A regression discontinuity analysis of graduation standards and their impact on students' academic trajectories☆

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A B S T R A C T

In 2006, North Carolina put in place high school exit standards requiring students to pass a series of high-stakes exams across several years. I use a regression discontinuity (RD) approach to analyze whether passing or failing one of these exams (Algebra I) impacts a student's decision between choosing a more rigorous college-preparatory math curriculum and an easier 'career' track math curriculum. I find a 5 percentage point gap in the probability of selecting the rigorous curriculum between 9th grade students who just passed and those who just failed the exam. RD results across two years (one year in which the graduation standards were not in place) suggest that the discontinuity arose due to fewer students opting into the college track as a result of the exam results.

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1. Introduction

The impact of high-stakes examinations on future student outcomes has been extensively studied in the literature. One group of studies has analyzed the use of standardized exams as a means of strengthening graduation standards. Imposing or strengthening high school exit standards through the use of high-stakes exams has the potential to affect various student outcomes, including graduation and dropout rates, college matriculation, and labor market outcomes, with theoretical arguments for both positive and negative impacts. Introduction of strict standards may lead to negative outcomes. Marginal students may decide that the additional study required to clear the bar is not worth the effort, leading to lower

graduation and college matriculation rates. On the other hand, the presence of standards may motivate marginal students and their teachers to additional exertions to make sure that they qualify for graduation. If additional effort results in real academic gains for students, this can lead to increase in graduation and college matriculation rates, as well as better labor market outcomes.

In general, the empirical literature has failed to find consistently large observable impacts of these exams. Some studies have found negative impacts of failing an exit exam on on-time graduation and increased drop-out.[1] Some tie the increase in the number of dropouts to other negative externalities in society, such as increased crime rate arising from poverty.[2] Many studies have found small positive impacts on academic achievements and earnings.[3] Indeed, many papers find that exit standards have not

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[1] See for example, Jacob (2001), Dee (2003), among others.
[2] See Larson (2011).
[3] See for example, Woessmann, Ludemann, Schutz, and West (2007), and Bishop and Mane (2001).

caused large changes in graduation, dropout, or college attendance, in either direction.[4] Recent work by Papay, Murnane, and Willett (2011) using regression discontinuity find that barely failing an exit exam results in a substantial reduction in the likelihood of graduating on time. Another paper by the same authors (2010) find, again using regression discontinuity, that being labeled as "advanced" results in higher on-time high school graduation and college enrollment.[5]

Many studies of graduation standards analyze the impact of a graduation exam that is usually administered toward the end of a student's senior year. This study examines a different graduation standard that was briefly in place in North Carolina. A series of End-of-Course (EOC) standardized exams on various subjects were administered throughout a student's high school career as part of the state's accountability system. From 2006 to 2009, the state used the results from some of these exams as its high school graduation standard: a student needed to score above a cut-off value on five exams (or be granted a waiver) to graduate.

While this system sounds demanding, in actuality, a student was given multiple chances to pass each exam, with extensive tutoring offered for those who needed help.[6] Passing EOC exams did not serve as a prohibitive barrier for students who were marginal between passing and failing these exams.[7]

Instead of (or in addition to) serving to sharpen the signal sent by a high school degree to post-secondary institutions and future employers, the results from these EOC exams may have helped the student and the school adjust future academic plans. If student performance on a high-stakes exam was viewed as a good measure of his or her academic ability, the test outcome may have directly impacted a student's selection of courses during his or her high school career and post-high school plans, even if poor performance on the exam did not automatically prevent graduation. A good outcome may encourage students to try their hands at tougher courses, while a bad outcome may deter students from pursuing a more rigorous curriculum. This study investigates whether 10th grade students were influenced by the results from an Algebra I EOC exam in selecting between a college preparatory math track and a career focused math track.

For the North Carolina high-stakes exams, the signal is most useful to students near the pass/fail cut-off. Students who are far below the bar may use the multiple opportunities and extra help to pass the exam and graduate. The bad outcome merely confirms for the students and the schools that they are located in the left-tail of the grade distribution. Similarly, students who are far above the bar do not change their academic plans as a result of passing the exams. The discrete pass/fail signal is most useful for students who may be unsure whether they should or should not pursue a more rigorous curriculum that can prepare them for post-secondary education.

This study focuses on students that are on the edge between passing or failing a high-stakes exam on their first try. The academic trajectories of these students may be especially malleable for two reasons. The gains to taking career preparatory math (which includes expected labor market outcomes and disutility from taking more difficult math courses) for these marginal students may be comparable to the expected gains from taking math courses designed for post-secondary education preparation. Alternatively, the lack of information on their academic potential may make valuation of taking tougher courses more difficult. In either case, the outcome of a standardized exam that is regarded as important by the state may strongly impact whether the student is placed in a more rigorous academic environment.[8]

If there is an impact on the likelihood that a student will move into a more rigorous math sequence based on the Algebra I exam results, this may also be attributable to the school's response to the signal. Students may be tracked into different math sequences, at least partially based on whether they passed or failed the exam. Students who failed may be counseled away from tougher courses, and learning resources may be diverted to lower achieving students (to get them closer to passing the Algebra I EOC exam) or higher achieving students (to strengthen their academic portfolio). Whether the response comes from the student or the school, a student who may be capable of being successful in a more difficult math sequence may be pushed away due to the outcome of the standardized exam.[9]

A regression discontinuity (RD) framework is particularly appealing here, as the high-stakes standardized exam is based on a continuous scale, yet whether a student passes or fails is determined by a sharp cutoff in exam scores. Two students with virtually identical abilities may send a positive or negative signal to the school

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[4] See for example, Grodsky, Warren, and Kalogrides (2009), Reardon, Atteberry, Arshan, and Kurlaender (2009), Warren et al. (2005), Dee and Jacob (2006), Carnoy, Loeb, and Smith (2001), Clark and See (2011), Jurges, Schneider, Senkbeil, and Carstensen (2012) among many others.

[5] For a complete review of the literature, see Holme, Richards, Jimerson, and Cohen (2010).

[6] Even after multiple (sometimes as many as five or six) failures, a student was not automatically prevented from graduating. He or she was evaluated by a committee of teachers and administrators and given a final recommendation, where one of the possible outcomes was being granted a waiver on passing the exams. School administrators may have had some motivation to push students through, as low graduation rates negatively impacted a school's adequate yearly progress (AYP) status and reflected badly on the principal's professional capabilities.

[7] Over 95% of 9th grade students in the sample require at most two attempts to pass the Algebra I exam.

[8] It is worth noting that students and schools may *perceive* passing or failing in different ways. A pessimistic student (or school counselor) may perceive the signal as bad news and move away from taking a rigorous course-load, while an optimist may perceive the exam result as a wake-up call and be motivated to work harder, pushing up (or at least not decreasing) the likelihood of opting into the rigorous curriculum. Both pessimistic and optimistic students who pass will respond by taking the more rigorous sequence. An estimated decline in the probability of taking a rigorous course-load in response to the *perception* from failing will be underestimated for pessimistic students and overestimated for optimistic students. Therefore, the treatment is the pass/fail signal itself and not the student's (or school counselor's) perception of the signal.

[9] Conversely, if the student was unlikely to do well in higher math courses, the student may have been dissuaded to his or her 'benefit.'