, taken between eight and ten years after retention, show much weaker effects, but still positive and significant for repeaters in the second-grade in math (0.09sd). Some negative effects for fourth-grade repeaters appear again for the college admission test in language and science.

The standardized tests analyzed used in this paper are taken by students in specific grades, hence, retained and promoted students differ in the age they are at the test (retained are one year older). Despite that retention cannot be applied without affecting the age of the student when she achieve specific grades, it is important to understand how much of the overall effect of retention is due to age maturation and how much comes from the extra instruction in the repeated grade.<sup>5</sup> I explore a two-dimensional RD (2D-RD), to separate the effects of retention from the effects of age. I find that nearly all the effect is due to the extra schooling caused by retention. Specifically, I use the schooling starting age cutoff (SSA-cutoff) as an instrument for age. Students born after the 31st of July of each year can enter first-grade one year later, relative to those born until that day. Students starting school at the age of seven take the standardized test when they are ten years old if they are continuously promoted, while students who start at six take the test also when they are 10 if they repeat a grade level. Students who are (marginally) above both cutoffs can be compared to those who are (marginally) below both cutoffs. The second group enters school one year earlier, but repeat a grade, therefore both take the test at the same age.

Finally, I explore behavioral and psychological outcomes on students and their parents. I find that retained students suffer a negative shock in self-esteem right after retention, which is completely reversed after one year and turns to be positive after two years. Moreover, retained students report having fewer problems understanding the content and focusing during lectures, they also report being more able to complete class notes. From the parents perspective, I find that parents of retained students support their children more, investing time to help their children

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<sup>5</sup>This issue is not a problem for long-run attainment variables described earlier, because attainment is independent of age, i.e., measured at the age of attainment.



(studying, doing homework and completing assignments). Moreover, parents are more involved in the educational progress of their children congratulating good grades, and being aware of the student's marks. These effects on parental investments are still significant in the tenth-grade. Finally, parents also increase their expectations about their children educational attainment in all levels of education, which translates to more expected years of education.

The contributions of this paper are four-fold, showing effects on long-run outcomes, for cognitive achievement and its persistence, for psychological traits and learning experience, and, finally, for parental investments.

Regarding attainment, this paper reinforces recent research results showing that retention does not affect attainment, in the long-run, see for example Schwerdt et al. [2017] and Jacob and Lefgren [2009].<sup>6</sup> However, the evidence presented here expand our understanding on this type of policies since it explores the effects at different levels of retention (first- to fourth-grade) and on different levels of abilities (different GPA-cutoffs), showing that retention at any educational or ability level does not reduce educational attainment. Moreover, this paper goes beyond compulsory education to explore the effects on application to higher education.

Recent papers are more positive about the effects of retention on cognitive achievement. However, they show that these gains disappear in a few years. Contrary to this evidence, this paper is the first showing long-lasting effects on standardized test scores, for students retained at earlier grades. The gains in cognitive achievement last up to 10 years after the application of the policy. Moreover, this paper presents a novel identification to disentangle the effects of retention from the effects of aging, using exogenous variation in school starting age. The paper shows that the effects are mainly driven by the extra year of schooling.

Additionally, this paper contributes to the literature being the first showing (arguably) causal effects of retention on parental investments. Moreover, it shows how parental expectations varied over time, as a consequence of the policy. Finally, the paper presents positive causal effects in psychological traits and the overall school experience.

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<sup>6</sup>Manacorda [2010] studies retention at later grades in Uruguay and he finds that retention in seventh-grade affects enrollment and graduation from high school.

Compared to previous literature, the policy studied here is not confounded with other remedial activities the students receive when they fail promotion. As noted by Schwerdt et al. [2015], the policies typically applied in the US, simultaneously require attending summer school and being assigned to a high-performance teacher, which prevents disentangling the effects. The most typical application of a retention policy, however, implies that students start the specific grade level again. For example, in most European countries, students with learning difficulties are treated with remedial activities before retention, but once retained they go back to normal school activities in the same grade (see Borodankova and Coutinho [2011], p27).

## 2 BACKGROUND

Compulsory education in Chile consists of 12 years divided into three cycles of four years: elementary, middle and high school (primer ciclo básico, segundo ciclo básico and educación media). Most of the students enter the educational system when they are six years old and finish when they are 18.<sup>7</sup>

Yearly, about 260,000 students enroll in first grade and are divided into classes of 23 students on average in 8,300 schools across the country. Schools are divided in public (or municipal), voucher and private schools. However, all of them follow similar the promotion rules.<sup>8</sup> Marks are graded on a scale from 1 to 7 in intervals of 0.1, with a minimum passing mark of 4.

The rules for promotion have been stable over the last 60 years (established first in 1961) and are regulated by national law. Students are promoted when they pass all subjects,<sup>9</sup> and attend 85% of the class-days. If a student fails at most one subject, promotion is granted when the student obtains a GPA of 4.5 or higher, and if the student fails at most two subjects, she is required to have a 5.0 to avoid repetition.<sup>10</sup>

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<sup>7</sup>Chile has alphabetization rates that are similar to developed countries (98.6 in 2015), such as the US and Sweden.

<sup>8</sup>See more details about the Chilean Educational system in Urquiola and Verhoogen [2009].

<sup>9</sup>implying an overall GPA of 4.0 or higher.

<sup>10</sup>A contemporaneous paper, Diaz et al. [2017], uses these promotion rules to study the effects of retention on juvenile crime. In contrast with the present paper, they study retention for older students, from fourth to eighth grade, using a “donut-hole” fuzzy RD analysis, because of the presence of manipulation on the running variable in the grade-levels they study.

In 2002 a modification of the law established automatic promotion for all students in the first and third-grade, but schools were allowed to determine their own rules, and most of them went back to the old promotion scale. Only in 2002, there is no discontinuous variation in the probability of retention at first and third-grades. I will describe the policy effects on the retention probability in Section 5.

The curriculum in each grade is normed by the Ministry of Education, establishing that students receive instruction in nine subjects.<sup>11</sup> All subjects are considered for the GPA calculation, and marks in each of them determined by the subject teacher. In most of the schools, the grade levels considered in this paper are taught by a generalist teacher who evaluates most of the subjects.<sup>12</sup> Students are evaluated continuously throughout the year, and in general, each subject's annual mark considers more than four evaluations. At the end of the year, all marks in all subjects are averaged to determine the GPA and promotion rule is applied. However, the school director can change the promotion status officially informing to the Ministry the reason for the waiver.

In 2003, a law extended the compulsory education from eight to 12 years, which may affect the rate of high school attendance and graduation and other measures. However, all the cohorts studied in this paper achieved the eighth-grade at 2006 or later, therefore, they are not affected by this policy change.<sup>13</sup>

A school year starts at the end of February and lasts until mid-December. For the analyzed period, enrolling in first-grade requires students to be six years old by the 31st of July of the enrollment year. However, each school can choose a different school starting age cutoff stating it officially in the school regulation and informing to the Ministry.<sup>14</sup> In Section 6.3, I show evidence of the application of this rule and use it as an instrument for age.

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<sup>11</sup>Math, Spanish Language and Communication, Science, History and Social Sciences, Physical education and Health, Visual Arts, Technology, Music and English Language.

<sup>12</sup>Specific teachers are more common in Arts, Music, Technology, and English. Starting in fifth grade, subjects are taught by specialized teachers.

<sup>13</sup>In practice, there is no observable change in high school enrollment since 2003.

<sup>14</sup>Since 2017 the cutoff date is the 31st of March and director cannot modify it.

### 3 Data

The data used in this paper corresponds to individual-level administrative records from three different sources. The main source of information corresponds to school performance of the universe of students in the educational system, from the first to the 12th grade. The data is collected by the Ministry of Education of Chile and included the years 2002 to 2016. All schools are mandated by law to report yearly the overall GPA, the attendance rate, and the promotion status for each student. This registry contains information about the gender, the exact date of birth, and the exact classroom of the students. The data consist of 3.5 million individuals observed on average for eight years, the oldest cohort is observed for 15 years.<sup>15</sup>

The second source of information corresponds to the census test SIMCE, performed every year in the country for selected grades: fourth, sixth, eighth and tenth grade. The SIMCE test is the main source of information about school performance in the country and allows comparing performance between schools using a standardized measure.<sup>16</sup>

The SIMCE data contains test scores in mathematics, language, and science, and survey responses for three levels: students, parents, and teachers. Approximately 90% of the students take the test, from which 80% of students and parents respond the survey. I use SIMCE test from 2005 to 2014.

The surveys used in the paper are those containing answers from the students and the parents. Both surveys contain 30 questions, parents are asked about background characteristics, behavior, opinions, feelings, and beliefs, while students are asked about the learning process, school environment, and the interaction with parents. The data is provided by Agencia de la Calidad de la Educación, the agency in charge of measuring the quality of the education in Chile, and depends on the Ministry of Education.

From the data, I extract background characteristics to test the validity of the econometric design, and also potential outcomes of retention. Background question includes time-invariant

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<sup>15</sup>The data is publicly available from the Ministry of Education website.

<sup>16</sup>In this paper all test scores are standardized,  $Z_i = (S_i - \bar{S})/\hat{\sigma}_S$ .

characteristics, such as race, parental education, and pre-school attendance. Also include household features that may vary over time, such income, the ownership of common assets (car, computers, etc.), and the presence of home appliances, however, are highly persistent and offer a good picture of the household quality. SIMCE data has been used for many authors, for example, Bharadwaj et al. [2017] uses information on parental investments, and how students perceive it to study the effects of birth weight on school performance and parental investments.

The third source of information is the scores in the college admission test (Prueba de selección Universitaria, PSU) from the Council of University Chancellors (CRUCH) and the higher education enrollment registry from the Ministry of Education.

As a consequence of grade retention, promoted and retained students take the SIMCE test in different years. Therefore, the performance of students in one cohort will be observed in different years, implying the need for a test in consecutive years. Initially, the SIMCE test in a given grade level was taken every two or three years, and part of the cohort was not observed. SIMCE-fourth started to be taken every year since in 2005, and the same happened for SIMCE 10th-grade in 2012, and for SIMCE 6th- and 8th-grade in 2013.

The requirement of consecutive standardized tests implies that outcomes variables will be measured with different cohorts. In general, variables measured at 4th-grade are observed for all cohorts, but variables at other grade levels will be observed for specific cohorts. For example, assuming that students repeat at most once, we can study the effect of retention at first-grade on 10th-grade SIMCE using first-graders in 2003 (first-grade cohort hereafter), because those who never repeat, achieve 10th-grade in 2012, while retained achieve 10th in 2013. The same is valid for first-grade cohort 2004, promoted achieve 10th in 2013 and retained in 2014, but is not for cohort 2005, since retained achieve 10th in 2015 for which there is no data available. A detailed explanation of how each sample is formed is given in Appendix 1.

For outcomes on long-run attainment, I face a similar problem. The outcomes require a long panel, for example, first-graders require at least 13 years to observe to full educational history, 12 for students that are always promoted, and 13 for those with at most one grade retention.

For retention in fourth-grade, however, eight and nine years are needed.

Nevertheless, some students repeat several times during their educational life and, therefore, a longer panel is needed. I restrict the analysis for cohorts that allow the observation of the outcome with two years of lag. In the worst case, the analysis is restricted to one cohort. For example, studying the effect of first-grade retention on maximum grade-level attained considers the cohort 2003: Students graduating on-time finish their education in 2014, while students that repeat once or twice in 2015 and 2016, respectively. Cohort 2004 cannot be used because twice-repeaters will be observed in 2017, which is not available.

Finally, a survey of parents and of students allow extracting data for expectations, psychological and behavioral outcomes, coming from the SIMCE test performed in fourth-grade. Therefore, the analysis can only be performed for the first to third grades.

This paper focus in retention the first cycle mainly because grades are given by one or two teachers to all students and, therefore it would be difficult to manipulate the grades for some students and not others, which can be perceived as unfair for those retained. Moreover, the conditions for a valid RD are valid.

## 4 IDENTIFICATION STRATEGY

In this paper, I exploit the promotion rules used in the Chilean education system where performance is evaluated on a scale from 1 to 7 in intervals of 0.1 points. The main promotion rule requires that students obtain a 4.5 GPA if the student fails at most one subject.

Consider  $y_i$ , an educational outcome of an individual, which is affected by retention in grade  $g$  the following way

$$y_i = \gamma_0^g + \gamma_1^g \text{Retention}_i^g + \mathbf{X}_i \cdot \gamma + \epsilon_i \quad (1)$$

If students were randomly retained,  $\gamma_1^g$  would be the causal effect of being retained in grade

$g$ . Since retained students are likely to differ in many observable or unobservables ways from those who are not retained, an OLS regression of equation (1) would yield a biased estimate.

The GPA-cutoffs gives exogenous variation in retention because students are not able to completely manipulate their GPA, thus, at a small vicinity of the rule cutoff, students are as good as randomly assigned to grade retention, and we can unbiasedly estimate  $\gamma_1^g$ .

However, the GPA-cutoffs offers a good source of exogenous variation in retention. If students, parents or teachers are not able to completely manipulate the GPA, students in a narrow window around the threshold are as good as randomly assigned to retention. The GPA of the students is a function of intrinsic ability measures, background characteristics, and a random shock (i.e., a random component in each evaluation). Therefore, for equivalent students, the random shock determines her position across the cutoff, and the comparison between students just above and just below the GPA-cutoff gives the causal effect of retention on educational outcomes.

Hahn et al. [2001], Imbens and Lemieux [2008] and Lee and Lemieux [2010] describe the conditions under which RD gives a causal estimation. In general, I following two-stage least squares (2SLS) :

$$y_i = \alpha_0^g + \alpha_1^g Retention_i^g + f(GPA_i^g) + \mathbf{X}_i \cdot \alpha + \epsilon_i \quad (2)$$

$$Retention_i = \beta_0^g + \beta_1^g \mathbb{1}(GPA_i^g \geq 4.5) + f(GPA_i^g) + \mathbf{X}_i \cdot \beta + \epsilon_i \quad (3)$$

Equation (3) captures the, arguably, exogenous change in the retention rate at the 4.5 cutoff, which is equivalent to the change in the probability of retention that happens at the cutoff. Equation 2 uses the exogenous source of retention estimated in Equation 3 to determined the causal effect of retention on educational outcomes

The 2SLS estimates of  $\alpha_1^g$  gives the local average causal effects, LATE, on educational outcomes of being barely retained at grade  $g$  for compliers, i.e., students that are retained when they

score below the cutoff but would have been promoted if they score 4.5 or more. I focus on the rule at 4.5 GPA-points because it is consistent through time and grade levels, but I also use the other two rules to explore heterogeneity by student ability.

One problem with the estimation in this setting is that the running variable, the distance to the GPA-cutoff, is discrete in intervals of 0.1 points, implying that even when the number of observations goes to infinity, there will be no observations below the cutoff for windows smaller than 0.1. As a consequence, robust standard errors would ignore the group structure of the data and will underestimate its true value. Lee and Card [2008] suggest clustering the standard errors by the discrete value of the running variable to account for the imperfect fit of the parametric function away from the threshold. All regression presented here will use standard errors using this procedure.

Moreover, the existence of the other two cutoffs, at 4.0 and 5.0, implies that the parametric functional form away from the 4.5 GPA cutoff needs to include the potential changes in the probability of retention at those thresholds. Instead of adding a more complex parametric function, I restrict the analysis to the window  $GPA \in [4.0, 5.0)$ , which includes 5 points of support to each side of the cutoff. Thus, the other cutoffs do not affect the estimation at 4.5.<sup>17</sup> All regression in the paper uses this same window and local linear regressions.

## 5 VALIDITY OF THE RD

In this section, I test the validity of the regression discontinuity design. Following Imbens and Lemieux [2008], I perform three tests to show that the rules described earlier create exogenous variation in grade retention: the first stage, the balance of covariates and the McCrary test. Figure 1 shows that the probability of being retained decreases discontinuously at the cutoff of 4.5 GPA-points. The four graphs show the retention rules applied in first to fourth grade. Very similar patterns emerge in each grade level, jumps of 25 to 30 percentage points depending on

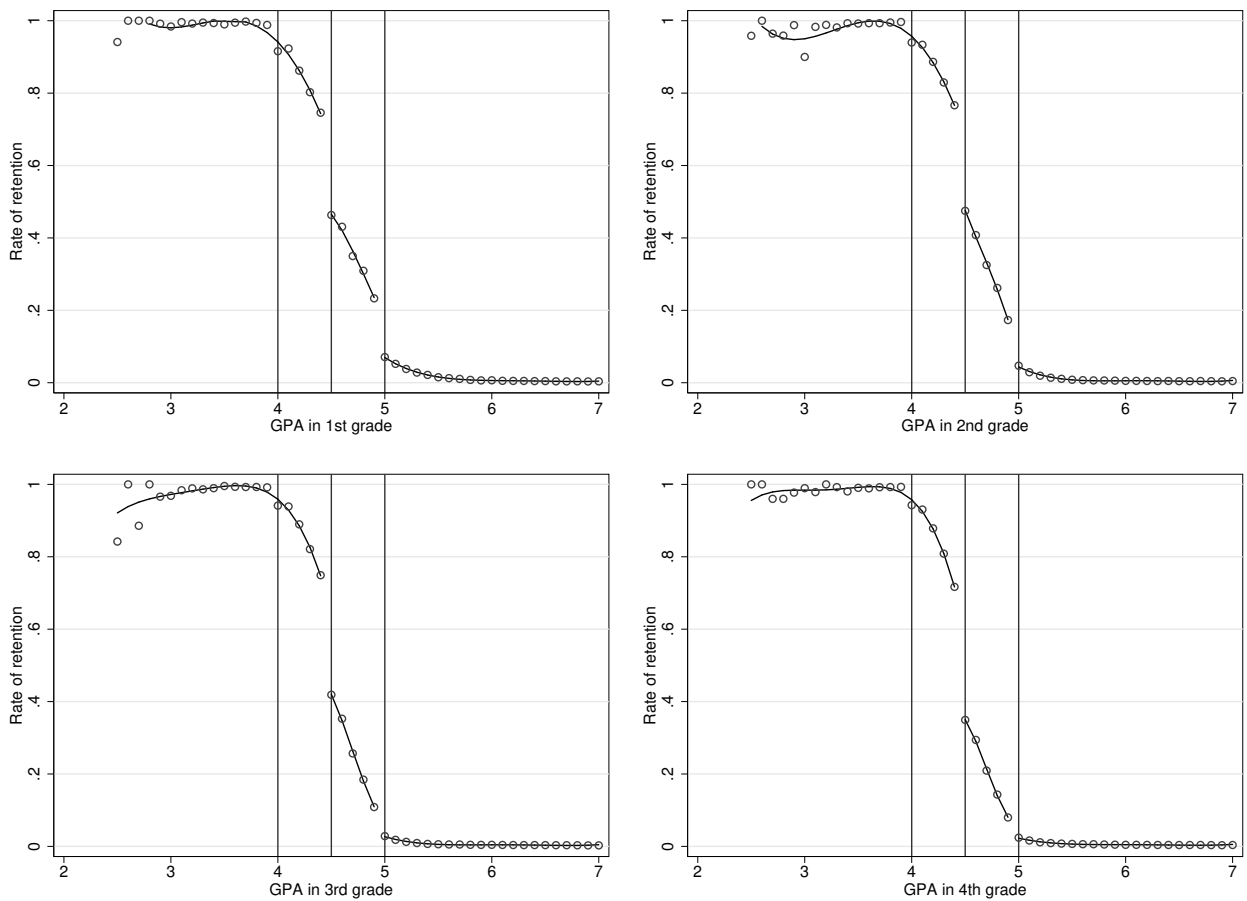
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<sup>17</sup>Robustness check, including different bandwidths and different specifications of the local regression gives essentially the same results, but are omitted as a simplification.



the level of repetition. In the figures, dots represent the promotion rate among students within bins of 0.1 GPA-points. For example, in the upper left figure, the dot at the vertical line in 4.5 shows that 50% of the students scoring exactly 4.5 were retained in first-grade. Among who score 4.4 points the retention rate is 75%. In first and second-grades the underlying retention function is also discontinuous at 4.0 and 5.0 GPA-points, however, I will focus in the effects at 4.5 points mainly because, first, it produces the greatest jump in the retention rate, and second, because produces an exogenous change in all four grades.<sup>18</sup>

Figure 1: First Stage by grade. All sample



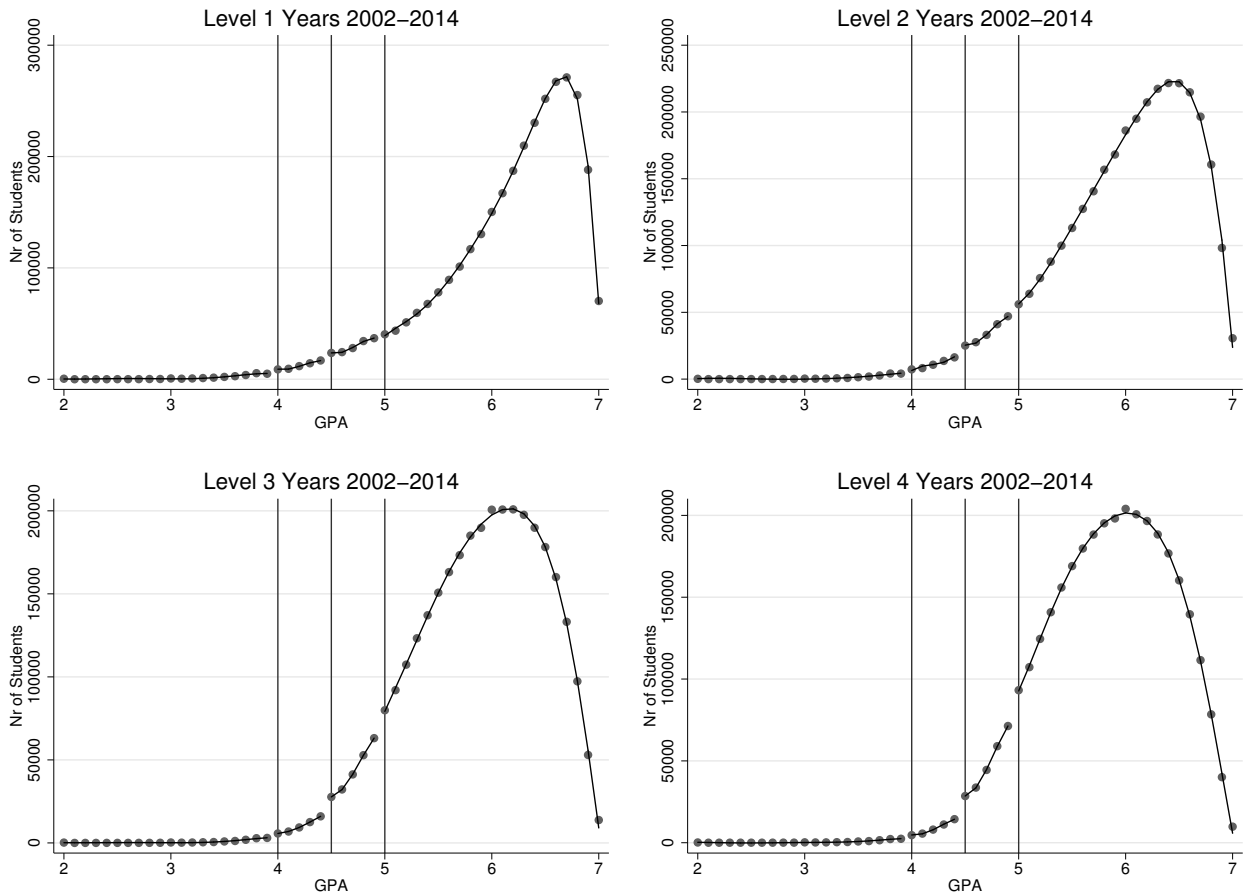
**Note:** Each dot represents the rate of retention among students scoring specific GPAs in bins of 0.1 points. The vertical lines represent the promotion cutoffs: 4.0, 4.5 (the one used in the paper) and 5.0 for students with zero, one, and two failed subjects, respectively.

Second, Figure 2 shows the empirical density of students by GPA for the four grades invol-

<sup>18</sup>Similar educational results appear for the other cutoffs, results are available upon request.

ved. The density looks continuous, i.e., there is no sizable bunching at either side of the cutoff, indicating that students, parents or teachers are no able to completely manipulate the GPA score to be promoted. Additionally, from these graphs, we observe that the margin of students affected by this rule is at the bottom of the ability distribution.

Figure 2: Empirical Distribution of promoted students.



**Note:** Each dot represents the number of students scoring specific GPAs in bins of 0.1 points. The vertical lines represent the promotion cutoffs (see the previous figure note).

Finally, Table 1 compares “pre-determined” characteristics between “treatment” and “control” group. The covariates analyzed in the table are measured ex-post, they come from the survey to parents collected with the SIMCE test in fourth-grade, three to one year after students were exposed to the treatment, therefore they can potentially be affected retention.

However, there still many variables that are time-invariant and others that vary little and are not likely to be affected by retention. Examples of time-invariant are race and parental edu-

cation, and pre-school attendance. Examples of stable characteristics are family assets, family size, and parental income.

Each regression corresponds to 2SLS estimates as in 2 and 3, where the dependent variable is the characteristic. The first column corresponds to the characteristic average for students who score just below the cutoff, column (2) shows the size of the jump at the cutoff and column (3) shows the standard error of the jump. The following columns repeat this order.

Table 1: Balance of covariates

	First Graders			Second Graders			Third Graders		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Response rate	0.59	0.12	(0.1)	0.65	0.06	(0.04)	0.71	0	(0.05)
Family income	195.25	-5.21	(33.11)	186	19.44	(43.02)	192.77	14.02	(81.41)
No. of books at home	26.37	6.19	(2.79)**	27.46	6.13	(3.32)***	30.33	1.75	(6.23)
Internet at home	0.16	0.01	(0.09)	0.16	0.02	(0.13)	0.14	0.06	(0.22)
Computer at home	0.3	0.02	(0.11)	0.29	0.06	(0.15)	0.27	0.1	(0.26)
Have DVD player	0.58	-0.02	(0.18)	0.54	0.08	(0.08)	0.54	0.07	(0.18)
Telephone	0.24	-0.05	(0.07)	0.23	0.02	(0.03)	0.26	-0.03	(0.03)
Cable TV	0.25	0.01	(0.21)	0.2	0.09	(0.04)**	0.21	0.08	(0.18)
Car	0.14	0.08	(0.05)	0.14	0.08	(0.02)***	0.15	0.07	(0.05)
Microwave	0.29	0.09	(0.15)	0.31	0.05	(0.03)	0.33	0.04	(0.15)
Water heater	0.4	-0.01	(0.18)	0.36	0.1	(0.03)***	0.42	0.05	(0.14)
Shower	0.84	-0.03	(0.14)	0.85	0	(0.05)	0.89	-0.06	(0.07)
Household size	5.65	0.04	(0.28)	5.5	0.24	(0.19)	5.53	-0.01	(0.41)
Father years of Educ.	7.26	-0.16	(1.89)	7.76	-0.69	(1.76)	7.91	-0.52	(2.69)
Mother years of Educ.	7.76	-0.74	(1.7)	7.78	-0.51	(1.94)	7.84	-0.14	(2.94)
Mother no indigenous	0.85	-0.01	(0.04)	0.88	-0.02	(0.03)	0.88	-0.03	(0.02)***
Father no indigenous	0.88	-0.04	(0.04)	0.85	0.04	(0.04)	0.89	-0.02	(0.02)
Preschool	0.68	0.03	(0.39)	0.69	0.02	(0.07)	0.67	0.05	(0.44)
Kinder	0.52	0.03	(0.33)	0.53	0.01	(0.15)	0.52	0.05	(0.29)
Pre-Kinder	0.43	0.04	(0.21)	0.44	0.03	(0.09)	0.43	0.04	(0.3)
Day care	0.1	0.03	(0.04)	0.13	-0.03	(0.06)	0.13	-0.01	(0.06)

**Note:** This table shows fuzzy regression discontinuity regressions for covariates reported in the parent survey in fourth-grade. Column (1) shows the average characteristics for compilers below the cutoff in first-graders, column (2) the change on the characteristics for barely promoted students, and column (3) the standard deviation of the latter. Columns (4) to (6) repeat the structure for second-graders, and columns (7) to (9) for third-graders. Retention is instrumented with an indicator of having a GPA equal to or greater than 4.5 points for the three grades. All regressions include a linear control function for the running variable for each size of the cutoff and are estimated over a window of .5 GPA points at each side of the threshold. All regression use all the years available in the data and depend on the years when the questions were asked. See more in the appendix.

(\*):  $p$ -value  $\leq .1$ ; (\*\*):  $p$ -value  $\leq .05$ ; (\*\*\*):  $p$ -value  $\leq .01$ . Standard errors are clustered at the running variable.

This table indicates that students at the margin of retention come from low socioeconomic backgrounds, as measured by the family income and parent education. On average, parents that do not complete middle school (8th-grade) and have family income just above the minimum wage. Most characteristics appear to be balanced across the cutoff. The greatest difference occurs with the number of books at home, which is significantly different from zero at the cutoff in first and second-grade. However, all the difference indicates that retained students come from richer households, indicated by a having more books, owning a car and some other assets. For retention in third-grade, the groups differ in the race of the mother, retained are more indigenous. It is a worrisome sign of manipulation, perhaps a sign of racial discrimination. Nevertheless, is the only variable with this type of problems of the 21 analyzed.

The three tests are passed, and therefore, the condition for a valid RD are satisfied.

## 6 MAIN RESULTS

I present four sets of results on educational attainment, cognitive achievement, parental investment, and psychological measures. First, educational attainment considers medium and long-run educational outcomes such as high school attendance, high school graduation, the maximum level attained, and years in school. Second, cognitive measures in math and language using the SIMCE tests at fourth-, sixth-, eighth- and tenth-grade, plus scores in the college admission test for the subset of students that graduate from high school and choose to write the test. Third, parental investments, consider time investments and involvement in the educational process and also includes expectations about school attainment in fourth and tenth-grade. Finally, I present psychological measures of personality traits and health, including self-confidence and the overall learning satisfaction for students in fourth-grade.

All estimates correspond to the effect of being retained on the outcome, estimated by 2SLS as in equations (2) and (3) including local linear regression at both sides of the cutoff, over a bandwidth of 0.5 points, including cohort fixed effects, and controls variables.<sup>19</sup> The standard

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<sup>19</sup>Controls are gender, age at retention, number of students in the class and type of school.

errors are clustered at the running variables (for more details see Section (4)). The interpretation of the coefficients is the usual for the RD, i.e., is it the difference between students that scored just below the cutoff and students that scored at or barely above. I will abstract from these conditions and refer to the comparison of retained and promoted.

## **6.1 EDUCATIONAL ATTAINMENT**

Table 2 shows the effects of retention for the four levels of retention (from column (1) to (4)) on four outcomes: high school enrollment, high school graduation, maximum level attained, and years in the educational system. Panel A, indicates that retained students are equally likely to enroll in high school as promoted. Panel B shows that there is no difference in high school graduation either.

Panel C shows the effects on the highest educational level attained. Retained students attain about 0.5 grade levels less education than promoted in first and third, and no effect for second and fourth. The result is puzzling, but is consistent with the following outcome where the number of years in the educational system increases for students in second and fourth, while is the same for first and third.

For these students in second and fourth, we can say that the age of entry to the labor market differs in six months or zero. If the effect is sizable may be detected using income data.

## **6.2 COGNITIVE ACHIEVEMENT**

The second set of outcomes shows the effects on cognitive ability using the census tests SIMCE in math and reading (Section (3) describe the details), in fourth, sixth, eighth, and tenth grade. Additionally, the results on scores on the college admission test, are conditional to graduating from high school and writing the test.

Table 2: Long term educational achievement. By level of repetition.

	1st (1)	2nd (2)	3rd (3)	4th (4)
<u>A. Enrollment in High School</u>				
Retained at	0.016 (0.038)	0.0052 (0.010)	-0.026 (0.015)	-0.017 (0.015)
Obs.	68,004	96,885	134,139	165,642
<u>B. Graduation from High School</u>				
Retained at	-0.074 (0.054)	-0.011 (0.028)	0.021 (0.016)	-0.00094 (0.0097)
Obs.	16,151	59,675	66,273	123,336
<u>C. Maximum level attained</u>				
Retained at	-0.43** (0.18)	0.050 (0.13)	-0.54*** (0.091)	-0.11 (0.12)
Obs.	16,151	59,675	66,273	123,336
<u>D. Years in the Educational System</u>				
Retained at	-0.070 (0.19)	0.49** (0.19)	-0.22 (0.17)	0.26* (0.13)
Obs.	16,151	59,670	66,264	123,312
Controls	x	x	x	x
Cohort-Year FE	x	x	x	x

**Note:** This table shows fuzzy regression discontinuity regressions, where retention is instrumented with an indicator of having a GPA equal to or greater than 4.5 points. All regressions include local linear regression at both sides of the cutoff, estimated over a window of .5 GPA points to each side. Column (1) to (4) show retention in first- to fourth-grade respectively. The sample used in each column correspond to the cohort(s) that can attain the educational variable in an interval of three years. Retention in first grade Panel A uses first-graders between 2002 and 2005. Panel B students second-graders between 2003 to 2006, Panel C, third-graders between 2004 and 2007 and Panel D fourth-graders between 2005 to 2008.

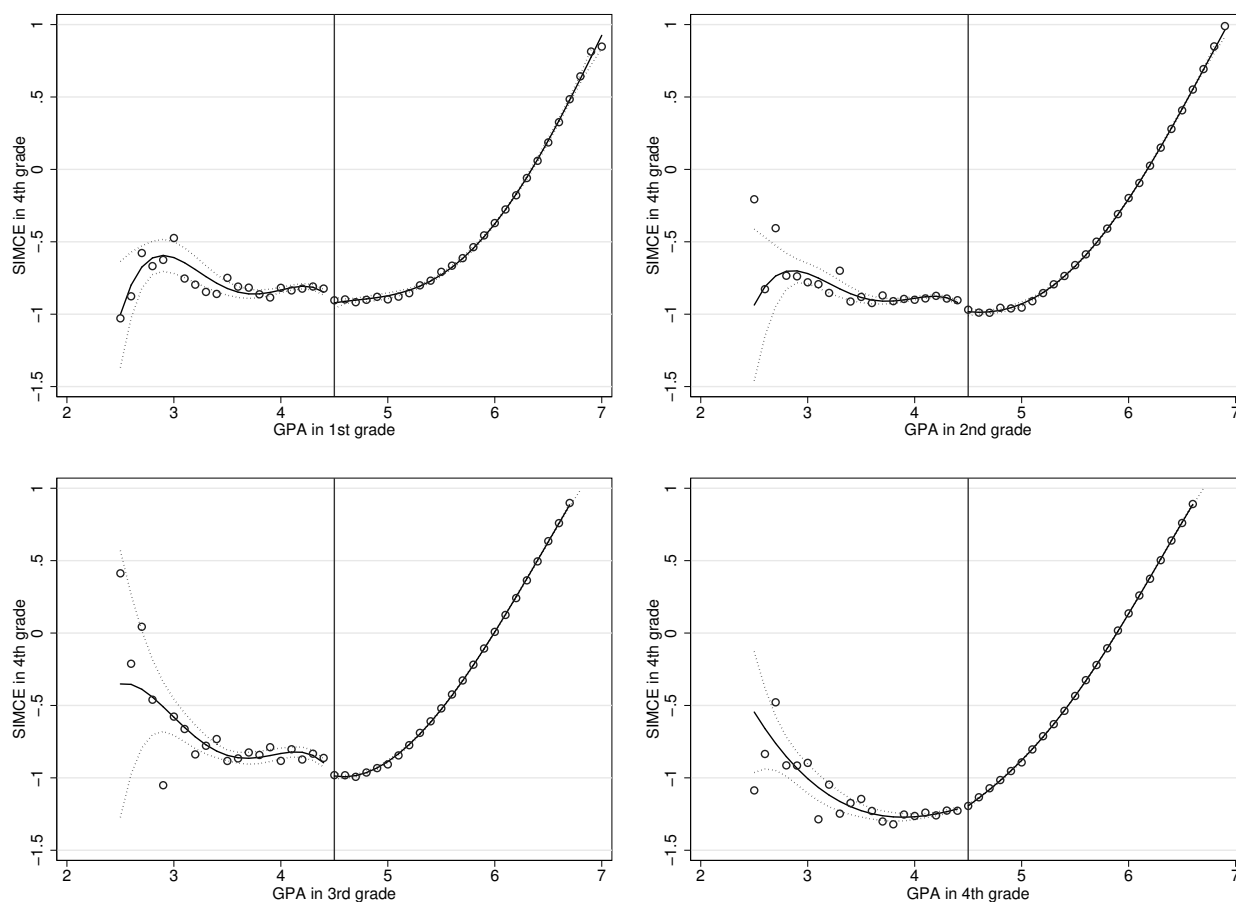
\*:  $p$ -value  $\leq .1$ ; \*\*:  $p$ -value  $\leq .05$ ; \*\*\*:  $p$ -value. Standard errors are clustered at the running variable.

Graphs in Figure 3 gives an interesting perspective on the problem. It shows the relationship between test scores and the instrument, the GPA-cutoff (the reduced form), showing the relation for the whole GPA domain. The effects can be noticed by small bumps in the first three figures at the cutoff. The 2SLS estimated in the formal analysis correspond to the reduced form coefficient

(the size of the bump) divided by the first stage, which is about 0.25. The figure contains fitted values from the estimation of a fourth order polynomial and 95% confidence intervals.

The bottom-right figure corresponds to the fourth grade, where SIMCE scores are determined before retention. Thus, the fourth grade serves as a placebo test. The only figure without the bump is exactly the placebo. In this figures, we observed that the margin of retention is established around students who score one standard deviation below the average.

Figure 3: Cognitive ability



Figures 4 to 7 contain close-ups of the situation. The figures restrict the analysis to the same bandwidth used in the regression analysis below. Moreover, it presents linear fits and confidence intervals to match the specification in the regression analysis. The size of the bubbles reflects the number of observations in each bin. In general, Figure 4 and 5 show jumps of 0.1 standard deviations for all tests, implies a causal effect of about 0.4 standard deviations, considering the

first stage. Figure 6 about third-grade retention shows weaker effects but still mostly positive and significant. Finally, Figure 7 starts with the placebo test in the top left figure. Since then, the effects appear in sixth-grade but become zero in 8th and 10th.

Figure 4: The effect of retention in 1st-grade on cognitive achievement in different grades (closed up).

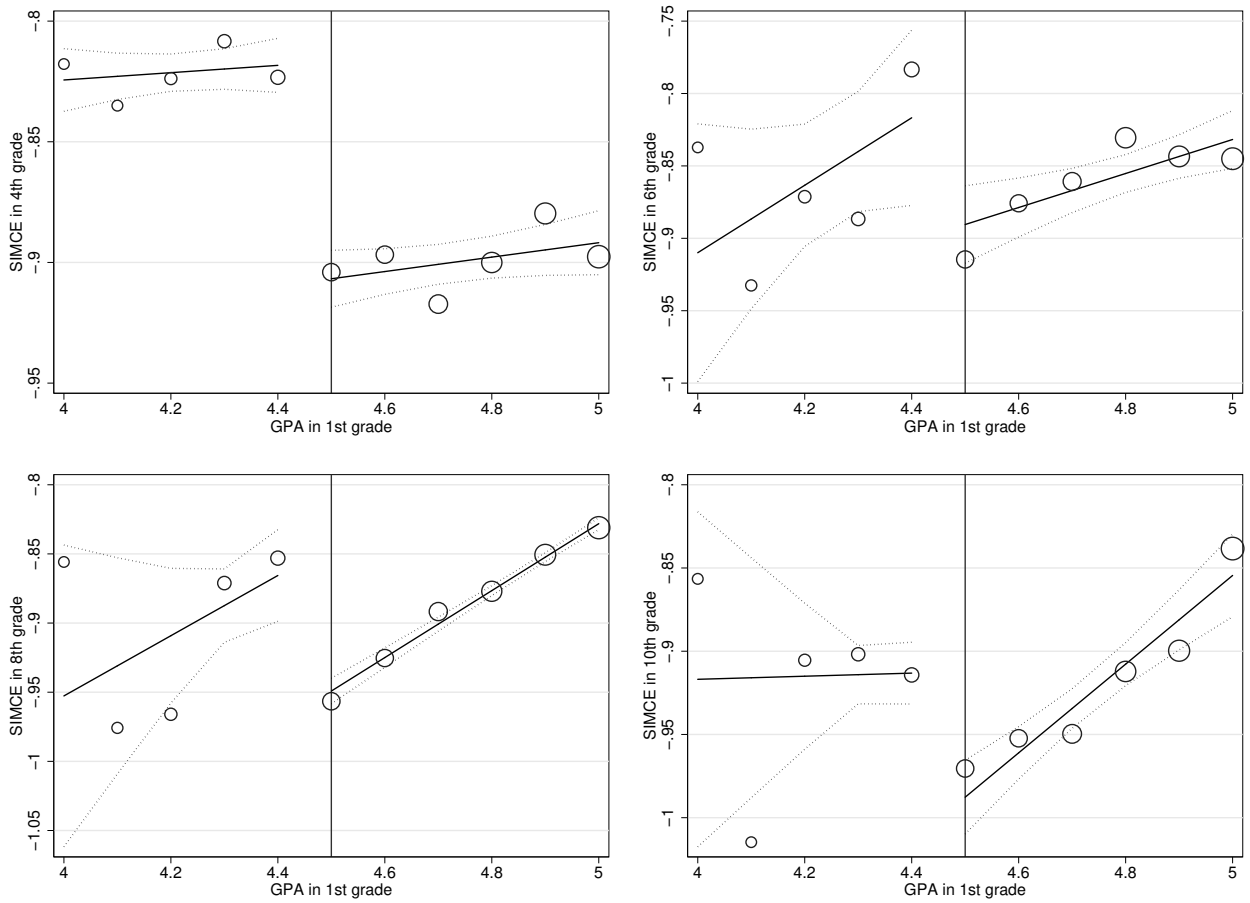




Figure 5: The effect of retention in 2nd-grade on cognitive achievement in different grades (closed up).

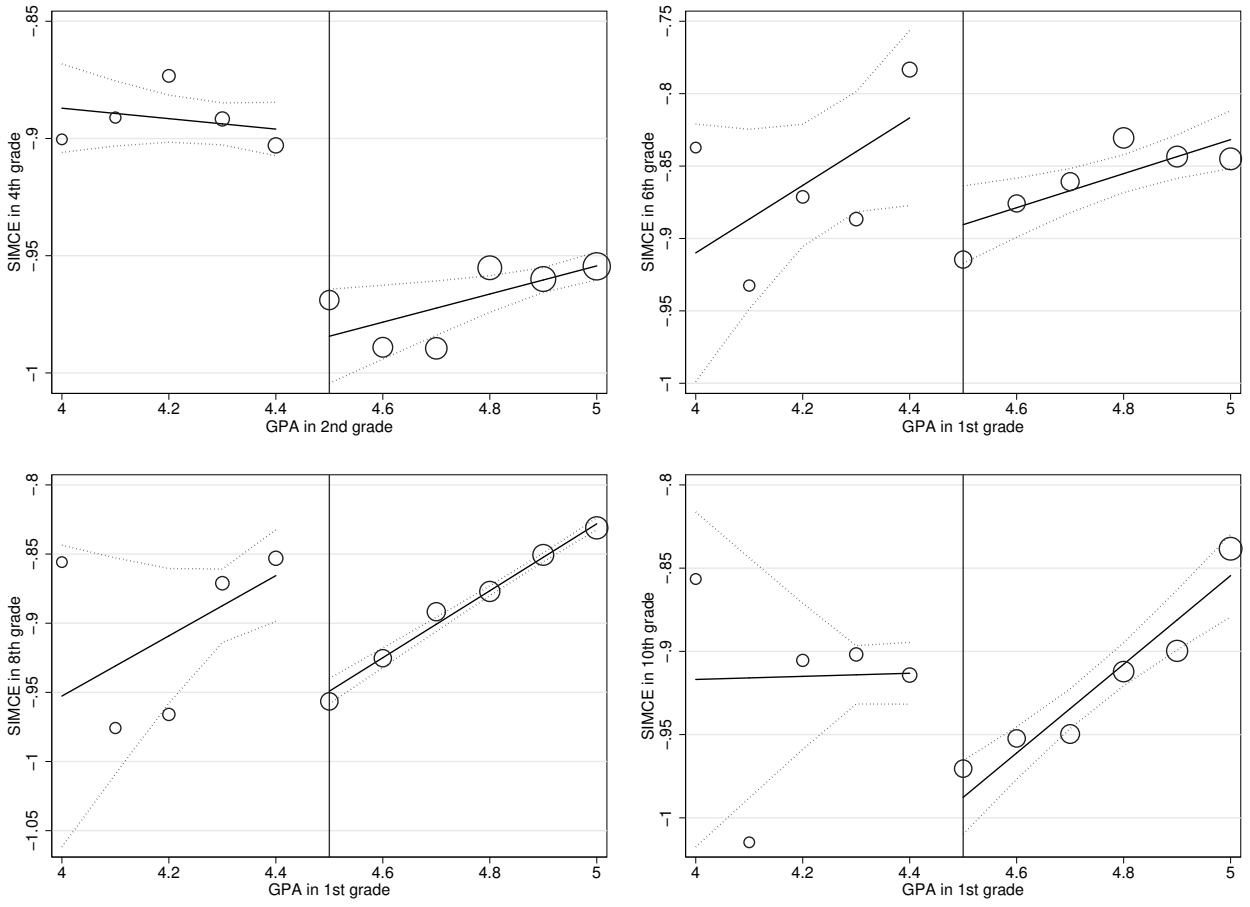


Figure 6: The effect of retention in 3rd-grade on cognitive achievement in different grades (closed up).

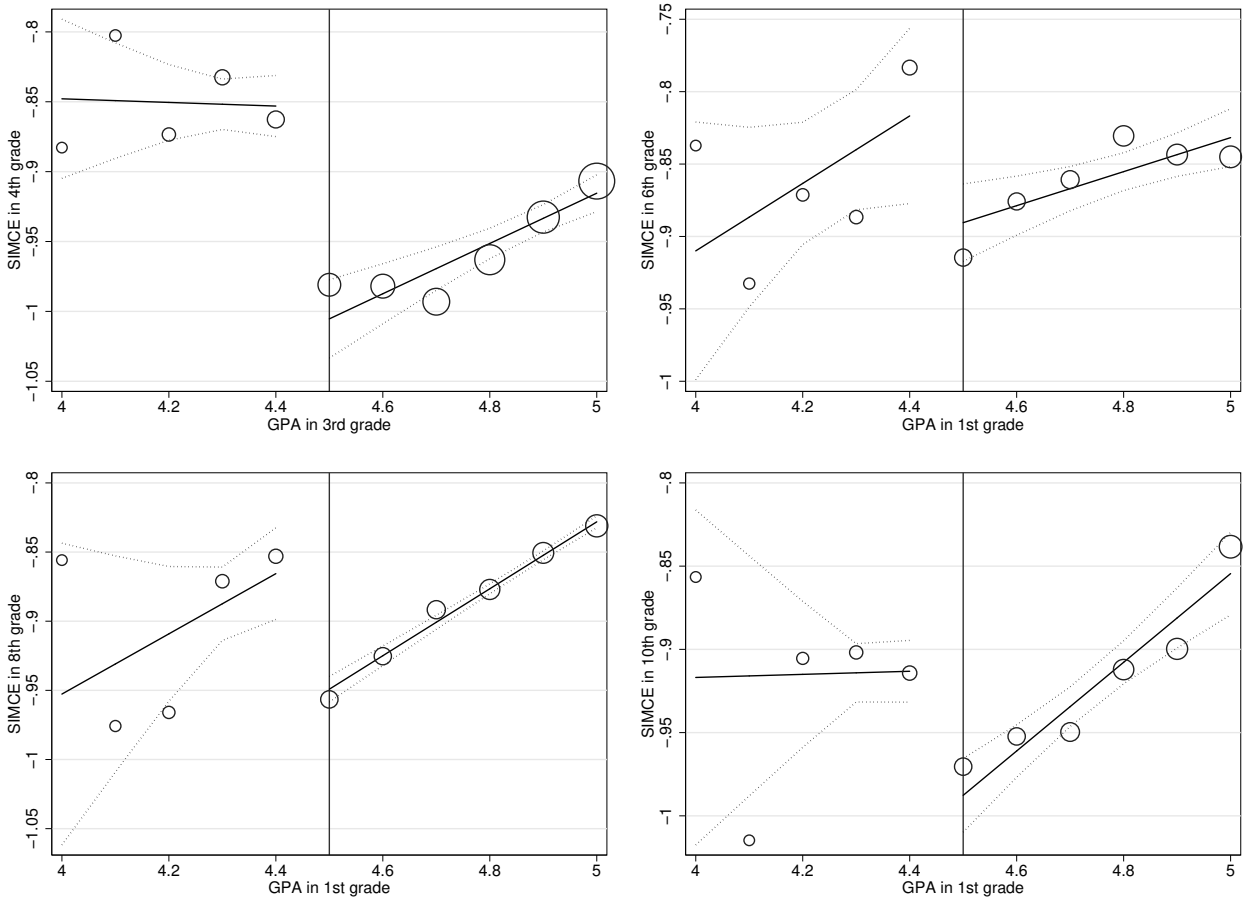
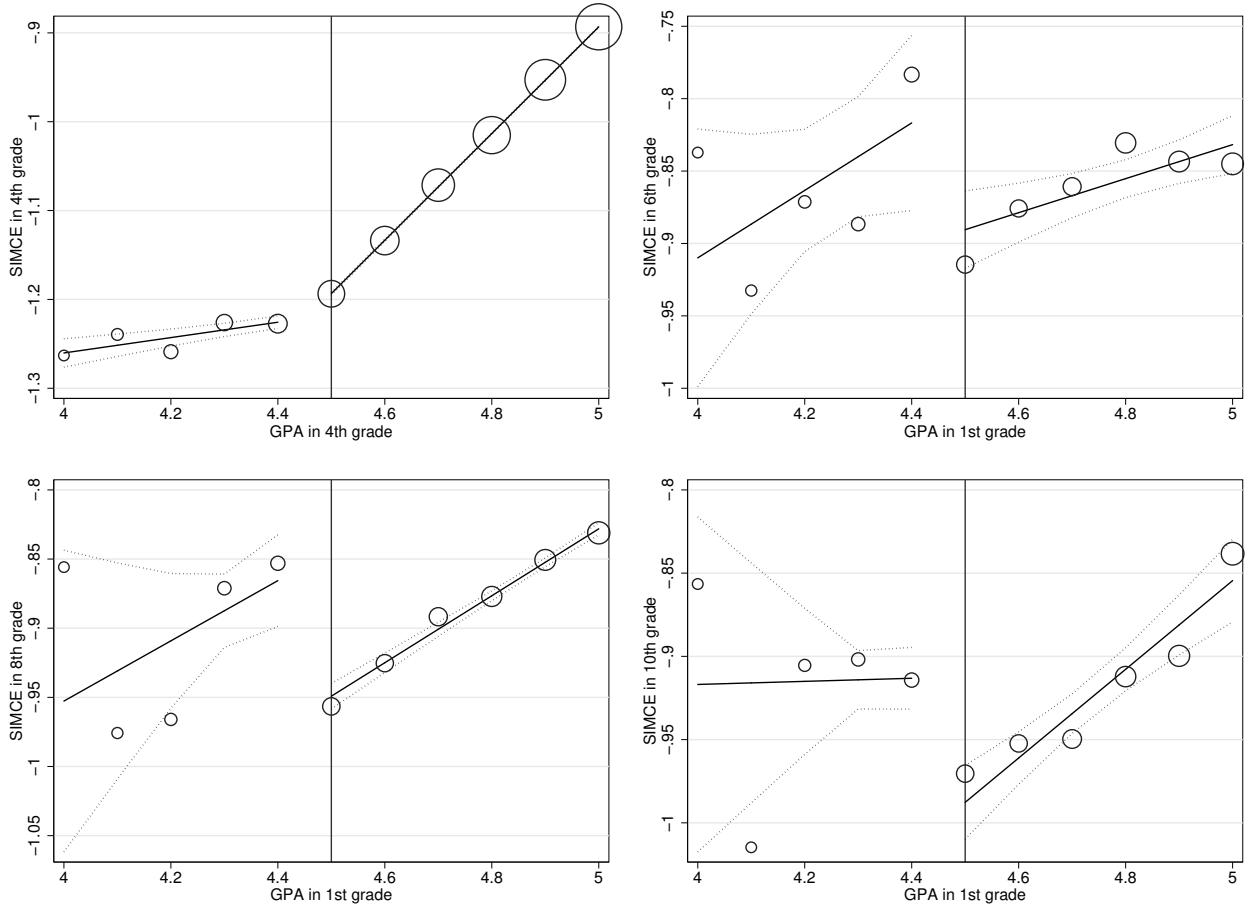


Figure 7: The effect of retention in 4th-grade on cognitive achievement in different grades (closed up).



More formally, tables 3 to 6 show regression equivalent results. Table 3 presents the effects for first-grade retention in SIMCE scores over time. The first column presents the average SIMCE in math and reading, the main two tests. Columns (2) and (3) disaggregate into math and reading, and columns (4) and (5) describes attrition.

Table 3 shows that retention implies a persistent effect of about 0.5 standard deviations regarding the average SIMCE scores. The standard errors of the scores at tenth-grade are high enough to prevent the rejection of a zero effect, but the size of effects are stable.

Some problems are affecting these estimates. In three out of four cases, the number of people taking the test is not balanced across the GPA-cutoff (see column (4)). Column (5) explains in part this attrition. Retained students are more likely to drop out as early as in fourth-grade. In

the SIMCE tests at 4th and 6th, the percentage of test-attrition is about the same magnitude to the one on grade-attrition or dropping out. Attrition occurring at the 8th grade appears more random. Finally, attrition appears with the opposite sign in 10th. In any case, the effects are always about 0.5 standard deviations.

Table 3: Effect of Retention in First-Grade on SIMCE scores.

	Average Simce	Math	Language	Take the test	Enroll in grade
	(1)	(2)	(3)	(4)	(5)
<b>A. SIMCE 4th-grade</b>					
Retained at 1st	0.43*** (0.020)	0.37*** (0.053)	0.43*** (0.038)	0.060*** (0.012)	0.057*** (0.013)
Obs.	85,107	82,674	82,811	132,917	132,917
<b>B. SIMCE 6th-grade</b>					
Retained at 1st	0.58*** (0.12)	0.60*** (0.039)	0.46** (0.17)	0.089* (0.045)	0.11** (0.039)
Obs.	7,508	7,815	7,811	16,679	16,679
<b>C. SIMCE 8th-grade</b>					
Retained at 1st	0.66*** (0.050)	0.56*** (0.056)	0.54*** (0.079)	0.00073 (0.100)	0.029 (0.044)
Obs.	5,985	6,355	6,235	17,098	17,098
<b>D. SIMCE 10th-grade</b>					
Retained at 1st	0.51 (0.49)	0.70 (0.49)	0.19 (0.37)	-0.029** (0.0095)	0.10** (0.034)
Obs.	4,630	4,964	4,840	34,755	34,755
Controls	x	x	x	x	x
Cohort FE	x	x	x	x	x

**Note:** Fuzzy RDs. Retention is instrumented with an indicator of having a GPA equal to or greater than 4.5 GPA-points. Columns (1) to (3) consider standardized SIMCE scores. All regressions include a local linear regression for each side of the cutoff using students with (GPA-4.5) strictly lower than 0.5. The last two columns show the probability of taking the SIMCE test compliers and have ever achieved fourth-grade for the. Panel A uses cohorts 2003 to 2010. Panel B restricts the sample to the 2008 cohort, Panel C to cohort 2006, and Panel D, cohorts 2003 and 2004 (See Section 3)

(\*):  $p$ -value  $\leq .1$ ; (\*\*):  $p$ -value  $\leq .05$ ; (\*\*\*):  $p$ -value  $\leq .01$ . Standard errors are clustered at the running variable.

Among second-graders in Table 4, a similar situation unveil, retained students score between

.02 and 0.7 standard deviations better than promoted students.<sup>20</sup> The results are positive for the four SIMCE levels, although not significant for the SIMCE-6th. Interestingly, is significantly positive at the 5% in the tenth-grade. Attrition appears to be a lesser of a problem here since only is not balanced in the 4th grade SIMCE.

Table 4: Effect of Retention in Second Grade on SIMCE scores.

	Average Simce	Math	Language	Take the test	Enroll in grade
	(1)	(2)	(3)	(4)	(5)
<b>A. SIMCE 4th-grade</b>					
Retained at 2nd	0.33*** (0.036)	0.30*** (0.053)	0.28*** (0.038)	0.064** (0.027)	-0.0020 (0.0069)
Obs.	112,132	109,011	109,271	162,126	162,126
<b>B. SIMCE 6th-grade</b>					
Retained at 2nd	0.021 (0.044)	0.079 (0.064)	0.044 (0.077)	0.022 (0.049)	0.038 (0.024)
Obs.	8,668	9,042	9,045	16,650	16,650
<b>C. SIMCE 8th-grade</b>					
Retained at 2nd	0.71** (0.21)	0.62* (0.28)	0.36 (0.23)	0.0051 (0.030)	-0.033 (0.048)
Obs.	7,318	7,784	7,666	18,427	18,427
<b>D. SIMCE 10th-grade</b>					
Retained at 2nd	0.41** (0.12)	0.73*** (0.094)	0.067 (0.23)	-0.038 (0.022)	-0.0074 (0.023)
Obs.	5,731	6,121	5,988	37,134	37,134
Controls	x	x	x	x	x
Cohort FE	x	x	x	x	x

**Note:** Fuzzy RDs. Retention is instrumented with an indicator of having a GPA equal to or greater than 4.5 GPA-points. Columns (1) to (3) consider standardized SIMCE scores. All regressions include a local linear regression for each side of the cutoff using students with (GPA-4.5) strictly lower than 0.5. The last two columns show the probability of taking the SIMCE test compliers and have ever achieved fourth-grade for the. Panel A uses cohorts 2003 to 2011. Panel B restricts the sample to the 2009 cohort, Panel C to cohort 2007, and Panel D, cohorts 2004 and 2005 (See Section 3)

(\*):  $p$ -value  $\leq .1$ ; (\*\*):  $p$ -value  $\leq .05$ ; (\*\*\*):  $p$ -value  $\leq .01$ . Standard errors are clustered at the running variable.

Table 5 shows that the effects on third-grade are weaker. The effects are only significant

<sup>20</sup>Considering that the SIMCE test is taken in June, retained students take the test 1.5 years after being retained, while promoted, only 0.5 years.

in the short run, the next year, and never different from zero since 6th-grade. Some negatives effects appear for language, but in math, the effects are significantly positive even in the tenth-grade.

Table 5: Effect of Retention in Third Grade on SIMCE scores.

	Average Simce	Math	Language	Take the test	Enroll in grade
	(1)	(2)	(3)	(4)	(5)
<b>A. SIMCE 4th-grade</b>					
Retained at 3rd	0.43*** (0.035)	0.39*** (0.034)	0.42*** (0.044)	-0.034** (0.013)	-0.039*** (0.010)
Obs.	144,077	140,172	140,411	194,626	194,626
<b>B. SIMCE 6th-grade</b>					
Retained at 3rd	0.0072 (0.049)	0.098 (0.11)	-0.11** (0.039)	-0.11** (0.037)	-0.068*** (0.020)
Obs.	12,793	13,338	13,354	21,055	21,055
<b>C. SIMCE 8th-grade</b>					
Retained at 3rd	-0.17 (0.17)	-0.14 (0.098)	-0.15 (0.20)	0.099 (0.069)	0.16*** (0.013)
Obs.	10,253	10,893	10,749	22,059	22,059
<b>D. SIMCE 10th-grade</b>					
Retained at 3rd	0.090 (0.052)	0.18** (0.066)	-0.097** (0.040)	-0.081*** (0.024)	0.088*** (0.020)
Obs.	8,730	9,344	9,156	45,807	45,807
Controls	x	x	x	x	x
Cohort FE	x	x	x	x	x

**Note:** Fuzzy RDs. Retention is instrumented with an indicator of having a GPA equal to or greater than 4.5 GPA-points. Columns (1) to (3) consider standardized SIMCE scores. All regressions include a local linear regression for each side of the cutoff using students with (GPA-4.5) strictly lower than 0.5. The last two columns show the probability of taking the SIMCE test compliers and have ever achieved fourth-grade for the. Panel A uses cohorts 2004 to 2012. Panel B restricts the sample to the 2010 cohort, Panel C to cohort 2008, and Panel D, cohorts 2005 and 2006 (See Section 3)

(\*):  $p$ -value  $\leq .1$ ; (\*\*):  $p$ -value  $\leq .05$ ; (\*\*\*):  $p$ -value  $\leq .01$ . Standard errors are clustered at the running variable.

Table 6 start with the placebo at fourth-grade and continues with effects at 6th, 8th, and 10th. Reassuringly, placebos are all zero. Attrition appears problematic here as well, since is not balanced in three out of four levels of treatment. As before, the attrition is mainly explained for

early dropouts.

Interestingly, the 10th-grade SIMCE indicates a negative effect for retained in math and reading, while they were still positive in 6th and 8th-grade, especially in math.

Table 6: Effect of Retention in Fourth Grade on SIMCE scores.

	Average Simce	Math	Language	Take the test	Enroll in grade
	(1)	(2)	(3)	(4)	(5)
<b>A. SIMCE 4th-grade</b>					
Retained at 4th	-0.019 (0.027)	-0.0064 (0.013)	-0.0058 (0.037)	0.065*** (0.0060)	0 (.)
Obs.	155,417	151,015	151,170	198,170	198,170
<b>B. SIMCE 6th-grade</b>					
Retained at 4th	0.032 (0.044)	0.16*** (0.019)	-0.12 (0.088)	-0.038 (0.064)	0.081** (0.025)
Obs.	12,030	12,601	12,629	18,685	18,685
<b>C. SIMCE 8th-grade</b>					
Retained at 4th	0.37** (0.13)	0.44*** (0.093)	0.20 (0.14)	-0.11*** (0.031)	-0.0016 (0.047)
Obs.	9,669	10,294	10,140	20,032	20,032
<b>D. SIMCE 10th-grade</b>					
Retained at 4th	-0.24** (0.074)	-0.33** (0.13)	-0.12 (0.15)	-0.096*** (0.013)	-0.0031 (0.011)
Obs.	9,376	10,009	9,829	45,274	45,274
Controls	x	x	x	x	x
Cohort FE	x	x	x	x	x

**Note:** Fuzzy RDs. Retention is instrumented with an indicator of having a GPA equal to or greater than 4.5 GPA-points. Columns (1) to (3) consider standardized SIMCE scores. All regressions include a local linear regression for each side of the cutoff using students with (GPA-4.5) strictly lower than 0.5. The last two columns show the probability of taking the SIMCE test compliers and have ever achieved fourth-grade for the. Panel A uses cohorts 2005 to 2011. Panel B restricts the sample to the 2011 cohort, Panel C to cohort 2009, and Panel D, cohorts 2006 and 2007 (See Section 3)

(\*):  $p$ -value  $\leq .1$ ; (\*\*):  $p$ -value  $\leq .05$ ; (\*\*\*):  $p$ -value  $\leq .01$ . Standard errors are clustered at the running variable.

Table 7 shows the effect on the college admission test, and therefore are conditional on graduation from high school. As long-term educational outcomes, the score on the college admission requires a long panel and can only be properly studied with one to few cohorts depending

on the grade. As a consequence, the sample sizes are lower, and the estimates are less precise. This evidence presents an additional complication, PSU test scores are conditional to graduation from high school and whether the student takes the test.

Table 7: The Effect of Retention in the College Admission Test.

	Average PSU (1)	Math (2)	Language (3)	Take the test (4)
Retained at 1st	-1.20 (0.68)	-0.45 (0.62)	-1.78** (0.61)	-1.75** (0.57)
Obs.	841	843	867	1,182
Retained at 2nd	0.21 (0.15)	0.058 (0.061)	0.29 (0.20)	0.093 (0.062)
Obs.	7,516	7,550	7,700	10,832
Retained at 3rd	0.055 (0.076)	0.15 (0.12)	-0.073 (0.16)	0.082 (0.083)
Obs.	8,105	8,136	8,272	11,665
Retained at 4th	-0.096 (0.062)	0.061 (0.045)	-0.21* (0.11)	0.0054 (0.024)
Obs.	19,791	19,874	20,242	28,748
Controls	x	x	x	x
Cohort FE	x	x	x	x

\*:  $p$ -value  $\leq .1$ ; \*\*:  $p$ -value  $\leq .05$ ; \*\*\*:  $p$ -value. Standard errors are clustered at the running variable.

Retention implies a decrease in the take up of the test in first grade, but nothing on the other grade levels. The effects are not significantly different from zero in most cases, only the language score is affected negatively, but the estimates are much weaker than before.

The overall view of these tables indicates that retention implies short and long-term benefits on cognitive achievement that persist for early grades, and is more ambiguous and even negative for later grades.



### 6.3 Separating the Age effect from the retention effect

The main problem with the estimation in Section (6.2) is that retention implies that at the moment of the SIMCE test retained students differ from promoted in two aspects. First, they have been studying concepts for a second time, the desired treatment, and second, they are one year older. If the score depends on the level of maturity, i.e., the age at the test, we cannot separate the effects of the retention policy from the effects of age. Schwerdt et al. [2017] address this problem comparing scores vertically integrated test in Florida, which measures the same content for all years, but also promoted students take the test at an earlier age.

In this section, I propose a method to separate the effects of age at the test and retention using exogenous variation on both variables in a two-dimensional regression discontinuity framework.

Let's assume for simplicity that the score can be written as a function of the student's age at the test, and whether or not the student has repeated a grade level

$$Score_{ig} = \beta_0 + \beta_1 \cdot Age_{ig} + \beta_3 R_{ig}^* + \epsilon_i \quad (4)$$

$Score_{ig}$  is the score of student  $i$  taking the test at grade  $g$ ,  $R_{ig}^*$  is an indicator whether the student has been retained up to  $g$ -th grade,<sup>21</sup> and  $Age_{ig}$  corresponds to the age at the moment of the test. Age at the test is equal to the school starting age,  $SSA_i$ , plus the number of years of instruction before the test, i.e.,  $Age_{ig} = g - 1 + SSA_i + R_{ig}^*$ , for example a test taken in  $g = 4$ , for a students starting school at six,  $SSA_i = 6$ , and retained  $R_{ig} = 1$ , in only one time between 1 and  $g$ , then the age at test is 10 years old. Replacing this expression in (4) allows us to relate the score to two well know educational policies, school starting age and retention:

$$Score_{ig} = \alpha + \beta_1 SSA_i + \gamma R_{ig}^* + \epsilon_i \quad (5)$$

---

<sup>21</sup>The definition of retention  $R_{ig}^*$  could be modified to capture different of aspects of retention, such as being retained in a specific grade level, or counting the number of times the student has been retained up to the grade  $g - 1$ , etc. Without loss of generality, I assume that students are retained only once.

with  $\alpha = \beta_0 + \beta_1 g$ , and  $\gamma = \beta_1 + \beta_3$ .

The interpretation of  $\gamma$  is challenging because the school starting age affects simultaneously the age at the test and the probability of retention (Eide and Showalter [2001], Elder and Lubotsky [2009] and Dobkin and Ferreira [2010]). However, two students will have the same age at the test if one enters early and repeats a grade, while the other enters late but is promoted continuously. The difference between these two students is that under repetition, the student is in school receiving education for one more year, while starting one year later implies staying at home or in a substitute form of care, but not necessarily receiving formal instruction.<sup>22</sup>

I instrument age at the test using the *SSA-cutoff* that determines the minimum age needed to enter school. In the literature, the most common cutoff is the first of January (see for example Black et al. [2010], and Fredriksson and Öckert [2014]). Students need to turn six (or seven depending on the country) by the calendar year they enter to first-grade. The cutoff implies that students who are born in December have to enter one year earlier than those born in the following January (See for example, Angrist and Krueger [1991] and Oreopoulos [2006] for related discussion). Since the date of birth is arguably exogenous, we can use this rule as an exogenous variation for the age at the test. In Chile, the date cutoff is exactly one semester later than in the northern hemisphere, the first of July.

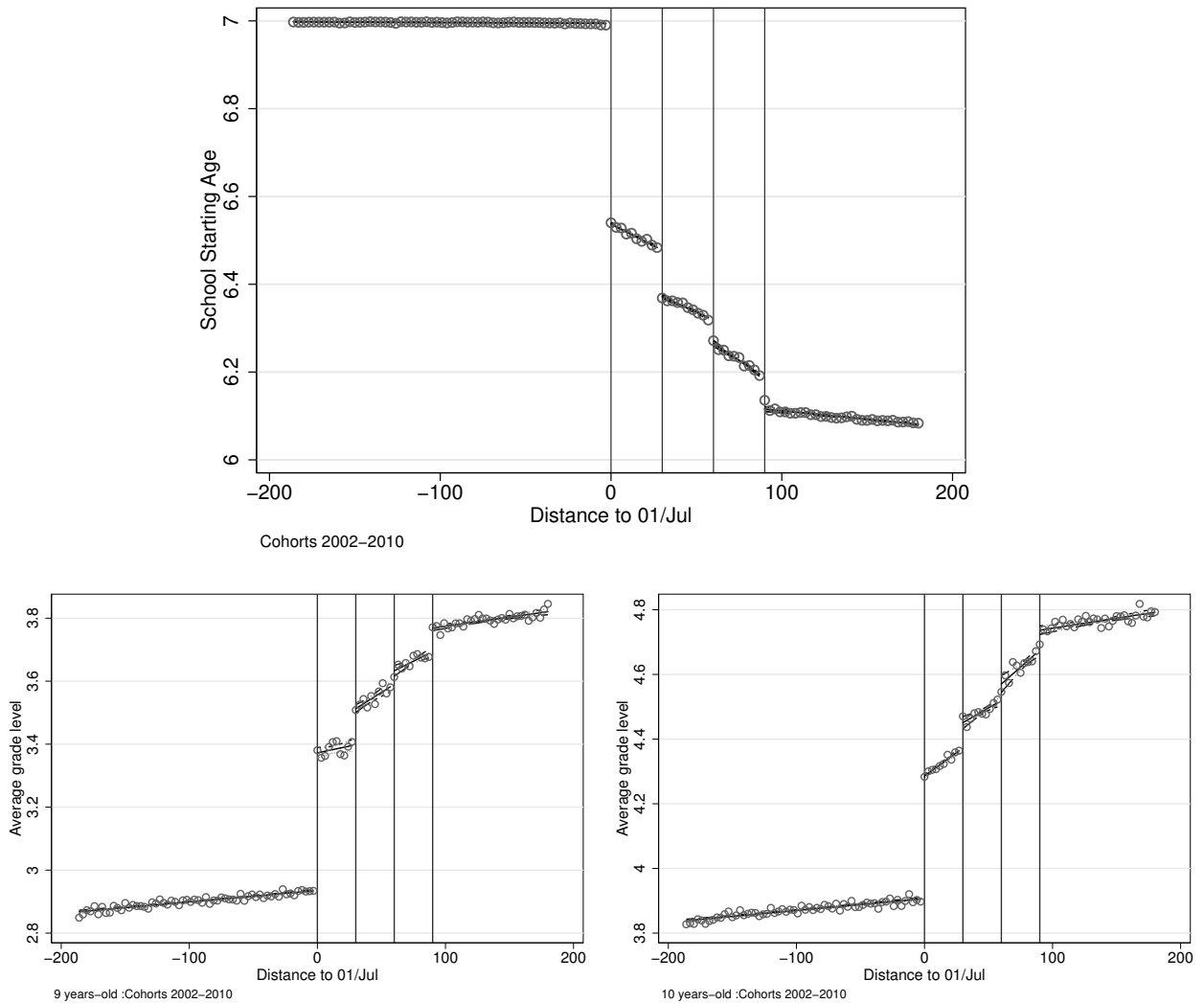
I start showing that Age at the test has a strong effect on scores. I instrument the age at the test using the *SSA-cutoff*, which generates exogenous variation on the school starting age in an RD framework. The top panel of Figure 8 shows that students born just before the first of July start school about half a year earlier; the difference is stable over time. The bottom panels shows the average grade for students that turn ten-years-old in a given calendar year, which correspond to the nominal or intended age for the test. Most students turning ten are in fourth-grade, however, about 40% of them are already in the fifth-grade, and some still in third. Table 8 confirms these figures. Columns (1) to (3) show the change in the age at the test for students around the *SSA-cutoff*. As shown in the figure, students take the 4th-grade SIMCE test when

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<sup>22</sup>The later-entrant may spend one more year in the home environment or could attend preschool for one more year. The human capital accumulated in that year will vary. See for example Heckman papers

they are on average ten years old, but those marginally older take the test 0.42 years early.<sup>23</sup>

Figure 8: School Starting Age. All Cohorts together.



Columns (4) to (6) show the reduced form regression, i.e., the relationship of the *SSA*-cutoff with the 4th-grade SIMCE test score. Columns are very stable and robust to specifications, showing that marginal early-entrants score about 0.2 standard deviations lower in the test. Table 8 shows 2SLS estimates for the effect of age at the test on the SIMCE scores. Columns (1) to (3) use different specifications (see footnote 23) to show that taking the test one year later implies

<sup>23</sup>All specifications use local linear regressions. Columns (1) and (2) use a 30- and 60-days bandwidth respectively, and Column (3) adds covariates and birth-year fixed effects in a bandwidth of 30 days. Columns (4) to (6) have the same structure

an increase of 0.5 standard deviations in the test.<sup>24</sup> Column (4) to (7) show the effect for different birth cohorts to show robustness.

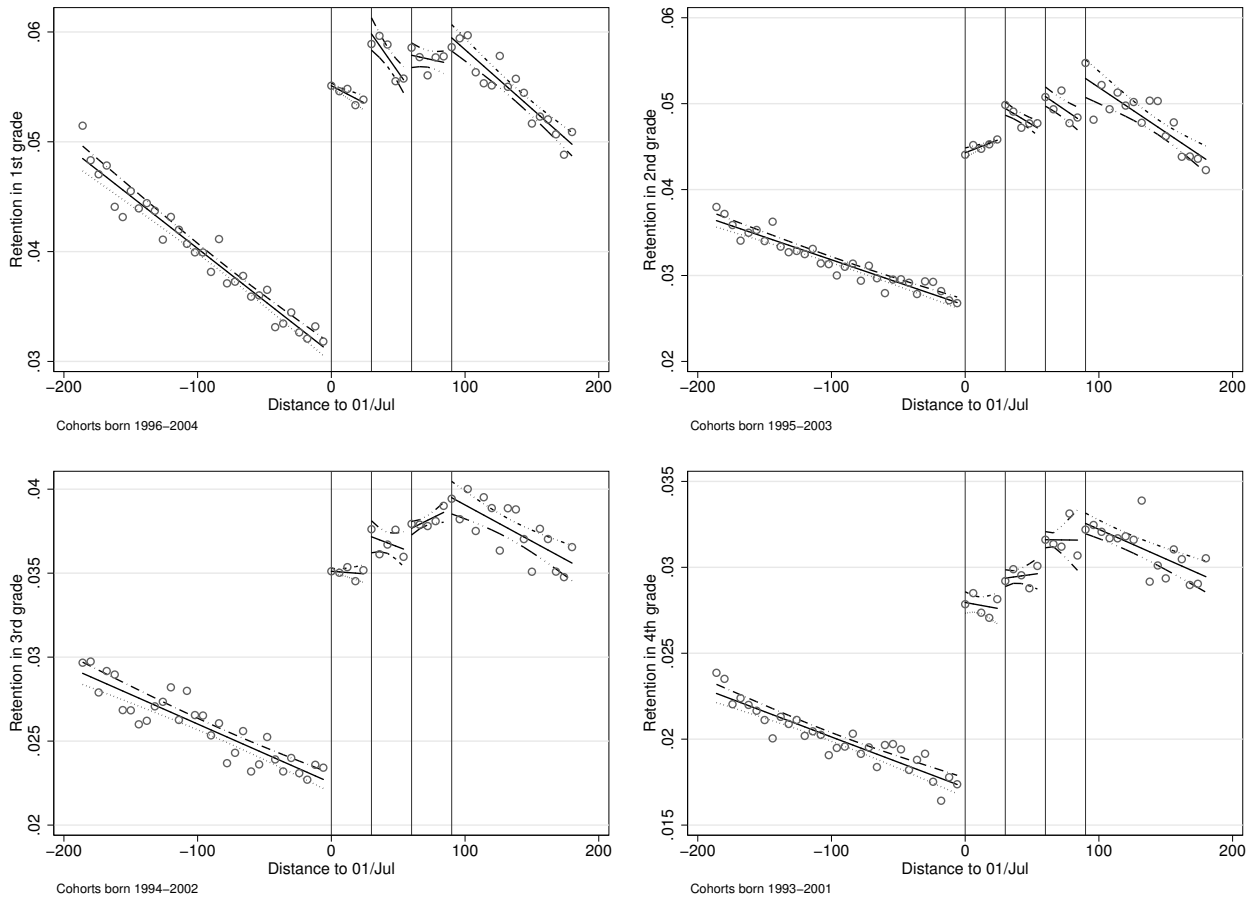
Table 8: *SSA* and age at the test. First stage and reduced form

	First Stage			Reduced Form		
	(1)	(2)	(3)	(4)	(5)	(6)
Above SSA-cutoff	-0.41*** (0.0035)	-0.39*** (0.0025)	-0.40*** (0.0035)	-0.21*** (0.0071)	-0.19*** (0.0050)	-0.20*** (0.0069)
Const.	10.1*** (0.0017)	10.1*** (0.0012)	10.1*** (0.0042)	0.18*** (0.0051)	0.18*** (0.0036)	-0.15*** (0.0088)
Obs.	315,682	625,057	315,682	315,682	625,057	315,682
Controls			x			x
Birth-Year FE			x			x
Birth bw. (days)	30	60	30	30	60	30
2SLS						
	All Cohorts		1997	1998	1999	2000
Age at SIMCE 4th	0.52*** (0.018)	0.51*** (0.018)	0.81*** (0.082)	0.29*** (0.061)	0.69*** (0.093)	0.38*** (0.069)
Obs.	315,682	315,682	37,950	36,146	36,034	35,462
Controls		x	x	x	x	x
Birth-Year FE	x	x	x	x	x	x
Birth bw. (days)	30	30	30	30	30	30

As mentioned before, these effects are not causal because school starting age also increases the probability of retention. Figure 9 shows that the probability of being retained increases for (marginal) early-entrants in this context. The likelihood of being retained increases by 2.5 percentage points in the first-grade, and is higher by 1.7, 1.2 and 1pp in the second-, third- and fourth-grade respectively.

<sup>24</sup>The results are very similar to those found in the US context by Elder and Lubotsky [2009].

Figure 9: SSA and Retention. Reduced Form



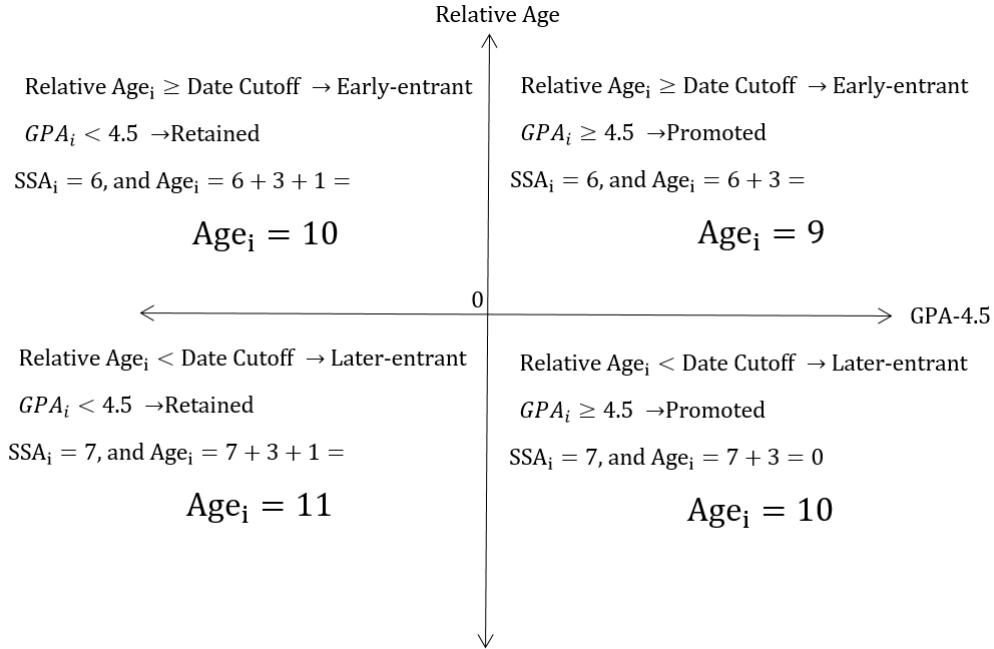
### 6.3.1 2D-RD

Having shown in Section 5 the validity of the GPA-cutoff as an instrument for retention, and in the previous paragraphs the validity of the *SSA*-cutoff as an instrument for age at the test, we can use both in the same regression to disentangle the effects of age and retention.

I compare marginal early-entrants who are barely retained to marginal late-entrants who are barely promoted in a two dimensional (2D) regression discontinuity (RD). Figures 10 explains the situation. The horizontal axis represents the *SSA*-cutoff, implying that students in the first and second quadrants are early entrants, those in quadrant third and fourth, enter one year later. On the other hand, students in the first and fourth quadrant score enough to be promoted, while those below the GPA cutoff, in quadrants II and III, are retained. As consequence students in

the second and fourth quadrants take the test at age 10, one has spent one more year at home or in pre-school while the other has spent one more grade at school.

Figure 10: Combination of retention and school starting age.



When we approximate to the origin, students become more and more comparable regarding of ability (implicit in GPA) and age, until the point they are assigned to retention and to a lower *SSA* as good as randomly, in the Lee [2008] terminology. The students that allow the comparison correspond to students entering school at age six and repeating a grade, which are compared to those who enter one year later and are promoted continuously.

Since both instruments are valid at the respective cutoffs, the reduced form of the 2D-RD can be expressed as follows:

$$Score_{ig} = \alpha + \beta_1 \cdot \mathbb{1}[ssa_i \geq 0] + \gamma \cdot \mathbb{1}[gpa_{ig} \geq 4.5] + f(ssa_i) + g(gpa_i) + \epsilon_i \quad (6)$$

Where  $\mathbb{1}[gpa_{ig} \geq 4.5]$  is an indicator variable that takes the value one when a student in grade *g* obtain a GPA higher than the minimum to be promoted, 4.5, while  $\mathbb{1}[ssa_i \geq 0]$

is the indicator whether the students are old enough to start school a year early.<sup>25</sup>  $f(\cdot)$  and  $g(\cdot)$  are flexible functions to account for the influence of the running variables,  $ssa_i$  and  $gpa_i$  respectively.<sup>26</sup>

Table 9 shows the results for different level of retention. Column (1) to (3) compare different specifications, while (4) to (7) show some heterogeneity by cohort. The results indicate that estimates of the retention effect is about the same as in previous sections and the effects of age are zero. The most preferred specification in column (3) include covariates and birth cohort fixed effects, estimated using a uniform kernel in the bandwidth  $(x, y) \in (-0.5, 0.5) \times [-60 \text{ days}, 60 \text{ days}]$ , i.e., student with  $gpa_i \in [4.1, 4.9]$  and at most, born 60 days away from the SSA-cutoff date.

Table 9 shows that the effects are very similar regardless the year of retention. Retention in third-grade, however, implies a slightly higher effect compared to the baseline specification in Table 5, from 0.33 to 0.46 standard deviations. The heterogeneity by birth cohort shows some variation, mainly explained by the reduction in the sample size. However, the results are pretty stable in all years. The only exception being the cohort 2000 in retention at third-grade, with a non-significant negative effect.

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<sup>25</sup>For example, someone born on July 30th of 1996 will have a  $ssa$  of 1, meaning that she is one day older than the minimum age to enter school in 2002, i.e., she turned six one day earlier than the  $SSA$ -cutoff for her birth cohort.

<sup>26</sup>In most of the specifications presented here,  $f(\cdot)$  and  $g(\cdot)$  will be a local linear regression such as  $h(x) = \pi_1^h \cdot x + \pi_2^h \cdot \mathbb{1}[x \geq c_j] \cdot x$ , with  $x = \{gpa, ssa\}$  and  $h = \{f, g\}$

Table 9: The simultaneous effect of age and retention on scores. A 2-dimensional RD

	Baseline All Cohorts			By Birth Cohort			
	(1)	(2)	(3)	1997 (4)	1998 (5)	1999 (6)	2000 (7)
<b>A. 1st-grade</b>							
Retained at 1st	0.42* (0.23)	0.49*** (0.14)	0.50*** (0.14)	0.42 (0.29)	0.75** (0.34)	0.66* (0.38)	0.68 (0.46)
Age at SIMCE 4th	0.0095 (0.053)	0.014 (0.036)	0.012 (0.036)	-0.0042 (0.098)	0.033 (0.10)	-0.036 (0.12)	0.17 (0.14)
Obs.	12,400	25,642	25,642	3,330	3,210	3,154	3,053
<b>B. 2nd-grade</b>							
Retained at 2nd	0.46*** (0.16)	0.53*** (0.11)	0.54*** (0.11)	0.59** (0.27)	0.55** (0.24)	0.66 (0.49)	0.83** (0.38)
Age at SIMCE 4th	-0.0045 (0.055)	0.028 (0.037)	0.017 (0.037)	-0.032 (0.10)	-0.039 (0.098)	-0.11 (0.14)	-0.077 (0.12)
Obs.	15,172	30,754	30,754	3,698	3,522	3,453	3,419
<b>C. 3rd-grade</b>							
Retained at 3rd	0.43*** (0.13)	0.39*** (0.095)	0.44*** (0.094)	0.60** (0.29)	0.34 (0.24)	0.46** (0.23)	-0.083 (0.28)
Age at SIMCE 4th	0.076 (0.054)	0.077** (0.039)	0.046 (0.038)	-0.019 (0.097)	0.051 (0.11)	0.10 (0.11)	0.086 (0.10)
Obs.	18,268	36,718	36,718	4,823	4,691	4,424	4,210
Controls			x	x	x	x	x
Birth-Year FE	x	x	x	x	x	x	x
Birth bw. (days)	30	60	60	60	60	60	60

The long runs effects are consistent with these set of results, but the standard errors substantially increase because of the lack of consecutive SIMCEs (see section 3). Table 10 reports the effects for the test taken at sixth-, eighth- and tenth-grade, showing two specifications for each test. Both specifications include birth year fixed effects and controls, the first consider a narrower windows, 30 days around the SSA-cutoff, and the second expands the bandwidth to 60 days.



Table 10: The simultaneous effect of age and retention on scores. Long term effects using a 2-dimensional RD

	SIMCE 6th-grade		SIMCE 8th-grade		SIMCE 10th-grade	
	(1)	(2)	(3)	(4)	(5)	(6)
<b>A. 1st-grade</b>						
Retained at 1st	0.45 (0.28)	0.40* (0.24)	0.36 (0.30)	0.32 (0.26)	0.82 (0.52)	0.91* (0.47)
Age at SIMCE	0.00095 (0.37)	-0.20 (0.34)	-0.49* (0.29)	-0.42 (0.26)	-0.25 (0.23)	-0.17 (0.18)
Obs.	6,075	7,703	4,910	6,218	3,385	4,321
<b>B. 2nd-grade</b>						
Retained at 2nd	0.34 (0.25)	0.32 (0.21)	0.28 (0.24)	0.16 (0.21)	0.35* (0.21)	0.25 (0.20)
Age at SIMCE	-0.27 (0.29)	-0.28 (0.28)	-0.54* (0.30)	-0.68** (0.27)	-0.22 (0.15)	-0.21* (0.12)
Obs.	6,502	8,222	5,441	7,026	5,226	6,603
<b>C. 3rd-grade</b>						
Retained at 3rd	0.15 (0.17)	0.19 (0.15)	-0.0020 (0.16)	-0.13 (0.15)	0.40** (0.20)	0.35* (0.19)
Age at SIMCE	-0.13 (0.28)	-0.11 (0.28)	-0.47 (0.28)	-0.32 (0.23)	-0.15 (0.16)	-0.15 (0.13)
Obs.	7,941	10,010	6,980	8,915	6,881	8,668
Controls	x	x	x	x	x	x
Birth-Year FE	x	x	x	x	x	x
Birth bw. (days)	60	75	60	75	60	75

Column (1) in Panel A shows that retention in first-grade implies a 0.4 standard deviation significant increase in scores in the sixth-grade, which is slightly higher than the one reported in Table 3 to 5. However, despite that the size of the effect, the estimation is only significant Column (2) when a wider window in age is included. For eighth-grade the effects are lower to those in the tables 3 to 5 (0.53sd) and are not significant. For the tenth-grade, the effects are about twice the size of those in tables 3 to 5, and are significant at the 10% level for the preferred specification in column (6). Retention in second and third-grade, shown in Panels B and C, show similar patterns. The only significant effect appears in SIMCE-10th for those retained in

third, with a 0.35 standard deviation increase in test scores. The rest are all positive, from 0.1 to 0.35 standard deviations.<sup>27</sup> Interestingly, most of the estimates are high and positive. The non-significance of these effects responds to the increase in the standard errors, which are 1.5 to three times higher than those presented in the previous section. The 2D-RD requires both running variables to be close to the cutoff becoming more data demanding. In the Appendix D I show a sensitivity analysis.

## **6.4 PARENTAL INVESTMENTS**

The data allows testing some hypotheses about behavioral responses from students and parents. Parent responses include time investments, measures of awareness on the student performance, and expectations about educational attainment. All figures in this section correspond to the reduced form estimation and are made using the simple average within bins of 0.1 points, a local linear regression is fitted, and 95% confidence intervals are shown. As before, the size of the circles indicates the number of observations in each bin, and the fourth-grade serves as placebo.

### **6.4.1 Time Investments**

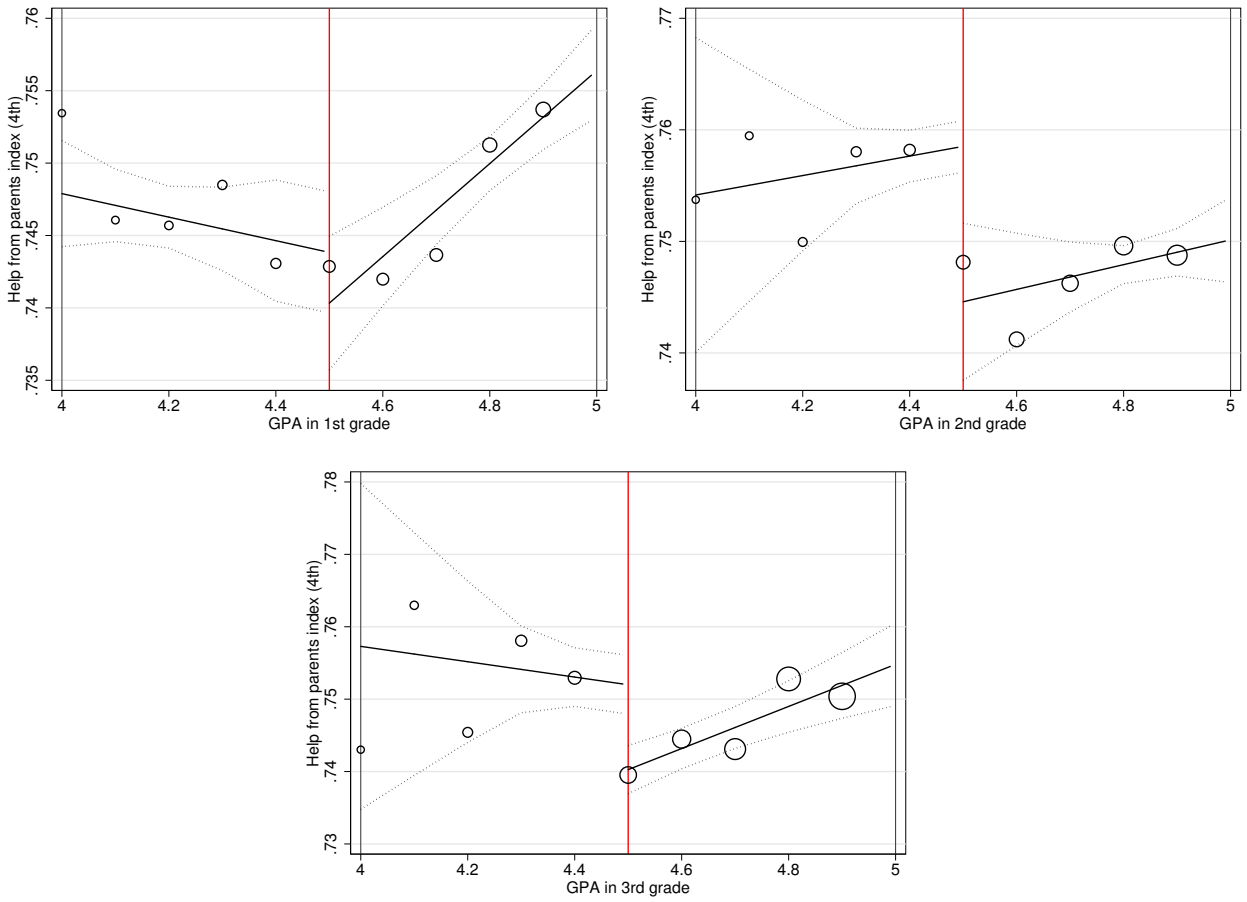
One important factor in the process of educational attainment is the influence of parents. Parents help, impose norms, play role models, and invest in educational inputs to improve student's performance. Here I present some evidence in this type of behavior. Parents of retained children react to the bad outcome of retention exerting higher effort. The retention rule acts as an incentive mechanism for parents, causing higher time investment in the form of time spent with the students studying. Also, parents show more awareness of the student performance in general, and motivate the student with congratulations as incentive device.

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<sup>27</sup>Except for SIMCE-8th for those retained in third, which presents negative effect.

Figure 11: RD figures for Help from Parents in 4th grade.

**A. Parent investments in 4th-grade, Index**



**B. Placebo and Dynamics**

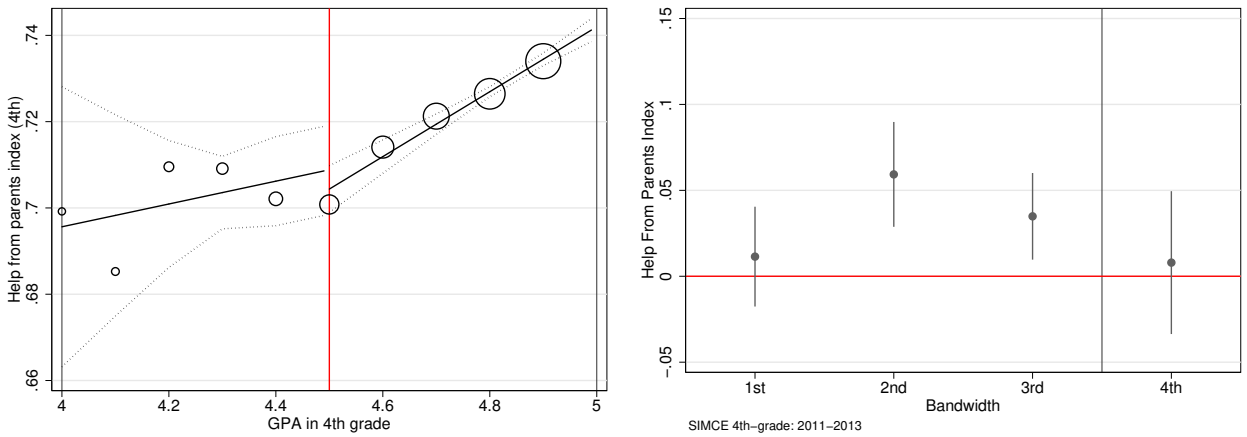


Figure 11 shows that marginally retained students in second- and third-grade received 0.015 percentage points higher parental investment, which translates to a 6 percentage points effect

of retention in these grade levels.<sup>28</sup> Table 11 confirms these findings. Help and parental investments increase by 6 and 3.5 percentage points in second- and third-grade. The table also shows the six components of the index. Column (2) shows a measure of parental incentives to influence better performance, a congratulation when the student obtain a good grade. Column (3) is a measure of awareness, implies higher monitoring to the students from the parent. Finally, columns (4) to (6) represent pure investments on time, such as explaining and helping in the execution of homework and assignments. These measures of parental investment may interact with the ability of the parent, or her level of education.

Table 11: Help from parents

	Help from Parent index (1)	Parent congrats good grades (2)	Parent knows my grades (3)	Parent explains material (4)	Parent help me studying (5)	Parent help with homework (6)
<b>A. 1st-grade</b>						
Retained at 1st	0.011 (0.015)	0.093** (0.032)	0.036 (0.020)	-0.019 (0.020)	-0.042* (0.021)	-0.034 (0.021)
Obs.	33,793	33,069	32,980	33,159	33,273	33,127
<b>B. 2nd-grade</b>						
Retained at 2nd	0.059*** (0.016)	0.047** (0.015)	0.073 (0.045)	0.038*** (0.011)	0.051** (0.015)	0.079*** (0.012)
Obs.	35,934	35,130	35,081	35,319	35,361	35,213
<b>C. 3rd-grade</b>						
Retained at 3rd	0.035** (0.013)	0.0098 (0.013)	0.051** (0.017)	0.019 (0.011)	0.0057 (0.026)	0.063*** (0.015)
Obs.	48,133	47,067	47,065	47,388	47,414	47,207
<b>D. 4th-grade</b>						
Retained at 4th	0.0079 (0.021)	0.045 (0.026)	-0.027 (0.020)	0.0059 (0.019)	-0.0084 (0.015)	0.017 (0.033)
Obs.	51,623	50,399	50,456	50,833	50,822	50,563
Controls	x	x	x	x	x	x
Cohort-Year FE	x	x	x	x	x	x

(\*):  $p$ -value  $\leq .1$ ; (\*\*):  $p$ -value  $\leq .05$ ; (\*\*\*):  $p$ -value  $\leq .01$ . Standard errors are clustered at the running variable.

<sup>28</sup>In first- and fourth-grade (the placebo), the estimates are zero statistically.

The overall conclusion is that parents react positively to the negative outcome of retention. For second- and third- grade the effects are the strongest. The estimates are positive and significant for four out of five measures in second-grade, and three out of five in third. All coefficients are positive for these two grades levels, and none is significant for the placebo. In first-grade there is mix evidence, the dominant effect is positive, the congratulations in column (2), but negative in terms of help for studying. The sample contains three cohorts given that this question is only registered consecutively in the years 2011 to 2014 (see Section 3)<sup>29</sup>

Table 12: Help from parent 10g

	Parent congrats good grades (1)	Parent knows my grades (2)	Parent demands good grades (3)	Parent willing to help (4)
<b>A. 1st-grade</b>				
Retained at 1st	-0.061 (0.046)	-0.061 (0.046)	0.040 (0.033)	0.069 (0.042)
Obs.	3,608	3,593	3,585	3,599
<b>B. 2nd-grade</b>				
Retained at 2nd	0.024 (0.051)	0.043 (0.051)	0.0070 (0.035)	0.090** (0.037)
Obs.	4,382	4,364	4,340	4,363
<b>C. 3rd-grade</b>				
Retained at 3rd	-0.0015 (0.024)	-0.012 (0.055)	0.054 (0.034)	0.052* (0.028)
Obs.	5,751	5,725	5,693	5,732
<b>D. 4th-grade</b>				
Retained at 4th	-0.069** (0.032)	-0.060 (0.040)	-0.045** (0.018)	-0.031 (0.030)
Obs.	6,650	6,627	6,600	6,626
Controls	x	x	x	x
Cohort-Year FE	x	x	x	x

(\*):  $p$ -value  $\leq .1$ ; (\*\*):  $p$ -value  $\leq .05$ ; (\*\*\*):  $p$ -value  $\leq .01$ . Standard errors are clustered at the running variable.

<sup>29</sup>For first-grade, cohorts 2008 and 2010 are included. For example, promoted students in cohort 2008 would take SIMCE in 2011, and retained in 2012.

Interestingly, the time-investment can also be measured in the 10th-grade (the question is asked in 2012 and 2013), restricting the analysis to students in one year for each repetition level. For example, students enrolled in first-grade in 2003, would achieve 10th-grade in 2012, and those who at most repeat once would be interviewed in 2013. The problem is similar to the one discussed in Section 6.1 when long-run outcomes implied the need for a longer panel.

Table 12 shows similar zero effects for first-grade. For second-grade, the effects are all positive, but only significant for the question about willingness to help. Willingness to help is also significantly positive for third-grade retention, while the effects of the other variables turn sometimes negative but very close to zero. For this questions, the estimates for the fourth-grade is not a placebo. The questions are asked when student achieve the 10th grade, six years after the previous measure. Now the effects are all negative and significant for congratulations and for demand for grades. Reconciling this change of sign is difficult, probably, the reduced sample size (around six thousand observations in the best case, compared to eight times that size for the previous SIMCE) implies less power and therefore a higher type II error.

#### **6.4.2 Expectations**

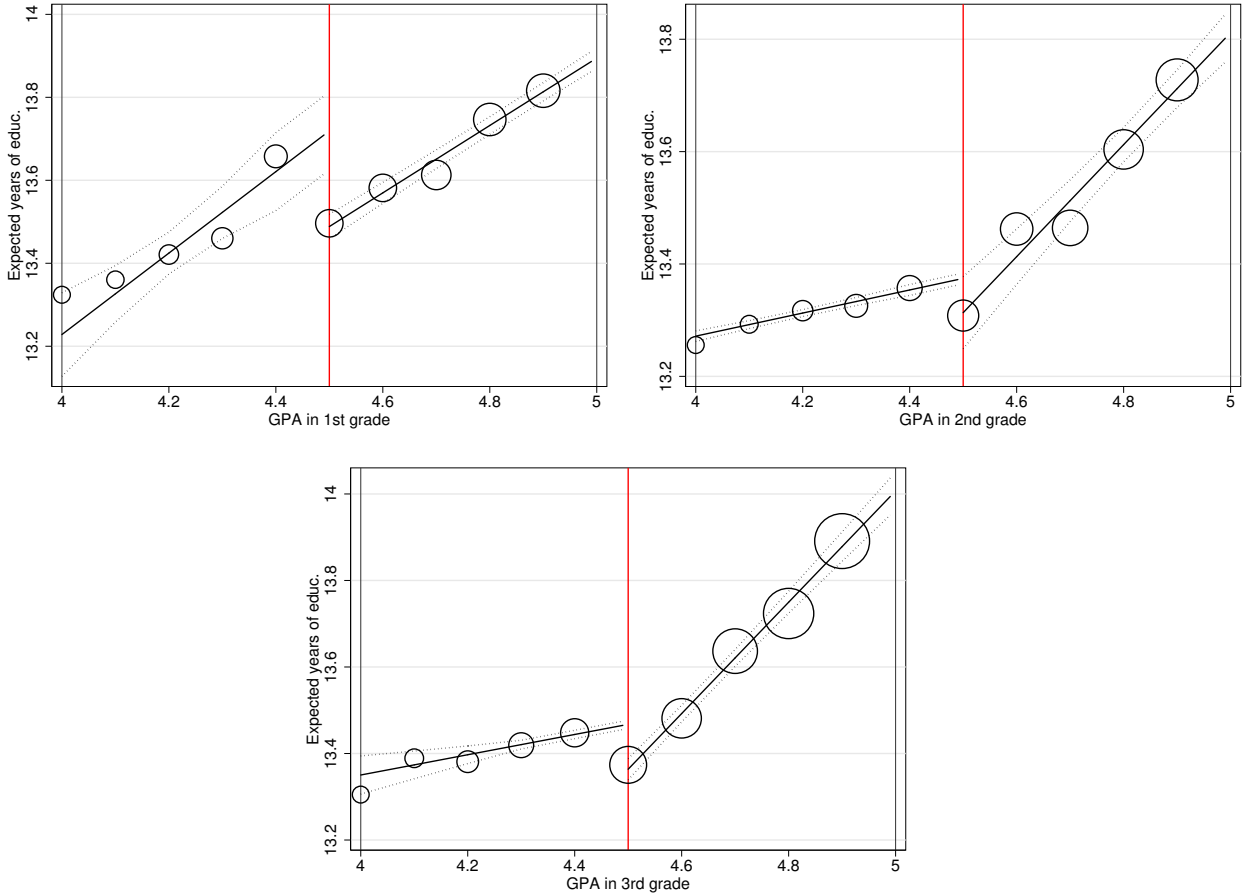
Figure 12 shows the expectations of parents about the years of education of their children, for each level of retention. Parent are asked about the level of attainment, middle school high school, vocational higher education, and college and then transformed in years of school considering the expected time to complete each category.

For students who score marginally below the GPA-cutoff, parents expect 13.7 years of education, while for those marginally above the expectations drop in about 0.2 years. The first stage for this sample indicates that, at the cutoff, the probability of first-grade retention drops by 0.25 percentage points, implying a 2SLS estimate of 0.8 years, i.e., parents of (marginally) retained students have 0.8 years higher expectations. Additionally, retention in second and third also imply higher parental expectations, decreasing with grade. The placebo, as expected, shows no effects, and the last graph shows the evolution of the effect in time, highlights the much stronger

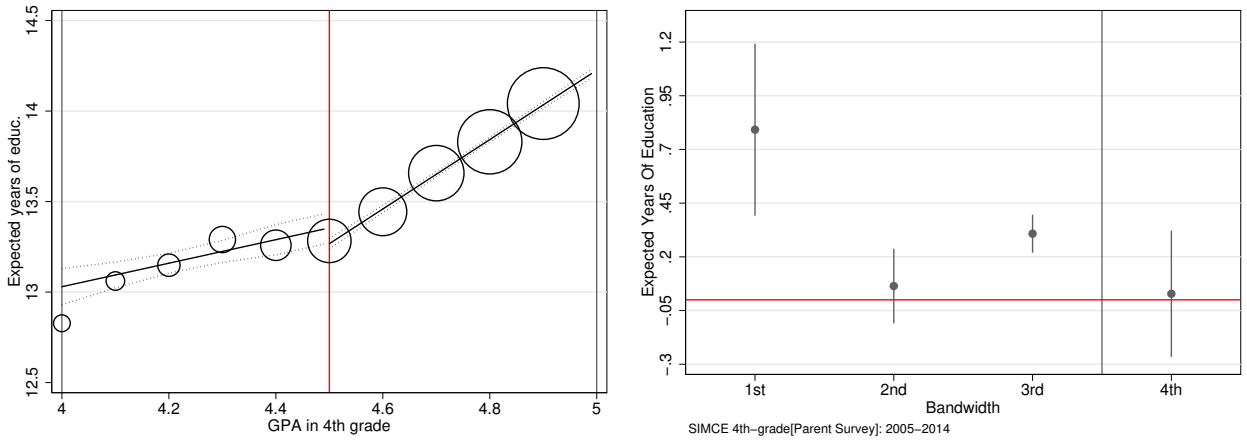
effects for first grade, which may be a period on the student life that complement very well with retention or because the students takes some time to detect the good consequences of retention.

Figure 12: RD figures for Parental Expectations.

**A. Parental Expectations in 4th-grade Index**



**B. Placebo and Dynamics**



To explore the results with more precision, Table 13 shows the regression equivalent to the previous exercise. As before, the 2SLS regressions include year fixed effects and controls. Confirming the evidence derived from the figure, parents of first-grade retained students have a 0.8 years higher expectation on their children attainment. It goes down to practically zero for second-graders and again a positive and significant 0.3 extra years.

The sample size of 85-140 thousand students allows a precise estimate. Expectations from parents appear in the parent survey since 2005 to 2014, therefore, includes about ten cohorts. In the following sections, the questions were not asked continuously, or there are consecutive SIMCEs to pair a cohort separated for the retention rule. As a consequence, the precision will diminish.

Table 13: Parent expectations at 4th grade.

	High School (1)	Higher Education (2)	University (3)	Years of Education (4)
<b>A. 1st-grade</b>				
Retained at 1st	0.061*** (0.015)	0.13** (0.051)	0.071*** (0.014)	0.79*** (0.20)
Obs.	85,203	85,203	85,203	84,427
<b>B. 2nd-grade</b>				
Retained at 2nd	0.0030 (0.011)	-0.0093 (0.010)	0.044* (0.019)	0.064 (0.088)
Obs.	108,717	108,717	108,717	107,085
<b>C. 3rd-grade</b>				
Retained at 3rd	0.030* (0.013)	0.042*** (0.0066)	0.042** (0.013)	0.31*** (0.045)
Obs.	134,865	134,865	134,865	132,941
<b>D. 4th-grade</b>				
Retained at 4th	0.0079 (0.025)	-0.0036 (0.016)	0.021 (0.016)	0.028 (0.15)
Obs.	142,965	142,965	142,965	140,824
Controls	x	x	x	x
Cohort-Year FE	x	x	x	x

(\*):  $p$ -value  $\leq .1$ ; (\*\*):  $p$ -value  $\leq .05$ ; (\*\*\*):  $p$ -value  $\leq .01$ . Standard errors are clustered at the running variable.



## 6.5 Students Beliefs and Learning Experience

This section presents evidence on two student-reported categories: self-confidence, and difficulties in learning. Specifically, self-confidence measures have generated heated debate in the school psychology as one of the negative consequences of grade retention, the generation of stigma, either the self-perception of being a low performer or the social believe about someone. The questions propose to the students a statement such “I am as able as my classmates” or “if I work hard I can solve a hard task” and the student answer if she agrees in a four point.

Moreover, similar question allows exploring how the student interacts with the environment. Questions as “I do not understand,” “It is hard to focus in classes” or “My notes are generally incomplete” allow to know if the students are adapted to the level f difficulty of learning.

### 6.5.1 Self-confidence

Figure 13 shows positive effects for first-grade, zero for second- and negative for third-grade. The figures are not as clear as the previous ones, however, the formal regressions offer a clearer picture. 14 shows the same pattern, students retained in first-grade, report better self-perception measures, second-graders, show no effects, and third-graders, show a significant loss of self-esteem (significantly negative in column (1) and a negative but not significant in column (2)).

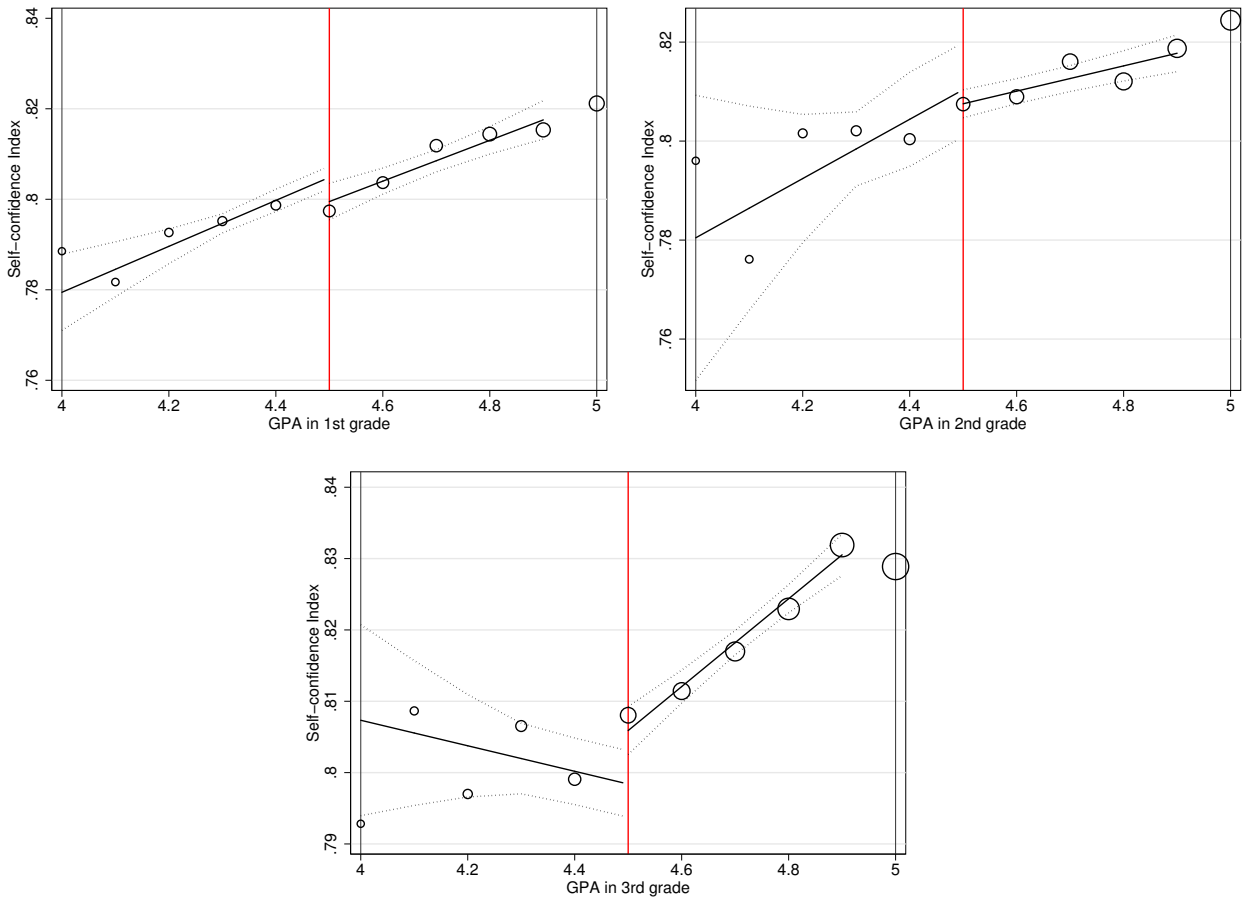
One interpretation of this feature is that the effects of retention on self-esteem are temporary, and a potential improvement in the learning experience could bring the self-esteem high again and beyond the original levels. The measures for third-grade retention serve as the immediate reaction of the students to retention, students repeated a grade one year and a half before the interview in the fourth-grade SIMCE. In contrast, students retained in first-grade repeated 3.5 years ago, having more time to gain self-confidence, after a few years of positive reinforcement.<sup>30</sup>

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<sup>30</sup>In Section 6.1 I show that students perform better in life-GPA, daily attendance, and ranking among the class.

Figure 13: RD figures for Self-Confidence in 4th-grade.

**A. Self-Confidence in 4th-grade Index**



**B. Placebo and Dynamics**

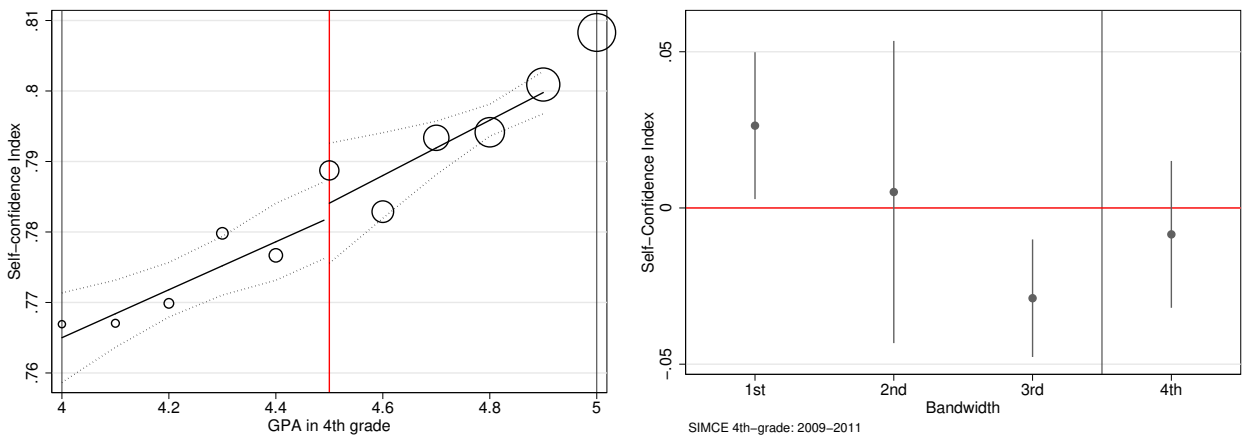


Table 14: Students Self-esteem

	I am able (1)	With effort I can (2)	Confidence index (3)
<b>A. 1st-grade</b>			
Retained at 1st	0.024* (0.012)	0.041** (0.015)	0.026* (0.012)
Obs.	22,904	22,730	23,310
<b>B. 2nd-grade</b>			
Retained at 2nd	0.027 (0.038)	-0.012 (0.015)	0.0051 (0.025)
Obs.	26,455	26,324	26,890
<b>C. 3rd-grade</b>			
Retained at 3rd	-0.049*** (0.0071)	-0.0082 (0.012)	-0.029** (0.0096)
Obs.	33,436	33,296	33,876
<b>D. 4th-grade</b>			
Retained at 4th	-0.017 (0.017)	-0.0055 (0.015)	-0.0085 (0.012)
Obs.	45,781	45,551	46,447
Controls	x	x	x
Cohort-Year FE	x	x	x

### 6.5.2 Learning Experience

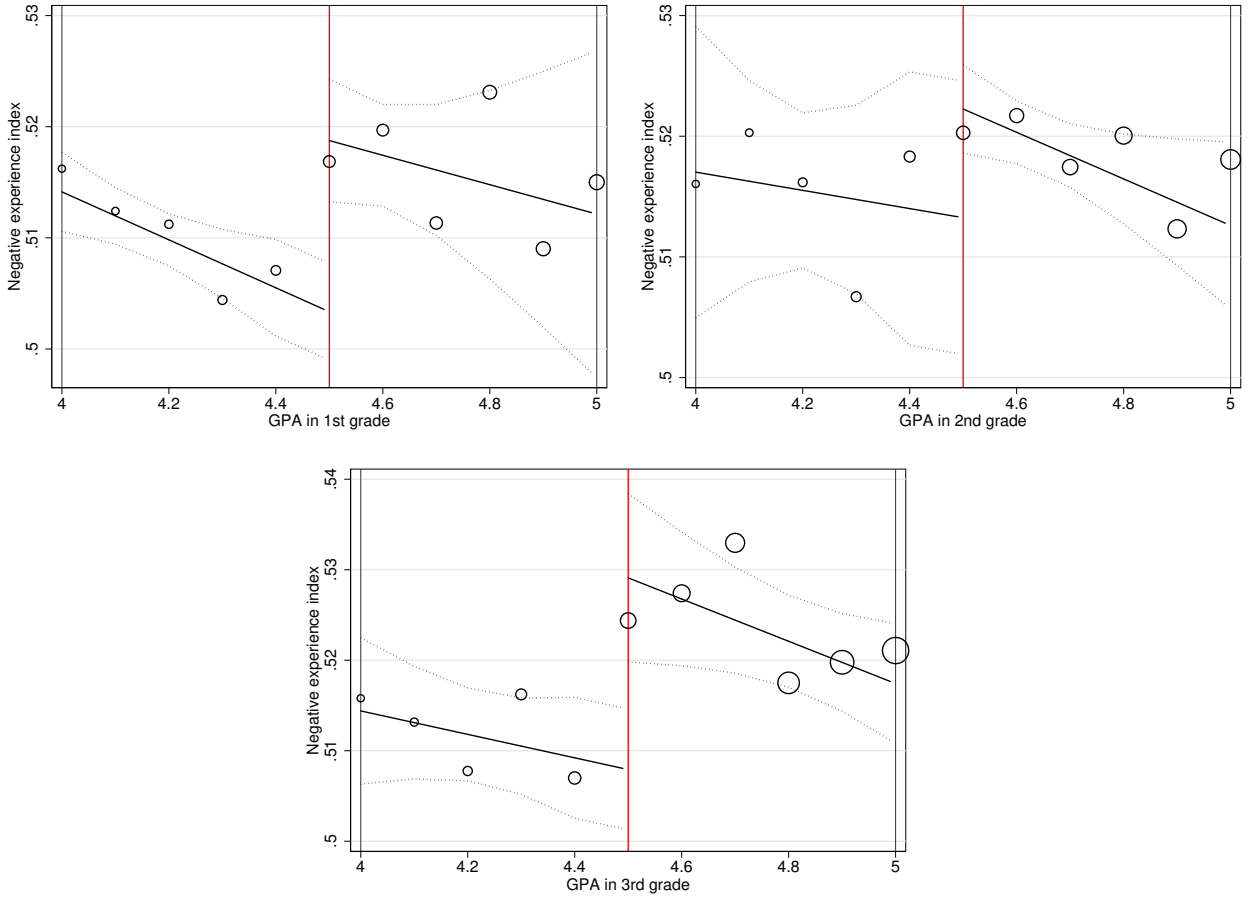
Finally, we review the effects in how adapted the student feels to the learning process. Three questions are analyzed, (self-reported) ability to understand the content, the ability to focus, and the ability to carry good class notes. Figure 14 shows the effects on an index of these three variables. Retained students report higher levels of satisfaction, which are significantly estimated in the first- and third-grade.<sup>31</sup> The share of students who do not understand, cannot focus, or have incomplete notes is lower among retained. This result is consistent with the hypothesis that retention allows the students to find a better match in the educational process,

<sup>31</sup>The placebo is the closest to zero of the four estimates as expected the lowest effect.

leading to higher levels of understanding and comprehension.

Figure 14: RD figures for Learning Experience.

**A. Negative Learning Experience in 4th-grade Index**



**B. Placebo and Dynamics**

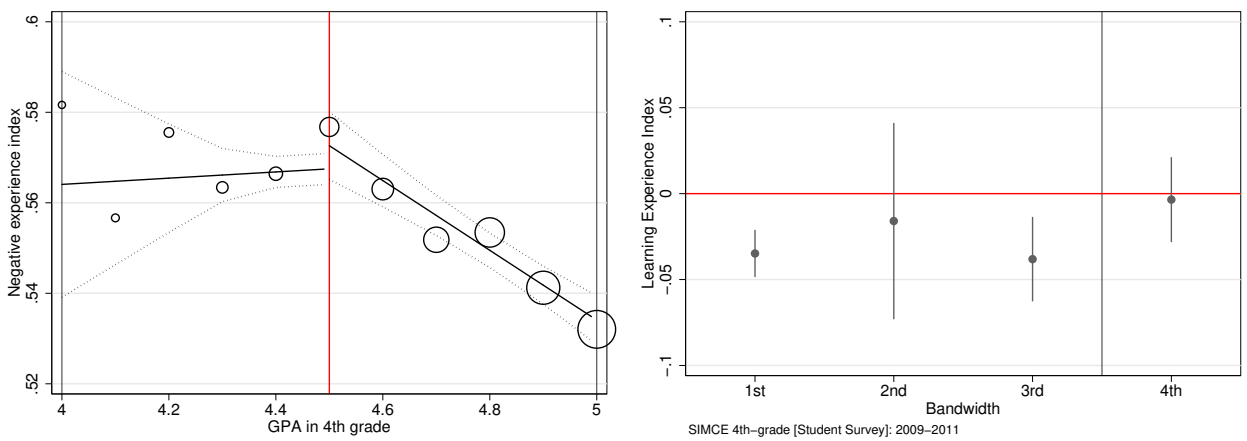


Table 15: Learning Experience

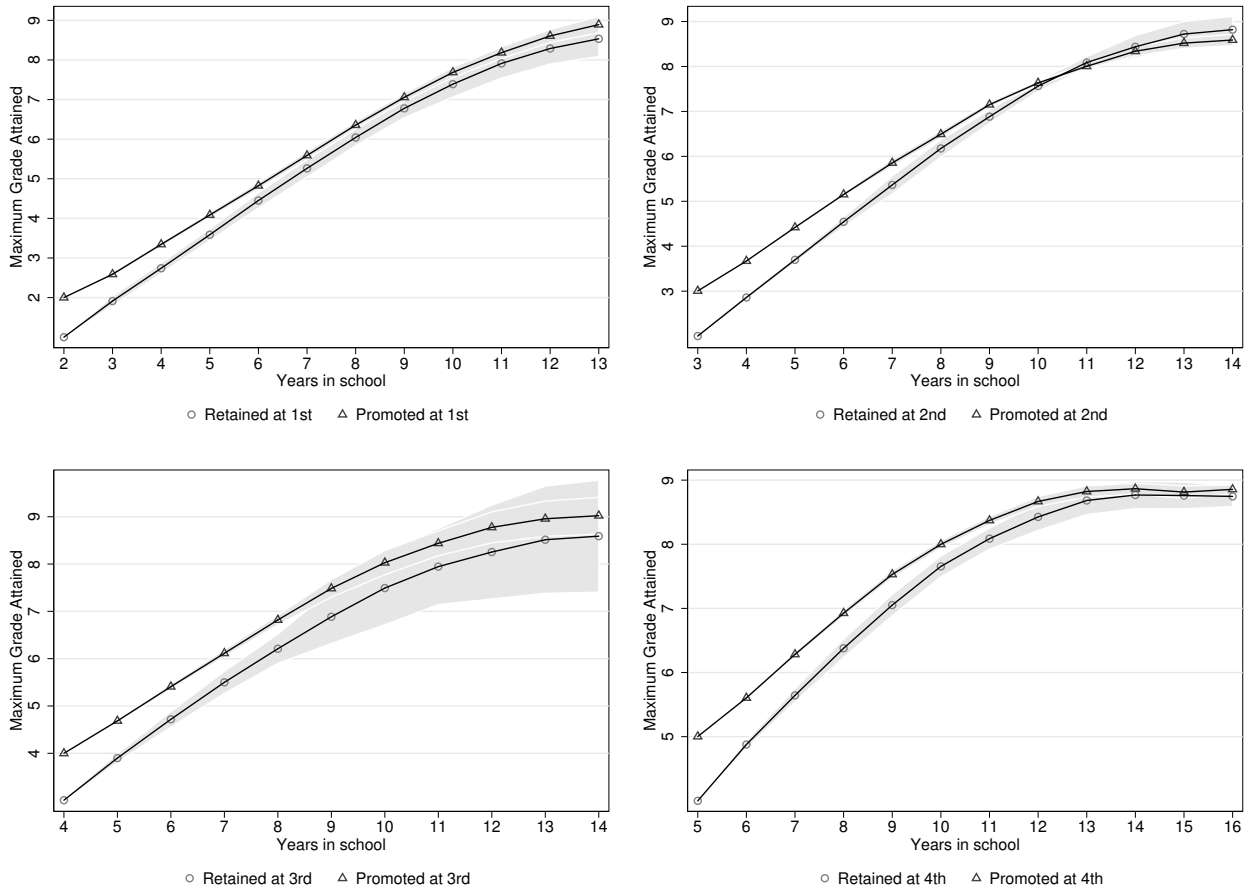
	Bad experience index	I do not understand	I cannot focus	Incomplete class notes
	(1)	(2)	(3)	(4)
<b>A. 1st-grade</b>				
Retained at 1st	-0.080*** (0.019)	-0.034* (0.017)	-0.075 (0.081)	-0.16*** (0.046)
Obs.	23,198	22,531	22,538	22,312
<b>B. 2nd-grade</b>				
Retained at 2nd	-0.032 (0.025)	-0.031 (0.022)	-0.16*** (0.019)	0.070 (0.056)
Obs.	26,804	26,079	26,029	25,814
<b>C. 3rd-grade</b>				
Retained at 3rd	-0.069*** (0.016)	-0.045** (0.019)	-0.087*** (0.017)	-0.066** (0.021)
Obs.	33,810	33,091	32,998	32,764
<b>D. 4th-grade</b>				
Retained at 4th	-0.014 (0.013)	-0.0060 (0.020)	0.016 (0.022)	-0.050* (0.026)
Obs.	46,333	45,222	45,190	44,719
Controls	x	x	x	x
Cohort-Year FE	x	x	x	x

## 7 The importance of a long panel

Lastly, I offer a brief discussion about the importance of observing the complete educational history of an individual to the study on retention. Figures 15 and 16 show the RD estimation considering one year of information at the time. For example, the top left graph of figure 15 shows the dynamics of first-grade retention, year one. The figure depicts the maximum level attained for retained and promoted in first grade. In the year immediately after retention (2 in the x-axis), we observe a difference of exactly one. In the next year, the difference shrinks because a share of promoted students does not advance to third, so the average goes to 2.7.

Retained are much less likely to be retained again, and the average moves close to 2.0. The difference stays significantly different from zero until the seventh grade.

Figure 15: Problem with short panels



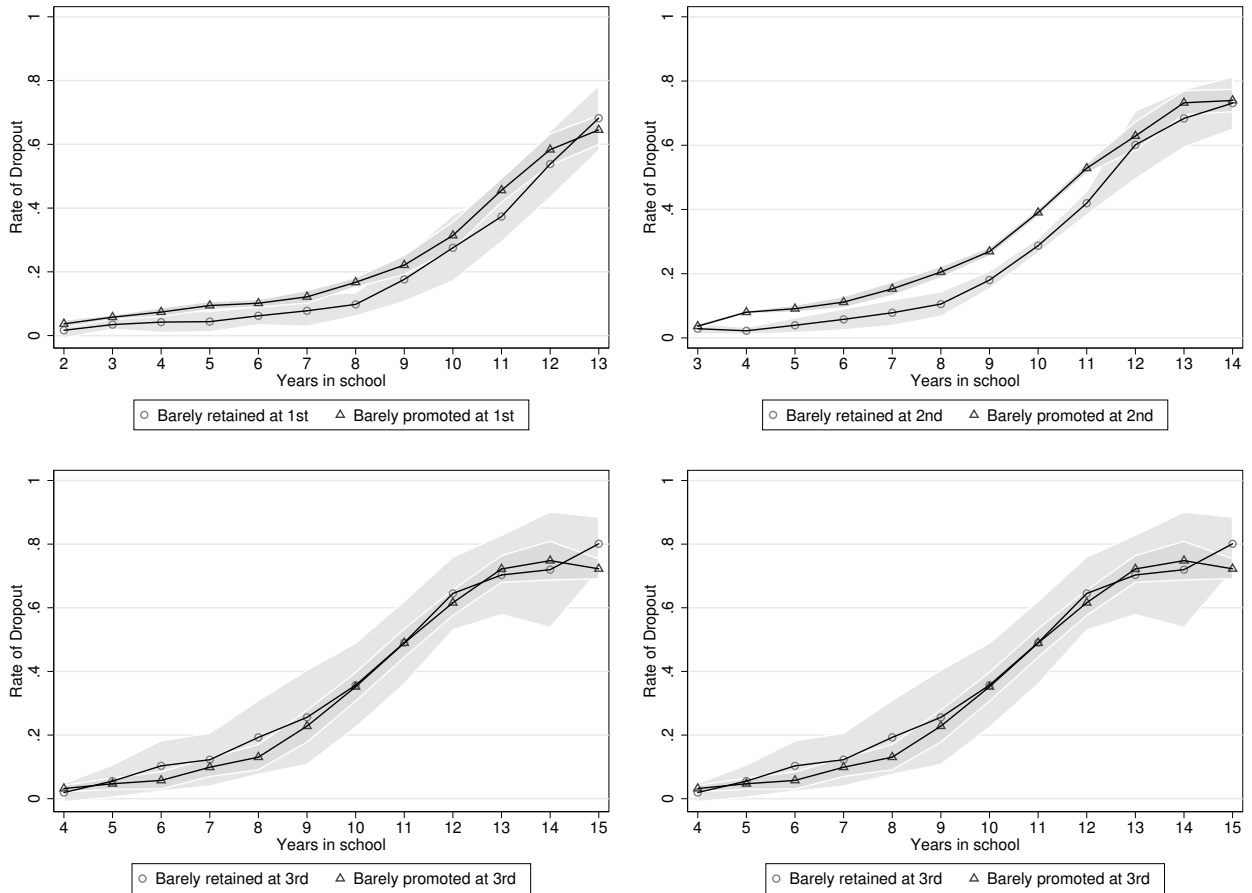
Similar results appear for retention in the other grades. The hypothesis of no effect is rejected for 5 to 7 years later. A shorter panel may conclude a negative effect on attainment.

The same analysis can be performed to understand the attrition process. Here, the dropout rate in a given year is defined as the absence in the data, or simply the attrition.

Only second and fourth-grade retention have differential attrition, which lasts for 8 years in second, and only 2 in fourth. This attrition in second occurs in years when the data provides information. Therefore an attrition bias may exist. Specifically, the nonrandomness of the attrition is worrisome to all measures on cognitive achievement, and the information on parental investment, and students attitudes.

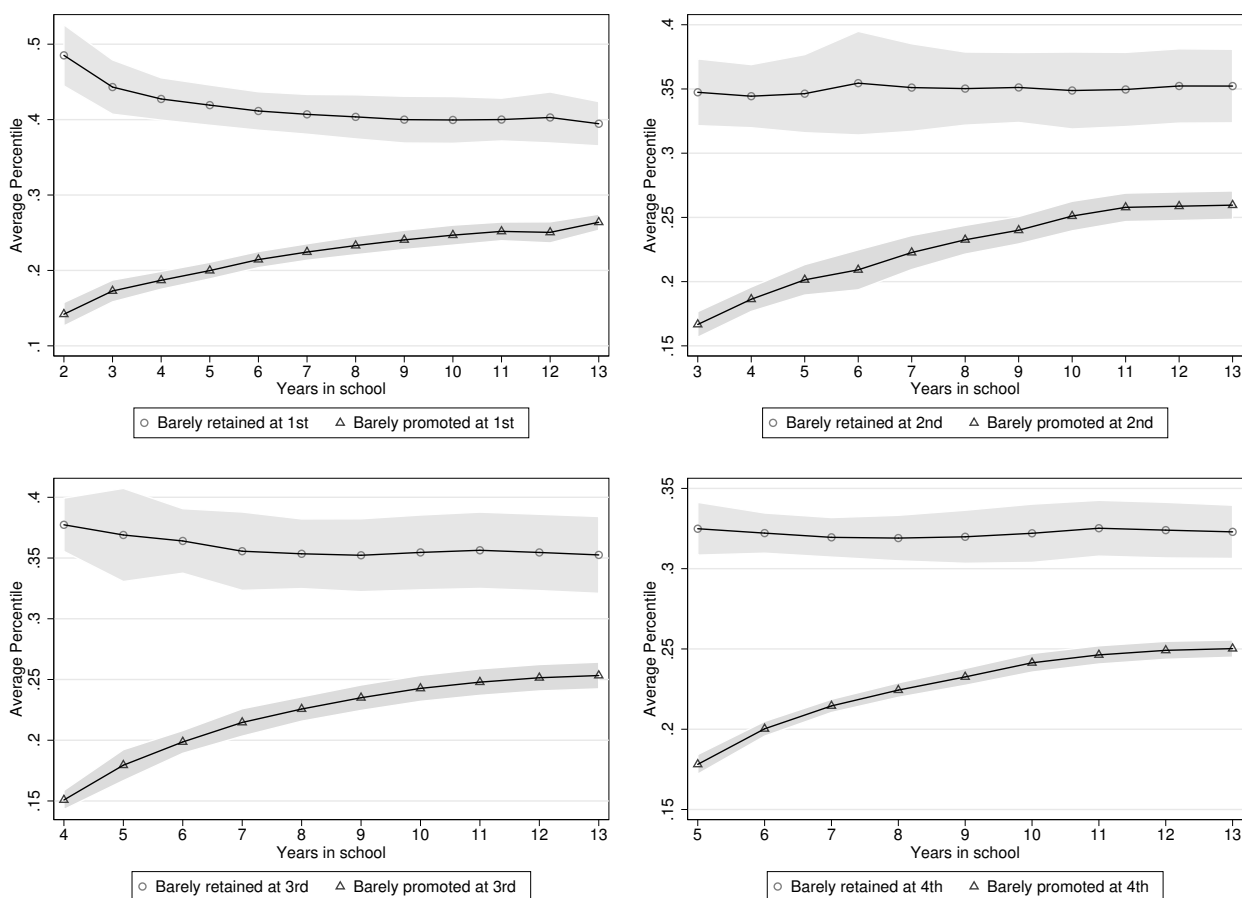
Fortunately, the other retention grades do not exhibit this problem so that the conclusions will put less weight on those results from second-grade retention.

Figure 16: The dynamics of the Dropout analysis



A final note about dynamics. Figure 17 shows how is the trajectory over time in terms of class ranking. The figure compares the ranking percentile at the cutoff of (marginally) promoted versus retained, indicating that the performance of retained students increase by 30 percentiles from the 15th percentile to near the median. Over the years the retained performance percentile stabilizes around the percentile 40th, while barely promoted around the 25th. The evolution indicates that retained students fit better with the new class, with similar classmates regarding abilities.

Figure 17: Post Retention Performance



## 8 Conclusion

This paper shows an integrated view of the effects of retention considering, within the same setting, several questions posed in the literature. The paper starts exploring the long run effects on educational attainment. Continues with the cognitive achievement, proposing a novel method to disentangle the effects of retention and age. It follows, considering the complementarity of parental effort and investment, which are triggered by this policy. The paper ends addressing the psychological and behavioral effects evidenced by students, which has been highlighted as very important consequences of grade retention that may justify its elimination.

One more advantage of this setting is that considers a long panel and a rich dataset allowing to add up several cohorts to achieve a cleaner better estimation. In many cases, the effects sensi-



tive to statistical specification and the length of the panel, which may explain the contradictory findings in the literature, in very similar settings.

However, the overall summary of the policy is mixed. Especially in the long term, we observe some negative effects, such as the reduction in high school enrollment for third graders. Perhaps the greater consequence is the half-year delay in the entrance to the labor market, which may have longer-term consequences. Although, these effects are concentrated in second and fourth-grade repetition. While the effects seem to vary depending on the grade level repeated, all of them experience some bad outcomes in a low degree.

Beyond attainment, the effects appear to be positive in the other three dimensions. Students' cognitive achievement increases by half a standard deviation in a standardized test, and the effects are persistent up to the tenth grade. Parents get involved more actively in the educational process increasing their time investments and their monitoring efforts while using other motivation devices such as congratulations when the student obtain good marks. Students improve their overall educational experience, being able to focus more in class, increasing their understanding, and being able to improve their notes. Besides that, students increase their overall GPA, class attendance and relative performance over all the years they are in the educational system. These positive effects in student-class match translate to an increase in their self-confidence, which after an initial negative shock become positive three years after retention.

The improvement in the learning process, unfortunately, does not translate to a higher attainment.

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## A APPENDIX: ADDITIONAL TABLES

Table 16: Application of SIMCE test and its survey by year and grade-level.

Year	SIMCE scores				Parent Survey			
	Match, Reading and Science				4th grade		10th grade	
	2nd	4th	8th	10th	Parents	Students	Parents	Students
1998				x				
1999		x						
2000			x					
2001				x				
2002		x						
2003				x				
2004			x					
2005		x			x			
2006		x		x	x			
2007		x	x		x			
2008		x		x	x			
2009		x	x		x	x		
2010		x		x	x	x		
2011		x	x		x	x		
2012	x	x		x	x	x	x	x
2013	x	x	x	x	x	x	x	x

Note: This table show the years when each question has been applied in the SIMCE survey of parents. It is necessary to have two consecutive years to evaluate promoted and retained students.

Table 17: Questions about Household characteristics

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Who respond the survey	x	x	x	x	x	x	x	x	x
Household size	x	x	x	x	x	x			
Shower	x	x	x	x	x	x			
Water heater	x	x	x	x	x	x			
Microwave oven	x	x	x	x	x	x			
TV Cable or satelital	x	x	x	x	x	x			
Telephone line	x	x	x	x	x	x			
DVD or video recorder	x	x	x	x	x	x			
computer	x	x	x	x	x	x	x	x	x
Internet Conection	x	x	x	x	x	x	x	x	x
How many book at home	x	x	x	x	x	x	x	x	x
Father years of education	x	x		x	x	x	x	x	x
Mother years of education	x	x		x	x	x	x	x	x
Family Income	x	x	x	x	x	x	x	x	x
Parent indigenous		x	x	x	x	x	x	x	
Preschool			x	x	x	x	x	x	x
Expectations including basic	x	x	x	x					
Expectation from EM	x	x	x	x	x	x	x	x	x

Note: This table show the years when SIMCE has been applied. It is necessary to have two consecutive years to evaluate promoted and retained students.

Table 18: Examples of construction of samples

Grade	Cohort:									
1	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
3	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
4	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
5	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
6	2007	2008	2009	2010	2011	2012	2013	2014	2015	
7	2008	2009	2010	2011	2012	2013	2014	2015		
8	2009	2010	2011	2012	2013	2014	2015			
9	2010	2011	2012	2013	2014	2015				
10	2011	2012	2013	2014	2015					
11	2012	2013	2014	2015						
12	2013	2014	2015							
	2014	2015								
	2015									

Grade	Cohort:									
1	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
3	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
4	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
5	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
6	2007	2008	2009	2010	2011	2012	2013	2014	2015	
7	2008	2009	2010	2011	2012	2013	2014	2015		
8	2009	2010	2011	2012	2013	2014	2015			
9	2010	2011	2012	2013	2014	2015				
10	2011	2012	2013	2014	2015					
11	2012	2013	2014	2015						
12	2013	2014	2015							
	2014	2015								
	2015									

Note: This table show the years when SIMCE has been applied. It is necessary to have two consecutive years to evaluate promoted and retained students. Years in red correspond to the time where the educational measure is taken. Blue represent years of SIMCE 6th, 8th, and 10th

## B First Stages by year and level

Table 19: First Stage at 4.5

	1st-grade	2nd-grade	3rd-grade	4th-grade
	(1)	(2)	(3)	(4)
Year 2002	-0.016 (0.011)	-0.22*** (0.0066)	-0.0032 (0.014)	-0.28*** (0.014)
Obs.	14,751	23,320	19,059	26,778
Year 2003	-0.20*** (0.0077)	-0.21*** (0.010)	-0.21*** (0.014)	-0.28*** (0.010)
Obs.	16,159	22,314	20,782	26,677
Year 2004	-0.22*** (0.010)	-0.23*** (0.0099)	-0.25*** (0.0088)	-0.28*** (0.013)
Obs.	17,375	19,028	23,172	24,466
Year 2005	-0.22*** (0.017)	-0.26*** (0.021)	-0.24*** (0.016)	-0.29*** (0.0058)
Obs.	17,400	18,363	22,336	24,843
Year 2006	-0.19*** (0.010)	-0.22*** (0.012)	-0.27*** (0.017)	-0.28*** (0.0054)
Obs.	17,109	18,793	23,093	24,365
Year 2007	-0.20*** (0.014)	-0.22*** (0.011)	-0.27*** (0.0061)	-0.32*** (0.028)
Obs.	17,336	18,439	22,743	23,014
Year 2008	-0.22*** (0.013)	-0.24*** (0.0047)	-0.29*** (0.010)	-0.31*** (0.018)
Obs.	16,683	17,954	22,073	22,297
Year 2009	-0.19*** (0.022)	-0.23*** (0.0085)	-0.28*** (0.0097)	-0.32*** (0.017)
Obs.	16,000	16,653	20,794	20,044
Year 2010	-0.18*** (0.0098)	-0.23*** (0.011)	-0.29*** (0.010)	-0.34*** (0.020)
Obs.	14,903	16,019	21,057	19,528
Year 2011	-0.18*** (0.020)	-0.22*** (0.012)	-0.25*** (0.013)	-0.38*** (0.013)
Obs.	13,835	14,631	20,576	18,691
Controls	x	x	x	x

Note: First stage using local linear regressions in a window of 0.5 point at each size of the cutoff and a rectangular kernel. Each regression includes the following covariates: gender, student age at retention, class size, and indicator for voucher school, and an indicator for private school. Standar errors clustered at the running variable. \*\*\*:p<1%; \*\*:p<5%; \*:p<10%;



Table 20: First Stage at 5.0

	1st-grade	2nd-grade	3rd-grade	4th-grade
	(1)	(2)	(3)	(4)
Year 2002	0.012 (0.0097)	-0.055*** (0.0075)	0.0080* (0.0040)	0.0047 (0.0065)
Obs.	30,672	45,218	52,256	66,662
Year 2003	-0.063*** (0.0070)	-0.072*** (0.0087)	0.0085 (0.0079)	-0.00079 (0.0048)
Obs.	30,605	44,022	54,233	65,536
Year 2004	-0.096*** (0.0076)	-0.043*** (0.0060)	0.0017 (0.0050)	0.013*** (0.0037)
Obs.	32,605	42,069	56,929	65,089
Year 2005	-0.085*** (0.0084)	-0.058*** (0.012)	0.014 (0.0080)	0.014** (0.0046)
Obs.	32,667	41,945	57,732	67,512
Year 2006	-0.11*** (0.0075)	-0.039*** (0.0079)	-0.0062 (0.0065)	0.014** (0.0044)
Obs.	31,740	42,397	57,898	67,742
Year 2007	-0.11*** (0.0091)	-0.063*** (0.0058)	0.011 (0.0070)	0.018** (0.0061)
Obs.	32,389	42,026	59,083	66,015
Year 2008	-0.16*** (0.0100)	-0.080*** (0.011)	-0.0076 (0.0068)	0.027*** (0.0060)
Obs.	30,783	41,634	57,851	66,521
Year 2009	-0.14*** (0.013)	-0.088*** (0.0084)	-0.0040 (0.013)	0.022** (0.0088)
Obs.	30,149	40,793	58,644	64,003
Year 2010	-0.21*** (0.016)	-0.099*** (0.0092)	-0.021** (0.0069)	0.020 (0.011)
Obs.	28,421	40,287	58,763	65,102
Year 2011	-0.17*** (0.0079)	-0.087*** (0.0093)	-0.0030 (0.0041)	0.011** (0.0046)
Obs.	27,614	39,865	60,472	63,910
Controls	x	x	x	x

Note: see note in Table 19

Table 21: First Stage at 4.0

	1st-grade	2nd-grade	3rd-grade	4th-grade
	(1)	(2)	(3)	(4)
Year 2002	-0.35*** (0.034)	-0.067*** (0.019)	-0.29*** (0.046)	-0.036 (0.027)
Obs.	5,946	9,855	4,236	7,123
Year 2003	-0.10*** (0.013)	-0.034* (0.017)	-0.038 (0.031)	-0.030** (0.014)
Obs.	7,039	9,018	4,857	6,874
Year 2004	-0.075** (0.034)	-0.040 (0.024)	-0.065* (0.033)	-0.0067 (0.013)
Obs.	7,610	6,245	6,072	5,158
Year 2005	-0.056*** (0.016)	-0.026 (0.017)	-0.018 (0.023)	-0.022 (0.021)
Obs.	7,510	6,004	5,610	5,022
Year 2006	-0.040* (0.023)	-0.016 (0.017)	-0.021 (0.019)	-0.0026 (0.028)
Obs.	7,764	6,444	6,165	4,889
Year 2007	-0.019 (0.020)	-0.017 (0.020)	-0.020 (0.018)	-0.019 (0.018)
Obs.	7,938	6,066	5,852	4,536
Year 2008	-0.0075 (0.011)	-0.031* (0.018)	0.0028 (0.020)	0.00068 (0.027)
Obs.	7,658	6,171	5,897	4,064
Year 2009	-0.020 (0.013)	-0.014 (0.019)	-0.0068 (0.020)	-0.0078 (0.025)
Obs.	7,164	5,291	4,906	3,390
Year 2010	-0.016 (0.015)	0.000041 (0.016)	-0.024** (0.011)	0.0093 (0.034)
Obs.	6,578	4,900	4,932	3,144
Year 2011	-0.021 (0.013)	0.00047 (0.018)	0.0053 (0.021)	-0.019 (0.026)
Obs.	5,970	4,199	4,602	2,926
Controls	x	x	x	x

Note: see note in Table 19

# B.1 Graphical Evidence

Figure 18: First stages First-grade retention by year

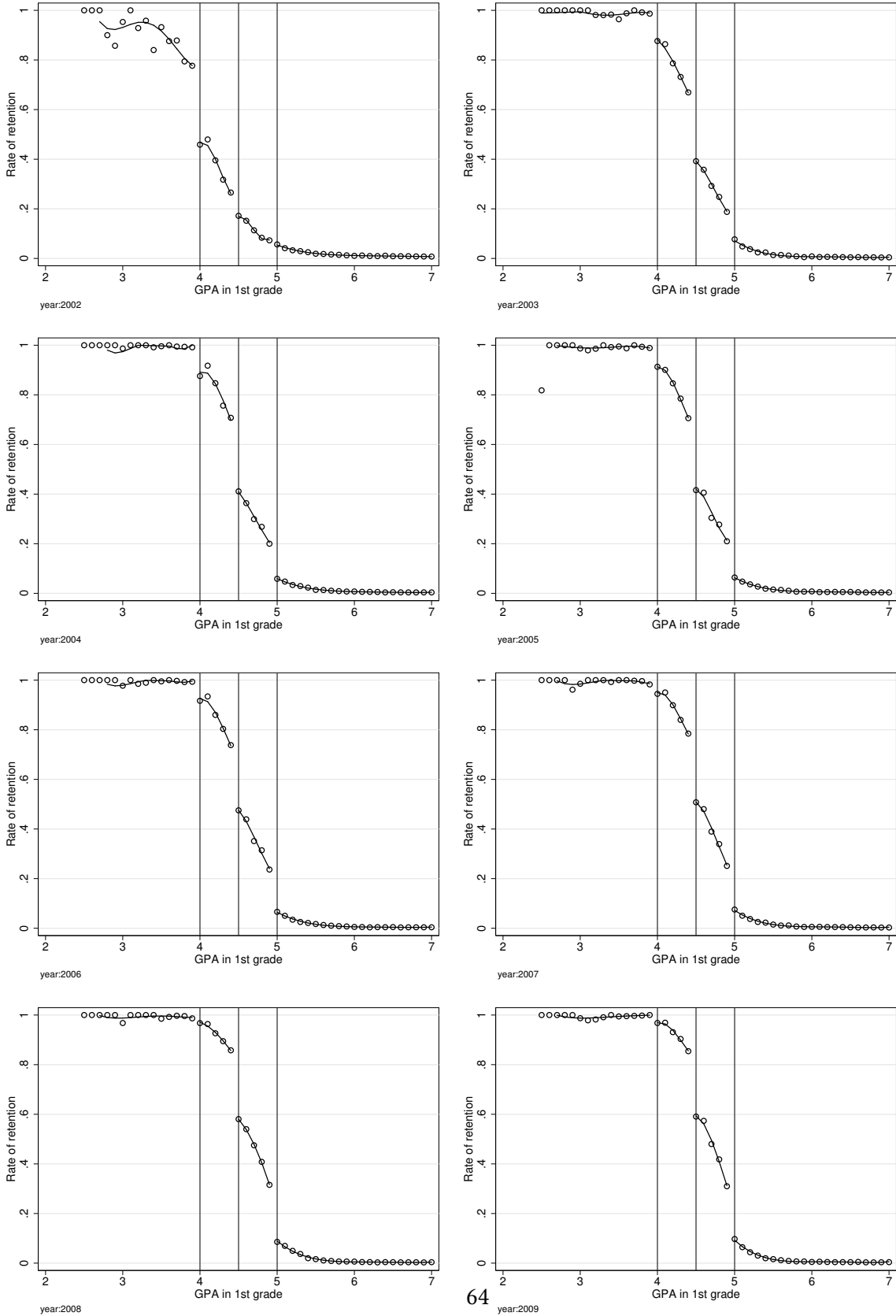


Figure 19: First stages second-grade retention by year

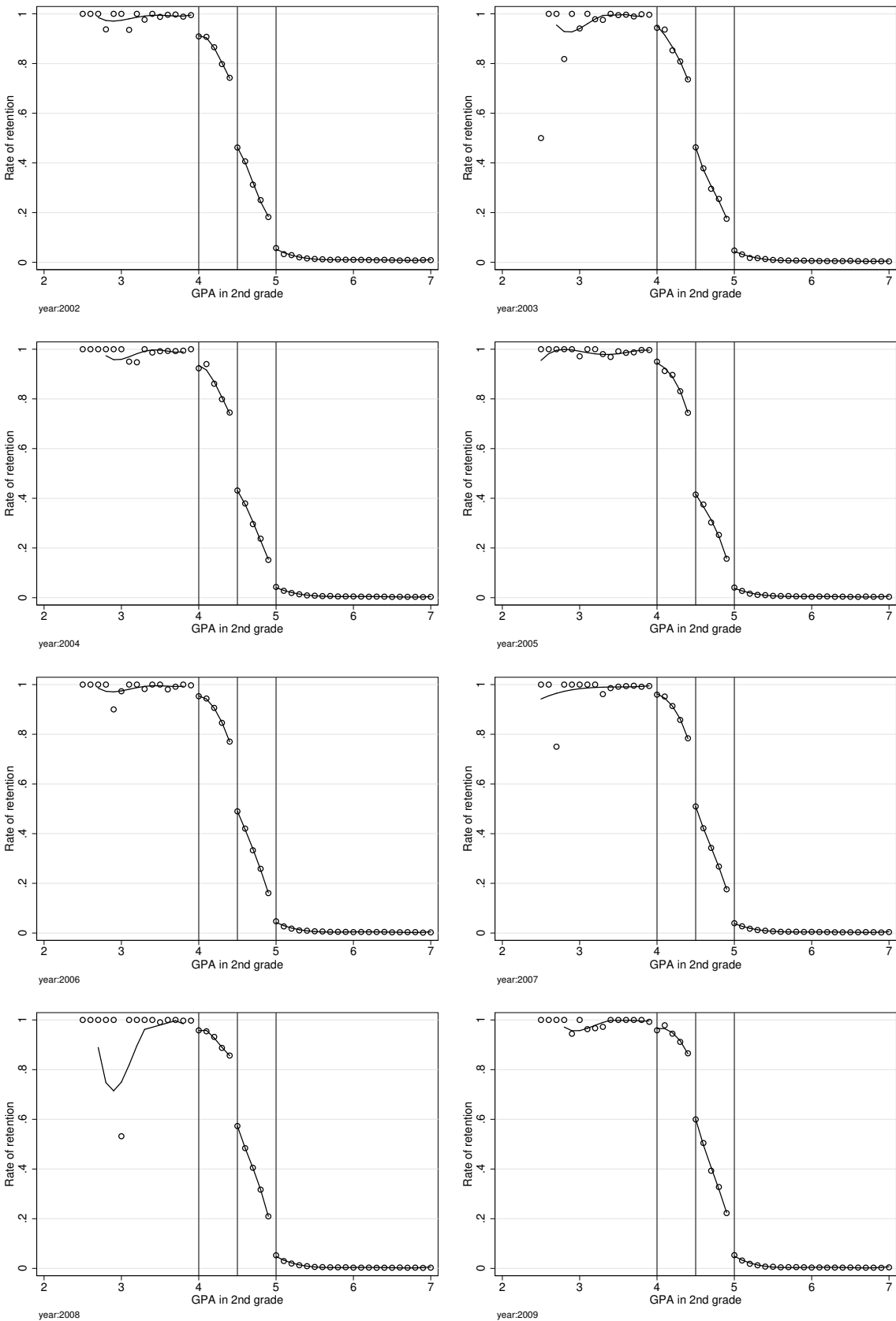


Figure 20: First stages third-grade retention by year

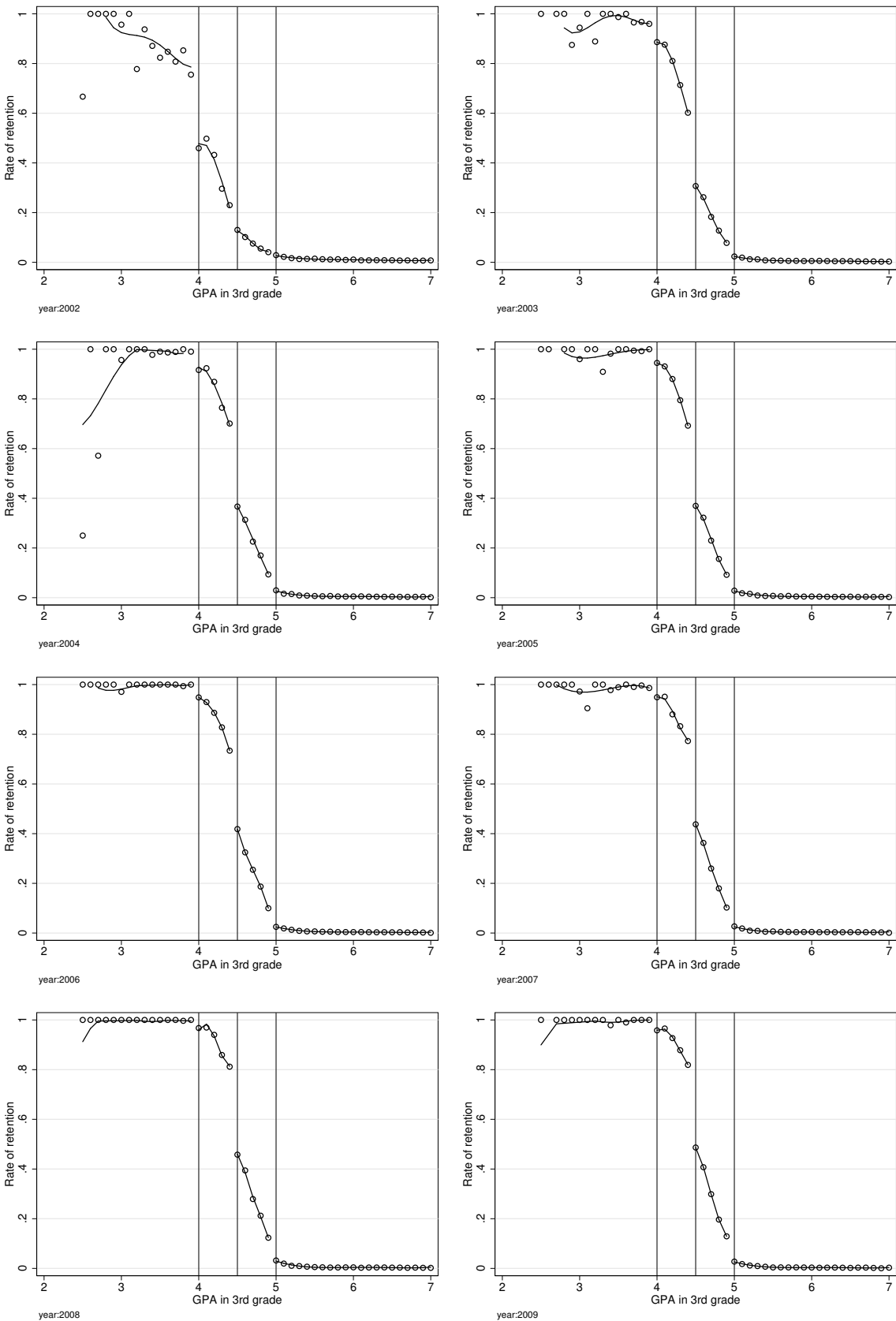
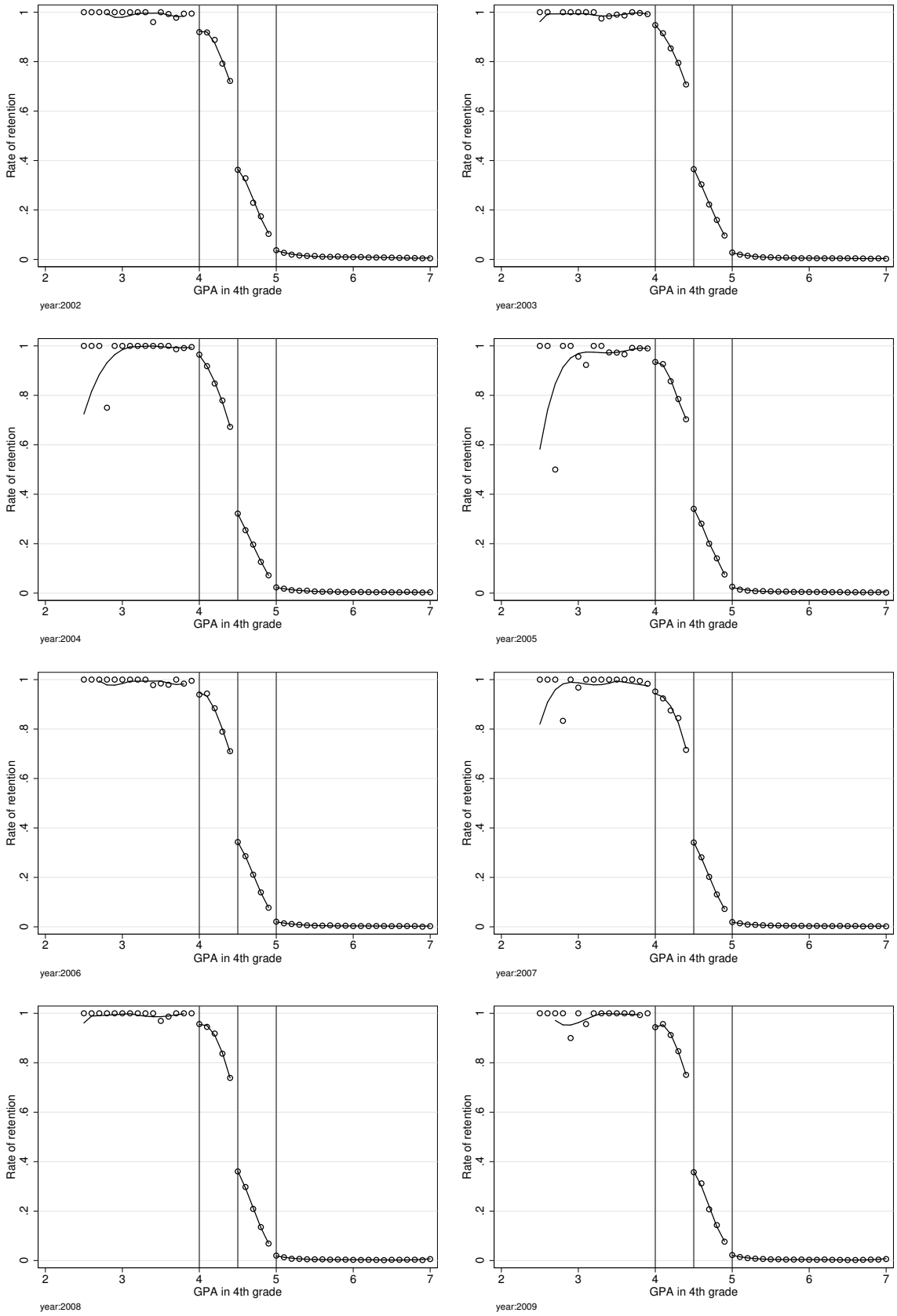


Figure 21: First stages fourth-grade retention by year



# C First Stage SSA

Figure 22: School Starting Age for different cohorts.

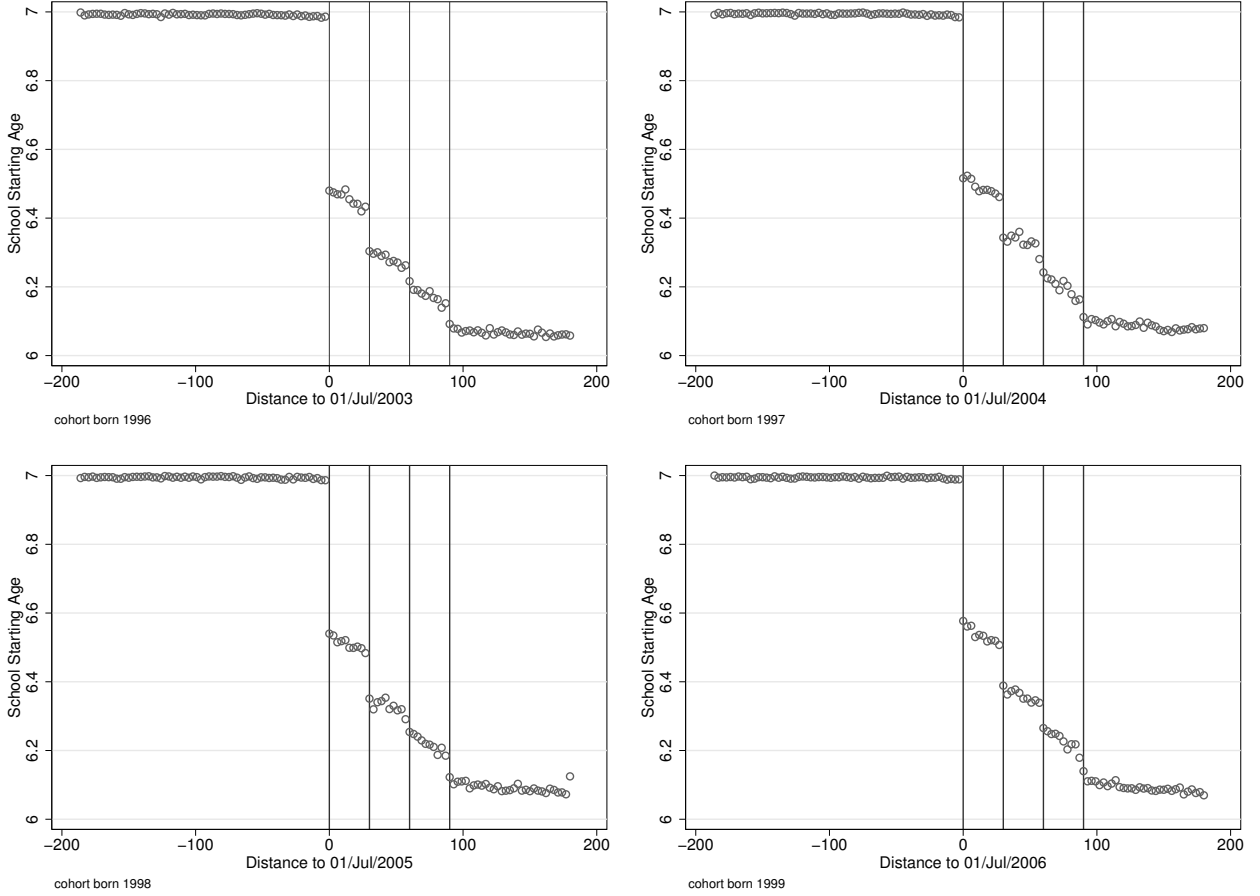
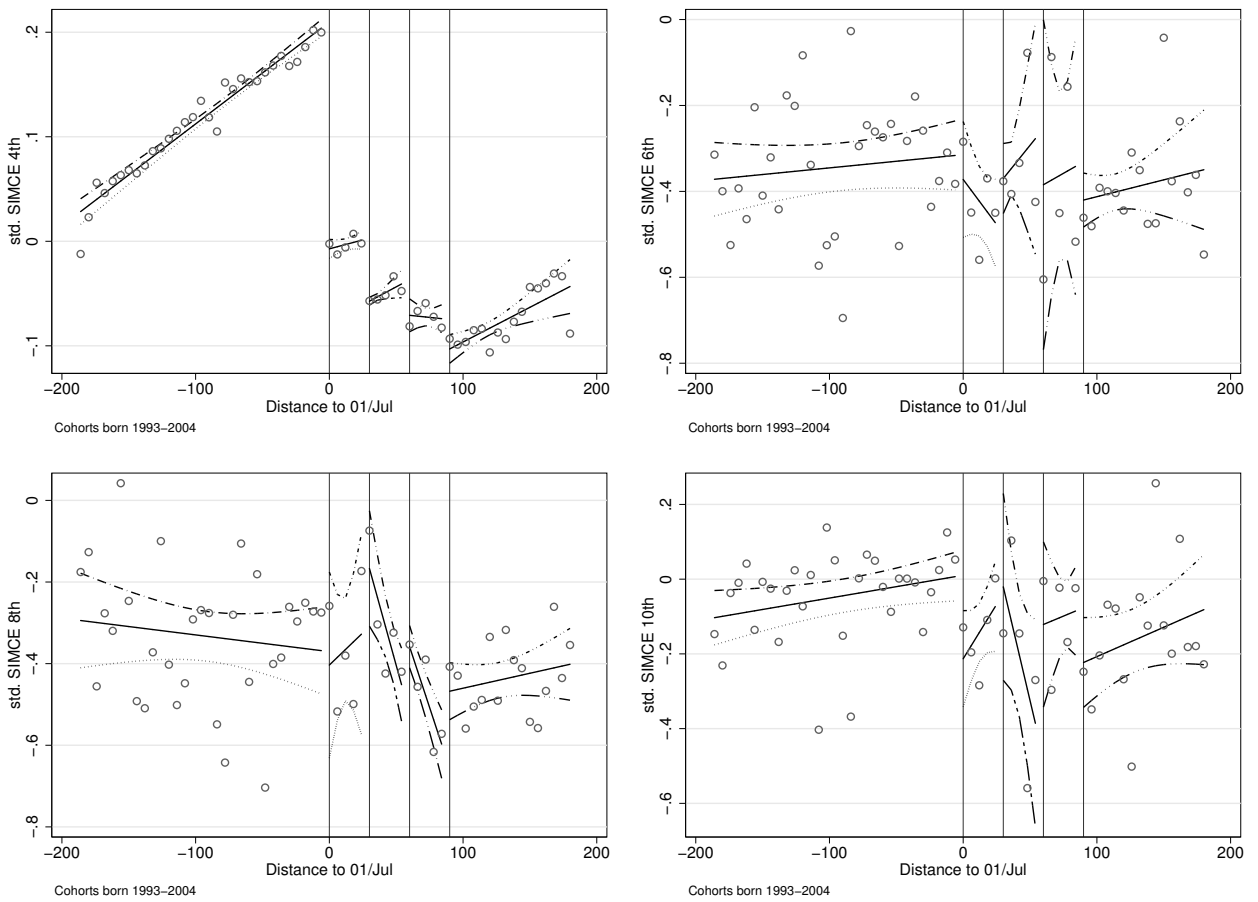


Figure 23: The effect of Age at the test on the SIMCE scores. Reduced form.





## D Additional Figures

### D.1 Long-Run Outcomes RD figures

Figure 24: Maximum Attainment

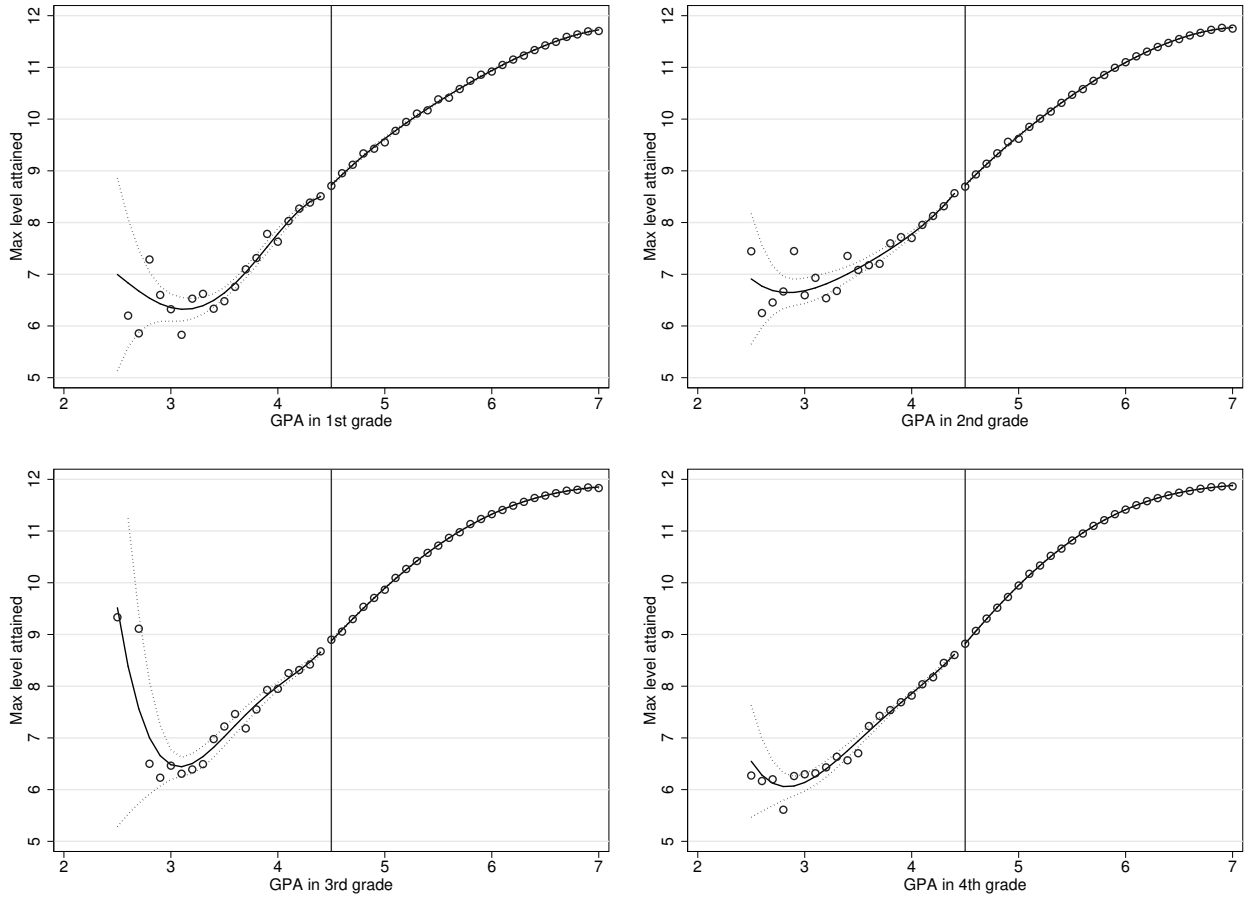
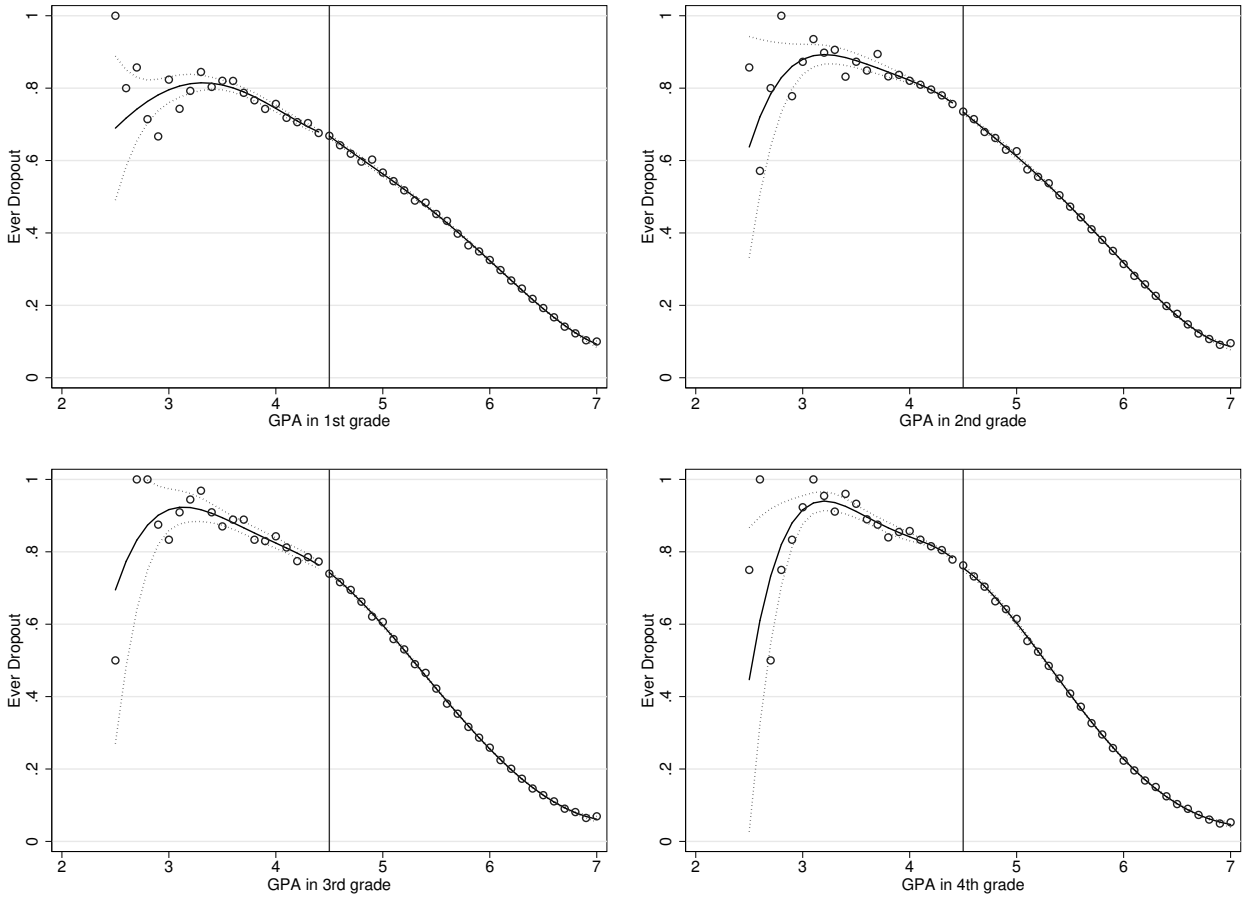


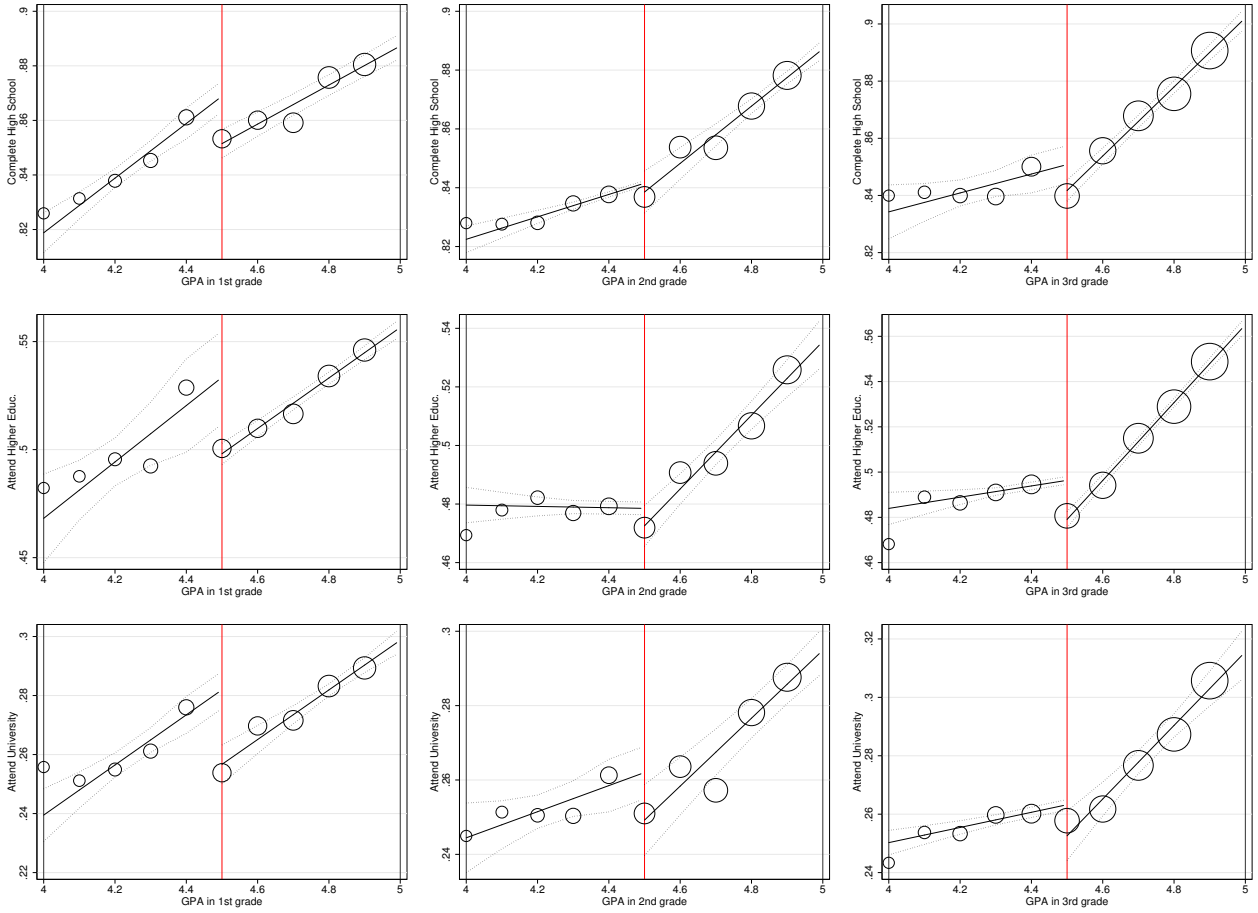
Figure 25: Dropout From School



## D.2 Behavioral RD figures

Figure 26: RD figures for all variables in Parental Expectations

**A. Parental expectations variables**



**B. Placebos**

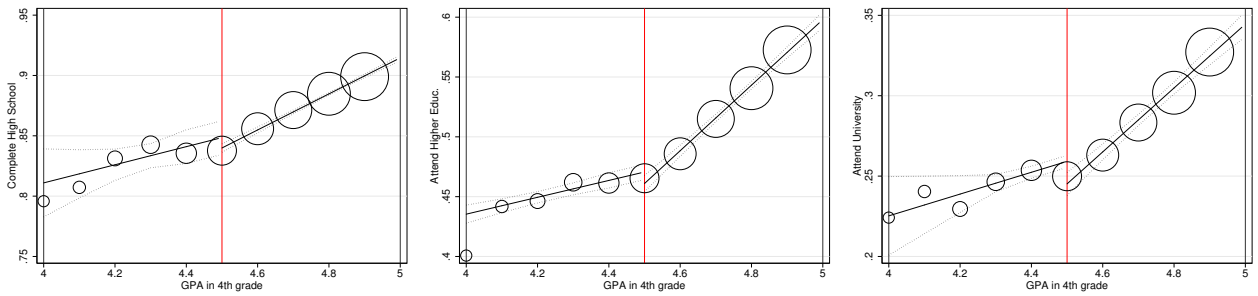
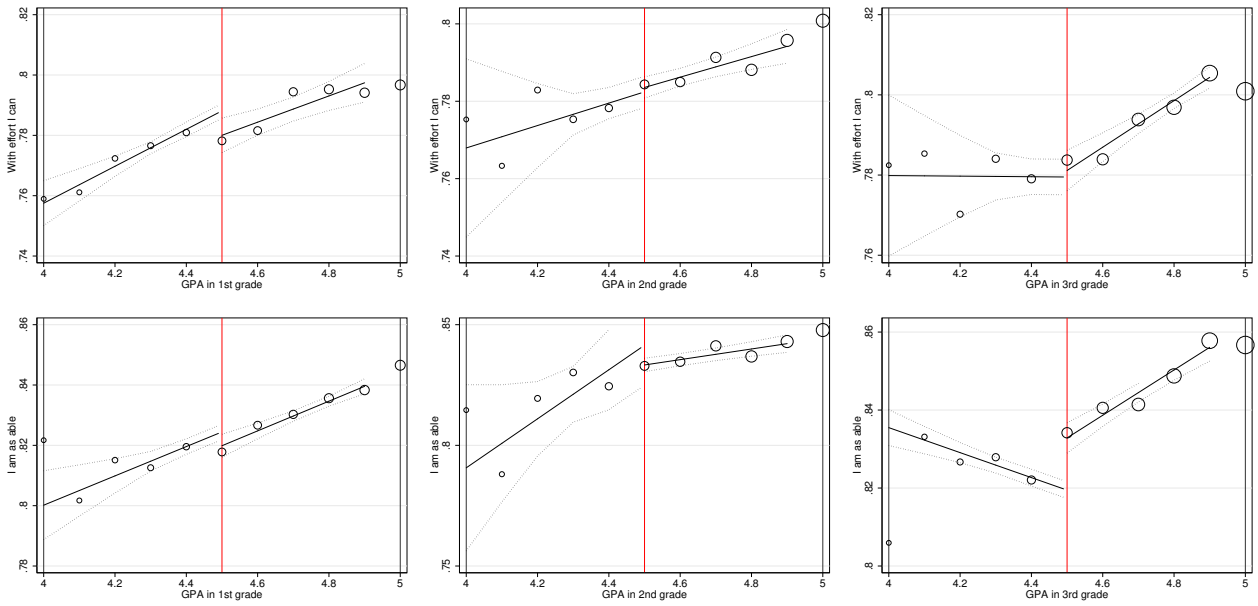


Figure 27: RD figures for all variables in Self-confidence

**A. Self-confidence Variables**



**B. Placebos**

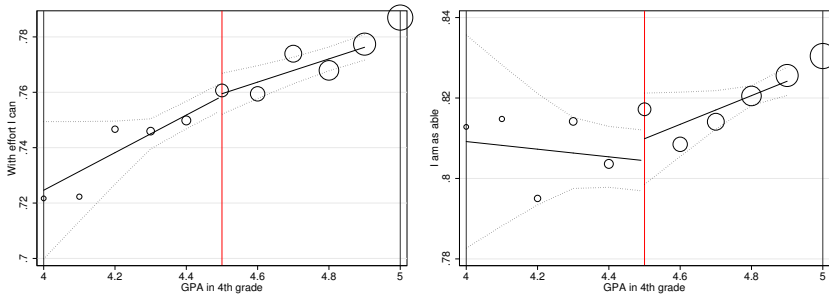
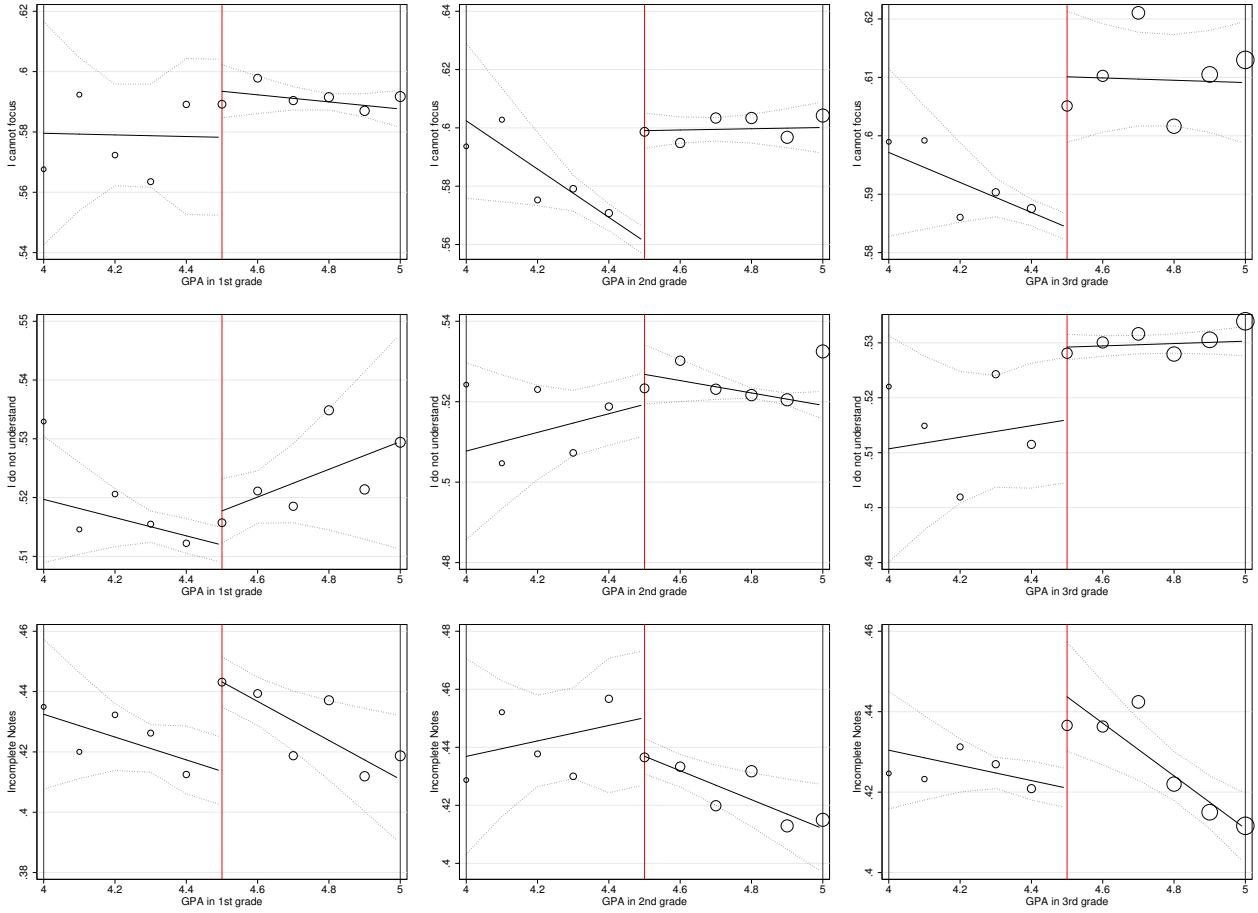
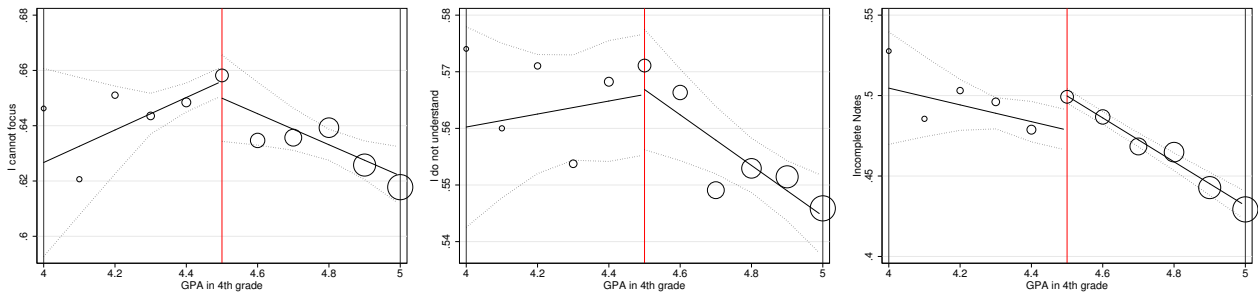


Figure 28: RD Figures for all variables in Learning Experience.

**A. Learning Experience Variables**



**B. Placebos**



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