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Assessing Transitional Kindergarten's Impact on Elementary School Trajectories

Technical Appendices

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Appendix A. Data and Sample Selection

We rely on data from five anonymous California districts that are part of the CORE district collaborative. The districts are all large, and therefore not representative of the state. They span across several regions of the state, and predominately enroll students who are designated as high-need by the state's funding formula (low-income, English Learner, and/or foster youth).

Through our agreements with these districts, we utilize student-level longitudinal records to track student outcomes from the time of TK enrollment onwards. We do not observe students before they enter one of our study districts, nor do we observe them if they exit – be it to another district in California or out of state.[1] We also do not observe what four-year students were doing before kindergarten, were they not enrolled in a TK classroom in one of the study districts.

The longitudinal structure of the data allows us to observe student outcomes several years after they initially attended TK. The primary outcomes of focus in our study include:

- English Learner and Special Education identification/reclassification codes
- Test scores in math and ELA, in grades 3-4
- Social-emotional learning assessments given annually in grades 3-5
- Attendance rates, absences, disciplinary records in elementary school

Sample Selection Criteria

Our study focuses on TK cohorts from 2013-14 to 2019-20. In the administrative files, students who are in a TK program have a grade code of kindergarten. To determine TK attendance, we use a separate file that identifies enrollment in a TK program by date. We additionally define any student who was in kindergarten in two consecutive years, with the first time being at age 4 and being born on or after the September 2nd TK eligibility cutoff as having participated in TK.

To then compare outcomes for TK and non-TK attending students, we restrict attention to students enrolled in kindergarten (and not TK) at any point from 2014-15 through 2020-21. We further restrict our sample to include only those students born within 40 days of the December 2nd cutoff. Table A1 below reports the summary sample for kindergarteners in these cohorts, separately for students who attended TK vs. those who did not.

[1] We find no differential attrition due to TK across the cutoff for grades 1-6 (Figure B24)

TABLE A1

Sample statistics for kindergarteners in our sample, by TK participation

	Non-TK	TK
Female	48%	49%
Low-income (i.e., FRPM)	68%	78%
Homeless	3%	2%
EL	28%	37%
Ever EL	34%	44%
Foster	<1%	<1%
Parent: any college	32%	29%
Special Education	8%	11%
Ever Special Ed	13%	14%
Avg Grade of Special Ed Identification	G1	KG
American Indian	<1%	<1%
Asian	8%	6%
Black	9%	7%
Filipino	1%	1%
Latino	63%	73%
Pacific Islander	<1%	<1%
White	13%	9%
Multi-race	4%	3%
Number of students	50,482	39,254

SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTES: Includes all students in sample in KG from 2014-15 to 2020-21 with a birthday within +/- 40 days of the Dec 2 TK cutoff. Percentages are rounded to the nearest percentage point, except where less than 1%. All cells contain at least 40 students.

TK Cohorts used by outcome and year

Our first TK cohort is from the 2014-15 school year, and our most recent data are from the 2020-21 school year. The outcomes we can study vary by grade level and school year. Table A2 illustrates the outcomes we can investigate for each TK cohort in our study.

TABLE A2

Outcome variables, by TK cohort, grade level, and school year

	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
2013-14 TK	K Attendance EL reclass Special ed Id Special ed exit	1 Attendance EL reclass Special ed Id Special ed exit	2 Attendance EL reclass Special ed Id Special ed exit	3 Attendance EL reclass Special ed Id Special ed exit SEL ELA Math	4 Attendance EL reclass Special ed Id Special ed exit SEL ELA Math	5 Attendance EL reclass Special ed Id Special ed exit SEL	6 Attendance EL reclass Special ed Id Special ed exit SEL
2014-15 TK		K Attendance EL reclass Special ed Id Special ed exit	1 Attendance EL reclass Special ed Id Special ed exit	2 Attendance EL reclass Special ed Id Special ed exit	3 Attendance EL reclass Special ed Id Special ed exit SEL ELA Math	4 Attendance EL reclass Special ed Id Special ed exit SEL	5 Attendance EL reclass Special ed Id Special ed exit SEL
2015-16 TK			K Attendance EL reclass Special ed Id Special ed exit	1 Attendance EL reclass Special ed Id Special ed exit	2 Attendance EL reclass Special ed Id Special ed exit	3 Attendance EL reclass Special ed Id Special ed exit SEL	4 Attendance EL reclass Special ed Id Special ed exit SEL
2016-17 TK				K Attendance EL reclass Special ed Id Special ed exit	1 Attendance EL reclass Special ed Id Special ed exit	2 Attendance EL reclass Special ed Id Special ed exit	3 Attendance EL reclass Special ed Id Special ed exit SEL
2017-18 TK					K Attendance EL reclass Special ed Id Special ed exit	1 Attendance EL reclass Special ed Id Special ed exit	2 Attendance EL reclass Special ed Id Special ed exit

Converting Social Emotional Learning (SEL) Answers to Standardized Scores

Students in grades 3 through 12 are given an SEL survey annually, with questions that students answer on an ordered scale from 0 to 4 (e.g., "strongly disagree to strongly agree"). Students typically answer around 25 questions, with 5 to 10 questions per construct depending on the year. The survey includes questions designed to measure four SEL constructs (Meyer, Wang, and Rice 2018):

- **Self-management**: regulation of emotions, thoughts, and behaviors; e.g., managing stress, delaying gratification, motivating oneself, and goal-setting (CASEL, 2005).
- **Growth mindset**: belief that one's abilities can improve with effort, practice, and/or perseverance.
- **Self-efficacy**: belief in one's ability to succeed at achieving a specific outcome, e.g., reaching a goal.
- **Social awareness**: ability to recognize others' perspectives, with empathy, recognition, and understanding of social norms, diverse backgrounds, and community supports. (CASEL, 2005).

To convert these survey answers to a single metric along each construct, we follow the guidance of Meyer, Wang, and Rice (2018) and use a generalized partial credit model (GPCM) calibrate and score the items on the SEL survey into scores on each of the constructs. We calibrate the model separately for each grade level and district. We report scores in standard deviation units. We also compute a "mean" SEL score for each student, as the simple average across the standard deviation scores on each of the four constricts. Notably, some districts in our study sample did not field an SEL survey at all or in all years. Based on the coverage of years and grades relative to the

TK cohorts we study, we are only able to use SEL scores from two of our five sample districts in our primary specifications.

Limitations of the Study

It is possible that despite providing good representation of large districts with substantial populations of English Learner students, our study districts may not be representative of TK programs statewide.

Students who leave the district permanently are lost to our analysis, but we include students and their outcomes for all years they are present.

While regression discontinuity design allows a high degree of confidence we can isolate the impact of the TK program on student outcomes, we acknowledge we do not know the quality of pre-kindergarten environments our kindergarten control group experienced. If a high proportion of these students are experienced a high-quality preschool environment, this may make it appear that TK programs do not improve outcomes.

There are a few aspects of TK classroom conditions we cannot measure, including whether TK and K classrooms are combined, the EL language services available to TK EL students, and whether TK is a full or half day program. We also cannot observe the alternative pre-K settings experienced by students who did not attend TK.

Our study focuses on outcomes for TK students that participated in TK prior to the current expansion. TK expansion includes resources and expectations for several program improvements. Thus, our findings may not illustrate the current impact of TK on student outcomes.

Appendix B. Regression Discontinuity Design (RDD) Estimation

TK participation is not random: comparisons of outcomes by TK participation nest biases due to differential selection into the program. To overcome these biases, we estimate causal effects by leveraging the birth date cutoffs determining TK eligibility in a Regression Discontinuity Design (RDD) framework. Students born on different sides of the December 2nd cutoff differ in their eligibility: students born on or after are ineligible, while students born just days earlier are eligible. This discrete change in eligibility generates a compelling natural experiment from which plausible causal estimates of TK effects can be ascertained. Right around the cutoff, students enter kindergarten with differing exposure to TK, due only to the random chance of being on either side of the eligibility cutoff.

Prior research has successfully utilized this empirical framework to study short-run TK effects. Manship et al. (2017) and Doss (2019) relied on the December 2nd cutoff to estimate causal effects of TK on kindergarten outcomes via a fuzzy regression discontinuity design (FRD). We use an analogous design and offer new evidence on the effects of TK beyond kindergarten in our five study districts.

Importantly, estimates reflect the Local Average Treatment Effect (LATE) of TK participation on students with birth dates right near the cutoff. There are two notable considerations that affect the external validity of these estimates. First, the LATE is specific to students who would take up the option to enroll in TK if offered, who may differ from the average participant. However, given that the state has decided to make TK universal, this LATE has direct policy relevance. Second, these estimates are relative to the counterfactual program students would have enrolled in, in the absence of TK. These options may vary across contexts and over time, complicating interpretation of treatment effects and their relevance to different contexts (Lipsey et al. 2015; Heckman et al. 2000).

Validating the RD Design

There are several potential threats to internal validity in the RD design. In many RD settings, there is concern that individuals may be able to manipulate their value on the specific metric used for the participation cutoff. In the case of TK, this is implausible: students cannot manipulate their birthdates (or easily report erroneous birthdates) to gain participation in TK. Figure B1 displays the number of students at each birthdate in our sample, for separate birthdate in the 60 days before and after the cutoff. There is no indication of any bunching or discontinuities across the threshold, as expected. We also find no evidence of differential attrition in any grade (Figure B24). Furthermore, grade repetition is also very rare in our sample (ranging from less than 0.1% to 0.6% of students each year in grades 1 to 4).[2]

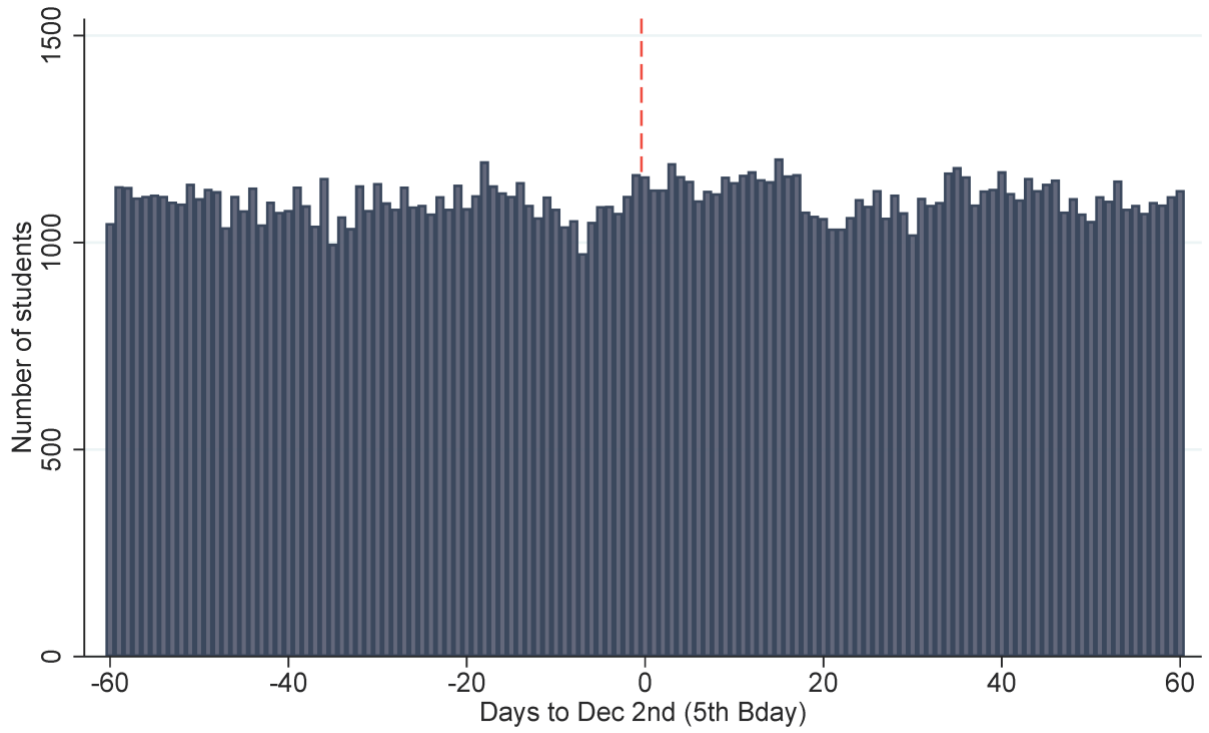
Figures B2-B3 then show the "first stage" relationship between TK participation and birthdate, in days relative to the December 2nd cutoff. Figure B2 shows a clear difference in participation across the cutoff. The introduction of "Early TK" (ETK) allowed districts the option to enroll some students after the Dec 2nd cutoff, starting in 2017-18; Figure B3 reports the first stage relationship separately for years before and after ETK. Prior to ETK, noncompliance with the Dec 2nd cutoff was very low, with roughly 3% of students born later in December after the cutoff attending TK. After the introduction of ETK, this increased to roughly 30% attending TK with birthdays after the Dec 2nd cutoff. Thus, for the first few TK cohorts prior to ETK—including the only cohorts for

[2] We find near-zero effects of TK on grade repetition in grades 1 to 4. Estimates are very small and insignificant for grades 1, 3, and 4. Grade 2 effects are significant but also very small, less than 0.3 percentage points, with a 95% confidence interval that can rule out effects greater than 0.5 percentage points. Given these findings and the rarity of repetition in our sample, differential sample selection due to grade repetition is unlikely to affect our estimates.

which we observe grade 3 and grade 4 test score outcomes—there is near-zero take-up of TK for those born after the cutoff. For outcomes measured on TK cohorts in later years after the introduction of ETK, RD estimates could be biased if there is differential selection into ETK; however, we find no evidence of differences in observable student characteristics across the Dec 2nd cutoff (Figure B4).

FIGURE B1

RD density: no discontinuities in birthdate counts across TK cutoff

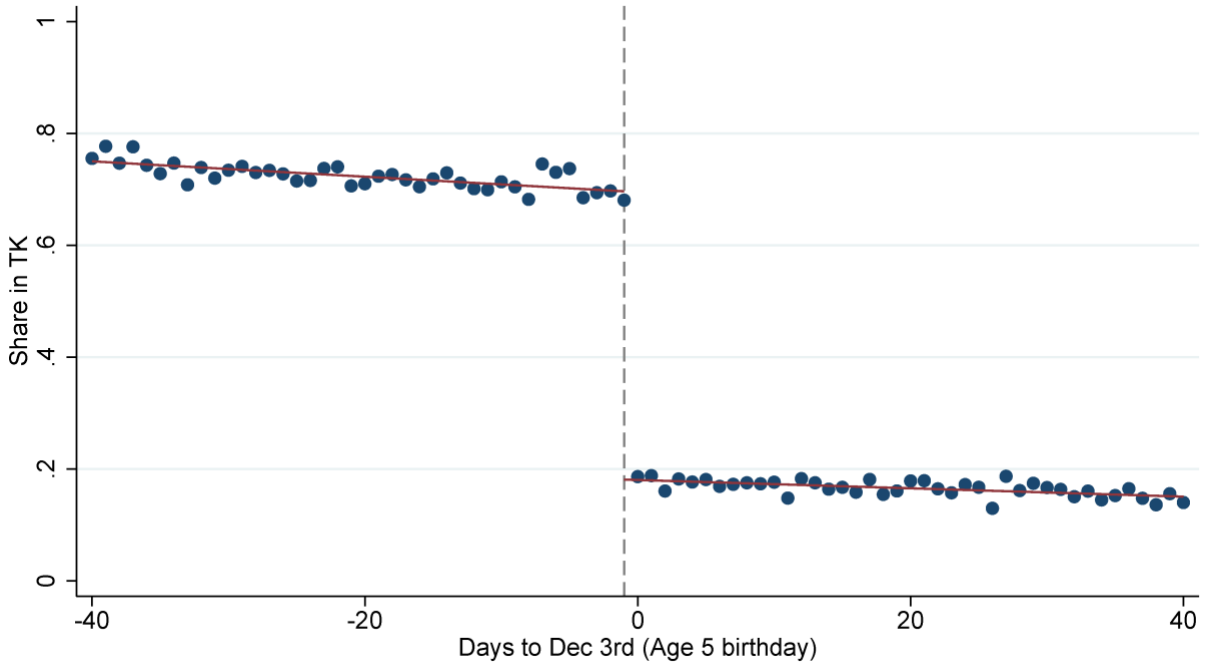


SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Number of students shown for each birthday, for all students in sample in KG from 2014-15 to 2020-21.

FIGURE B2

First stage: TK participation by age relative to cutoff

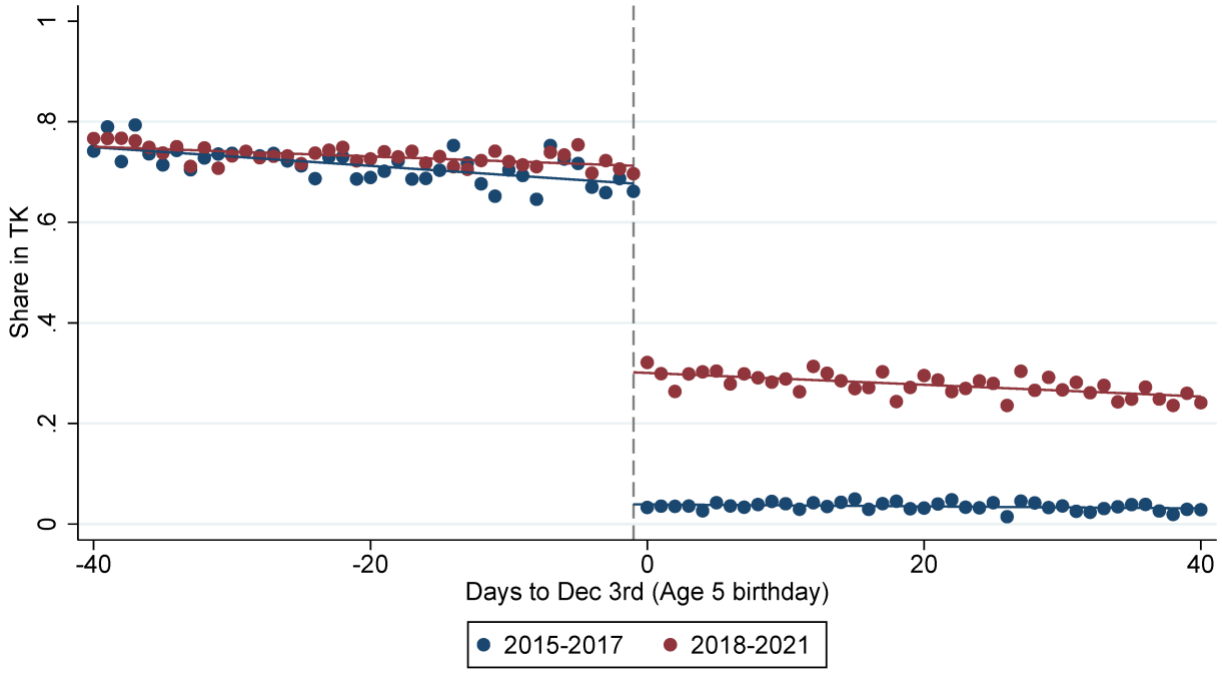


SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Bandwidth = 40 days. Linear RD line shown. Each data point shows mean of outcome by birthdate relative to cutoff.

FIGURE B3

First stage: TK participation by age relative to cutoff, separately by KG cohort year



SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Bandwidth = 40 days. Linear RD line shown. Each data point shows mean of outcome by birthdate relative to cutoff.

Estimating the RDD

To estimate our RD models, we restrict attention to only those students born within a narrow bandwidth on either side of the cutoff. We choose 40 days for our baseline estimates, similar to prior studies on TK that report results from bandwidths of 30 and 60 days (Manship et al. 2017; Doss 2019). Reassuringly, our primary results are qualitatively and quantitatively similar when choosing a smaller or larger bandwidths for most outcomes of interest. The main exception to this is for our SEL outcomes, which show larger and significant effects at small bandwidths, and smaller and insignificant impacts at large bandwidths. We therefore interpret these effects with greater caution.

We then estimate differences in TK participation and other outcomes for a student y_i around the December 2nd cutoff via equation (1):

$$(1) \quad y_i = \alpha_{c(i)} + \beta_1 Z_i + \beta_2 R_i + \beta_3 R_i * Z_i + \Gamma X_i + \epsilon_i$$

Where R_i is the distance in days from the December 2nd cutoff and Z_i is an indicator for having a birthdate after December 2nd. We also include fixed effects for kindergarten-school cohort, $\alpha_{c(i)}$, with the intuition that we want to directly compare students who attend kindergarten in the same school at the same time – and only differ in their birthdate and its effect via TK participation. We also include controls for time-invariant demographic characteristics of students, X_i, which include race/ethnicity, gender, free/reduced price meal eligibility, and parental education. First stage estimates of equation (1) are reported in Table B1. The first stage is around -0.5 and highly significant across specifications. Our final sample with non-missing controls includes 70,000 kindergarten students within our baseline bandwidth of 40 days.

To increase statistical power, we pool observations across grades (and subjects) and add additional fixed effects. For test score measures, we pool math and ELA scores in grades 3 and 4, and include grade-subject fixed effects. For SEL scores, we pool across grades 3-5, include grade fixed effects, and weight regressions by the inverse squared standard error from the GPCM model. In practice, weighting yields only slight improvements in precision and makes little quantitative and qualitative difference in the point estimates. Our primary estimates in the main text report results for both pooled and subject-specific models. We also report and grade-specific estimates below (Figures B14); test score effects slightly larger in grade 4, while SEL effects show suggestive but imprecise evidence of larger impacts in grade 3. [3]

Equation (1) shows a linear specification, but we also estimate results using quadratic functions of the birthdate, as well as "zero-order" polynomials that exclude the two R_i terms (akin to a more standard differences-in-differences approach). Results are generally robust to the decision of polynomial. Finally, we cluster standard errors by district-by-kindergarten cohort year, to allow for differential shocks to outcomes and TK treatment in different district-years.

Estimates of equation (1) excluding controls for student-level demographic outcomes are reported in Figure B4. For all demographic characteristics, there are no significant differences across the cutoff, and point estimates are precise and near-zero for each demographic variable. This provides additional validation that covariates are balanced across the threshold and estimates of the impact of TK are not biased by compositional differences in the students born on different sides of the cutoff. Our baseline estimates include controls for these differences, but as shown in Figures B10-B13, their inclusion generally has little impact on estimates of our main outcomes, across the distribution of bandwidths from +/- 20 to 60 days.

[3] We also examined impacts separately by district, but estimates were too imprecise to reject differences in effects across districts.

To estimate the impacts of TK participation we implement the regression discontinuity design via two-stage least squares (2SLS), using equation (2) to instrument for TK participation equation (3):

$$(2) \quad TK_i = \alpha_{c(i)} + \beta_1 Z_i + \beta_2 R_i + \beta_3 R_i * Z_i + \Gamma X_i + \epsilon_i$$

$$(3) \quad y_i = \gamma_{c(i)} + \pi TK_i + \psi_1 R_i + \psi_2 R_i * Z_i + \Phi X_i + \epsilon_i$$

Where TK_i is an indicator for participating in TK. Notably, 2SLS estimates of the effect of TK (π) in equation (3) provide estimates of the *treatment-on-the-treated* effect (TOT). Alternatively, equation (1) provides estimates of the *intent-to-treat* (ITT). While we are most interested in understanding the effects of TK for those who participate, the ITT is also interesting from a policy perspective, providing an estimate of impact of expanding the *offering* of TK to marginal students. Reduced form figures corresponding to these ITT estimates are shown in Figures B5 to B9. These figures show little evidence of a discontinuity for overall mean test and SEL scores; the discontinuity is more notable for SEL mean scores for English only but not DLL students (Figure B7). Most notably, ever being identified as an EL and the number of years spent as an EL show clear reduced form differences across the cutoff, of 6 percentage points and 1/5 of a year, respectively (Figures B8 and B9).

TABLE B1

Baseline first stage regression estimates

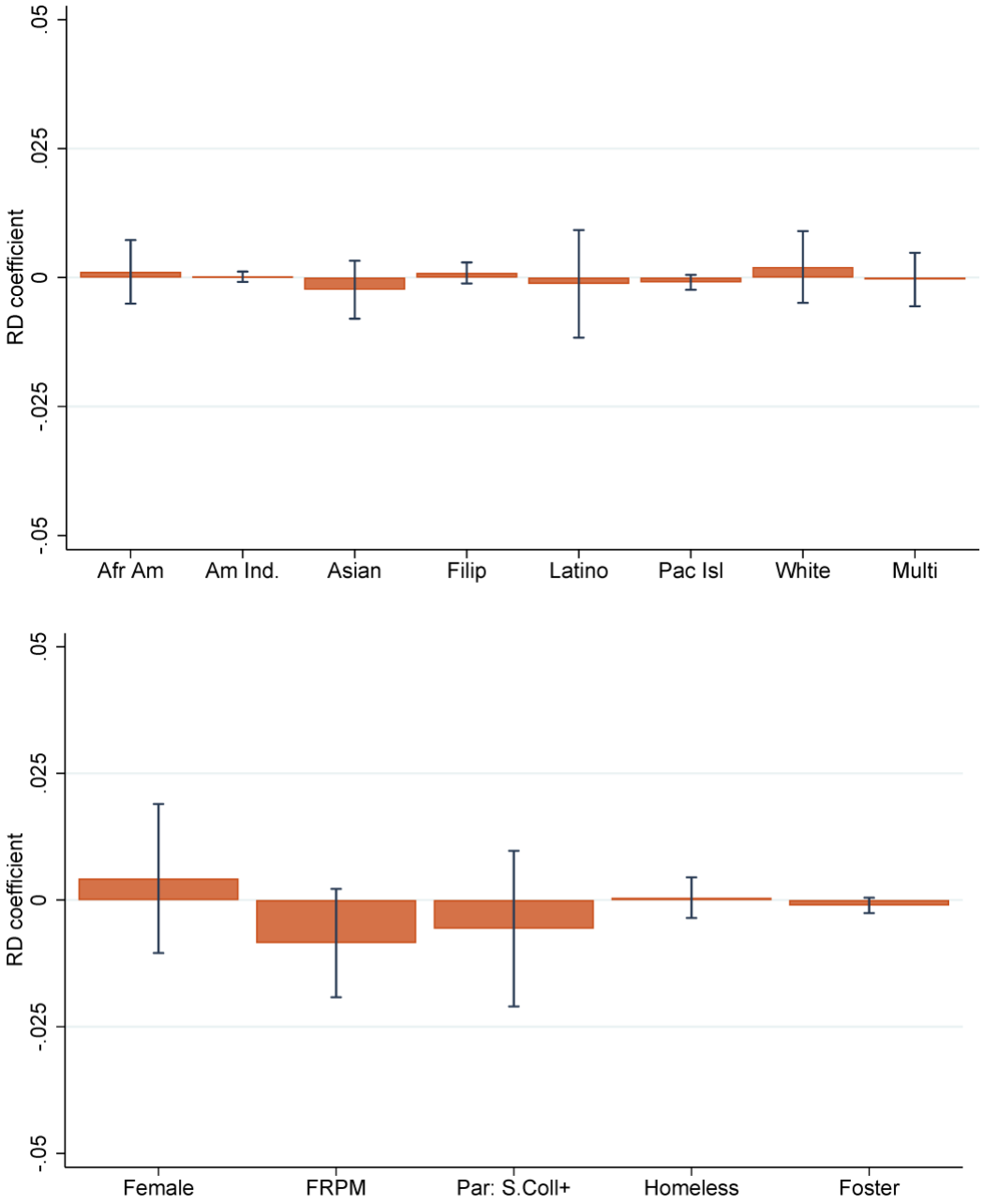
	(1)	(2)	(3)	(4)
Above cutoff	-0.515***	-0.516***	-0.522***	-0.522***
	(0.00677)	(0.00663)	(0.00753)	(0.0161)
Days to cutoff	-0.00137***	-0.00129***	-0.000966***	-0.000966***
	(0.000186)	(0.000186)	(0.000210)	(0.000185)
Days to cutoff*above	0.000629***	0.000631***	0.000134	0.000134
	(0.000235)	(0.000224)	(0.000254)	(0.000192)
Constant	0.695***	0.696***	0.598***	0.598***
	(0.00497)	(0.00449)	(0.0268)	(0.0268)
Observations	89,733	89,701	68,690	68,690
Cohort FEs		X	X	X
Controls			X	X
District-cohort clustering				X

SOURCES: Administrative records from participating study districts; Authors' calculations.

NOTES: Bandwidth = 40 days. Linear RD line shown. Standard errors clustered at the school-cohort level unless otherwise noted. * p<.1, ** p<.05, ***p<.01.

FIGURE B4

Covariate balance by gender, SES (top panel), race (bottom panel)



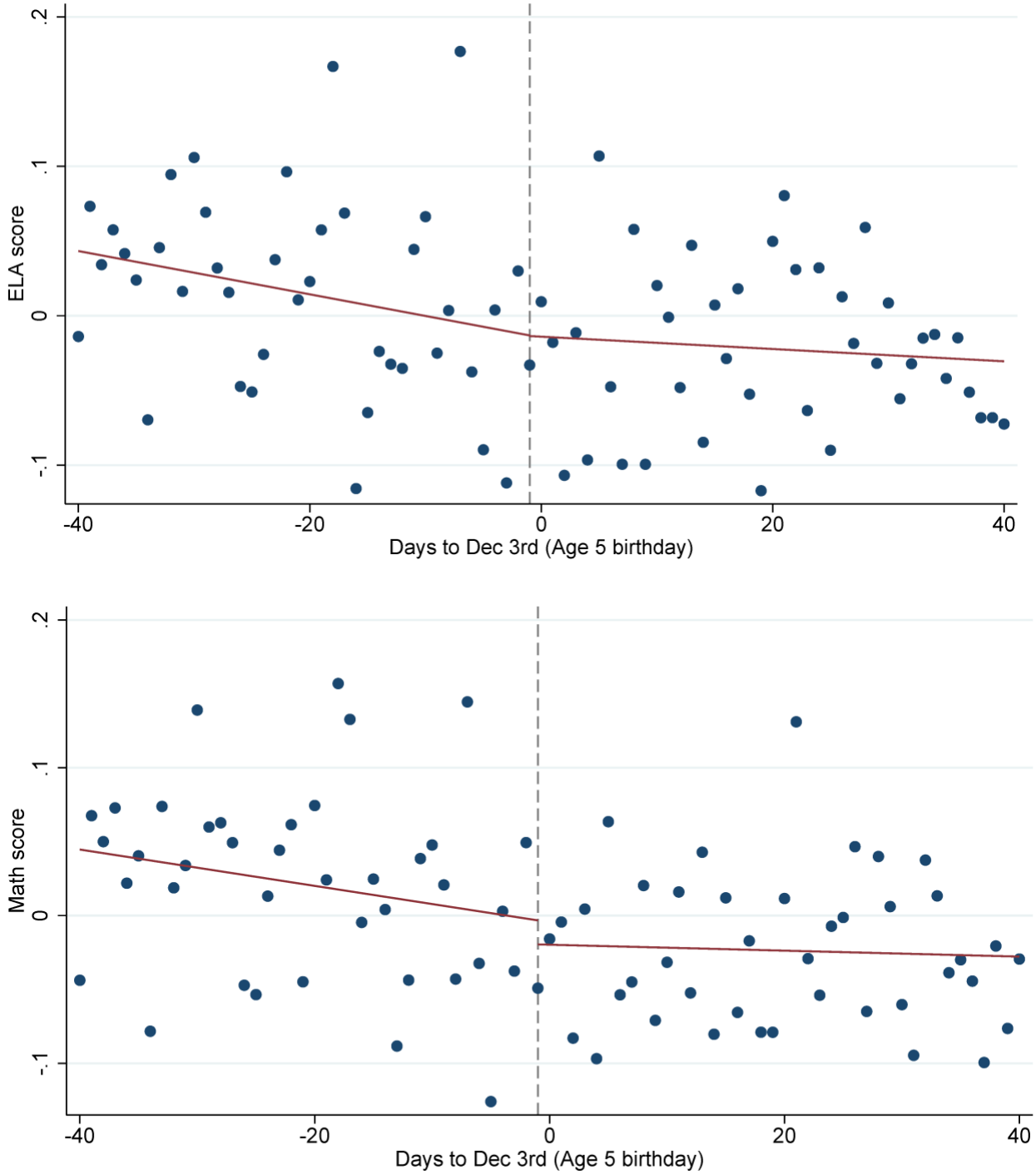
SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Bandwidth = 40 days. Linear RD line shown. 95% confidence intervals reported. Standard errors clustered at the school-cohort level.

Reduced-Form Figures of Differences in Outcomes Across Cutoff

FIGURE B5

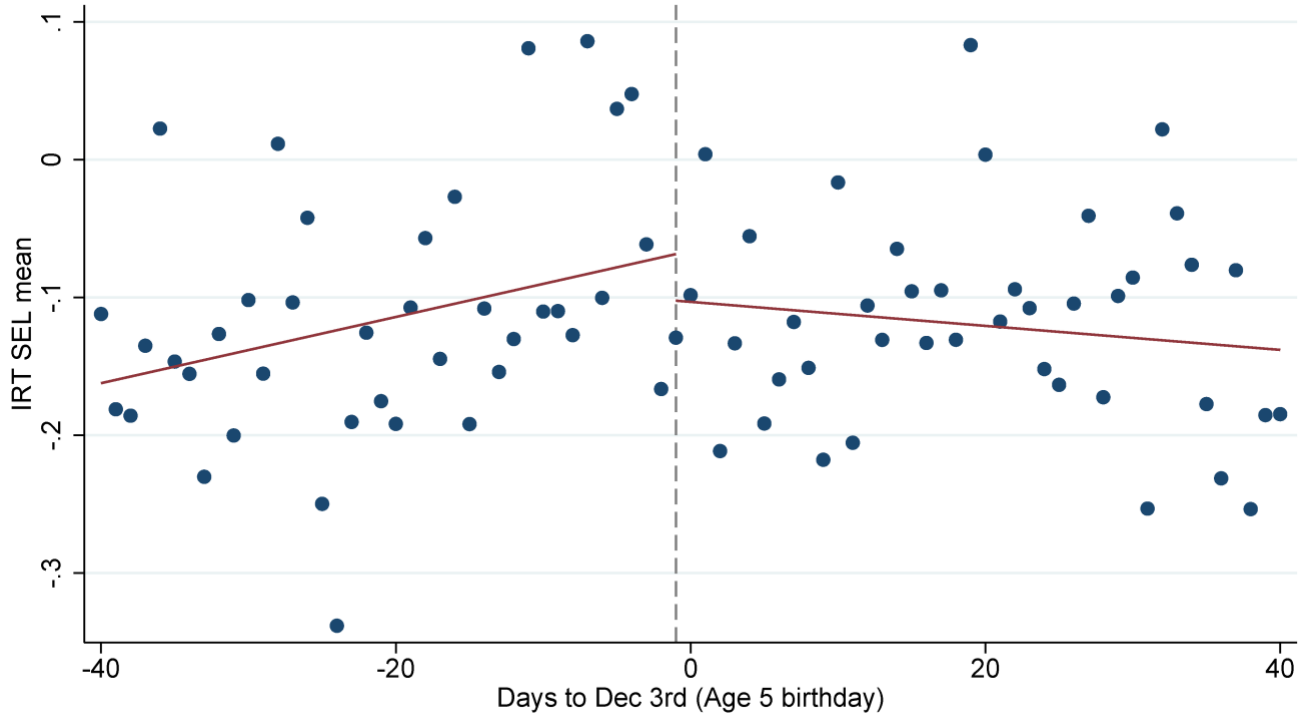
Reduced form figures, test scores (top panel ELA, bottom panel math)



SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Bandwidth = 40 days. Linear RD line shown. Each data point shows mean of outcome by birthdate relative to cutoff (no controls or fixed effects).

FIGURE B6
Reduced form figures, SEL mean

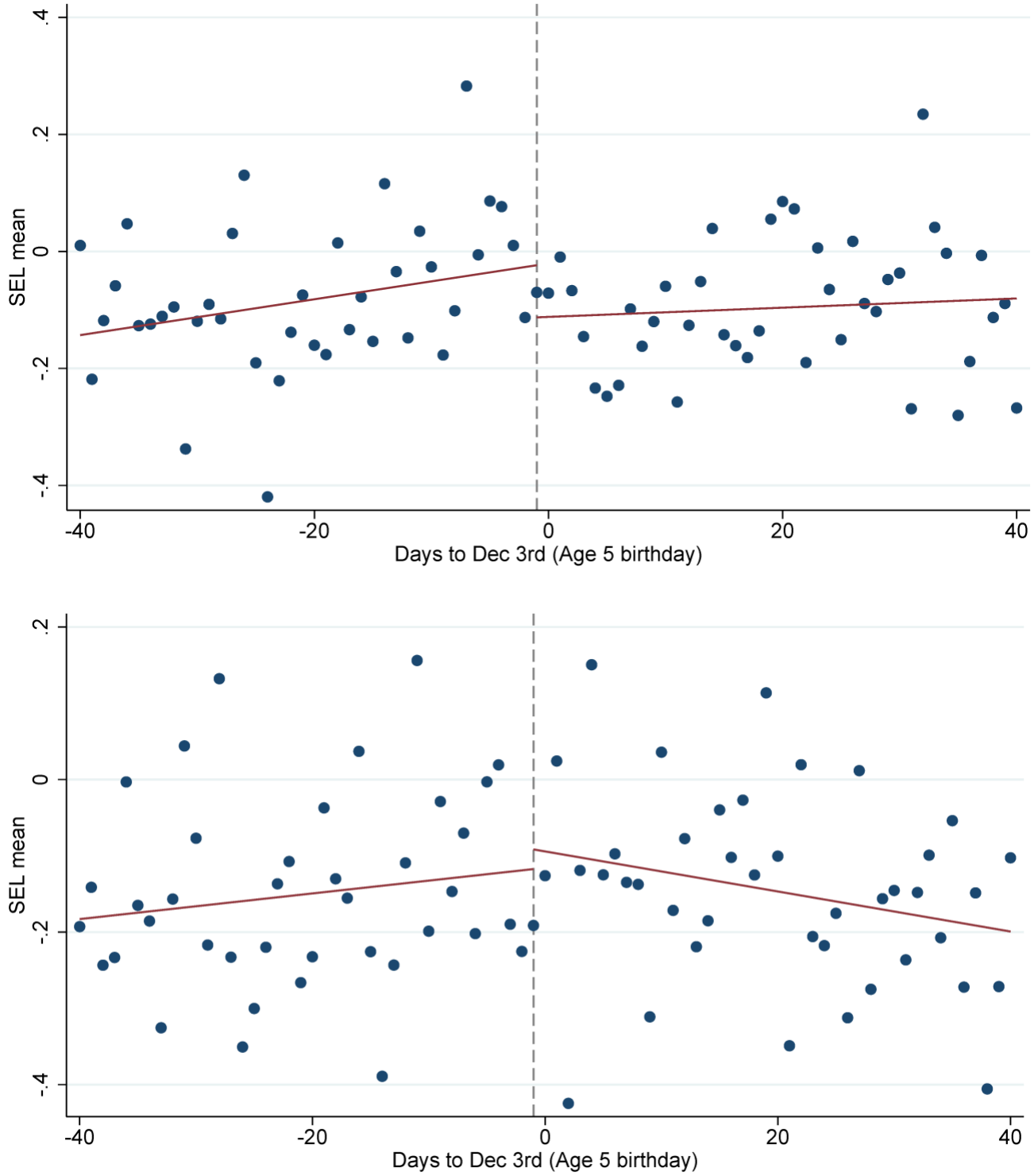


SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Bandwidth = 40 days. Linear RD line shown. Each data point shows mean of outcome by birthdate relative to cutoff (no controls or fixed effects).

FIGURE B7

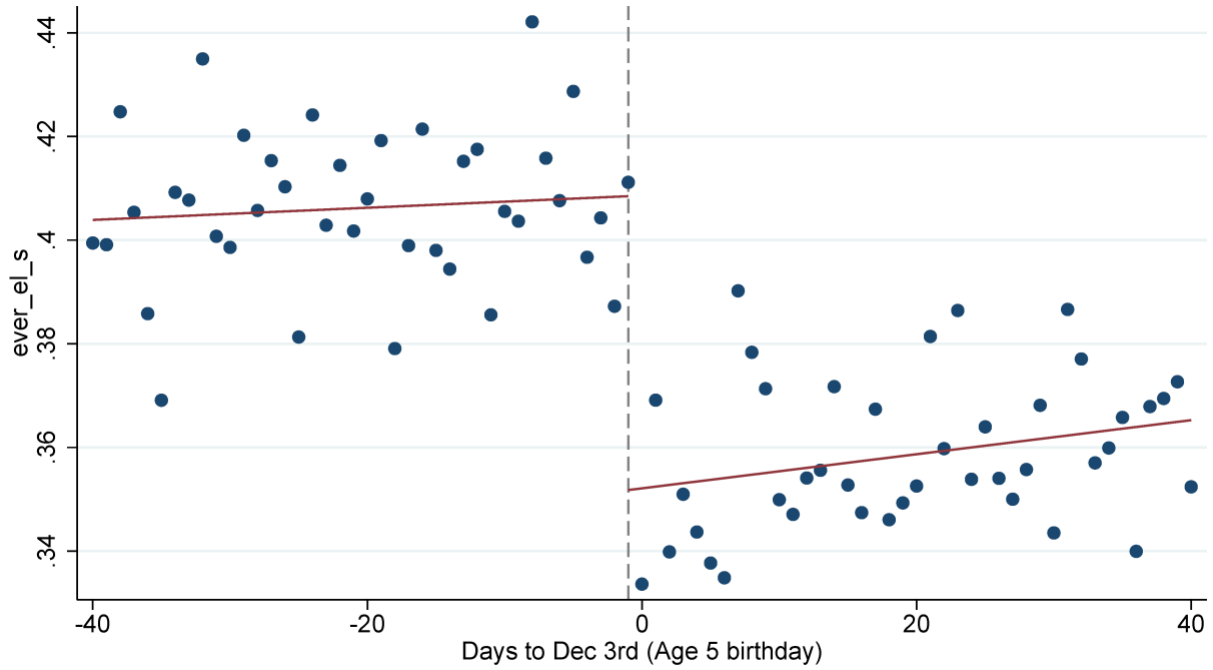
Reduced form figures, SEL mean, by English language (top panel, EO; bottom panel other home language)



SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Bandwidth = 40 days. Linear RD line shown. Each data point shows mean of outcome by birthdate relative to cutoff (no controls or fixed effects).

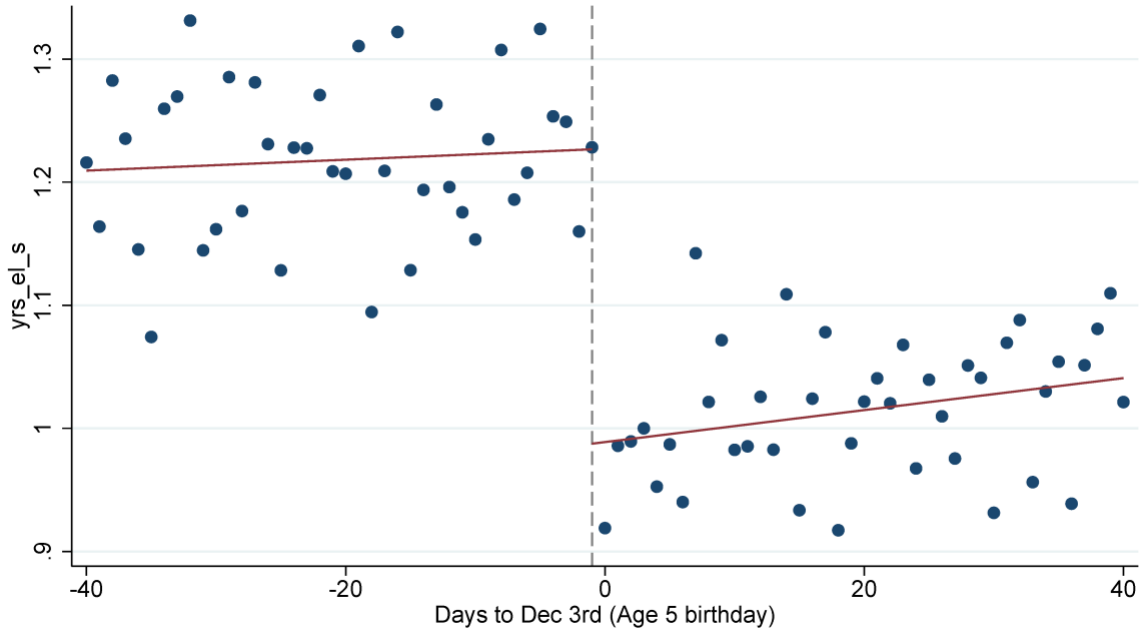
FIGURE B8
Reduced form figures, ever EL



SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Bandwidth = 40 days. Linear RD line shown. Each data point shows mean of outcome by birthdate relative to cutoff (no controls or fixed effects).

FIGURE B9
Reduced form figures, years EL



SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Bandwidth = 40 days. Linear RD line shown. Each data point shows mean of outcome by birthdate relative to cutoff (no controls or fixed effects).

Estimated 2SLS Impacts of TK

Regression tables for baseline results

TABLE B2

EL outcomes (Figure 4)

	Ever EL	Yrs EL	EL G1	EL G2	EL G3	EL G4	EL G5
TK	0.0872***	0.449***	0.0682***	0.0244*	0.00852	0.0132	0.00484
	(0.0161)	(0.0905)	(0.0115)	(0.0139)	(0.0157)	(0.0129)	(0.0144)
Days to cutoff	0.000172	0.00100*	0.000172	0.000292	0.000352	0.000570**	0.000599*
	(0.000174)	(0.000533)	(0.000161)	(0.000177)	(0.000206)	(0.000210)	(0.000276)
Days to cutoff*above	-0.0000964	0.0000459	-0.000139	-0.0000406	-0.0000555	-0.0000655	-0.000323
	(0.000208)	(0.000840)	(0.000214)	(0.000255)	(0.000315)	(0.000305)	(0.000340)
Observations	68,690	68,690	68,690	63,553	48,872	35,830	23,855
First stage F-stat	112.4	112.4	112.4	122.0	170.2	556.2	391.9
Cohort FEs	X	X	X	X	X	X	X
Controls	X	X	X	X	X	X	X

SOURCES: Administrative records from participating study districts; Authors' calculations.

NOTES: Estimates of equation (2). Bandwidth = 40 days. Linear RD line shown. Standard errors clustered at the school-cohort level. * p<.1, ** p<.05, ***p<.01.

TABLE B3

Reclassification in a given grade (Figure 5)

	In KG	In G1	In G2	In G3	In G4	In G5
TK	0.0389**	0.0573***	-0.0112	-0.0107	-0.00342	-0.00143
	(0.0173)	(0.0181)	(0.0165)	(0.0116)	(0.00452)	(0.00122)
Days to cutoff	-0.0000375	-0.000579**	0.0000545	-0.0000606	-0.0000106	-0.00000281
	(0.000107)	(0.000216)	(0.000250)	(0.000142)	(0.0000878)	(0.0000158)
Days to cutoff *above	-0.0000400	0.000344	-0.000375*	-0.000132	0.0000264	0.0000136
	(0.000150)	(0.000228)	(0.000205)	(0.000130)	(0.000156)	(0.0000481)
Observations	25650	25650	25650	25650	25650	25650
First stage F-stat	70.39	70.39	70.39	70.39	70.39	70.39
Cohort FEs	X	X	X	X	X	X
Controls	X	X	X	X	X	X

SOURCES: Administrative records from participating study districts; Authors' calculations.

NOTES: Estimates of equation (2). Bandwidth = 40 days. Linear RD line shown. Standard errors clustered at the school-cohort level. * p<.1, ** p<.05, ***p<.01.

TABLE B4

Special education timing (Figure 7)

	Grade ID'd	Gr: Specific LD	Gr: Autism	Gr: Speech/Lang
TK	-0.560***	0.0837	-1.024***	-0.517***
	(0.166)	(0.193)	(0.214)	(0.178)
Days to cutoff	0.00404*	0.00353	-0.00257	0.00311
	(0.00210)	(0.00497)	(0.00455)	(0.00234)
Days to cutoff *above	0.000931	0.00292	0.000543	0.00175
	(0.00352)	(0.00436)	(0.00541)	(0.00262)
Observations	7,561	788	746	2,151
First stage F-stat	113.6	121.2	80.14	43.43
Cohort FEs	X	X	X	X
Controls	X	X	X	X

SOURCES: Administrative records from participating study districts; Authors' calculations.

NOTES: Estimates of equation (2). Estimates conditional on having a specific special education classification, by column. Bandwidth = 40 days. Linear RD line shown. Standard errors clustered at the school-cohort level. * p<.1, ** p<.05, ***p<.01.

TABLE B5

Test score and SEL estimates (Figures 8 and 9)

	Pooled	ELA	Math	SEL mn	Self-Mng	Gr Mndst	Self-Effc	Social Awr
TK	0.0157	0.00915	0.0222	0.0454	0.0115	0.0755	0.0892*	0.0340
	(0.0351)	(0.0326)	(0.0391)	(0.0379)	(0.0460)	(0.0609)	(0.0433)	(0.0379)
Days to cutoff	-0.000782	-0.000848	-0.000721	0.00229**	0.00197*	0.00216	0.00241***	0.00261**
	(0.000973)	(0.000758)	(0.00123)	(0.000631)	(0.000812)	(0.00118)	(0.000261)	(0.000820)
Days to cutoff *above	0.000948	0.000893	0.00101	-0.00395***	-0.00409**	-0.00294*	-0.00331***	-0.00450***
	(0.00106)	(0.000753)	(0.00147)	(0.000743)	(0.00111)	(0.00130)	(0.000197)	(0.00119)
Observations	62991	31487	31468	7959	7943	7939	7941	7952

First stage F-stat	368.4	358.9	359.2	509.0	515.9	479.2	655.7	433.3
Cohort FEs	X	X	X	X	X	X	X	X
Controls	X	X	X	X	X	X	X	X

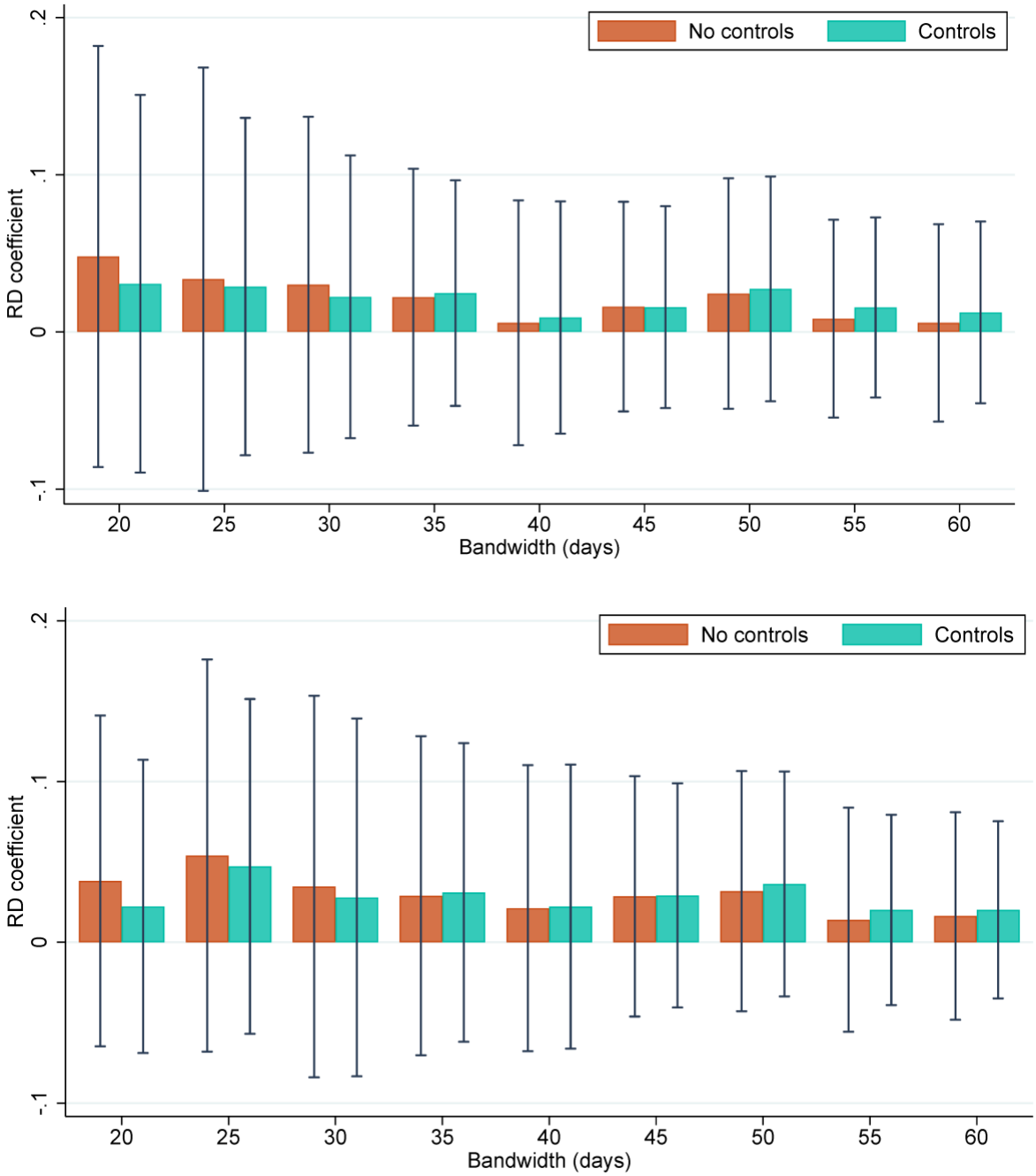
SOURCES: Administrative records from participating study districts; Authors' calculations.

NOTES: Estimates of equation (2). Bandwidth = 40 days. Linear RD line shown. Standard errors clustered at the school-cohort level. * p<.1, ** p<.05, ***p<.01.

Differences by Bandwidth and Inclusion of Controls

FIGURE B10

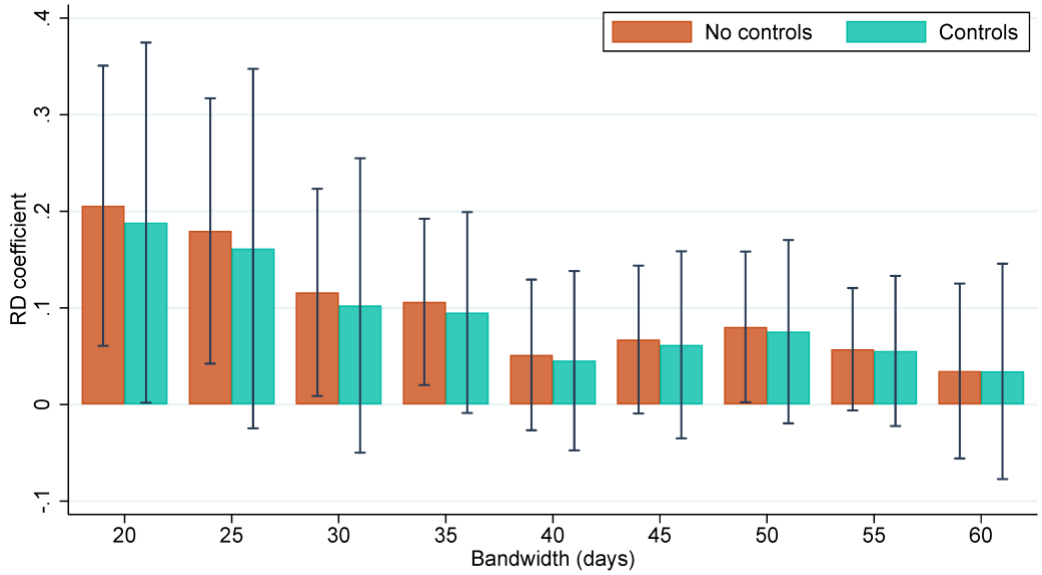
2SLS Impacts by Bandwidth, Test Scores (top panel ELA; bottom panel math)



SOURCE: Administrative records from participating study districts; Authors' calculations.

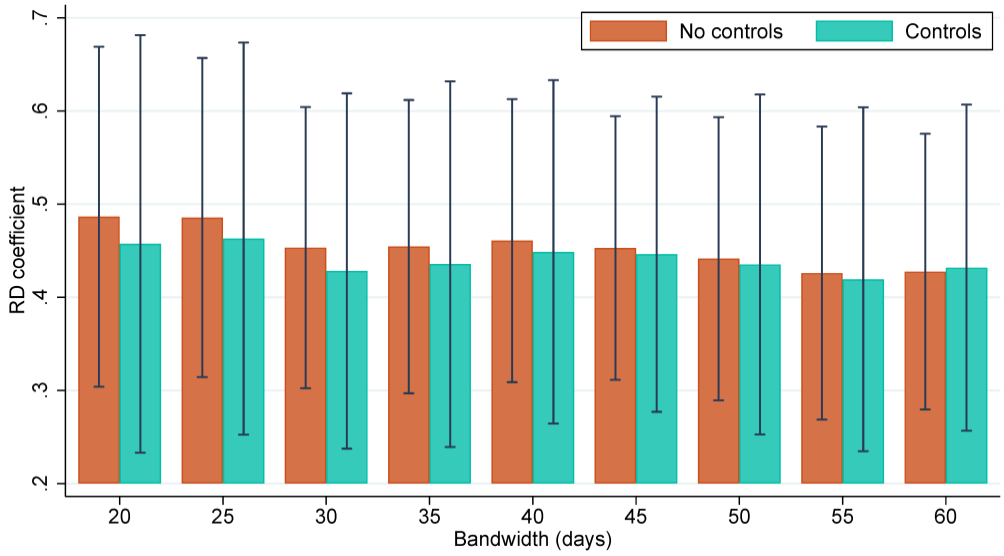
NOTE: Linear RD specification. 95% confidence intervals shown. Standard errors clustered at the school-cohort level.

FIGURE B11
2SLS Impacts by Bandwidth, SEL



SOURCE: Administrative records from participating study districts; Authors' calculations.
NOTE: Linear RD specification. 95% confidence intervals shown. Standard errors clustered at the school-cohort level.

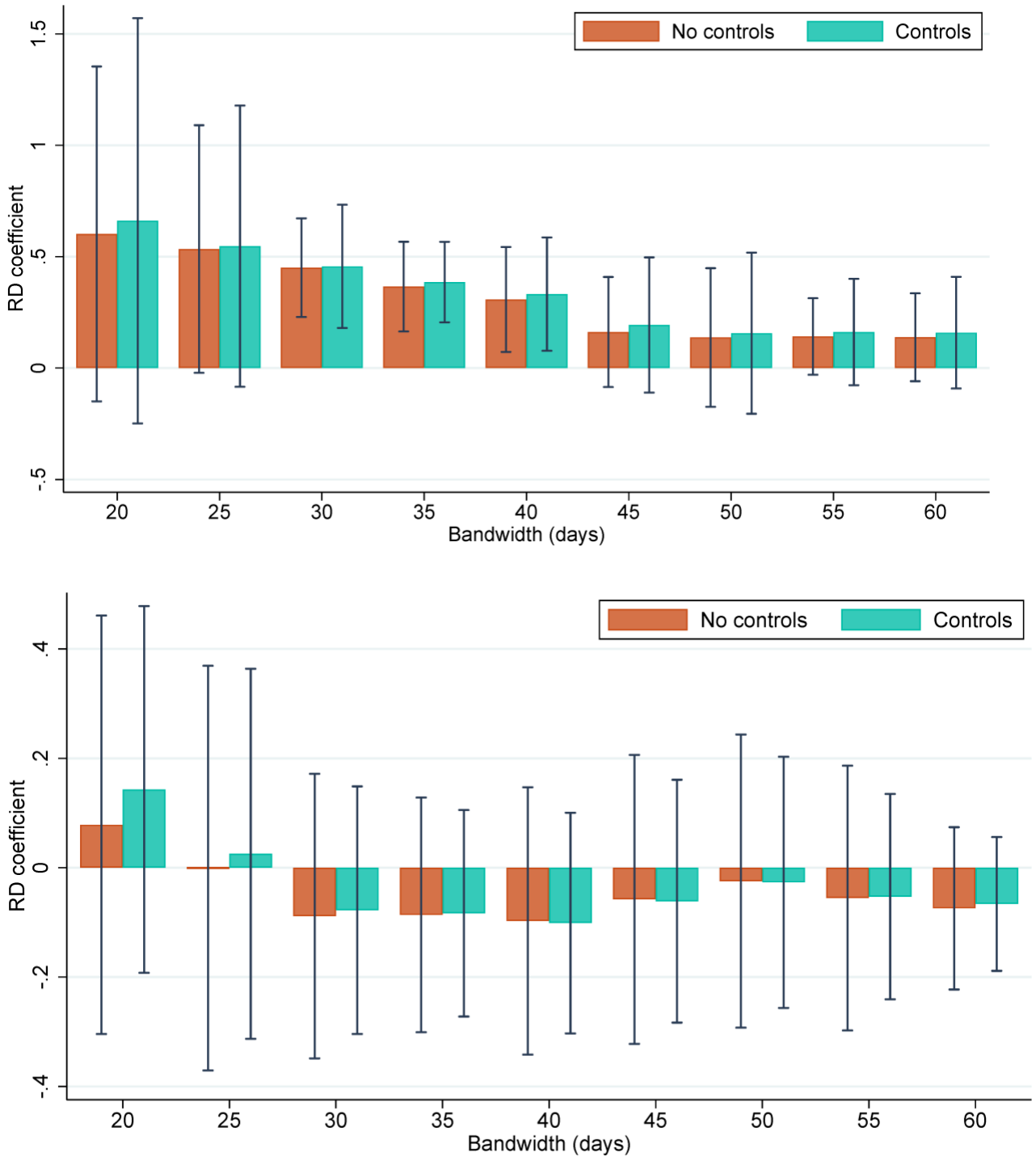
FIGURE B12
2SLS Impacts by Bandwidth, years as EL



SOURCE: Administrative records from participating study districts; Authors' calculations.
NOTE: Linear RD specification. 95% confidence intervals shown. Standard errors clustered at the school-cohort level.

FIGURE B13

2SLS SEL Impacts by Bandwidth, Heterogeneity by EL (top panel English Only; bottom panel other home language)



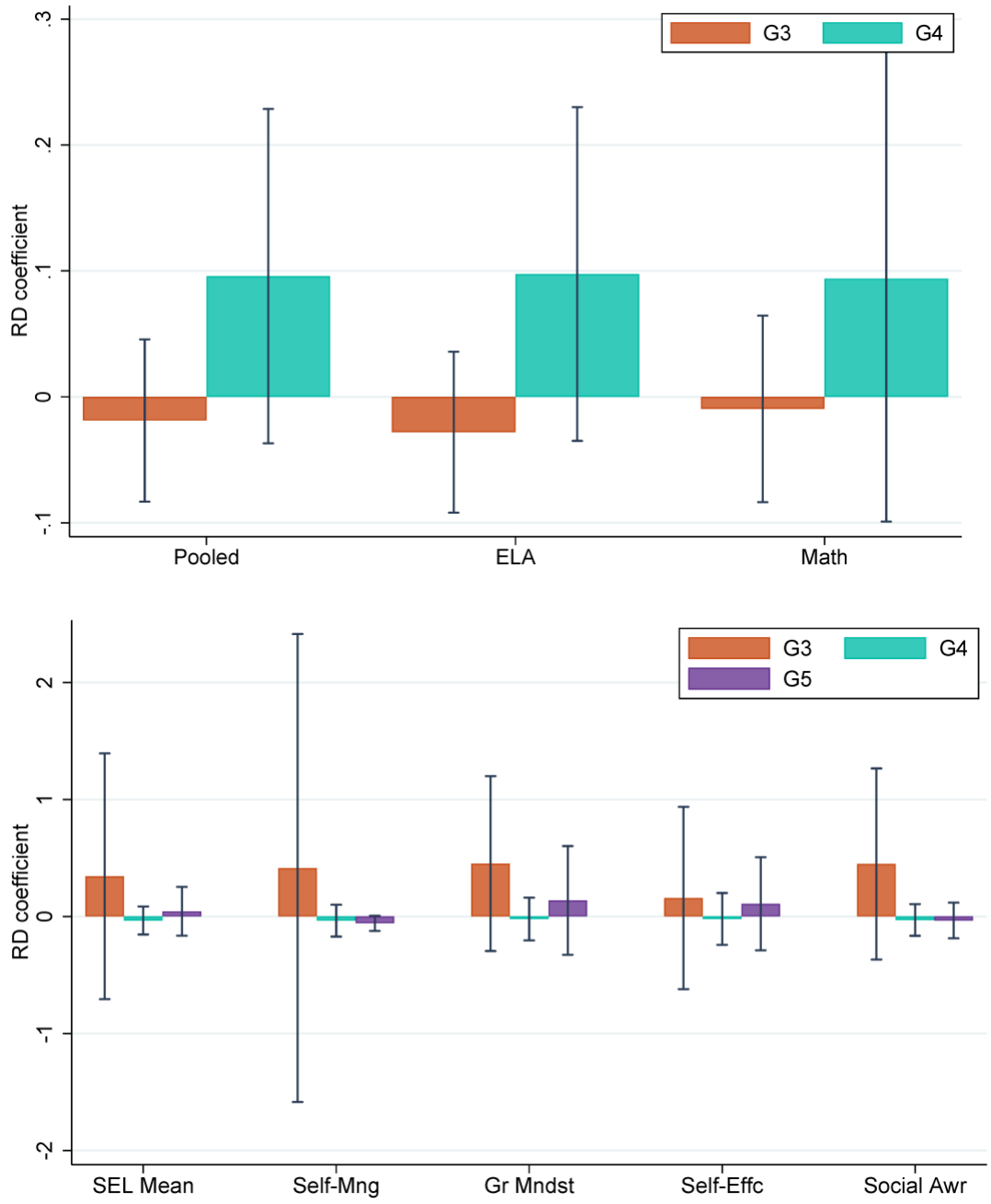
SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Linear RD specification. 95% confidence intervals shown. Standard errors clustered at the school-cohort level.

Additional Results and Heterogeneity

FIGURE B14

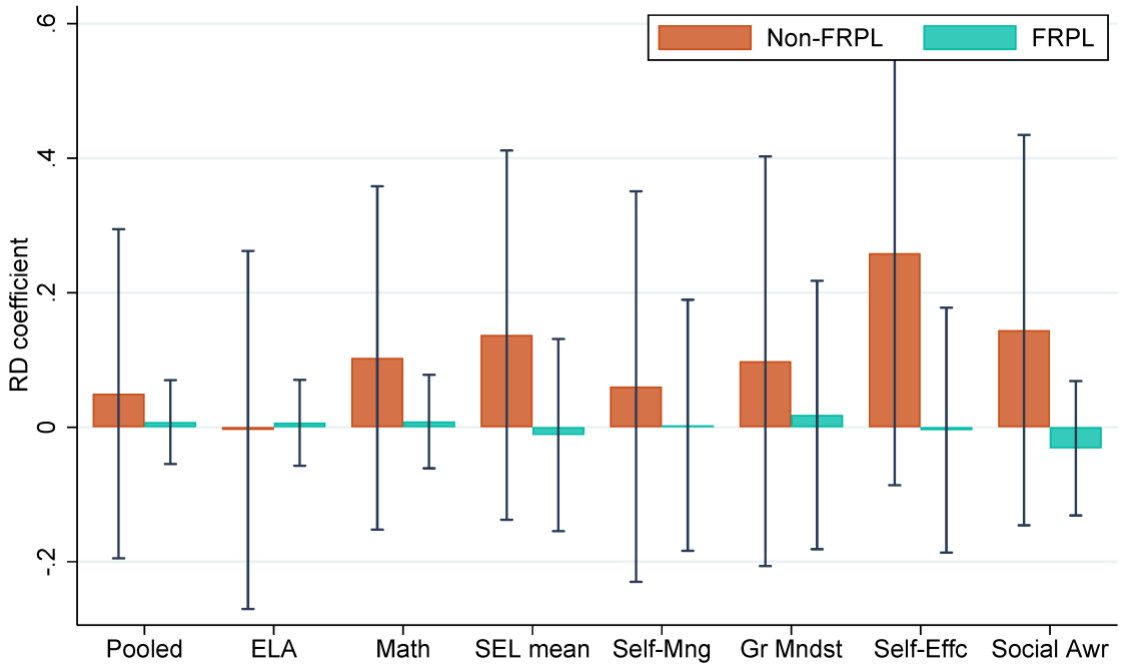
2SLS Impacts: Heterogeneity by grade (top panel: test scores; bottom panel: SEL scores)



SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Linear RD specification. 95% confidence intervals shown. Standard errors clustered at the school-cohort level.

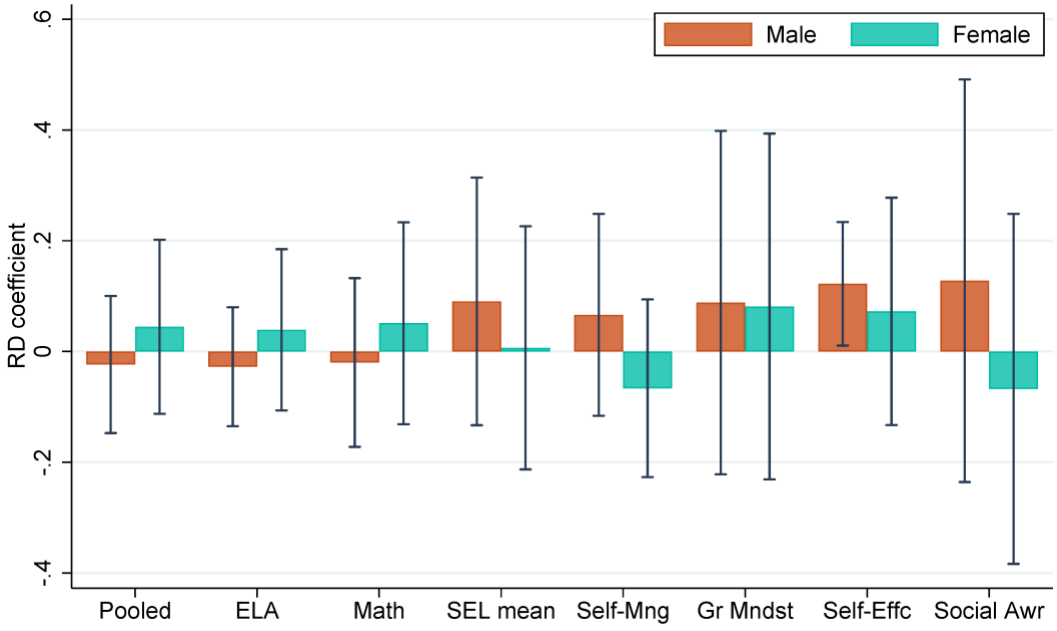
FIGURE B15
2SLS Impacts: Heterogeneity by FRPL status



SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: FRPL = free and/or reduced-price lunch eligibility. Bandwidth = 40 days. Linear RD specification. 95% confidence intervals shown. Standard errors clustered at the school-cohort level.

FIGURE B16
2SLS Impacts: Heterogeneity by Gender

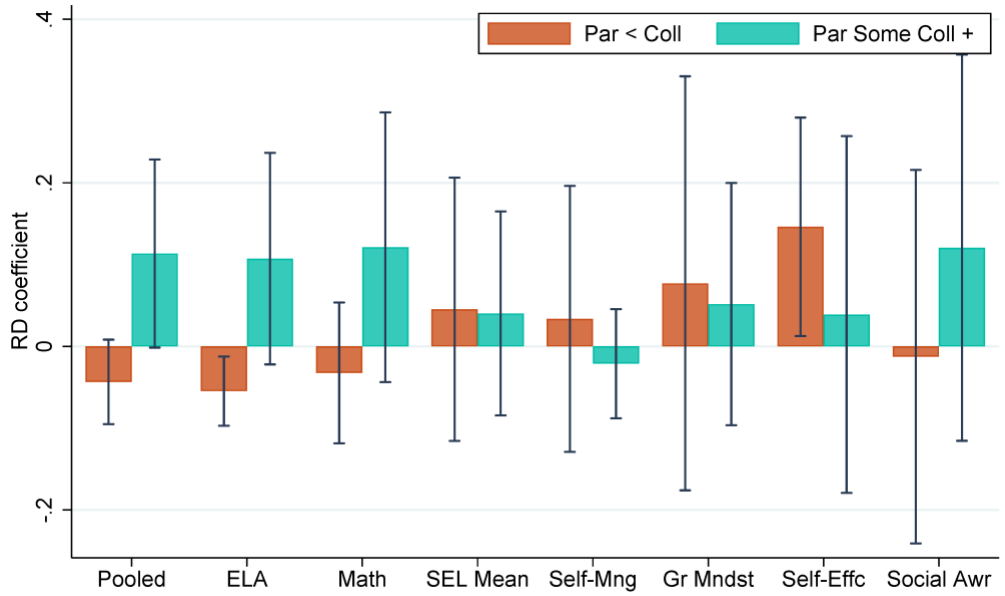


SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Bandwidth = 40 days. Linear RD specification. 95% confidence intervals shown. Standard errors clustered at the school-cohort level.

FIGURE B17

2SLS: Heterogeneity by Parental Education

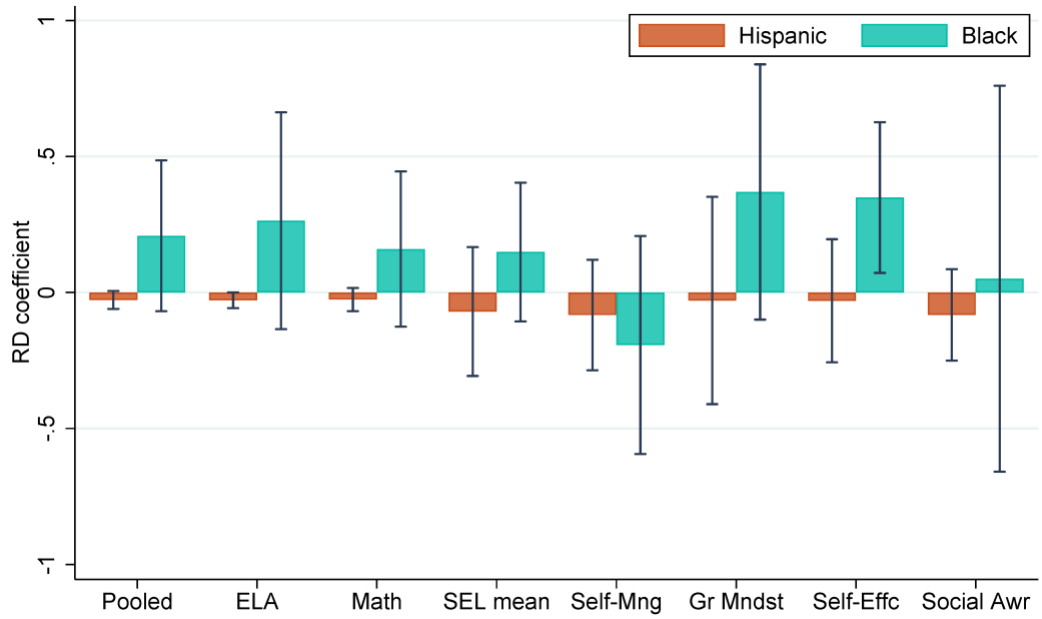


SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Bandwidth = 40 days. Linear RD specification. 95% confidence intervals shown. Standard errors clustered at the school-cohort level.

FIGURE B18

2SLS: Heterogeneity by Race (Hispanic/Latino, Black)

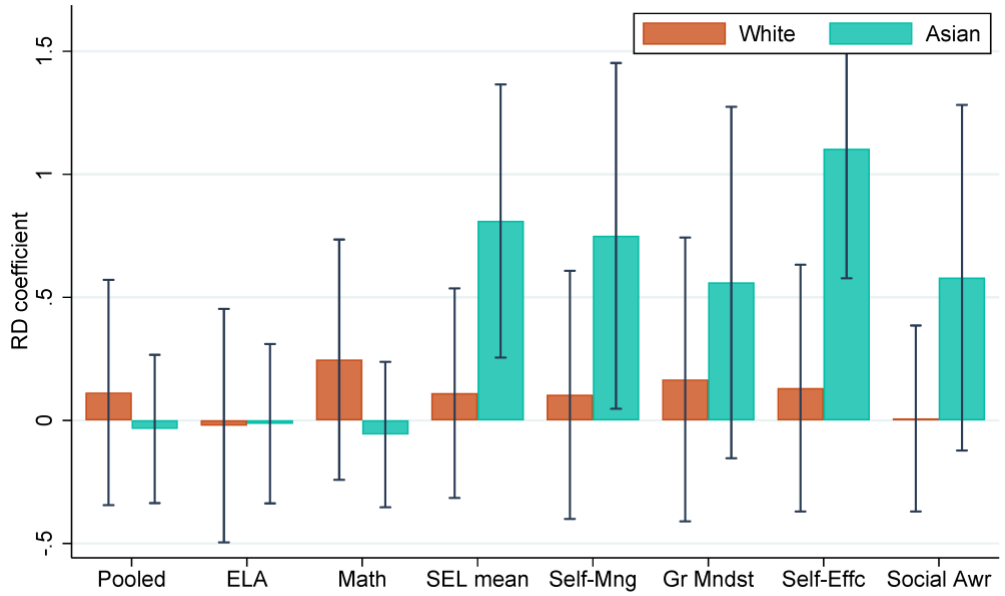


SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Bandwidth = 40 days. Linear RD specification. 95% confidence intervals shown. Standard errors clustered at the school-cohort level.

FIGURE B19

2SLS: Heterogeneity by Race (Asian, White)

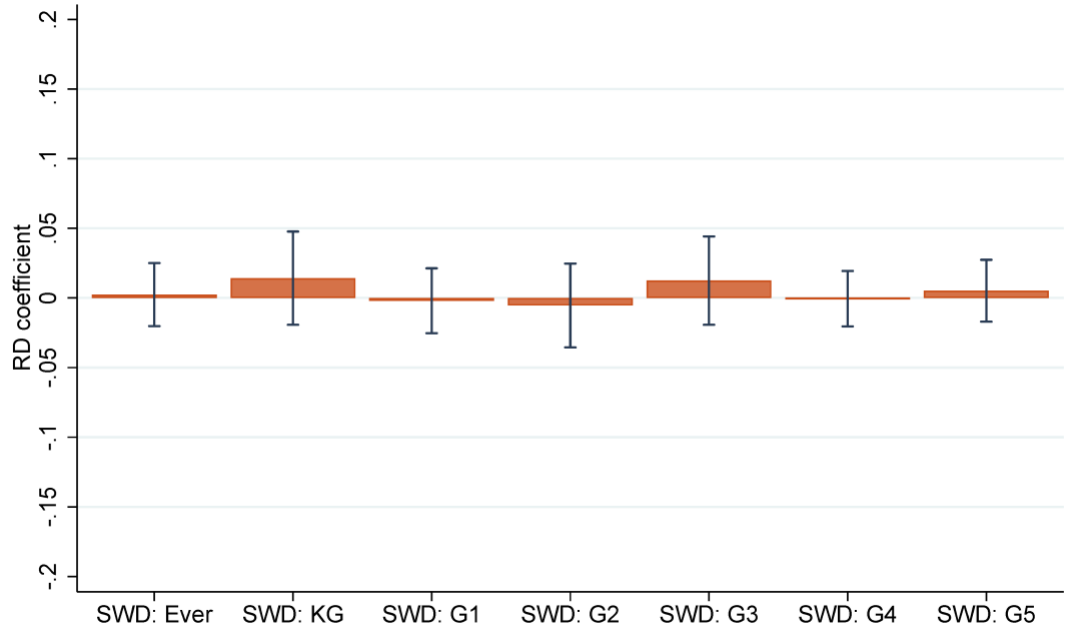


SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Bandwidth = 40 days. Linear RD specification. 95% confidence intervals shown. Standard errors clustered at the school-cohort level.

FIGURE B20

2SLS impacts on special education propensity, by grade

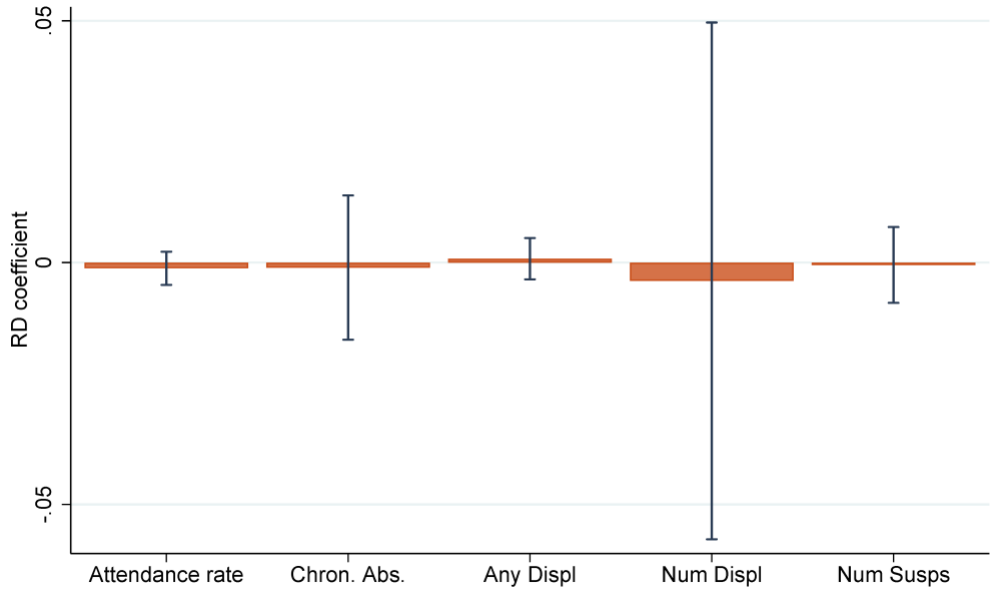


SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Bandwidth = 40 days. Linear RD specification. 95% confidence intervals shown. Standard errors clustered at the school-cohort level.

FIGURE B21

2SLS impacts on discipline and attendance.

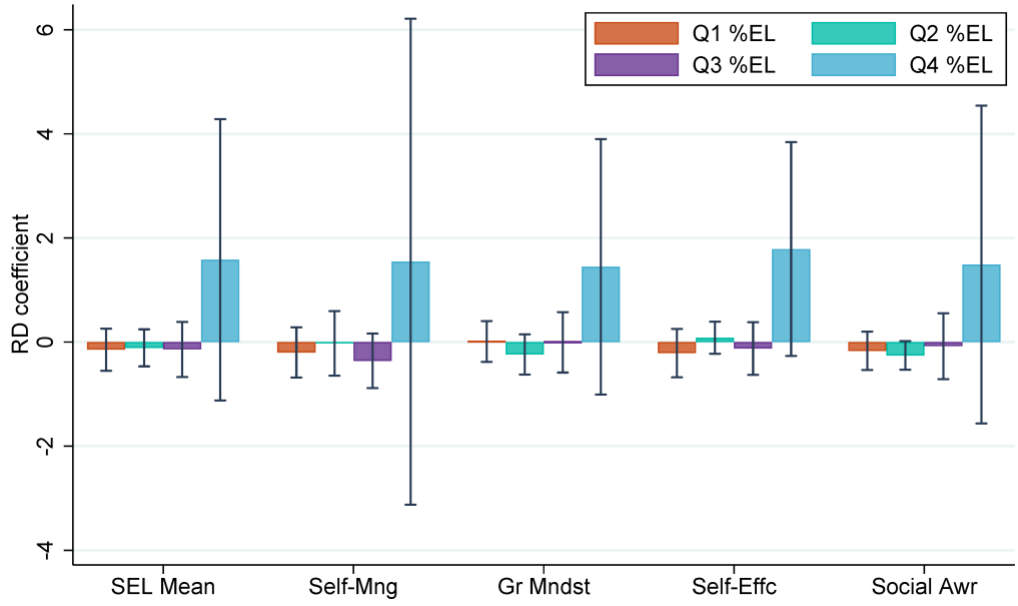


SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Bandwidth = 40 days. Linear RD specification. 95% confidence intervals shown. Standard errors clustered at the school-cohort level.

FIGURE B22

2SLS SEL impacts for non-English only students: Heterogeneity by share EL in cohort

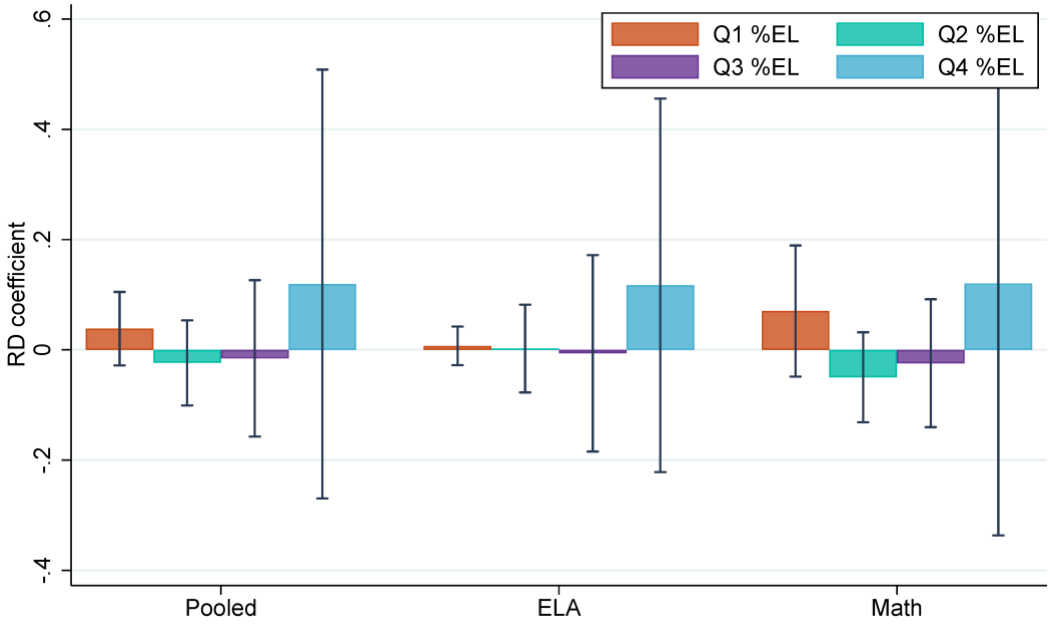


SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Quartiles of share ever-EL in kindergarten cohort at school attended. Linear RD specification. 95% confidence intervals shown. Standard errors clustered at the school-cohort level.

FIGURE B23

2SLS test score impacts for non-English only students: Heterogeneity by share EL in cohort

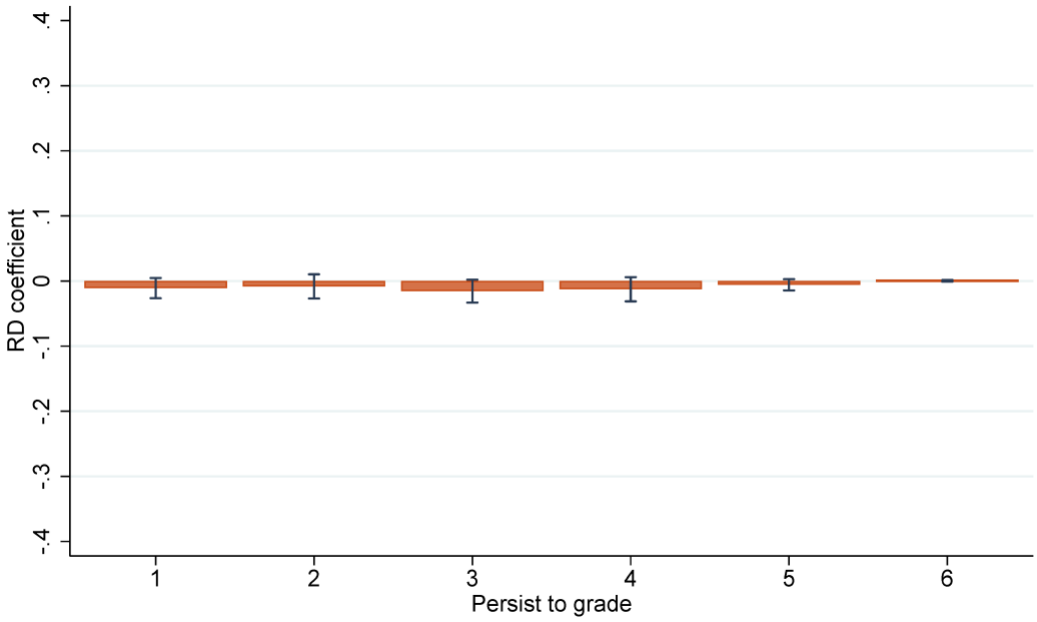


SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Quartiles of share ever-EL in kindergarten cohort at school attended. Linear RD specification. 95% confidence intervals shown. Standard errors clustered at the school-cohort level.

FIGURE B24

2SLS estimates of attrition, by grade

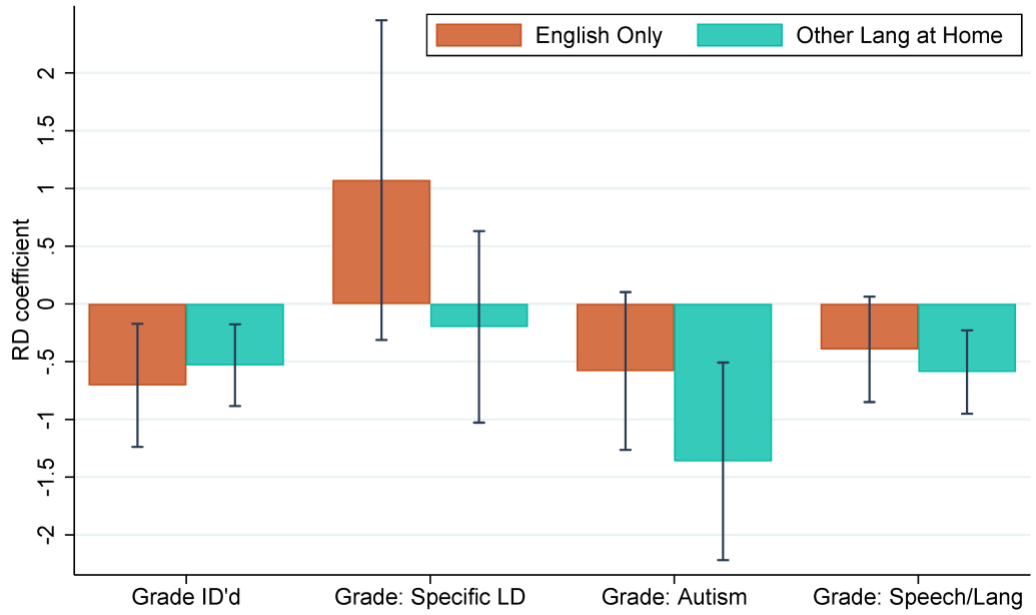


SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Linear RD specification. 95% confidence intervals shown. Standard errors clustered at the school-cohort level.

FIGURE B25

2SLS impacts on special education identification timing, by English only vs other language at home

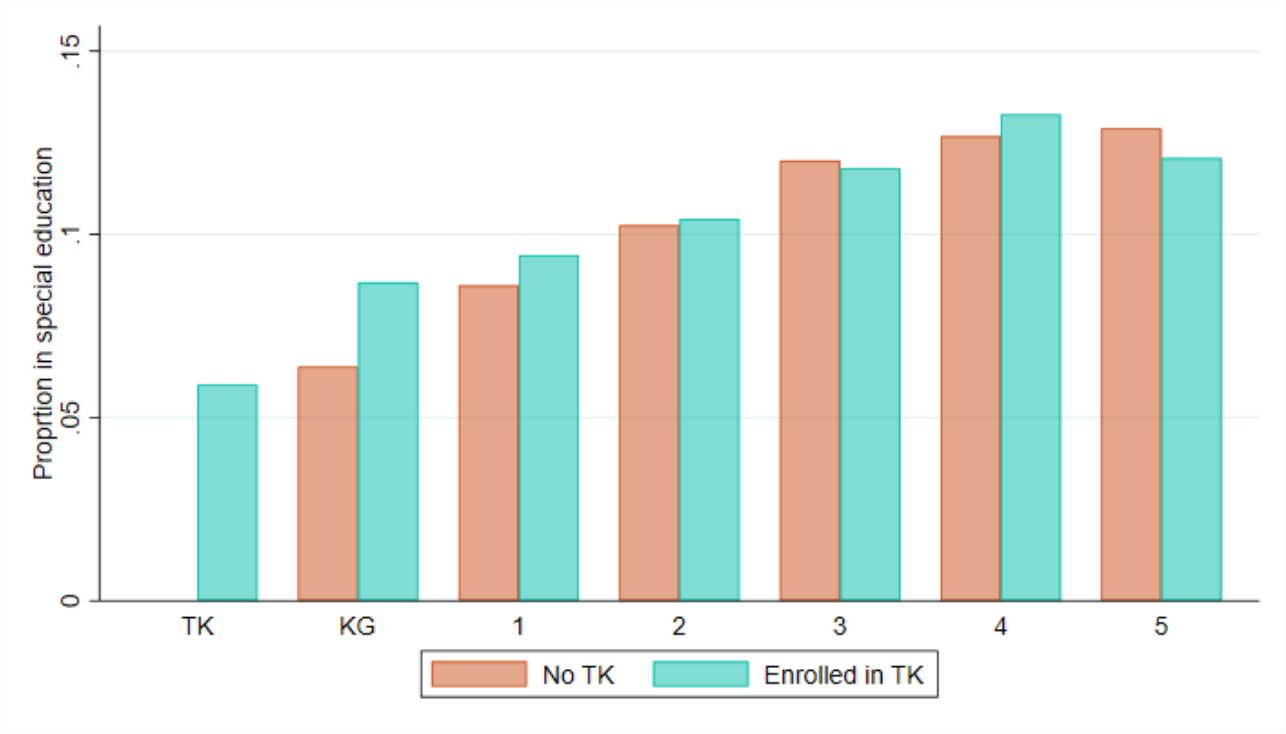


SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Bandwidth = 40 days. Linear RD specification. 95% confidence intervals shown. Standard errors clustered at the school-cohort level.

Appendix C: Additional Results

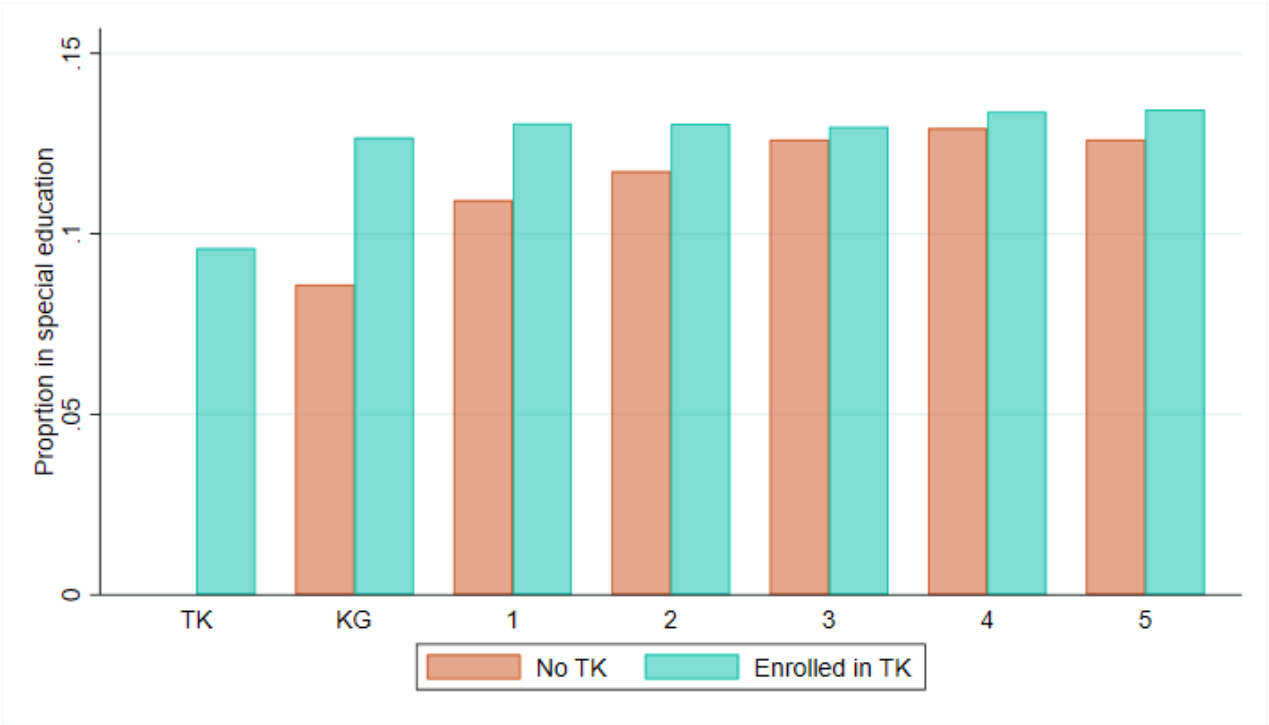
FIGURE C1
Special education rates by grade and TK, English Only



SOURCE: Administrative records from participating study districts; Authors' calculations.
NOTE: Only includes students within +/- 40 days of the Dec 2nd cutoff.

FIGURE C2

Special education rates by grade and TK, Language other than English at home

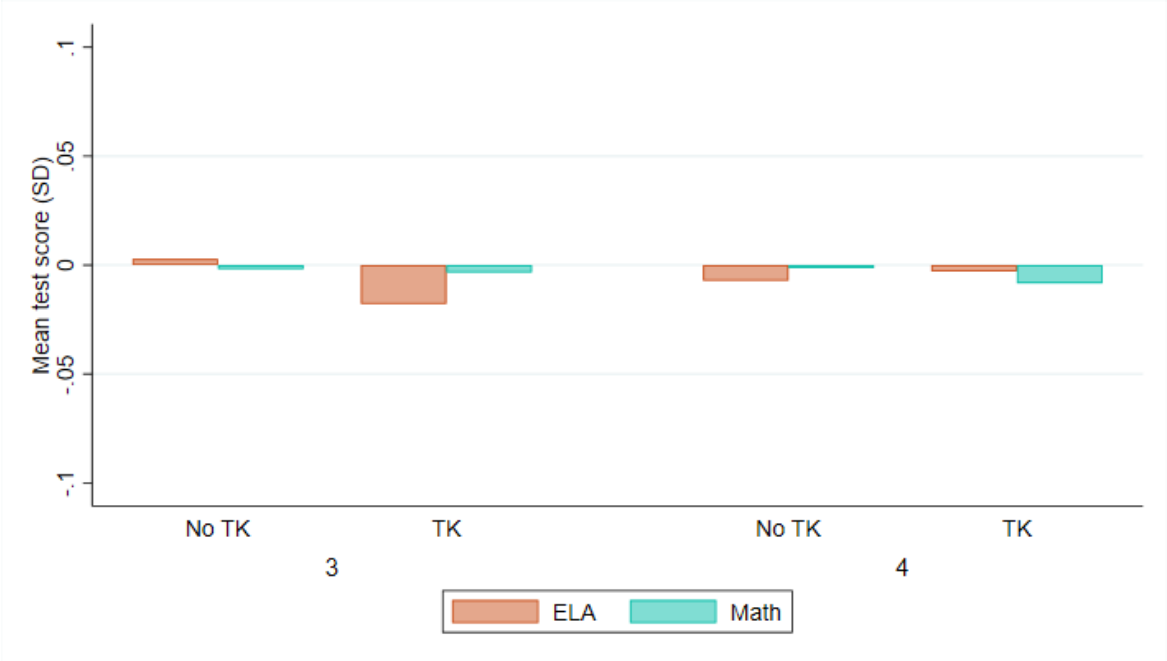


SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Only includes students within +/- 40 days of the Dec 2nd cutoff.

FIGURE C3

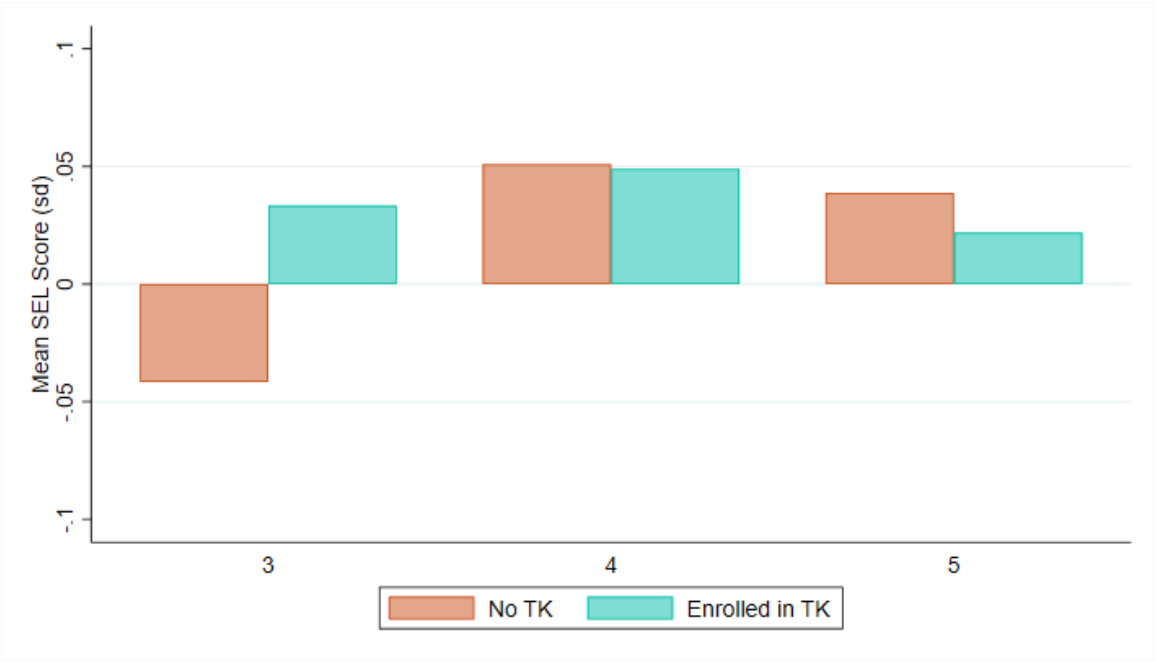
Mean test scores by grade, subject and TK



SOURCE: Administrative records from participating study districts; Authors' calculations.

NOTE: Only includes students within +/- 40 days of the Dec 2nd cutoff.

FIGURE C4
Mean SEL scores by grade and TK



SOURCE: Administrative records from participating study districts; Authors' calculations.
NOTE: Only includes students within +/- 40 days of the Dec 2nd cutoff

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