Detracking and tracking up:

Mathematics course placements in California middle schools, 2003-2013

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MANUSCRIPT ACCEPTED FOR PUBLICATION

Citation for published version:

Domina, Thurston, Paul Hanselman, NaYoung Hwang, and Andrew McEachin. 2016. "Detracking and Tracking Up Mathematics Course Placements in California Middle Schools, 2003–2013." *American Educational Research Journal* 53(4):1229–126.

Research reported in this article was supported by the Spencer Foundation (award no. 201400180), by the W. T. Grant Foundation (award no. 183913), and the Institute of Education Sciences (award R305B120013). The content is solely the responsibility of the authors and does not necessarily represent the official views of the supporting agencies.

Abstract:

Between 2003 and 2013, the proportion of California 8th graders enrolled in Algebra or a more advanced course nearly doubled to 65 percent. In this paper, we consider the organizational processes that accompanied this curricular intensification. Facing a complex set of accountability, institutional, technical/functional, and internal political pressures, California schools responded to the Algebra-for-all effort in diverse ways. While some schools detracked by enrolling all 8th graders in Algebra, others “tracked up,” creating more advanced geometry opportunities while increasing algebra enrollments. These responses created a new differentiated course structure that is likely to benefit advantaged students. Consistent with the Effectively Maintained Inequality hypothesis, we find that detracking occurred primarily in disadvantaged schools while “tracking up” occurred primarily in advantaged schools.

Many scholars view the United States' public education system as an institution that is uniquely resistant to change (Tyack & Cuban, 1995; Meyer & Rowan, 1975, 2006; Weick, 1976). But American schools do change, sometimes in ways that have fundamental implications for the technical core of classroom instruction. Consider, for example, the broad array of practices that schools use to sort students into instructional groups based on their observed achievement, often referred to as "tracking": In the 1960s and 1970s, the tracking system in the United States underwent a major transformation as secondary schools replaced overarching academic tracks with a system designed to allow students to opt into tracked courses on a subject-by-subject basis (Lucas, 1999). Today, the U.S. school tracking system is in the midst of a second major transformation. Over the last 30 years, American middle and high schools have undertaken a broad effort to enroll fewer students in low-track courses by requiring students to take more challenging ones. This change is particularly noticeable in mathematics, where between 1982 and 2004, the proportion of high school graduates completing at least Trigonometry increased from 24 percent to 57 percent (Domina & Saldana, 2012).

Since course placements are closely associated with student achievement growth (Adelman, 1999; Domina, Penner, Penner, & Conley, 2014; Long, Conger, & Iatarola, 2012), changes to academic tracking systems have the potential to equalize key inequalities within American schools. As schools move students out of low-track courses, one might expect gaps in high-level course completion to narrow as academic course structures become less differentiated. However, recent changes to the tracking system may have only partially realized that potential, narrowing inequalities in middle-track courses without changing inequalities in the highest tracks (Lucas, 1999; Domina & Saldana, 2012).

Given these cross-cutting trends, this paper investigates how and where tracking systems change. Research on detracking highlights that these changes are local and contentious. Yet we have relatively little systematic knowledge about how the recent wave of curricular intensification has played out across different schools. Our analyses focus on one particularly rapid recent change in secondary school tracking systems: the Algebra-for-all effort that doubled 8th grade algebra enrollment rates in California middle schools between 2003 and 2013. Given ambiguous messages in the state's call for expanding 8th grade Algebra, California middle schools chose among three distinct strategies: (1) Ignoring policy pressures and maintaining the status quo, (2) fundamentally detracking student course assignments and enrolling nearly all students in academically equivalent 8th grade Algebra, or (3) altering their tracking systems to maintain differentiated instruction even as they broadened access to this once elite course (i.e., open new advanced courses beyond algebra for high-achieving students). Our analyses take an organizational view, investigating the accountability, institutional, technical/functional, and internal political pressures that schools faced in the Algebra-for-all era and the heterogeneous ways that schools changed their middle school mathematics course placement systems in response to these complex and often competing pressures. As such, we address an under-studied question in educational sociology: How and why do tracking systems vary across schools and over time (Kelly, 2007; Kelly & Price, 2011; Lucas & Berends, 2002)? In particular, we investigate time trends and school-level predictors of changes for two dimensions of school tracking systems: the proportion of students enrolled in advanced courses and the extent to which school course offerings are structured to allow skills-differentiated instruction.

While some California schools detracked mathematics instruction by enrolling all 8th graders in algebra courses, others created new more-advanced academic pathways and, in the process, maintained differentiated mathematics instruction during this period. We describe this process, in which high-achieving students who might have once taken Algebra now complete Geometry, as “tracking up.” Particularly pronounced in relatively high-achieving and otherwise socially advantaged school settings, we argue that tracking up is a strategy through which socially-advantaged groups effectively maintain inequality.

HISTORICAL AND THEORETICAL BACKGROUND

Curricular intensification in California

Middle school mathematics is an early and important selection point in the United States’ educational system. While formal tracking is rare in U.S. elementary schools, many U.S. middle schools use a two-tiered tracking system in 8th grade mathematics. In this system, most students take a grade-level mathematics course that is often labelled “pre-Algebra” while a smaller proportion of high-achieving 8th graders enroll in Algebra. Since middle school math provides a gateway to high schools’ hierarchical structure of mathematics courses, students who take Algebra early are much more likely to gain access to Calculus and other advanced mathematics courses during their high school years. Accordingly, this initial sorting process has consequences for students’ later opportunities to learn, their postsecondary outcomes, and their transition to the labor market (Rose & Betts, 2004; Attewell & Domina, 2008; Long et al., 2012). State- and district-level policy-makers across the U.S. have thus attempted – with mixed consequences – to increase the proportion of students’ enrolled in 8th grade Algebra in order to intensify the rigor of mathematics curricula and narrow inequalities in opportunities to learn (Allensworth, Nomi, Montgomery, & Lee, 2009; Clotfelter, Ladd, & Vigdor, 2015; Domina, McEachin, Penner, & Penner, 2015; Loveless, 2008; Penner, Domina, Penner, & Conley, 2015; Stein, Kaufman, Sherman, & Hillen, 2011).

California is a national leader in this movement. Beginning in the late 1980s, the California Department of Education (CDE) repeatedly urged schools to place students into skills-heterogeneous 8th grade algebra courses in order to detrack schools and equalize students' opportunities to learn (CDE, 1985, 1991; Fenwick, 1987). The Algebra-for-all effort moved to the center of California's educational policy portfolio over the next decade, even as its policy rationale before more diffuse. The 1998 *Mathematics Framework for California Schools* identified Algebra as the only appropriate mathematics course for California 8th graders, opening the door for the Algebra-for-all effort to become a part of the state's school accountability policies. At the same time, the state stepped back from its earlier call for heterogeneous grouping, noting that "what students are taught has a greater effect on achievement than does how they are grouped" (CDE, 1998 pp. 13-14.) In doing so, state policy struck a balance that it maintained over the next 15 years – encouraging schools to enroll all 8th graders in Algebra while providing mixed messages about the appropriateness of skills-based grouping strategies to differentiate instruction among 8th grade Algebra classes.[1]

California's first comprehensive school accountability legislation – authorized in 1999 and fully implemented in 2004 – incorporated students' middle school mathematics course enrollments in the Academic Performance Index (API), the summary scale used to measure school quality in California's own accountability system. The California State Board of Education attempted to increase the accountability stakes associated with 8th grade Algebra in 2008, when it declared Algebra the "sole course of record" for 8th graders[2]. This move put

[1] At the time, educational observers viewed the 1998 Framework as a turning point in the state's "math wars," in which a relatively conservative group of educational traditionalists wrested power over state mathematics policy from an earlier leadership group that had advocated hands-on, concept-driven progressive mathematics instruction.
[2] Prior to California's SBE's ruling in 2008, schools' 8th grade algebra enrollment only affected their standing under California's accountability system, but not the federal NCLB system. If the 2008 California SBE ruling was enforced, schools would have to enroll students in Algebra to meet both state and federal accountability mandates.

schools that tracked a large proportion of 8th graders into less advanced courses at risk for state takeover or reconstitution as a charter school by requiring 8th graders to demonstrate proficiency on the state's end-of-course Algebra exam to satisfy federal and state accountability expectations (Rosin, Barondess, & Leichty, 2009). However, a series of California court rulings prevented the state's 8th grade Algebra-for-all mandate from being fully implemented (California Schools Board Association vs. California State Board of Education, 2010).

In the fall of 2010, California adopted the Common Core State Standards, which recommend a course of study for all 8th graders that combines pre-Algebraic and Algebraic concepts but are "designed to permit states to continue existing policies concerning Algebra in the 8th grade" (Common Core State Standards, 2010b). Some of the state's vocal Algebra-for-all advocates decried the CCSS as a step back in academic rigor (Wurman & Evers, 2010) and the CDE discontinued the use of 8th grade algebra enrollments in the calculation of API scores beginning in the 2012-13 school year. However, the state's 2013 Mathematics Framework includes a detailed appendix that attempts to guide schools toward mathematics course placement, acceleration, and sequencing policies that maximize the proportion of students taking advanced mathematics courses (CDE, 2013). In 2015, the state authorized legislation requiring districts to use explicit and objective criteria for middle school mathematics course placement.

Algebra-for-all and its consequences for organizational differentiation

California schools thus faced growing accountability pressures to increase 8th grade algebra enrollments between the late 1990s and 2010, when the state's move to the Common Core began to redirect those pressures. Throughout this period, however, California middle schools received ambiguous signals about what Algebra-for-all meant for instructional

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However, once the California courts struck down California's SBE mandate, only the state's accountability incentives for 8th grade algebra enrollment remained.

differentiation. The Algebra-for-all effort took early inspiration from the school detracking effort. Teacher professional development and curricular resources developed by the state in cooperation with educational professional organizations encouraged instructors to equalize students' opportunities to learn by enrolling all students in skills-heterogeneous 8th grade algebra courses (c.f. Laitsch, 2006; California Algebra Forum Statewide Network, 2009; Common Core State Standards 2010a). But by the time the state introduced accountability incentives associated with 8th grade Algebra in the early 2000s, the CDE had explicitly clarified that schools could maintain skills differentiated instruction even as they universalized 8th grade algebra enrollments.

The ambiguous signals embedded in California's Algebra-for-all effort left at least three responses open to the state's middle schools: (1) Given the loose coupling of the state's educational system, the policy's weak incentives, and the lack of direct federal accountability pressure, schools could ignore the Algebra-for-all push and continue to enroll relatively few students in 8th grade Algebra; (2) Consistent with the Algebra-for-all movement's early calls for heterogeneous instruction, they could detrack, replacing a middle school math course placement system that sorted students between 8th grade pre-Algebra and 8th grade algebra courses with a system that placed all students in 8th grade Algebra; or (3) Faced with pressures to maintain instructional differentiation, they could "track up," enrolling more students in 8th grade Algebra while maintaining differentiation in middle school mathematics by creating a new doubly-accelerated 8th grade geometry track.

Using panel data from the universe of California public middle schools, our analyses investigate how schools negotiated among a complex set of pressures as they chose among these three options. In the section that follows, we divide the pressures schools faced in the Algebra-for-all era into four broad categories – accountability, institutional, technical/functional, and internal political – and discuss their likely implications policies and practices related to middle school mathematics course assignments and instruction.

Accountability pressures

California's 8th grade Algebra-for-all effort attempted to link the proportion of 8th graders who took end-of-course California Standards Tests (CST) in Algebra or more advanced mathematics to the state's school accountability system. Such standards-based accountability policies have proliferated in the U.S. educational landscape, and several studies document the ways in which schools respond to accountability pressures. The existing evidence suggests that No Child Left Behind and other accountability policies have modest positive effects on observed achievement (Dee & Jacob, 2011), particularly in the schools most at risk for sanctions (Lauen & Gaddis, 2012). While the extent to which these gains reflect true improvements in students learning is unclear (Domina, et al., 2015; Booher-Jennings, 2005; Hallett, 2010; Neal & Schanzenbach, 2010; Reback, 2008), accountability policies clearly influence educational practice. Accordingly, we hypothesize:

Hypothesis 1: Implementation of policies linking 8th grade algebra enrollments to accountability sanctions corresponded with broad-based increases in advanced 8th grade mathematics course enrollments, particularly in schools most at risk for accountability sanctions under the state's accountability policy.

Institutional pressures

It is unlikely, however, that schools respond to accountability pressures alone. Decentralization is a defining characteristic of educational governance in the United States, and state authorities have limited power to influence school-level policies and practices (Bidwell, 2001; Henig, 2013; Meyer, Scott, & Deal 1979; Rowan, 1982). This may be particularly true in the current case, in which California's schools nearly doubled 8th grade algebra enrollment rates in the wake of a policy that was never fully implemented and thus lacked strong mandates or sanctions (Rosin et al., 2009; Domina et al., 2015). Meyer and Rowan (1975, 2006) argue that since the goals of schooling are diffuse, schools are structured less to maximize technical efficiency than to maintain social legitimacy. As a result, neo-institutionalism suggests that schools are sensitive to normative pressures and institutional isomorphism.

Beginning in 2004, schools faced incentives from the state's accountability system to increase 8th grade algebra enrollments. But the tide turned in 2010 when the courts blocked the state's move to make 8th grade Algebra the course of record. In the same year, the state took a second step away from the Algebra-for-all when it moved to adopt the CCSS. From a pure accountability perspective, one might expect 8th grade algebra enrollments to begin to decline during the post-2010 period. By contrast, neo-institutional theory suggests that Algebra-for-all may have developed a sort of social inertia in California schools. As schools spent time and resources developing curricula and instructional strategies consistent with the Algebra-for-all effort, teachers may have come to see broad access to accelerated Algebra as an instructional imperative. In such a case:

Hypothesis 2: Institutional pressures cause schools to maintain high levels of algebra enrollments even after the elimination of accountability pressures (see, c.f. Tolbert & Zucker, 1983).

Technical/functional pressures

The assumption that increasing the proportion of 8th graders enrolled in Algebra would accompany broader changes to the organization of mathematics instruction in California middle schools was central to the origin of California's 8th grade Algebra-for-all effort. Specifically, many Algebra-for-all advocates sought to replace a two-tiered system of 8th grade mathematics instruction – in which many students enrolled in grade-level general mathematics courses in 8th grade and a small number of students took accelerated Algebra – with a detracked Algebra-for-all system.

There is good reason to hope that making such a change would improve schools' educational effectiveness. As noted above, several studies indicate that students who are exposed to rigorous curriculum and instruction experience greater achievement gains on average than those who are not. However, these gains are by no means assured. Tracking systems make it possible for teachers to target their instruction to a relatively homogeneous set of students' skills and needs (Hallinan, 1994). As such, teachers in settings with a large variance in students' skills may prefer selective track systems (Rosenbaum, 1976, 1999; Kelly & Price, 2011). Further, several recent studies raise questions about the effectiveness of early Algebra efforts; pointing in particular to challenges associated with teaching Algebra to students who lack foundational mathematics skills and preparing teachers to teach new materials to more heterogeneous student populations (Clotfelter et al., 2015; Domina et al., 2015).

These technical concerns may discourage schools from responding to the state's Algebra-for-all push. In particular, technical pressures suggest that:

Hypothesis 3: 8th grade algebra enrollment rates increase slowly in relatively low-achieving schools as well as schools that enroll highly heterogeneous student populations. Additionally, these technical concerns encourage schools that educate students with a broad range of prior skills to continue to offer a range of skills-differentiated mathematics course offerings even as they increase 8th grade algebra enrollments.

Internal political pressures

Furthermore, many constituents in California schools likely had a vested interest in maintaining differentiation in middle school mathematics. Case-study research suggests that elite students and their parents resist detracking efforts, particularly in schools that enroll large proportions of academically advantaged students (Oakes & Lipton, 1992; Wells & Oakes, 1996; Wells & Serna, 1996; Welner & Burris, 2006). Resistance to detracking in California middle schools could have taken the form of direct defiance of the Algebra-for-all initiative and a simple refusal to increase algebra enrollments. Alternatively, schools could have resisted detracking by creating an even more advanced mathematics option to accompany increased access to Algebra.

The latter possibility is consistent with the theory of Effectively Maintained Inequality (EMI). EMI hypothesizes that in settings in which access to previously scarce educational opportunities broadens, privileged social actors effectively maintain their advantage by creating new meaningful distinctions (Lucas, 2001). For example, although the universalization of secondary degree completion inevitably corresponds with narrowing class-based inequalities in high school graduation (Raftery & Hout, 1993), college preparatory diplomas and other distinctions among high school graduates serve to maintain affluent students' educational advantages (Lucas, 2001). In our setting, a parallel process might involve the creation of a doubly-advanced new 8th grade geometry track in schools in which access to Algebra broadened considerably. At the school-level, EMI implies that efforts to create new forms of curricular differentiation will be most pronounced in settings serving large populations of students from privileged social backgrounds (e.g. Klugman, 2013). We therefore predict:

Hypothesis 4: Relatively affluent California schools were most likely to track up during the Algebra-for-all era, increasing the degree of differentiation in middle school mathematics by enrolling a growing proportion of students in a new, more advanced 8th grade geometry track.

DATA AND METHODS

School-level Panel Data, 2003-2013

This paper tracks school responses to California's 8th grade Algebra-for-all effort, using annual school-level panel data collected by the California Department of Education reported in the California Basic Educational Data System. These publicly available data include detailed information on school enrollments, demographics, course offerings, staffing, as well as student achievement for each school year beginning in 2002-03.[3] We focus on the balanced panel of 1,524 California schools that provide data on course enrollments between 2002-03 and 2012-13, which covers 85 percent of California 8th graders over the study period.[4] Descriptive analyses are weighted by 8th grade enrollments, so that the analyses reflect the average experiences of all 8th graders enrolled at sample schools during the study period. Multivariate models control for schools' 8th grade enrollment.

8th grade Algebra and Organizational Differentiation

Our analyses begin with a consideration of how 8th grade algebra enrollment rates changed in California middle schools during the Algebra-for-all period. We measure 8th grade algebra enrollment rates in California using data from the end-of-course California Standards Tests (CSTs). Like students in middle schools throughout the United States, 8th graders in most California middle schools enroll in one of several tiered mathematics courses, including general mathematics or pre-Algebra, Algebra, and Geometry. Since California students take the CST

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[3] Searchable and downloadable data are available at http://data1.cde.ca.gov/dataquest/
[4] Since we are interested in course placement trends across the time period, we exclude approximately 1,000 California schools that opened or closed during the study period or failed to report data in more than one study year. Excluded schools tend to be smaller (with mean enrollment half the size of included schools) with higher proportions of poor, black, and Hispanic students than the analytic sample. However, analyses conducted on partial panel data return substantively similar results.

linked to their 8th grade mathematics course, one can use students' math CST as a highly reliable proxy for 8th grade math course enrollment.[5]

We consider increases in the proportion of 8th graders enrolled in Algebra or a more advanced mathematics course as one indication of school-level compliance with the state's Algebra-for-all effort. To further investigate the policy's implementation, we construct an additional measure identifying schools that "detracked" under the Algebra-for-all policy by enrolling 90% or more of their 8th graders in Algebra. Importantly, this measure does not consider schools that enrolled a large proportion of students in 8th grade Geometry or a more advanced course as "detracked," since these more advanced courses differentiate instruction. Although we lack data to directly assess either the content of instruction in algebra courses or the extent to which schools sort students into separate Algebra classes based on their prior achievement, our analyses assume that enrolling virtually all students in the same level of coursework minimizes differentiation in 8th grade mathematics.

In subsequent analyses we focus on the proportion of students in California schools who take doubly-advanced 8th grade Geometry courses. These analyses provide preliminary insights into the extent to which increases in 8th grade algebra enrollments correspond with broader changes in organizational differentiation in California middle schools. To the extent to which California schools made 8th grade Algebra a universal offering, we would expect 8th grade

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[5] End-of-course tests provide important advantages over course title as a measure of course completion. Since California school accountability policy requires all districts report data on end-of-course test-taking for all students using a common form, comparable data are available on this measure across schools and over time. While student-level course enrollment data are not publicly available for California public school students, our analyses of data from one large California public school district indicates that end-of-course tests provide a relatively reliable proxy for course content. In this district, approximately 99% of 8th graders who enroll in pre-Algebra courses take the 8th grade General Mathematics CST. Similarly, 99% of students in Algebra I courses enroll in the 8th grade Algebra CST. In addition, several schools in this district offer a two-year Algebra course sequence. Approximately 95% of the 8th graders who take the first year of this two-year Algebra course sequence take the 8th grade General Mathematics CST. Analyses of data from another large California public school district point to a similarly high level of correspondence between course enrollment and end-of-course CST completion (Taylor 2011).

geometry enrollment rates to remain flat during the study period. Alternatively, we view increases in 8th grade geometry enrollments as indicators of a process through which schools maintain differentiated curricula even as they broaden access to 8th grade Algebra. We further explore curricular change by constructing a time-varying measure capturing whether or not schools offer Geometry or other advanced courses for 8th graders. [6] At the beginning of the study period, few California middle schools offered Geometry to 8th graders, and approximately 2 percent of the state's 8th graders completed this doubly-advanced mathematics course.

To investigate the ways in which organizational differentiation changed in California middle schools during the Algebra-for-all era, we construct a time-varying measure of the number of different mathematics courses schools offer to 8th graders. This measure is based on an annual CDE survey in which school leaders report on the number of students enrolled in a range of mathematics courses, with titles ranging from Developmental Mathematics to Algebra II. We count any course that enrolls at least one 8th grader as an available course, and sum the number of different courses each school offers to 8th graders annually. We view this as a direct measure of the range of curricula schools offer to 8th graders. As a supplement to this analysis, we consider whether a school offered a remedial or basic-level mathematics course in each of the study years.

Analyses

Our analyses address changes in the organizational structure of middle school mathematics instruction in California schools during the 2003-2013 period and the characteristics of schools that were associated with these changes. In addition to investigating

[6] Our school-level measures of course offerings, including the measure of whether or not schools offer Geometry or other advanced courses for 8th graders, the number of different 8th grade math courses schools offer, and whether or not schools offer 8th grade basic or remedial mathematics, are available for all survey years but 2009-10.

unconditional trends in each of the school-level measures of instructional differentiation, we use panel data on California schools to estimate a series of models that examine change as a function of time-varying school characteristics. Each of these models is a three-level mixed model,[7] including random intercepts to account for clustering within schools over time and among schools within districts. The models proceed in three steps. The first two models take following general form:

(1) $Y_{sdt} = \beta_0 + \beta_1 X_{sdt} + \gamma_t + \rho_s + \sigma_d + e_{sdt}$

where Y_{sdt} measures 8th grade math instructional organization for school *s* in district *d* at year *t*; X_{sdt} is a set of time-varying school-level covariates describing observable characteristics of s at time t (described in detail below); γ_t is a set of indicator variables (or time fixed-effects) comparing each study year with 2008, the year in which the state moved to make Algebra the test for record in 8th grade mathematics; $\rho_s$is a school-level random effect; σ_d is a district-level random effect; and e_{sdt} is the time-varying idiosyncratic school-level error term. This model draws upon the rich school-level data available from the CDE to control for time-varying observable school characteristics in X_{sdt}. Controls include: the natural log of total 8th grade enrollment and a socio-economic disadvantage scale constructed by averaging two variables: a standardized measure of the proportion of schools' 8th graders who are African-American or Hispanic and a standardized measure of the proportion of a schools' 8th graders who qualify for free or reduced lunch.[8] In addition, we control for the mean level of Algebra readiness among 8th

[7] Each of the multilevel models reported here, including models predicting dichotomous outcomes, are estimated using Stata's xtmixed comment, with random effects specified at the district and school level. Three-level logistic or probit regression models for the dichotomous school detracking and basic/remedial course offering outcomes do not converge. However, supplementary logistic two-level random effects models (with random effect at either the school or district level, but not both) return qualitatively similar results for these dichotomous outcomes.
[8] These two measures correlate at .81 in the full panel schools over the entire study period.

graders enrolled in school *s* in year *t* as well as the within-school variance in Algebra readiness, using lagged data on student achievement in prior mathematics CSTs.[9,10]

Our second model adds a measure of school exposure to pressure on California's school accountability law (Public School Accountability Act). Each year the state provides schools with an Academic Progress Index (API) score. This score, which ranges from 200 to 1000, is essentially a school-level weighted average of students' performance on math, reading, science, and history end of year and course assessments. The state's formula lowers students' scores by one proficiency level if they are not enrolled in at least Algebra in 8th grade. Although there are no immediate sanctions or rewards under PSAA, schools' API scores are publicly available and local media often rank schools by API score and API score change. As such, we include a school mean-centered version of schools' prior API scores in our model. Much like a school fixed effect, the demeaned value removes schools time-invariant influence and uses within school variation to estimate the relationship between our outcomes and schools' API standing. In other

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[9] We use lagged 7th grade mathematics CST scores and twice-lagged 6th grade mathematics CST scores to measure mean Algebra readiness in California middle schools. Each of these measures has advantages and disadvantages for our purposes. 7th grade CST scores are useful since they are most proximal to 8th grade mathematics course placement. However, a small proportion of California 7th graders take Algebra in order to be on track for 8th grade Geometry. These 7th grade Algebra scores are not directly comparable with 7th grade General Math scores. Furthermore, 7th grade Algebra test-taking is endogenous to the process under consideration in this paper. Therefore, we prefer 6th grade math CST scores as a measure of Algebra readiness. However, these scores are unavailable for approximately 1/3 of the schools in our sample since these schools do not enroll 6th grades. Therefore, we impute 6th grade mathematics CST scores for schools that are missing this measure, based on their mean 7th grade CST General Math scores, mean 7th grade Algebra CST scores, proportion of 7th graders who take the Algebra CST, and school demographics using Stata's "mi impute" sequential imputation for monotone missing data imputation package. For schools that have both 6th and 7th grade math CSTs, this equation explains more than 75% of the variation in 6th grade CST means.

[10] We use lagged 7th grade General Math CST scores as well as the proportion of 7th graders who take the Algebra CST in 7th grade to measure the variance in students' Algebra readiness within schools. In addition to providing school-level mean scores for 7th graders who take the General Math CSTs (approximately 97 percent of the 7th graders enrolled in sample schools over the course of the study), CDE provides data on the percent of students who scored at in each of 5 proficiency levels on this test: Far Below Basic, Below Basic, Basic, Proficient, and Advanced. We use these data to calculate:

$$\mathrm{Var(7th\ grade\ Gen\ Math)} = \frac{1}{n}\sum_{i=1}^{n}(x_1-\mu)^2$$

Where n=5 for the five proficiency bands; x_1 is the mid-point on each of the five proficiency levels and μ is the proportion of 7th graders in each school who score in each proficiency band.

specifications available upon request, we include both the demeaned API score and schools' average API score or schools twice lagged API score and the difference between their once and twice lagged API scores.[11]

The third model takes a growth approach, adding controls for lagged values of the dependent variable as time-varying measures of a school's 8th grade mathematics course structure:

(2) $Y_{sdt} = \beta_0 + \beta_1 X_{sdt} + \beta_2 Y_{sdt-1} + \gamma_t + \rho_s + \sigma_d + e_{sdt}$

where Y_{sdt-1}includes the once-lagged, standardized value of a school's 8th grade Algebra or higher enrollment rates, the quadratic of that measure, and lagged versions of the dependent variable as appropriate.[12]

Arguing that schools respond to accountability pressures, *Hypothesis 1* states that the proportion of California 8th graders enrolled in 8th grade Algebra or higher should increase over time, yielding positive coefficients on 8th grade Algebra or higher enrollment rates for each year after 2008, regardless of modeling strategy. Further, this hypothesis suggests that schools that experience a decrease in mean-centered API scores in the prior year will be more likely to further

[11] The school accountability literature often looks at the within school change in accountability standing to estimate the relationship between school accountability pressure and student achievement (Rouse, Hannaway, Goldhaber, & Figlio, 2013). We hypothesize that schools respond primarily to changes in their own API standing relative to the time-invariant effect on algebra enrollment--rather than absolute values. We construct our measure of accountability pressure by subtracting each school's mean API value across all study years from their time-varying lagged API value to capture these policy-relevant school-level deviations in API scores. Because API estimates are based only on within-school variation, this measure is analogous to those based on a school fixed effects specification (Raudenbush 2009). For example, we hypothesize that a school which experiences a dip in their API score in the prior year relative to their average performance will be more likely to increase algebra enrollment in the current year to help boost their current API score. By contrast, schools that experience a relatively high prior API score may feel less pressure to use 8th grade algebra enrollment as a means to boost API scores. Further, including school mean-centered API scores rather than absolute API scores mitigates concerns around the high correlation between school mean CST scores and API scores (r=.81 across the sample), which is due to the fact that CST scores contribute to API score calculation.

[12] Since the form of the dependent variable varies across models, these lags also vary slightly in form.

increase their algebra enrollments to avoid the API penalties for 8th grade students not enrolled in at least Algebra.

Even after the state began to relax accountability pressures in 2012, a neo-institutionalist approach posits that institutional pressures led schools to continue to increase 8th grade Algebra or higher enrollment rates. Accordingly, *Hypothesis 2* predicts that the coefficient for 2010-2013 in these models should remain positive.

Hypothesis 3 is based on the expectation that technical issues surrounding advanced course instruction impede the implementation of universal Algebra and encourage instructional differentiation, particularly in schools with low average achievement levels and high degrees of between-student variation in Algebra-readiness. It predicts a negative relationship between school-level 7th grade mean CST scores and geometry enrollments and the number of mathematics course offerings within schools, conditional on controls. Conversely, *Hypothesis 3* predicts a positive relationship between variance in 7th grade CST scores and these measures of instructional differentiation.

Finally, *Hypothesis 4* predicts that pressures to maintain the curricular advantages enjoyed by relatively affluent students will lead socio-economically advantaged schools to "track up." As such, this hypothesis suggests that 8th grade geometry course enrollments will increase particularly rapidly in economically advantaged schools, all else equal.

Findings

Table 1 provides a descriptive profile of the 8th graders enrolled in 1,524 California schools that compose our panel, and the ways in which they changed over the 2003-2013 period. The table clearly indicates that 8th grade algebra enrollments increased in California schools during the period in which the state pursued its Algebra-for-all effort. The proportion of 8th graders enrolled in Algebra or a more advanced course nearly doubled between 2003 and 2013, increasing from 35 percent to 65 percent. Eighth grade advanced course enrollment rates grew particularly rapidly between 2003 and 2005, increasing by nearly 40 percent. A second period of relatively rapid growth occurred during the period in which the state moved to make Algebra the course of record. Advanced course enrollment rates grew by 13 percent between 2007 and 2009. The growth in 8th grade algebra enrollments continued despite court rulings blocking the implementation of the state's effort to make Algebra the "course of record" for 8th graders, growing by an additional 11 percent between 2009 and 2011. Although this growth rate slowed in the 2011-13 period as the state moved toward to the Common Core and eliminated accountability incentives associated with enrolling students in 8th grade Algebra or more advanced courses, it did not reverse.

TABLE 1 AROUND HERE

It is not clear, however, that the trend toward curricular intensification reduced the degree of differentiation in middle school mathematics in California. The percent of students enrolled in 8th grade Geometry grew at a considerably faster rate than the percent of students enrolled in 8th grade Algebra. In 2003, less than 5 percent of California middle schools offered Geometry to 8th graders and just 2 percent of the state's 8th graders enrolled in the course. By 2013, approximately half of the state's middle schools offered the course and the rate of enrollment had more than tripled to 7 percent.

While smaller in absolute terms than the increase in algebra enrollments statewide, this rapid and accelerating geometry growth reflects meaningful changes in the structure of mathematics opportunities. To gauge the magnitude of these changes, consider a hypothetical "average" school enrolling the panel mean of 427 8th graders. The increase throughout the period corresponds to increasing from 10 students in Geometry (=427.2 * .0225) to 25 (=358.0 * .0703), enough for a full class of Geometry. The comparable increase for Algebra would have been from 149 students (=427.2 * 0.349) to 234 (=358.0 * 0.653). In most cases, this increase of 85 students in Algebra would occasion the creation of three to four new Algebra classes. Said differently, for every 5 extra students placed in Algebra between 2003 and 2013, 1 was placed in Geometry. Since these average increases include the third of schools that never offered Geometry, they understate the magnitude of changes at schools that pursued the tracking up strategy.

Consistent with the increase in the number of schools offering 8th grade Geometry, Table 1 further indicates that the mean number of 8th grade math courses offered by California schools increased over the study period. The average school offered approximately 2.5 distinct 8th grade math courses in each of the years 2003-2009. However, course offerings began to increase after 2010 (a year in which these data are not available). By 2013, the population-weighted mean number of math courses offered in California public schools reached 3.4, an increase of nearly one-third over the 2003 average. Course titles do not tell us how schools employ different mathematics courses, and in particular we lack data on the degree to which schools added "double-dose" mathematics courses to simultaneously enroll at-risk students in Algebra and a supplementary mathematics course (see Cortes, Goodman, & Nomi, 2015; Nomi & Allensworth, 2009, 2012.) However, if course offerings are hierarchically organized, as is the case in most U.S. middle and high schools, then increasing numbers of distinct courses may also reflect greater skills-based differentiation. Consistent with this reading, supplementary analyses indicate that in addition to the sharp increase in the number of schools offering 8th grade Geometry courses, the number of schools offering basic or remedial courses to 8th graders also rose modestly.

Table 1 also provides data on the student composition of our sample of California public schools. The proportion of Hispanic students in our sample schools grew by approximately 20 percent and the proportion of Asian students grew by 5 percent; while the proportion of white, African American and other-race students declined. The proportion of students who qualify for free or reduced priced lunch increased by more than a third during the study period that spans the Great Recession (2007-2010, approximately). Enrollments in our panel of schools declined slightly during the study period, presumably due to the construction of new schools to relieve overcrowding in growing communities.

As the three scatterplots in Figure 1 indicate, rates of enrollment in 8th grade Algebra or a more advanced course grew particularly rapidly in California middle schools that enroll relatively high proportions of poor, black, and/or Hispanic students. The y-axis on these scatter plots is the percent of students in each middle school who enrolled in Algebra or a more advanced course in their 8th grade year. The x-axis is the school socio-economic disadvantage scale. To improve legibility, these plots are based on a random sample of half of the schools in the full analysis panel. We display most California schools as grey dots; but in light of our focus on organizational differentiation in schools, we display schools that enroll at least 90% of 8th graders in the same mathematics course as plus signs. In both cases, the scatterplot is weighted, such that schools with larger 8th grade enrollments are displayed proportionately larger.

FIGURE 1 AROUND HERE

In 2003, relatively advantaged schools enrolled more students in 8th grade Algebra or Geometry than disadvantaged schools. While a small number of schools enrolled nearly all students in these advanced courses in 2003 – including a handful of highly disadvantaged schools – in general this plot shows a negative association between school disadvantage and the proportion of students enrolled in 8th grade Algebra or a more advanced course (r=-0.22). Over the course of the Algebra-for-all period, this relationship changed as many disadvantaged schools dramatically increased students' access to advanced courses. By 2008, there were few schools that enrolled fewer than 25 percent of students in 8th grade Algebra or Geometry. Meanwhile a large number of schools, represented as plus signs in the plots, detracked by enrolling nearly all students in 8th grade Algebra. Notably, this group includes a large mass of highly socio-economically disadvantaged schools. Accordingly, in 2008 and 2013 the association between school disadvantage and enrollment in 8th grade Algebra or Geometry is weaker than in 2003 (r=-0.09).

The proportion of students enrolled in 8th grade Algebra or Geometry continued to rise between 2008 and 2013. As a result, California middle schools are increasingly clustered at the top third of the 2013 scatterplot. However, we note a new divergence among schools that enrolled all or nearly all students in advanced mathematics courses in 2013. While a larger number of relatively advantaged schools enrolled nearly all students in 8th grade Algebra or higher in 2013, the bulk of these schools did so by splitting students between 8th grade Algebra and Geometry rather than detracking (represented by circles). By contrast, the majority of the schools who detracked by enrolling nearly all students in 8th grade Algebra in 2013 (represented by plus signs) served relatively large proportions of poor, black, or Hispanic students.

Trends in advanced course enrollment rates

The multivariate analyses that follow provide a closer look at these school-level enrollment trends and the related changes in schools' instructional offerings. Our first analyses focus on the measure that is most proximal to California's Algebra-for-all effort, the proportion of students who enroll in at least Algebra during the 8th grade. If schools respond to accountability pressures, the implementation of policies linking 8th grade algebra enrollments to accountability sanctions will correspond with broad-based increases in inclusiveness in 8th grade math courses, particularly in schools that are most at risk for accountability sanctions. While policy pressures associated with Algebra-for-all began to relax in 2009, norms about Algebra learning and instruction may have also changed in California middle schools. If so, isomorphic pressures may have caused California schools to continue to expand 8th grade algebra enrollments after the state began to deemphasize Algebra-for-all in 2010.

Table 2 reports a series of multilevel regression models that consider trends in the proportion of 8th graders enrolling in Algebra or Geometry and how these trends vary with school characteristics. The first model in Table 2 indicates that the increase in advanced mathematics course placements that we observe in the descriptive data reported in Table 1 is largely independent of changes in degree of socio-economic disadvantage, school size and 7th grade test scores that occurred during the same period. The reference category for the year fixed effects in this table and all subsequent multivariate analyses is 2008, the year that immediately preceded the CDE's move to make Algebra the course of record for 8th grade mathematics. Consistent with *Hypothesis 1*, the model indicates that 8th grade Algebra rates increased each year leading up to this decision, net of school demographics and achievement. However, consistent with *Hypothesis 2*, we find that algebra enrollments remained high after 2010.

TABLE 2 AROUND HERE

The fact that statewide curricular expansion is independent of demographic and other changes in California does not suggest, however, that advanced 8th grade math course enrollments are independent of school demographics and other factors. Model 1 of Table 2 suggests that large schools enroll a smaller proportion of students in 8th grade Algebra or

Geometry than smaller schools, net of controls. Further, consistent with *Hypothesis 3*, this model suggests that technical/functional pressures influenced the extent to which schools increased algebra enrollments. Model 1 points to a strong positive association between student Algebra readiness – as measured by school-level means in 7th grade mathematics test scores – and 8th grade algebra or geometry enrollments. A standard deviation increase in 7th grade mathematics test scores is conditionally associated with a 5 percentage point increase in 8th grade algebra and geometry course enrollment. Interestingly, however, the dispersion in students' 7th grade math test scores is negatively associated with the proportion of 8th graders who enroll in one of these advanced courses.[13] Our results thus suggest that relatively low-achieving and skills-heterogeneous schools are slow to increase curricular rigor, perhaps because these diverse schools use low-level courses to differentiate instruction.

This table's second model adds a control for schools' mean-centered API scores. Consistent with *Hypothesis 1*, this measure of school perceived accountability pressures is statistically significant and negative. The magnitude of this independent relationship is small, suggesting that a typical school might be expected to increase 8th grade algebra enrollments by approximately half a percentage point in response to a standard-deviation sized decline in its API score, net of other control variables. Nonetheless, this relationship suggests that state accountability pressures worked as designed, increasing 8th grade algebra enrollments on the margin.

The analyses reported in the second model in Table 2 indicate that these associations are largely robust to controls for path dependence in school advanced course enrollments. Schools

[13] Unconditional correlations (available by request) point to a negative association between school disadvantage and advanced course enrollment. However, disadvantage and student prior achievement are closely correlated. Model 1 indicates prior achievement completely explains the association between school disadvantage and advanced course enrollments.

that enroll large proportions of students in 8th grade Algebra or Geometry in a given year tend to continue to do so in the next year. Controlling for enrollment lags shifts the model's analytic focus from 8th grade algebra or geometry enrollment *rates* to the year-to-year *growth* in these rates. The year coefficients in this model compare schools' rate of 8th grade Algebra or geometry enrollment growth with their rate in the reference 2007-08 school year. In the 2008-09 year, school algebra or geometry enrollment rates grew approximately two percentage points faster than in the year before. This model reveals that advanced course enrollments grew particularly rapidly in 2008-09 and 2009-10 when the CDE made Algebra the course of record for 8th grade mathematics. But, consistent with *Hypothesis 2*, the conditional advanced mathematics course placement growth rate continued to be high even as accountability incentives relaxed. Net of controls, 8th grade algebra or geometry enrollment growth in California middle schools peaked in 2011-12. While growth stopped in 2012-13, when the state eliminated API incentives associated with 8th grade Algebra, it did not reverse. Furthermore, this model indicates that net of API scores and prior achievement, schools with socio-economically disadvantaged student populations enroll significantly more students in 8th grade Algebra than relatively advantaged schools.

The analyses reported in the second panel of Table 2 consider the odds that schools enrolled more than 90% of 8th graders in Algebra itself (excluding Geometry and other more advanced courses). Early Algebra-for-all advocates hoped this policy movement would lead to large-scale detracking in California middle schools, and Algebra-for-all detracking peaked in 2009 when the state signaled its intent to make Algebra the course of record for 8th graders. In that year, approximately 20 percent of California schools enrolled virtually all 8th graders in Algebra. That rate declined significantly both in absolute terms and conditional on school characteristics in the subsequent years. Schools with relatively high levels of disadvantage were more likely to pursue an Algebra-for-all course placement pattern. Further, the likelihood that schools pursued this path varies negatively with school mean-centered API scores, suggesting that accountability pressures may have influenced school decisions to detrack math sequences by enrolling all 8th graders in Algebra. Schools facing accountability pressures may have interpreted the state's Algebra-for-all push as an absolute mandate; alternatively, they may have responded to normative calls for detracking during the Algebra-for-all period.

Tracking up in the Algebra-for-all era

The analyses reported in Figures 1 and 2 as well as the multivariate analyses in Table 3 consider 8th grade geometry enrollments as an alternative approach to increasing 8th grade algebra enrollments. These analysis suggests that rather than detracking by enrolling all students in 8th grade Algebra, many schools tracked up, enrolling many students in 8th grade Algebra but sorting a smaller number of students into highly selective 8th grade geometry courses.

Figure 2 provides a graphic representation of 8th grade mathematics course enrollment trends in California schools during the study period. By overlaying a series of population-weighted violin plots for 8th grade Algebra and geometry enrollments, this figure represents the changing distribution of school placement patterns. In the middle of this time series – particularly 2005-2009 – the distribution of 8th grade Algebra became somewhat bimodal as a group of schools implemented universal or nearly-universal 8th grade Algebra placements. Although the rate at which 8th graders enrolled in Algebra or a higher course continued to grow between 2010 and 2013, fewer schools enrolled all or nearly all students in 8th grade Algebra during this period. Rather, many schools seem to have created a newer more academically-rigorous 8th grade mathematics tracking system, in which 8th grade Algebra is the modal course but a small group of advanced students enroll in 8th grade Geometry. As this figure makes clear, geometry enrollments remain small in absolute terms relative to algebra enrollments. However, these courses became increasingly important to the state's middle school mathematics curricula during the study period.

FIGURE 2 & 3 AROUND HERE

Figure 3 provides a graphical illustration of this tracking up phenomenon, reporting enrollment-weighted bivariate relationships between 8th grade geometry enrollments (on the y-axis) and total 8th grade Algebra and geometry enrollments (on the x-axis) for all schools in the analysis sample in 2003, 2008, and 2013. Figure 3 truncates the scale for 8th grade Geometry to draw attention to the ways in which the relation between geometry enrollments and any advanced course enrollments vary over time. In the 2003 and 2008 cohorts, the relationship between 8th grade algebra and geometry placement rates is curvilinear, with geometry enrollment rates approaching zero in schools where no students enroll in Algebra and declining in schools where nearly all students enroll in advanced courses. In the 2003 cohort the 8th grade geometry rate is highest in schools that enroll approximately 60 percent of 8th graders in advanced courses; in 2008 peak geometry enrollments occur in schools that enroll nearly 80 percent of 8th graders in Algebra. In 2013, this peak is much less pronounced, suggesting that rather than universalizing 8th grade Algebra, many schools tracked up by enrolling students in 8th grade Geometry.

While 8th grade geometry enrollment rates are far lower in absolute terms than 8th grade algebra enrollments, the multivariate analyses reported in Table 3 indicate that 8th grade geometry rates grew rapidly throughout the study period. This growth occurred across the time series, continuing even after the state abandoned an explicit push for Algebra-for-all and adopted the Common Core. We find that 8^{th} grade geometry enrollments are highly path dependent. Further, consistent with the technical/functional pressures articulated in *Hypothesis 3,* they vary positively with students' prior skill levels, as is the case for advanced course enrollments more generally. However, the demographic profile of schools that increased 8^{th} grade geometry enrollments is different in important ways from the demographic and skills profile associated with 8^{th} grade algebra enrollment rate increases. All else equal, we find that large schools tend to enroll more students in 8^{th} grade Geometry, while schools with more socioeconomically advantaged populations tend to enroll more students in this highly advanced course (net of prior achievement). The latter finding is consistent with EMI and *Hypothesis 4*. Further, mean levels of prior skills are positively associated with 8^{th} grade geometry enrollment rates net of controls, while within-school skills variance is negatively associated with 8^{th} grade Geometry. The models reported in the second panel of Table 3, which considers the odds that schools offered 8^{th} grade geometry course, return very similar results to models considering 8^{th} grade geometry enrollment rates.

TABLE 3 AROUND HERE

Taken together, these findings suggest that many relatively affluent and high-achieving California schools increased 8^{th} grade geometry enrollments and broadened the array of 8^{th} grade math courses they offered during the Algebra-for-all period. These trends–consistent with the idea that schools tracked up as they expanded access to high-status 8^{th} grade Algebra classes – seem to have persisted after the state abandoned its plan to tightly link the Algebra-for-all effort with the school accountability systems. These results may foreshadow trends in school tracking systems in the CCSS era and beyond.

The multivariate analyses reported in the first panel of Table 4 provide further evidence to suggest that on the whole California schools increased the degree of curricular differentiation in middle school mathematics during the study period. These analyses use a count of the number of different 8th grade mathematics courses offered in a school as a proxy for differentiation in California middle school 8th grade mathematics offerings. Their findings suggest that the number of mathematics courses offered in California middle schools increased modestly through the Algebra-for-all period even after controlling for demographic and other changes. Net of controls, we find that large schools tend to offer more 8th grade mathematics classes but schools that educate large proportions of Black, Hispanic, and poor students tend to offer fewer courses. The association between mean test scores and course offerings is nonlinear, with very high- and very low-achieving schools as well as schools with high levels of variance in prior-year CSTs offering a broader array of math courses. Adding a control for lagged API scores in Model 2 does not substantially change the relationships observed in Model 1. The second set of analyses in Table 4 indicates that many California middle schools also added remedial or basic 8th grade math courses during the study period. Notably, however, this increase in remedial courses occurred exclusively during the study period's final years, as the state began to move away from the Algebra-for-all effort. It is further notable that remedial course offerings are positively associated with school disadvantage and negatively associated with 8th grade algebra enrollment rates across the period. Discussions with school leaders suggest that in some cases these remedial courses are "double-dose" courses targeted at low-skill students in 8th grade algebra courses. While a systematic investigation of the spread of these courses is beyond this paper's scope, this analysis points to one way that curricular differentiation may increase in California middle schools that did not pursue a "tracking up" strategy.

TABLE 4 AROUND HERE

Tracking up and the distribution of educational opportunity

California middle schools faced a complex and conflicting set of accountability, institutional, technical/functional, and internal political pressures as they formulated their response to the state's Algebra-for-all effort. Further, they had a range of strategies at their disposal. California schools might have ignored the state's Algebra-for-all effort. Alternatively, they could have moved students from pre-Algebra or other lower-level 8^{th} grade mathematics courses to 8^{th} grade Algebra, increasing the degree of skills heterogeneity as well as racial and socio-economic diversity in high-level 8^{th} grade algebra courses and providing students who might have once been relegated to low-track courses new opportunities to learn. Finally, schools might have created new higher-level tracks, effectively reproducing existing structures of organization differentiation in the Algebra-for-all era. Such a strategy, which we label as tracking up, would more likely maintain previously existing patterns of inequality in access to the highest level courses, even as it allowed schools to dramatically expand 8^{th} grade algebra enrollments.

Our analyses indicate that in the aggregate, California schools took the third option, using 8^{th} grade geometry and other advanced courses to maintain organizational differentiation in middle school mathematics. Eighth grade geometry enrollments tripled in California during the period in which 8^{th} grade algebra enrollments doubled. While the phrase "Algebra-for-all" suggests a movement to decrease the degree of differentiation in mathematics, we find that the typical California middle school increased the number of middle school mathematics courses they offered during the Algebra-for-all period. Relatively socio-economically advantaged, high-achieving, and academically heterogeneous schools were particularly likely to pursue this tracking up strategy.

Tracking up is not simply a matter of reproducing prior track structures at a more advanced level. The number of California 8th graders enrolled in Algebra grew more in absolute terms than the number of 8th graders in Geometry. As a result, the 8th grade geometry track at the top of California's emerging middle school math track structure is small and highly selective, enrolling just 7 percent of students across the state in 2013. By contrast, approximately 35 percent of California 8th graders enrolled in Algebra in 2003, when that course tended to be the most advanced math course available. However, although the new high math track in California middle schools is smaller, California middle schools seem to have created a more highly differentiated organizational structure for 8th grade mathematics during the study period. California middle schools offer more different mathematics courses in 2013 than in 2003, enrolling 8th graders in courses that range from remedial mathematics to advanced Geometry.

Figure 4 demonstrates two different ways of thinking about the implications of this shift for the distribution of educational opportunity in California middle schools. The graphs in this figure look separately at course placement inequalities in schools with highly disadvantaged, moderately disadvantaged, and less disadvantaged student populations (defined via tertiles on the school socio-economic disadvantage scale.) The dashed lines in this figure represent temporal trends in the relative risk of enrolling in 8th grade Algebra or a more advanced course for non-poor and poor California students. In all three panels, these lines show a downward trend, suggesting that poor students are moving toward equity in access to this college preparatory milestone. Poor students continue to be considerably less likely to enroll in advanced courses than non-poor students in relatively advantaged middle schools. However, the dashed line representing the state's most disadvantaged middle schools dips below 1 in the middle of the time series, suggesting that poor students are more likely than non-poor students to enroll in 8th grade Algebra or a more advanced course.

However, the solid lines, which represent temporal trends in non-poor and poor students' relative risk of enrolling in their school's highest 8th grade mathematics course, tell a different story. In relatively disadvantaged schools, where 8th grade geometry course enrollments are rare, the trends in inequality in access to Algebra or a more advanced course largely parallel trends in inequality in access to schools' most advanced course. However, in relatively diverse "moderate disadvantage" schools as well as the more affluent "low disadvantage" schools, these trends diverge. By 2013, non-poor students are approximately three times more likely to enroll in the most advanced math courses offered in schools in both of these relatively advantaged school categories. Furthermore, this non-poor/poor gap in the opportunity to learn is growing rapidly in the state's most advantaged schools, where geometry enrollments are also rising most rapidly. Taken together, these figures suggest that tracking up processes mitigated the opportunity-equalizing consequences of the dramatic expansion of early Algebra in California schools, particularly in the state's most socio-economically advantaged schools.

FIGURE 4 AROUND HERE

CONCLUSION

Over the last several decades, middle and high schools across the United States substantially intensified curricula by enrolling a growing proportion of students in advanced classes once reserved for a relatively small college preparatory track. This movement has been particularly pronounced in California middle schools, where a state-led policy effort created both normative and accountability pressures to encourage schools to enroll more 8th graders in algebra courses. California's effort to universalize access to 8th grade Algebra thus provides a unique perch to view the processes of organizational change associated with curricular intensification and their consequences for educational inequalities both within and between schools.

Our analyses consider the ways in which California middle schools negotiated accountability, institutional, technical/functional, and internal political pressures during the Algebra-for-all era. Our findings suggest that each mattered. Schools across the state enrolled more students in 8th grade Algebra during the period in which the state ramped up accountability pressures associated with the course. Furthermore, we find that declines in school API scores are statistically significantly associated with small increases in 8th grade algebra enrollments. Although relatively few schools detracked middle school mathematics by enrolling virtually all students in 8th grade Algebra, schools that were particularly at risk for accountability sanctions were most likely to do so. These findings are consistent with *Hypothesis 1*, suggesting that accountability pressures played a role in the dramatic expansion of 8th grade Algebra that occurred between 2003 and 2013.

However, consistent with the idea that normative and other institutional pressures also influenced school course placement practices, the expansion of 8th grade algebra enrollments was far more widespread than one might expect if accountability pressures were the only forces that influenced schools' placement decisions. Indeed, while high-achieving schools faced few accountability pressures, we find that school prior achievement was strongly associated with 8th grade algebra enrollments during the study period (even though these schools tended to maintain tracked course sequences.) Further, consistent with *Hypothesis 2*, the fact that 8th grade algebra enrollment rates did not decline when the state's Algebra-for-all effort relaxed suggests that schools began to consider high rates of 8th grade algebra enrollment to be typical, creating institutionally isomorphic pressures that maintained the course's central position in the states' middle school mathematics curricula.

But perhaps our most striking finding is that on average, California middle schools tracked up in the Algebra-for-all era. The state's Algebra-for-all effort created few incentives for schools to enroll students in the doubly-advanced 8th grade geometry course. Indeed, many state educational leaders encouraged schools to detrack by enrolling high- and low-achieving students in 8th grade algebra courses together. However, we find that on average California schools expanded their mathematics curricula during the study period, enrolling a select group of students in doubly-advanced geometry courses. This approach was particularly prevalent in schools that educate advantaged student populations.

Consistent with the technical/functional explanation and *Hypothesis 3*, we find a positive association between schools' prior achievement levels and our tracking up measures. Further, we find that schools that enroll students at highly varying skills levels are less likely to pursue curricula intensification strategies and more likely to differentiate instruction. However, even after controlling for these trends, we find that highly socio-economically disadvantaged schools are more likely to pursue Algebra-for-all strategies and less likely to pursue tracking up strategies compared to more affluent schools. Consistent with *Hypothesis 4* and prior research describing parental and educator opposition to detracking efforts, this finding suggests that affluent and high-achieving schools create new academic opportunities for elite students as they intensify curricula, rather than creating heterogeneous learning environments.

This "tracking up" phenomenon is likely one process through which inequalities are maintained in the face of universalizing educational opportunities. During the Algebra-for-all period, California schools dramatically broadened access to 8th grade Algebra, placing hundreds of thousands of the state's middle school students on an accelerated mathematics track. Rather than corresponding with a decline in middle school mathematics curricular differentiation, we find that California's Algebra-for-all movement coincided with the creation of a new, more highly differentiated curricular structure in middle school mathematics. The tracking up phenomenon meant that the top 10 percent of students qualifying for at least Algebra were placed in Geometry by the end of our study sample. Given finite instructional resources, the creation and expansion of 8^{th} grade geometry courses may have redirected instructional resources from these 8^{th} grade Algebra classes, undermining their effectiveness. Although our analyses do not speak directly to the consequences of this curricular change for the distribution of student achievement or other educational outcomes, prior analyses suggest that curricular intensification in one California school district corresponded with declines in achievement for students at the bottom and the middle of the test score distribution (Penner et al., 2015).

Our findings thus point to important limitations to the effectiveness of policy efforts to equalize opportunities to learn in America's highly unequal and very loosely-coupled public education system. American school tracking systems do change over time, in some cases quite dramatically. But in the California case at least, the accountability pressures that are typically associated with contemporary American education policy seem to account for only a fraction of that change. Furthermore, it is not clear that the changes to California's middle school tracking system that we observe during the Algebra-for-all era translated into a more equitable distribution of educational opportunities within the state's middle schools.

Our findings are also relevant to a discussions about the extent to which curricular tracking is a technical/organizational adaptation to address the challenges associated with student heterogeneity or a practice that is more intrinsically linked to the production of social inequality.

Our analysis of changing middle school mathematics course placement practices in California schools suggests that both approaches have descriptive power. Consistent with Hallinan's (1994) treatment of tracking as a flexible (and thus potentially improvable) organizational practice, we find that California schools dramatically changed their middle school mathematics course placement systems during the Algebra-for-all period. At the same time, we also find evidence to suggest that in many schools a countervailing tendency to "track up" mitigated this movement's potentially egalitarian consequences. This finding resonates with Oakes's (1994) view of tracking as an inequality-producing mechanism, with an important qualification: The fact that the "tracking up" was particularly pronounced in relatively advantaged California middle schools suggests that pressures to produce inequality within schools may be particularly pronounced in relatively diverse and elite settings.

Our results are thus consistent with the theories of maintained inequality. While policy-makers and educational reformers often hope to narrow inequality by broadening access to once-scarce educational opportunities, schools may face strong pressures to create new pathways for the maintenance of educational opportunities. Tracking up patterns in California middle schools during the Algebra-for-all era suggest that these pressures toward maintained inequality are most pronounced in schools that educate relatively advantaged student populations. In addition to illustrating a key mechanism through which inequality in maintained in periods of broadening educational opportunities, our findings also have important policy implications. If the tracking up phenomenon obviates the equity gains associated with curricular intensification, increasing opportunity to learn may not narrow opportunity gaps.

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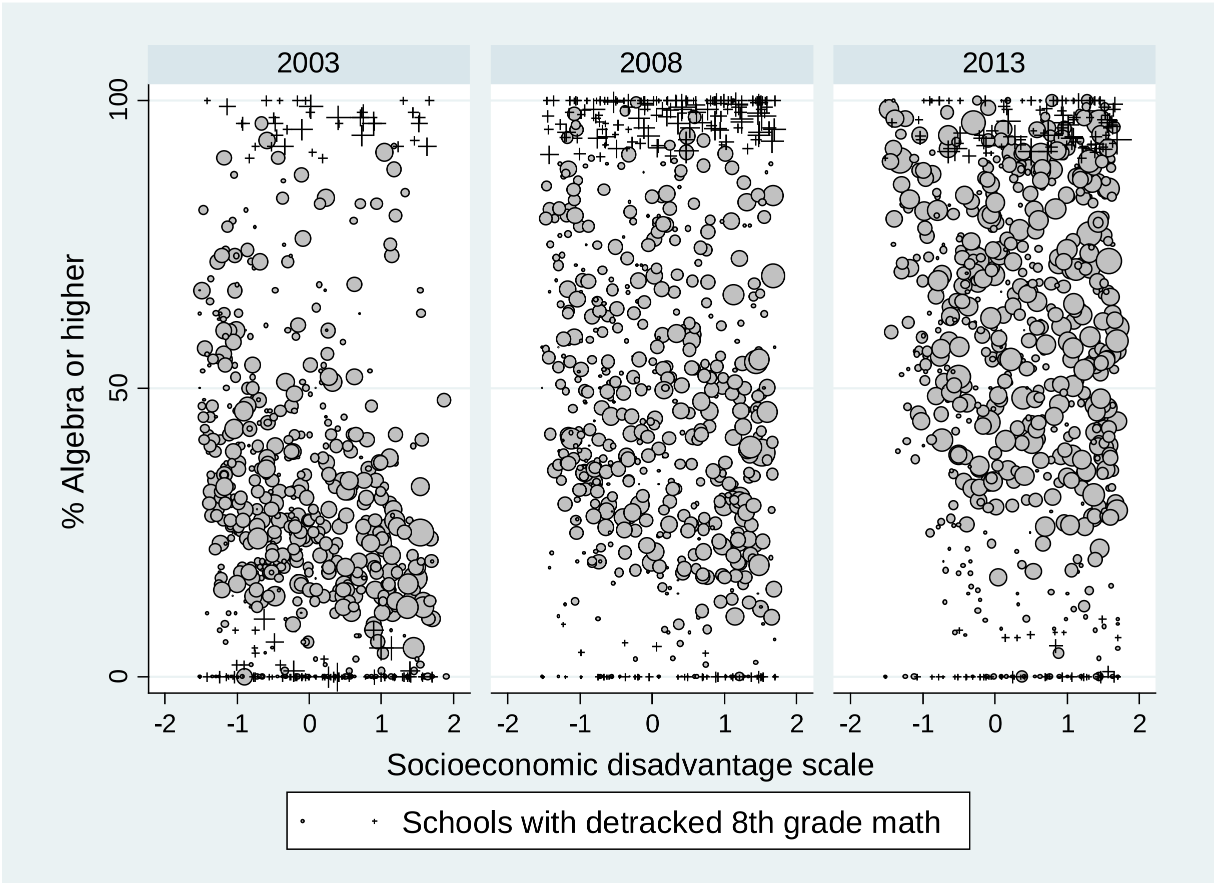
Table 1: Descriptive statistics, 8th grade enrollments in California public schools, 2003-13.

	2003	2005	2007	2009	2011	2013	Δ 2003-2013
% Algebra or higher	34.9	48.3	52.3	58.8	65.0	65.3	+87%
% Geometry	2.25	2.92	3.41	4.27	5.61	7.03	+212%
N math courses	2.71	2.35	2.66	2.66	3.08	3.45	+27%
School offers Geometry (%)	5.39	6.09	36.0	42.5	50.5	64.2	+1091%
N schools offer Geometry	74	77	383	457	557	752	+916%
% school offers basic/remedial math	49.0	39.9	40.5	41.7	52.8	62.7	+28%
N schools offer basic/remedial math	629	526	527	515	625	774	+19%
% Asian	11.5	11.4	11.9	12.2	12.2	12.1	5%
% African-American	8.2	7.6	7.3	7.0	6.2	6.1	-26%
% Hispanic	43.1	46.0	48.3	49.4	51.3	52.0	21%
% White	35.7	33.6	31.1	29.9	29	28.6	-20%
% Other	1.5	1.4	1.4	1.5	1.3	1.2	-20%
% Free/reduced lunch	44.2	49.6	51.9	54.4	58.0	60.2	36%
8th grade enrollment	427.2	437.8	415.9	398.7	374.3	358.0	-16%
API (school mean centered)	-1.25	-1.00	-0.33	0.03	0.57	0.94	2.19sd[14]
Algebra-readiness (std, lagged)	na	-0.04	0.19	0.16	0.24	0.35	0.39sd[15]
Math skills variance (std, lagged)	na	-0.12	0.33	0.22	0.34	0.50	0.62sd[16]
N(schools)	1,506	1,524	1,524	1,524	1,524	1,524	
Weighted N	427,957	440,605	412,921	409,316	390,287	376,700	

Notes: California Department of Education (http://data1.cde.ca.gov/dataquest/) school-level panel data, weighted by 8th grade enrollment. Analyses include only schools that provide 8th grade math course enrollment data in study year.

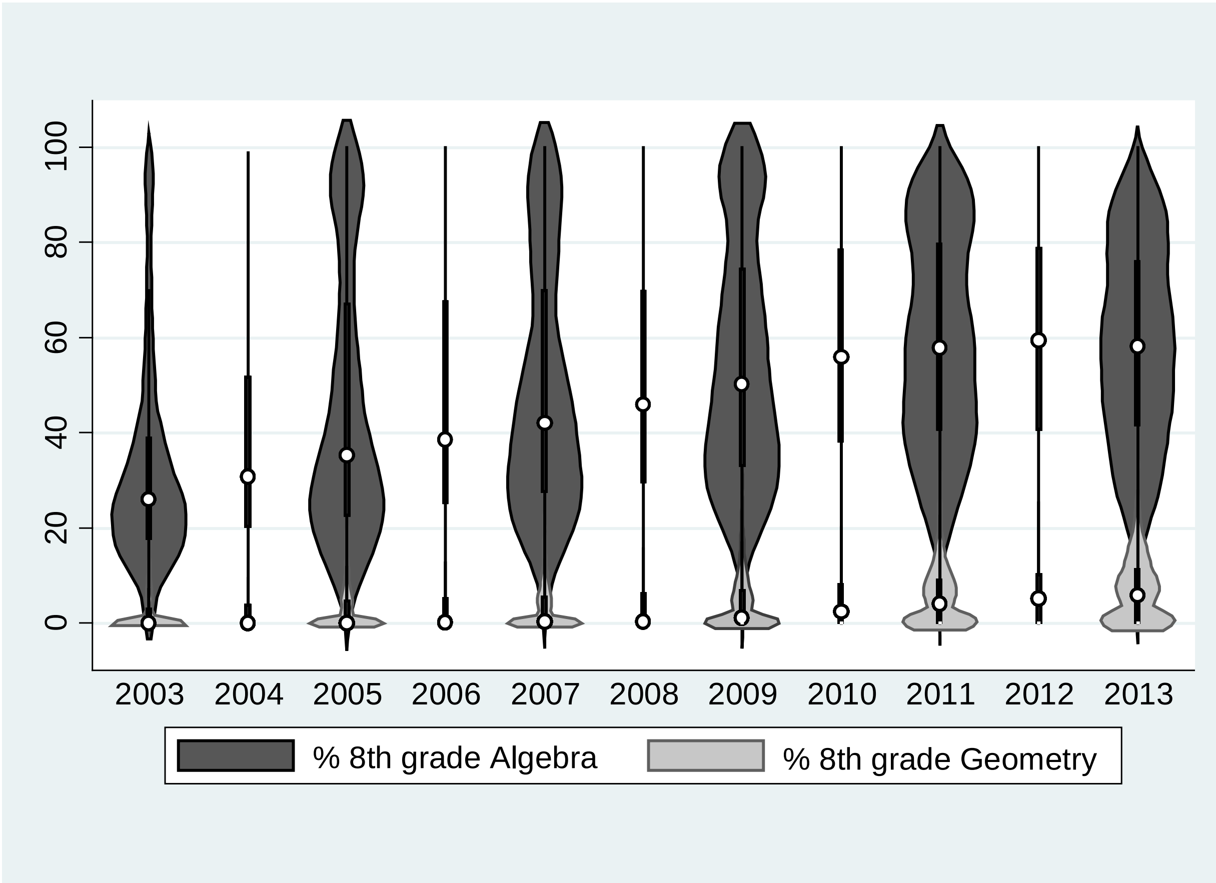
[14] Change in standard deviation terms, 2003-2013.
[15] Change in standard deviation terms, 2005-2013.
[16] Change in standard deviation terms, 2005-2013.

Figure 1: Percent of 8th graders enrolled in Algebra or higher math course by school-level socio-economic disadvantage scales in California middle schools, weighted by 8th grade enrollment.



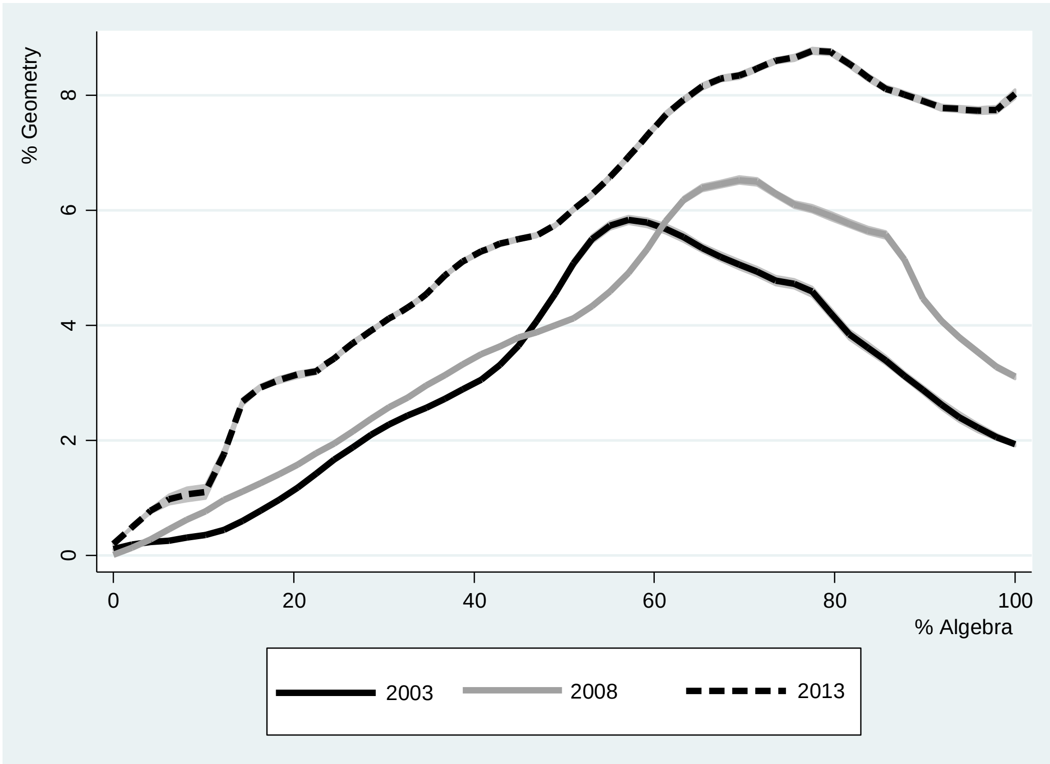
Notes: California Department of Education (http://data1.cde.ca.gov/dataquest/) school-level panel data, weighted by 8th grade enrollment. Plot includes a random sample of half of schools that provide 8th grade math course enrollment data in study year. "Detracked" schools, represented as "+", enroll 90 percent or more of students in the same level of mathematics in the 8th grade.

Figure 2: Violin plot, distribution of 8th grade Algebra and Geometry enrollments in California schools, 2003-13.



Notes: California Department of Education (http://data1.cde.ca.gov/dataquest/) school-level panel data, weighted by 8th grade enrollment.

Figure 3: Local polynomial bivariate plots, school 8th grade Geometry vs. 8th grade Algebra or higher enrollment rates, 2003, 2008, and 2013



Notes: California Department of Education (http://data1.cde.ca.gov/dataquest/) school-level panel data, weighted by 8th grade enrollment; bandwidth=5 percentage points on each plot.

Table 2: Multi-level regression coefficients, predictors of percent of 8th graders enrolled in Algebra or more advanced mathematics and Algebra-for-all detracking, California middle schools 2004-2013.

	% enrolled in 8th grade Algebra or higher		School enrolls more than 90% of 8th graders in Algebra	
	Model 1	Model 2	Model 1	Model 2
Year (reference=2008)				
2004	-13.699***	-2.166**	-0.047***	-0.015
2005	-7.912***	-0.397	-0.015	0.008
2006	-4.905***	-0.76	-0.012	-0.003
2007	-2.357***	-0.381	-0.015	-0.009
2008	--	--	--	
2009	3.419***	2.130***	0.007	0.005
2010	6.097***	3.080***	-0.032**	-0.032**
2011	7.294***	2.443***	-0.048***	-0.035***
2012	8.214***	2.487***	-0.063***	-0.045***
2013	6.141***	-0.176	-0.093***	-0.066***
8th grade demographics (std)				
Enrollment (ln)	-1.449**	-0.946***	-0.064***	-0.044***
Socio-economic disadvantage (std)	0.225	2.255***	0.084***	0.062***
Algebra readiness (y_{n-1})				
7th grade CST (std)	5.332***	4.683***	0.063***	0.044***
7th grade CST (std)^2	0.331*	0.247	0.003	-0.001
7th grade CST variance (std)	-0.627**	-0.553**	-0.004	-0.004
Accountability status (y_{n-1})				
API (school mean centered)	--	-0.571*	--	-0.022***
Placement patterns (y_{n-1})				
% 8th graders in Algebra or higher (std)	--	22.731***	--	-0.035*
% 8th graders in Algebra or higher(std)^2	--	-1.204	--	0.104***
Detracked Algebra-for-all school	--	-2.584***	--	0.307***
Constant	63.758***	54.968***	0.486***	0.328***
ICC(District)	0.37	0.03	0.12	0.00
ICC(School)	0.17	0.10	0.21	0.09
N(obs)	15,143	13,615	15,143	13,615
N(schools)	1,572	1,572	1,572	1,572

*p<0.05 **p<0.01 ***p<0.001

Notes: California Department of Education (http://data1.cde.ca.gov/dataquest/) school-level panel data. Model includes random effects at school and district levels.

Table 3: Multi-level regression coefficients, predictors of 8th grade Geometry enrollment rate and school offered 8th grade Geometry course, California middle schools 2004-2013.

	% enrolled in 8th grade Geometry		School offered 8th grade Geometry	
	Model 1	Model 2	Model 1	Model 2
Year (reference=2008)				
2004	-2.303***	0.527***	-0.346***	-0.323***
2005	-1.623***	-0.495***	-0.310***	-0.301***
2006	-0.820***	-0.221	-0.045***	-0.040**
2007	-0.470***	-0.211	-0.033*	-0.030*
2008	--		--	
2009	0.375**	0.084	0.039**	0.032*
2010	1.214***	0.424***	--	
2011	1.522***	0.206	0.127***	0.114***
2012	2.135***	0.651***	0.194***	0.174***
2013	2.957***	0.649***	0.281***	0.261***
8th grade demographics (std)				
Enrollment (ln)	1.236***	0.410***	0.169***	0.170***
Socio-economic disadvantage (std)	-1.895***	-0.482***	-0.095***	-0.094***
Algebra readiness (y_{n-1})				
7th grade CST (std)0	0.447***	0.299***	0.044***	0.039***
7th grade CST (std)^2	0.120***	0.095***	-0.006	-0.004
7th grade CST variance (std)	-1.094***	-0.353***	-0.085***	-0.088***
Accountability status (y_{n-1})				
API (school mean centered)	--	-0.015	--	0.012
Placement patterns (y_{n-1})				
% 8th graders in Geometry (std)	--	4.692***	--	0.071**
% 8th graders in Geometry (std)^2	--	-0.118***	--	-0.054**
% 8th graders in Algebra or higher (std)	--	0.681***	--	-0.006
% 8th graders in Algebra or higher(std)^2	--	-0.520***	--	0.00
School offered 8th grade Geometry	--		--	-0.602***
Constant	-3.359***		-0.583***	
		0.849***		-0.595***
ICC(District)	0.29	0.06	0.20	0.21
ICC(School)	0.20	0.00	0.14	0.13
N(obs)	15,140	13,596	11,876	9,736
N(schools)	1,572	1,570	1,482	1,472

*p<0.05 **p<0.01 ***p<0.001

Notes: California Department of Education (http://data1.cde.ca.gov/dataquest/) school-level panel data. Model includes random effects at school and district levels.

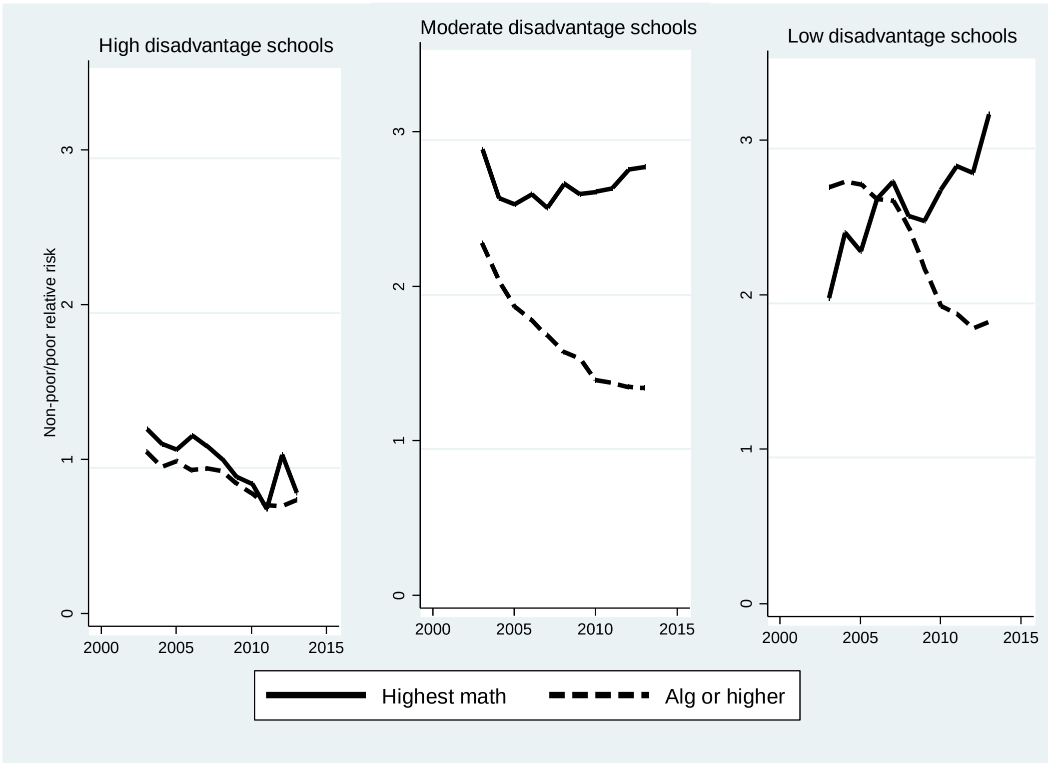
Table 4: Multi-level regression coefficients, predictors of number different of 8th grade math courses and school offered 8th grade basic/remedial mathematics, California middle schools 2004-2013.

	# 8th grade math courses		Offers remedial/basic math course	
	Model 1	Model 2	Model 1	Model 2
Year (reference=2008)				
2004	-0.204***	-0.171***	0.017	-0.007
2005	-0.373***	-0.339***	0.006	-0.005
2006	-0.100**	0.008	0.026	0.007
2007	-0.057	-0.054	0.018	0.003
2008	--		--	
2009	-0.01	-0.043	0.014	0.017
2010	--	--	--	
2011	0.374***	--	0.100***	0.117***
2012	0.480***	0.296***	0.103***	0.122***
2013	0.717***	0.470***	0.197***	0.225***
8th grade demographics (std)				
Enrollment (ln)	0.657***	0.370***	0.127***	0.123***
Socio-economic disadvantage (std)	-0.107***	-0.044**	0.041***	0.037***
Algebra readiness (y_{n-1})				
7th grade CST (std)	-0.019	0.009	-0.020*	-0.012
7th grade CST (std)^2	-0.034***	-0.022*	-0.007	-0.008
7th grade CST variance (std)	-0.066***	-0.037**	-0.01	-0.006
Accountability status (y_{n-1})				
API (school mean centered)	--	0.014	--	-0.01
Placement patterns (y_{n-1})				
% 8th graders in Algebra or higher (std)	--	0.410***	--	-0.105***
% 8th graders in Algebra or higher(std) ^{2}	--	0.045	--	0.067**
N courses	--	-0.075	--	0.003
Offered remedial/basic math	--		--	0.029**
Constant	-0.931***	-0.401***	-0.286***	-0.263***
ICC(District)	0.16	0.07	0.16	0.16
ICC(School)	0.10	0.00	0.05	0.05
N(obs)	11,876	9,249	11,876	9,736
N(schools)	1,482	1,446	1,482	1,472

*p<0.05 **p<0.01 ***p<0.001

Notes: California Department of Education (http://data1.cde.ca.gov/dataquest/) school-level panel data. Model includes random effects at school and district levels.

Figure 4: Non-poor/poor inequality in enrollment in school's highest 8th grade mathematics course compared to inequality in 8th grade Algebra and Geometry enrollment California 8th graders by school disadvantage tertile, 2003-2013



NOTE: California Department of Education (http://data1.cde.ca.gov/dataquest/) school-level panel data. Non/poor relative risk is calculated separately for each school observation as the proportion of non-poor students enrolled in focal courses divided by the proportion of poor students enrolled in focal courses. If a school enrolls 8th graders in Geometry, the "highest math" relative risk is derived from Geometry enrollments; if not, it is derived from Algebra enrollments.