College Now...or Later: Measuring the Effects of Dual Enrollment on Postsecondary Access and Success

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Abstract

Research suggests that earning college credits in high school increases the likelihood of postsecondary progress and graduation. In this study, we measure the impact of dual enrollment in high school and college courses through the College Now (CN) program on college enrollment for students in New York City. Our sample is students who graduated on-time from a public high school in 2016 and includes students who enrolled in CN during 2014-2016 in the 11th or 12th grade from the 74% (443 out of 599) of New York City's public high schools where the program is offered. We use a regression discontinuity design (RDD) methodology that estimates the causal local average effect of the treatment — eligibility for dual enrollment in college classes while in high school — on college enrollment. We find that being eligible for CN leads to a 7% point increase in the likelihood of college enrollment and an 8.6% point increase in the likelihood of enrollment in a four-year college. Students who were eligible for CN and enrolled in CN were 20% points more likely to enroll in college.

I.   Introduction

Research demonstrates that the returns to a college degree have increased over time. In 2014, full-time workers with a bachelor's degree earned approximately 49 percent more than full-time workers with a high school degree, as compared to the college wage premium of 26 percent in 1980 (Valletta, 2017). While college enrollment rates have increased overall, they remain lower for low-income students and students of color (Shapiro et al., 2017; Deming, Hastings, Kane, & Staiger, 2017). Furthermore, college completion rates have not increased at a similar rate (Bound, Lovenheim, & Turner, 2010). College completion rates remain low — particularly for low-income students and students of color, who often receive less academic preparation in secondary schools and are more likely to attend under-resourced schools (Shapiro et al., 2017; Cahalan et al., 2016). Given the return to a college degree, policymakers have focused on increasing both college enrollment and degree attainment (Page & Scott-Clayton, 2016).

Dual enrollment is one college preparation strategy designed to increase the likelihood of postsecondary access and success for high school students (Karp, Calcagno, Hughes, Dong, & Bailey, 2007). Dual enrollment aims to increase rates of college enrollment and success through early exposure to college and the possibility of earning college credits while in high school. Many states and localities have dual enrollment programs. Forty-seven states and Washington, D.C. currently have dual enrollment statewide policies and the remaining three states have policies administered through local districts (Zinth & Barnett, 2018).

The format of the dual enrollment programs vary widely across states by eligibility requirements, location of classes (high school and/or college campus), type of instructor (high school teacher or college professor), course offerings (college credit and/or developmental courses), mix of students (high school versus college student peers), type of credit (high school credit and/or college credit) and timing of courses (regular school day or evening classes) (Edwards, Hughes, & Weisberg, 2011). Policies include programs where courses are taught only virtually and dual enrollment programs where courses are taught either virtually, in high schools, and on college campuses. The majority of the states, including geographically diverse states such as Alabama, Delaware, Florida, and Wyoming, have programs where students take college courses both at local high schools and colleges. The types of courses also vary by state. While twenty-two states do not allow students to take remedial, or developmental courses, through their

dual enrollment program, another eighteen states do not specify in their state laws whether students may take these courses through dual enrollment, and the remaining states explicitly allow it (Zinth & Barnett, 2018).

Given the local nature of college systems and partnerships between school districts and colleges, many of the dual enrollment programs are administered on the local level. One city with a dual enrollment program is New York City (NYC). College Now (CN), the dual enrollment program partnership between New York City public schools and the city public college system, The City University of New York (CUNY), commenced in 1984 at Kingsborough Community College, one of the public community college campuses in NYC (College Now Program, Kingsborough Community College, n.d.). In 1999, the program expanded to all of the public community colleges and the public four-year colleges in NYC (Hoffman, 2005).

In 2018, the CN program served as the largest urban dual enrollment program in the country, offered at over 76% (443 of the 599) of the New York City public high schools with an annual enrollment of close to 22,000 students. Through CN, students may earn up to 12 college credits to apply toward a terminal degree. The goal of College Now is to help students successfully transition to and through college. College Now seeks to increase both college enrollment and retention by providing the courses and exposure to college that increase college readiness (CUNY, 2018). Students in NYC are eligible for CN based on a combination of their high school weighted grade point average (GPA) and their scores on the New York State Regents Exams in either English or math, as well as recommendations from teachers and counselors.[1]

A growing body of research provides evidence of a positive relationship between earning college credits in high school and postsecondary enrollment, momentum, and graduation (Allen & Dadgar, 2012; An, 2013; Fink et al., 2017; Smith, Hurwitz, & Avery, 2017). While some work has been done on the effectiveness of dual enrollment, both at the state and national level, a comprehensive and current analysis of the effect of dual enrollment in New York City via its system-wide program, College Now, has not been done (Fink et al., 2017). One prior study

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[1] Although the GPA in the sophomore year is one of the criteria for admission to CN, the admission data shows that the program admission is primarily determined by Regents grades. As a result, we use the Regents grades for the analysis.

explored the effects of CN enrollment on postsecondary outcomes including first semester GPA, number of credits earned, and CUNY retention to a third term for the cohort of freshmen entering in 2009 (Allen & Dadgar, 2012). We update these results in light of some of the changes to the CUNY's college readiness metrics, changes to Regents exams (adopting Common Core standards), as well as the increase in the likelihood of college enrollment over the past ten years for students in NYC public high schools. Further, we differentiate outcomes between students who only took developmental courses and those who took college-level courses because the college-level courses count towards a degree, as opposed to developmental courses which prepare students to enter college courses after graduating from high school but do not count towards a degree. This study thus sheds light on whether dual enrollment programs are successful at scale for the marginal college students in large urban districts with numerous public community colleges and a large proportion of students who are Black, Latinx, and low-income.

Given that CN is the largest urban dual enrollment program in the country, it is important to measure whether this program, at scale, leads to a higher likelihood of college enrollment. Nationally, college enrollment rates for students for urban schools remain about five percentage points lower (62% versus 67%) than the rate for students from suburban schools, in part due to some of the structural challenges, from teacher experience levels to resources allocated per student in elementary and secondary schools in urban districts (Shapiro et al., 2017; Deming, Hastings, Kane, & Staiger, 2017). Further, more than three out of four students coming from urban public schools are assigned to remedial courses when entering college, though research also suggests that remedial courses do not improve student postsecondary outcomes and the remedial course placement process predicts students who will receive a higher grade in college level courses but does not accurately predict those who are likely to fail (Hughes & Scott-Clayton, 2011; Martorell & McFarlin Jr, 2011). Access to dual enrollment could ensure that students from urban public schools are more likely to enter and graduate from college without the need for remediation. The results may have policy implications for cities looking to increase college degree attainment and reduce the use of remediation in higher education, and particularly cities in which a large number of students enroll in public colleges and are assigned to remediation.

In order to answer the aforementioned question, we use a quasi-experimental regression discontinuity design that compares outcomes for students who just met the criteria for CN with

the outcomes for students who just missed the benchmark score for college credit course enrollment. Our sample is the 2016 cohort of on-time high school graduates (i.e., completed grades nine to 12 in four years). These students were enrolled in grades 11 and grade 12 during 2014-15 and 2015-2016 academic years respectively. Using administrative data from the College Now Program database, NYC Department of Education (NYCDOE), administrative data from City University of New York (CUNY), and data from the National Student Clearinghouse, we find that being eligible for CN leads to a 7 percentage point increase in the likelihood of enrolling in college when compared to not enrolling and a greater likelihood of enrolling in a four-year college.

This paper is organized as follows. In the second section, we review the literature around dual enrollment and its impact on college enrollment and graduation. Next, we discuss our data sources and empirical strategy. In our fourth section, we discuss our results and the additional specification checks that we performed. We conclude with implications of the work and future directions for research.

II.   Literature Review

Dual Enrollment and College Enrollment

Prior research finds that dual enrollment increases the likelihood of college enrollment but might have diversionary effects with respect to the level of college attended (An, 2013; Cowan & Goldharber, 2015). For example, An (2013) uses the nationally representative dataset, the National Education Longitudinal Survey of 1988 (NELS 88) data, to explore the effects of dual enrollment on college enrollment for low-income students. While students who were dually enrolled were more likely to enter college in this study, other evidence exists that shows that dual enrollment has no effect on postsecondary outcomes or might divert students planning to enroll in four-year colleges to two-year colleges (An, 2013; Cowan & Goldharber, 2015).

These mixed findings on the impact of dual enrollment on postsecondary outcomes suggest that context matters. Speroni (2011) used administrative data from Florida and a regression discontinuity approach to estimate the effects of dual enrollment on student postsecondary outcomes in Florida, using the high school GPA as the forcing variable. She found no evidence of positive effects of dual enrollment in a college credit-bearing class for students

who were high school juniors and seniors in 2000 and 2001 on high school graduation and college enrollment. However, Cowan and Goldharber (2015) use administrative data from the state of Washington to explore the association between dual enrollment and postsecondary outcomes for students enrolled in ninth grade from 2004–2007 and found positive effects on college enrollment. This descriptive study finds that students who were in dual enrollment were more likely to enroll in college part-time and complete an associate's degree. However, the authors also found some evidence of diversionary effects, whereby students who might have enrolled in a four-year college in the absence of this intervention instead enrolled in a two-year college. Importantly, the students enrolled in dual enrollment from this study were higher income and higher achieving than the average student in Washington State. As a result, findings from this study are not generalizable to students nationally, or to students in NYC, particularly given the very small population of Black and Latinx students in both the state of Washington and the study.

A more recent study by Fink, Jenkins, and Yanagiura (2017) provides descriptive analysis of the characteristics of dual enrollment students enrolled in community college and high school in the fall of 2010 and their post-graduation college enrollment and success using data from National Student Clearinghouse (NSC). The authors follow the students for six years. They find that, on average, more than half of dual enrollment students enroll in two-year college after graduation and approximately half of students who enter college earn a postsecondary credential after five years. Furthermore, large differences in college completion rates exist between higher- and lower-income students and large variation exists across states. Beginning with college enrollment as an outcome, the results demonstrate the need for more research on dual enrollment programs within cities and the ways in which local contexts shape student outcomes.

College Now Program

In New York City, through College Now, a city-wide dual enrollment program, students can earn up to twelve college credits in 11th and 12th grades. CN is a partnership between CUNY and NYCDOE, with 18 participant colleges and over 440 NYC public high schools. The College Now central office oversees the implementation of the program in order to maintain program quality. Campus teams (directors and liaisons) are responsible for identifying and

recruiting students and maintaining relationships with the partnering public high schools that implement the program. Public high schools receive support from College Now through professional development for instructors and curriculum development.

There are four mechanisms through which College Now can impact student outcomes. The first is a collaborative partnership between NYC high schools and CUNY. Seventy percent of first-time freshmen at CUNY are NYCDOE graduates. Of these first-time CUNY freshmen, over 30 percent participated in College Now while in high school. This partnership ensures that students taking CN courses will be able to apply them to their degree program and have access to the colleges in which the majority will be enrolling. Secondly, the program design also could increase the likelihood of student postsecondary success by decreasing the likelihood of assignment to remediation. CN is a multilevel program, including developmental and college-level courses that help to prepare students for college-level work, if needed, through pre-college developmental education courses, after which students can subsequently enroll in college credit coursework. For the students who are prepared to take college credit courses, as determined by their score on the Regents exam, they have the option to take those courses either on their host college campus or at a high school location. Third, college professors or trained high school teachers who provide college instruction should have college-level expectations in their classrooms with regards to student coursework. Fourth, the program offers a variety of gateway courses, which are foundational courses that students need in order to complete their major requirements in college. Finally, unlike most college programs, the cost of the courses and all materials needed to complete the coursework is free to participating students, and costs are borne by CUNY and the NYCDOE.

This intervention is designed to provide early academic, structural, attitudinal, and financial support to students in order to increase the probability of college enrollment and degree attainment. For example, if students took and passed at least six credits in their 12th-grade year and 15 credits during their first semester in CUNY, they would have 21 credits by the end of their first semester and could accumulate 30 credits by the end of their first year — which is the expected number of credits for a full-time freshman. For students who started College Now in 11th grade and continued to take courses in 12th grade, the impact within one year could be even larger, possibly earning 27 credits by the end of their first semester of college. Importantly, College Now serves a diverse population of students in NYC, particularly underrepresented and

low-income students who have fewer opportunities to access higher education when compared to their higher-income peers (An, 2013).

Dual enrollment in New York City

Two prior studies provide some evidence on the effectiveness of College Now in increasing student success in postsecondary education. Karp, Calcagno, Hughes, Jeong, and Bailey (2007) carry out a descriptive comparative analysis of the College Now program in NYC and the statewide dual enrollment program in Florida. They focus on the effects of dual enrollment on both short and long term postsecondary outcomes for students and particularly students enrolled in career and technical education (CTE) courses of study in high school. Further, they explore how these effects vary by demographic characteristics. The sample from NYC was based on students who graduated from a vocational high school and enrolled in CUNY in 2001 and 2002. They find that students from vocational high schools in NYC were more likely to enroll in a four-year college than their peers who did not participate in CN and had 0.133 points higher GPAs on average. An important caveat to their findings was that dosage of CN was important. The effects on GPA were found only for students who took two or more CN courses. Students with two or more courses also were about 3.5% more likely to enroll full-time when compared to those who were not enrolled in CN, and had higher levels of persistence to degree completion. While this descriptive study provides evidence that CN increases both the likelihood of college enrollment and persistence to degree with CTE students who are generally less likely to enroll in college, this study suggests that additional causal work is needed to evaluate the effects of CN. Allen and Dadgar (2012) carried out an analysis of the effects of CN on postsecondary outcomes using administrative data for first-time freshmen who entered CUNY in the fall of 2009. Employing a quasi-experimental difference-in-differences (DD) approach, the authors find that taking at least one CN course leads to a greater likelihood of earning one additional credit during the first semester and a .16 point increase in college GPA.

While previous studies have been done on the effectiveness of College Now for students enrolled prior to 2010 (Allen & Dadgar, 2012; Karp et al, 2007), this study seeks to update the results in view of increasing enrollment in College Now over the past ten years. This is the first study to use a Regression Discontinuity (RD) approach to measure the effects of College Now on postsecondary outcomes. Thus our research will contribute to existing work by providing

rigorous causal analyses of the program's effect on college enrollment, as standards for college readiness have changed in NYC over time. We measure the effects of College Now on college enrollment using the sample of 2016 high school graduates, in comparison to prior studies which focused on students who participated in College Now prior to 2009. More broadly, this study will add to the literature on dual enrollment by examining the effects of a dual enrollment program at scale, using student level administrative data from K-16. Importantly, the significant sample size of this research study—of the largest American school district, which serves primarily Black, Latinx, and low-income students—has the potential to deepen understanding of which students benefit most from dual enrollment programs, and to explore the differential effects of CN on low-income and minority students.

The research question we explore in this paper is:

Does eligibility for the College Now program increase the likelihood of college enrollment?

III.   Data

We use administrative data from the following sources for this study: CUNYFirst for College Now course enrollment; CUNY's Institutional Research Database (IRDB) for CUNY postsecondary enrollment and performance data; the NYCDOE data for background characteristics and secondary academic performance; the American Community Survey for median household income based on census tracts; and the National Student Clearinghouse (NSC) for non-CUNY post-secondary enrollments. Student demographic data include gender, race and ethnicity, grade level, native language, and country of origin. Academic performance data includes NYS Regents, GPA for grades 10, 11, and 12, and high school diploma type. CN program data has detailed student and course level data such as course type, grades, disciplines pursued, location of the dual credit course, type of instructor, number of college credits attempted, number of college credits earned, and duration of participation.

We obtained postsecondary enrollment and performance data through CUNY's administrative data extracted from the Institutional Research Database (IRDB) for students who enroll at any of CUNY's two- or four-year institutions. The postsecondary data contains college enrollment records and transcript data, including grades, degree pursued, credits attempted and earned, credits transferred, semester and cumulative GPA, as well as Pell/Tap indicators. Lastly, college enrollment records through National Student Clearinghouse (NSC) were also obtained to

track students who enroll outside the CUNY system. NSC matches are based on first name, last name, and birthdate for the sample of eligible students to NSC. NSC data includes college enrollment, type of college attended, and persistence (number of semester enrolled). One of the limitations of the NSC is that it does not have student GPA or course information. As a result, we only have access to detailed and reliable semester continuation and course data for students who enroll in CUNY.

As a proxy for socioeconomic status, we extracted poverty indicator based on the American Community Survey (ACS) census tract data.[2] Approximately 95.8 percent of the addresses were matched to a geocode census tract. We also created a categorical variable with three levels: 1) less than 10 percent, 2) between 20 to 29 percent, and 3) greater than or equal to 30 percent as recommended by the New York City Department of Health and Mental Hygiene (Toprani & Hadler, 2013).

The Assignment Variable: Regents Exam Scores

The assignment variable is the state Common Core English Regents exam.[3] There are 24 multiple choice questions and then students choose three of four passages and write essays arguing a particular viewpoint on those passages in the exam. The multiple choice questions are answered via an electronic scanned sheet and the essays are handwritten. Each multiple choice question is worth one point and each essay receives a grade of one to four. Once a raw score has been assigned, teachers use a conversion chart developed by the state to assign a scaled score. As of June 2013, exams are scored in a centralized location. Scaled scores range from 0 to 100; however, the same scaled scores are not used in each year. For example, in June 2014, a student could receive a grade of 71 for a raw score of 32, or a 73 for a raw score of 33, but the grades of 72 or 74 were not possible. The following year, in June of 2015, a student could receive a grade of 72 for a raw score of 33 or a 74 for a raw score of 34, but the grades of 71 or 73 were not possible.

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[2] We gathered the addresses of the students from the NYCDOE data files into separate comma separated values (csv) files that included the street, city, state, and zip code for address batch uploads to the United States Census Bureau geocoding website. The results are based on the 2010 census data and include the state Federal Information Processing (FIP) standards' county FIP, and 6-digit census tract code. These codes are concatenated to create an 11-digit Census Bureau Geo ID, which is used to match to census tract-level data of the poverty level and median household income data from the Census American Factfinder. The poverty indicator in this dataset is constructed using the American Factfinder variable of the estimate of the percentage of the population that was below the federal poverty line in that census tract.
[3] Over 95% of students who are enrolled in CN take courses based on the English Regents exam, while approximately 5% take courses in math. Due to the small sample sizes for math, the analysis is for the English exam.

For English Regents scores above 40, the distribution is not normal, as seen in Figure 1. Because of the exam scale design, there are no scores at particular values, which gives the appearance of manipulation. To account for the non-continuous nature of scores of the exam, we use the strategies developed by Dee et al. (2018). We use the score conversion tables from NYS to 1) identify which scaled scores were not possible, 2) drop observations with impossible scores, 3) count the frequency of raw scores that map on to the same scaled scores and 4) create a weight for scaled scores based on the frequency of scores.[4] We then use the weight to create a histogram of scores that takes into account the number of possible score combinations to achieve the score.

Sample

Approximately, 22,175 NYC students are enrolled in CN from the 420 high schools that participated in 2016. Of the students enrolled, approximately 22 percent are Asian, 24 percent are Black, 33 percent are Latinx, and 17 percent are White. On average, 60 percent of CN students are female. In the city's high schools, about 16 percent of students are Asian, 30 percent are Black, 39 percent are Latinx, and 13 percent are White.[5] Thus, in the CN program, White students are slightly overrepresented and Asian, Black, and Latinx students are slightly underrepresented. Also, 13 percent of high school students in NYC in 2013-14 were English language learners and 16 percent received special education services. Nearly 65 percent (21,197 out of 32,178) of enrollments in College Now took place in community colleges.

The sample consists of 70,852 students who were seniors in 2016 and graduated on-time from New York City public high schools in 2016. We restrict our sample in a number of ways. With regard to the Regents scores, first we include only students who took Regents between the January of 2015 and the January of 2016 (the last opportunity to enroll in a College Now college credit course).[6] In other words, we exclude observations with Regents exams taken by students prior to junior year (before January 2015) and after January of senior year (after January 2016). Second, we use each student's maximum exam score from the four tests, as this is the score that rendered them eligible for CN.[7]

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[4] There were 51 observations with impossible scores.
[5] https://www.ibo.nyc.ny.us/iboreports/new-york-city-public-school-indicators-demographics-resources-outcomes-october-2015.pdf
[6] Data is based solely on Regents ELA examinations attempts, not course taking.
[7] We do not differentiate between Common Core and Non-Common Core exams since the cut-off for college readiness is 75 for both ELA Common and Non-Common Regents exams.

Table 1 describes the demographic characteristics of students who were seniors in NYC in 2016 and also students who participated in CN. Column (1) provides the demographic characteristics of 12th grade students in 2016 who graduated in four years from a NYC public high school. Column (2) limits the sample to students who scored between a 65 and an 85 on the English Regents by January of their senior year. Column (3) presents the characteristics of students who scored between a 69 and an 81 on the exam by January of senior year. The demographic characteristics of the population of on-time 12th graders in NYC and the samples in both column (2) and (3) are similar. However, differences exist in terms of the likelihood of college enrollment for 12th grade students in NYC when compared to students in the sample.

 Approximately half of the seniors in NYC in column (1) and also in the two samples in column (2) and column (3) are female. In terms of racial and ethnic affiliations, there are relatively similar proportions of Black, Latinx, and Asian students in both NYC and the samples (respectively: 29%, 39%, and 17%). Fifty-five percent of students in the high schools and fifty-four percent in our sample are Native English speakers while approximately one-quarter speak Spanish as their first language. Three quarters of the population and the samples are native born and similar numbers live in census tracts that are below the poverty level across the population in column (1) and the samples in column (2) and (3).

Students in the samples are more likely to enroll in any level of college, approximately 70%, when compared to 12th grade students in NYC, where 63% enroll. The restricted and analytic sample are more likely to enroll in a two-year college, with percentages between 43% and 46%, as compared to the population, where 29% enroll in two-year college. The sample of students with English Regents grades between 65 and 85 are slightly less likely to enroll in a four-year college, between 24% and 26% enroll, when compared to the population of students (31%) in this cohort. The students in the sample are also more likely to enroll in CUNY than the 2016 cohort (52% versus 39%). These differences in the likelihood of college enrollment between the sample and the population of students have implications for the generalizability of the findings for students who score either higher than an 85 or lower than a 65 on the English Regents exam.

While some differences exist between our sample and the population of students with respect to college enrollment that limit external validity of the findings, we next verify the internal validity by measuring whether systematic differences exist between the treatment and

control groups in the sample in Table 3. If students who score just above 75 and those who score just below 75 do not have differences in the average demographic characteristics, this suggests that we are comparing similar students. To ensure that our treatment and control groups do not differ on observable characteristics prior to the intervention, which would bias the estimates, we carry out baseline equivalence tests on student demographic characteristics on either side of the NYS English Regents score of 75 in Table 3. In column (1), we compare the characteristics of students who scored three points above and three points below the cutoff score of 75 on the English Regents exam prior to January of their senior year. Column (2) compares the summary statistics for students who scored five points above and below the score and column (3) widens the bands to 10 points above and below the score of 75.

In columns (1) and (2) of Table 3, there are no significant differences in terms of the gender, race, ethnicity, native language, poverty levels, or college enrollment in SUNY colleges, NYS private colleges, or out-of-state colleges, when comparing students who score just above and just below a 75. Students who score above 75 are slightly more likely to be born in the United States and enrolled in college. However, we might anticipate that students who are eligible for College Now might be more likely to both enroll in college and enroll in CUNY, given their early exposure to CUNY through dual enrollment. To address the potential bias of students who are US born being more likely to score above 75 on the English Regents, we limit the sample to students born in the United States as a sensitivity check to see if this changes the results of the analysis.

IV.   **Empirical Strategy**

The study uses a regression discontinuity design (RDD) to evaluate the impact of dual enrollment in New York City high schools via College Now during the 2016-2017 academic year on college enrollment. We use a sharp regression discontinuity design (RDD) methodology that estimates the causal local average effect of the treatment - eligibility for dual enrollment in college classes while in high school via CN - on college enrollment. The unit of analysis is the individual student.

To measure the causal effect, we compare college enrollment for students eligible for CN who fall directly above and those directly below the score cutoff, as students who fall just below the cutoff scores and are not enrolled in CN represent a valid counterfactual. The RDD provides

a causal estimate by using a local experiment at the cutoff value of the assignment variable where variations in scores just above and below the cutoff value are attributed to random variation due to measurement error.

       Our basic equation (1) for our sharp regression discontinuity for the English scores is:

(1) $Y_i = \beta_0 + \beta_1 Z_1 + \beta_2 (X_i - X_c) + \varepsilon_i$

where Y_i is our outcome. Our outcome is college enrollment. Our intercept term is β_0 and Z_i is our treatment variable, which is 1 if a student is eligible for CN and 0 if the student is not eligible for CN. Thus, the coefficient β_1 captures the treatment effect. X_i is the assignment variable, the student's score on the English Regents exam. X_c is our cutoff score on the exams that determines eligibility for CN, which is 75 on the English Regents exam. The coefficient on the difference between the student score and the cut score, β_2, represents the predicted outcome based on the score on the Regents exam.

       For the fuzzy regression discontinuity using English Regents scores, our basic equations are:

(2) $Y_i = \beta_0 + \beta_1 D_i + \varepsilon_i$ as the structural equation

(3) $Y_i = \beta_0 + \pi_2 \, 1(X_i \geq X_c) + \zeta_{2i}$ as the reduced form

(4) $D_i = \pi_0 + \pi_1 \, 1(X_i \geq X_c) + \zeta_{1i}$ as the first stage

      The fuzzy regression discontinuity is a two-stage least squares instrumental variables (IV) approach, where the probability of receiving treatment does not move from 0 to 1 as occurs in the sharp RD but instead the probability of treatment can be less than one. Following the conventions of Lee and Lemieux (2010), we quantify the treatment effect by comparing the outcomes of the proportion of students that are eligible and enroll in CN with those who do not enroll at the threshold using instrumental variable (IV) regression, based on the assumption that the cutoff is related to the probability of treatment. In equation (2), our structural equation, we have the regression of the outcome Y_i (college enrollment, level of enrollment) on the instrument D_i, which is the probability of enrolling in CN if you are a student at or above the cutoff. Equation (4) is our first stage where we measure the probability of treatment, also known as the instrument, for students who have a score equal to or higher than the cutoff score. Equation (3), the reduced form, is the regression of the outcomes Y_i on whether students fall above the cutoff and are enrolled in CN. The IV approach for the fuzzy regression discontinuity

captures the local average treatment effect for students who comply with the assignment to CN or not CN based on their Regents exam scores.

V. Results

College Enrollment Graphical Analysis

We commence by checking for evidence of Regents score manipulation using both a visual inspection and a local polynomial density estimation approach. In Figure 1, we graph the forcing variable, the Regents exam score for English, against the outcome of college enrollment. Each point is an average value of college enrollment for a given English Regents score. In Figure 1, significant differences exist in the rate of college enrollment between students who receive 75 or higher on the English Regents exam (and are thus eligible for the College Now program) and those who receive a lower score. The average difference in the likelihood of enrollment is approximately 6 percentage points—which provides some descriptive evidence that eligibility for College Now increases the likelihood of college enrollment.

Next, we test for manipulation of the English Regents score in two ways. We create a histogram of the Regents score for visual inspection of scores and also use a local polynomial density estimation approach (Cattaneo, Jannson, & Ma, 2016). While there is a higher density of some scores on the English Regents exams, as seen in Figure 2, there does not seem to be evidence of systematic manipulation of scores near the cutoff for this program. There is not a jump in the density of scores at 75, which is the cutoff score. In order to formally test for manipulation, we use a bandwidth of approximately four points on either side of the score of 75 and restricted testing, which constrains the higher order derivatives and the cumulative density function to be equal for both groups on either side of the cut-off. The local polynomial density estimation results demonstrate that there is no evidence of score manipulation with a p value of 0.4694.

College Enrollment

Table 3 provides the results for the regression discontinuity analysis for college enrollment. Each of the rows represents a different outcome. The first column is for any college enrollment as compared to not being enrolled. The second column is the IV analysis. The third column is enrollment in a four-year college—the comparison group is students enrolled in a two-

year college or not enrolled in college. In column four, the outcome is enrollment in a private college in New York State as opposed to being enrolled elsewhere or not enrolled. The fifth and final outcome in column 4 is being enrolled in an out-of-state college as compared to being enrolled elsewhere or not enrolled.

Row 1 provides the likelihood of any college enrollment for students who are eligible for College Now English courses, as compared to students who just missed eligibility for this program. This is the Regression Discontinuity estimate of the intent to treat (ITT) in all columns except column 2, as it measures differences in the likelihood of enrollment between treatment and control, or those eligible for CN as compared to those who missed eligibility—but does not take into account program enrollment. Row 2 provides the ITT RD estimate after the inclusion of covariates, and the second column is the treatment on the treated estimate once covariates are added to the model. We include the following covariates: race, ethnicity, gender, country of birth, language spoken at home, 12th grade GPA, and an indicator for living in a census tract where different proportions of the population live below the poverty level.

From Column (1), receiving a 75 or higher on the English Regents exam—meaning that a student is eligible for enrollment in College Now—leads to an increase in the likelihood of college enrollment of approximately 9 percentage points. This is a 14% increase in the probability of college enrollment, given that approximately 70% of secondary students in our sample enroll in college after graduating from high school. When we add covariates to the model in column (2), the likelihood of college enrollment for students eligible for CN is 7 percentage points higher than enrollment for their peers who are not eligible. For the IV estimate in Column (2) with controls, being eligible for and enrolling in CN increases the likelihood of college enrollment by 20 percentage points. There is also an increase of 8.6 percentage points in the likelihood of enrolling in a four-year college. We do not find significant differences in the likelihood of enrolling in NYS private colleges and the likelihood of enrolling in an out-of-state college is approximately 2.3 percentage points lower for CN students, as compared to students who missed the eligibility criteria.

One of the limitations of the study is that CUNY uses a grade of 75 as both a barometer of college readiness and for entry into four-year colleges. In order to address this threat to the validity of our analysis, we carry out the RD for a subsample of high school students who would not have been impacted by this policy—students who did not enroll in CUNY—a sample of

approximately 25,000 students. In Table 4, the point estimates are similar in magnitude and direction to those for Table 3, which suggests that the eligibility for dual enrollment leads to increases in the likelihood of college enrollment and enrollment in a four-year college. One difference in the findings between the whole sample in Table 3 and the sample of students not enrolled in CUNY in Table 4 is that students not enrolled in CUNY are much more likely (44 percentage point increase as compared to a 20 percentage point) to enroll in a four-year college.

Robustness checks

      We carry out a number of robustness checks in order to ensure that our results are not sensitive to changes in population or bandwidth choice. We commence by exploring the characteristics of non-compliers, or students who enrolled in CN although they did not have a 75 or higher on the English Regents. There were 2,088 students in the sample that did not comply with the eligibility guidelines. These students either were *never eligible* based on their Regents scores and took a college credit course (n=922) or students who took a college credit course *before becoming eligible* based on their Regents score (n=1,166). To determine whether this population of "non-compliers" would skew our analysis, we conducted descriptive summaries to determine whether the non-compliers had a distinct pattern of characteristics that were unique compared to the larger sample. According to our analysis, there were no distinct patterns in their English Regents performance that were not different for the non-compliers compared to the sample (M = 78.32, SD = 11.28). There were also no distinct patterns to the way they performed overall in high school based on their GPA (M = 84.48, SD = 8.38). Lastly, the non-compliers attended high schools all throughout the five boroughs of NYC as well as all of the colleges in the CUNY network.

      We also limit the sample to students born in the United States, given that there appeared to be baseline differences in the population born in the U.S. and born in other countries in our baseline equivalence tests in Table 2. When we carry out the same analysis and limit it to students born in the United States, we have a similar point estimate, magnitude, and significance. This finding suggests that our results are not dependent on our sample.

      We test different bandwidths in Table 5 to ensure that our estimates remain stable. The bandwidth used for the prior estimates in Table 3 were chosen using the bandwidth selection process outlined by Calonico, Cattaneo, and Titiunik (2014). The bandwidth was approximately

7.4 for college enrollment. We verify bandwidths on either side of this bandwidth, from a bandwidth of 10 points on each side to a bandwidth of five on each side of the English exam score. The estimates remain positive, significant, and within three percentage points of the RD results in Table 3.

Finally, we carry out falsification tests to verify if we are picking up a spurious relationship unrelated to eligibility for College Now. We test for significant difference in college enrollment on either side of a bound that does not determine program participation—a score of 60. If there are positive effects using a score of 60, this suggests that our results might not be due to program eligibility. We find that there are no significant differences in terms of the likelihood of college enrollment when we use a cutoff score of 60.

VI. Discussion and Implications

College entry and success is a high priority issue in the New York City landscape, particularly for CUNY, and for the broader higher education landscape. In this study, we use a regression-discontinuity approach to examine the effects of eligibility for and enrollment in college credit English, social sciences, and humanities courses in New York City's system-wide dual enrollment program, College Now, on college enrollment. Compared to the control group students who fall just below the eligibility cut score and do not take college credit-bearing humanities or English courses, students who are eligible for credit-bearing humanities or English CN courses are 1) more likely to enroll in college (7 percentage points more likely); 2) more likely to enroll in a four-year institution (8 percentage points more likely).

Our findings on the likelihood of enrollment in college immediately after graduating high school is in line with earlier descriptive studies on this outcome but does not align with prior causal analyses carried out in other states. For example, while Cowan and Goldharber (2015) find that dual enrollment students are more likely to enroll in college immediately after graduating high school, Speroni's quasi-experimental study (2011) finds no effect of dual enrollment on the same outcome in Florida. It is important to note that the students in this sample were more likely to be Black, Latinx, and low-income then students in prior studies. In the New York City context, this study brings new understanding of the role of dual enrollment in boosting college enrollment levels for students in an urban public school district.

The present study further challenges existing findings of the role of dual enrollment in diverting students from four-year to two-year colleges (An, 2013; Cowan & Goldharber, 2015). While our descriptive breakdown suggests that nearly half of the analytic sample pursue a two-year degree, which corresponds to the descriptive findings of Fink, Jenkins, and Yanagiura (2017), the results of the quasi-experimental analysis shows that, compared to the control group, dual enrollment students were more likely to enroll in a four-year institution than a two-year institution or not enrolling. Our results show that dual enrollment in the New York City context likely impacts student post-secondary outcomes in differential ways when compared to results from studies in other contexts. However, we also find that students who are eligible and enroll in a four-year college are much more likely to enroll in this level of institution if they are not attending CUNY. While this does not suggest that diversionary effects exist, it does suggest that understanding how NYCDOE students make college level enrollment decisions warrants additional study.

Unintended Consequences

Dual enrollment programs provide students with an opportunity to gain exposure to college and earn credits with no cost to the student, which is especially important for low-income and minority students. However, interventions that are "free for all" can exacerbate the already existing gap in opportunities, as compared to a targeted intervention. In Pennsylvania, a study on access and equity of dual enrollment programs was conducted by Museus, Lutovsky, & Colbeck (2007). These researchers surveyed two- and four-year colleges and universities that served students enrolled in a dual enrollment program with their college or university. The survey results revealed disproportionate differences in enrollment rates by race. About 90% of the students were white, while white students make up only 78% of the public secondary school enrollment in Pennsylvania. In the NYCDOE context, White students are also slightly overrepresented in the dual enrollment population (Chelliah, Faiaz, & Symns, 2018).

Other ways in which policy can hinder the equity goal in dual enrollment programs are the limitations set in place for students to participate in the program. Dual enrollment programs that strictly apply an age or grade level minimum, requirements of placement exams, or requirements of achieving a certain score on a standard placement exam to participate, can cause limitations on who can easily access this opportunity (Cassidy, Keating & Young, n.d.). Cassidy

and colleagues conclude that a program can be considered equitable if the opportunity is well known to the students that need it. In NYC, the College Now intervention is accessible to low-income and minority students because of its availability network wide and the relatively low qualifying score. However, take-up rates of CN within schools is not as high as anticipated. Future work should seek to understand the factors impacting CN take-up within schools.

VII. Conclusions

This research commences a series of investigations into the effects of the CN program on enrollment. Future work will focus on whether CN leads to sustained momentum and a higher likelihood of graduation. For example, although descriptive results show that CN college-credit taking students close out the first year with almost two more credits than other college entrants, we do not know if this impact is caused by CN, if it fades over the remaining years, and if CN students are likely to graduate sooner. More of the trends from descriptive studies need to be analyzed using causal inference. Further work will also study momentum outcomes such as persistence and meeting gateway course requirements sooner. While we have some prior evidence of the effects of dual enrollment on third-semester persistence (Allen & Dadgar, 2012), little is known about the effects on meeting gateway requirements and the impact on college completion.

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Table 1: Summary Statistics of the Data

	All seniors in NYC public schools (2016 Graduation)	Restricted sample - Maximum English Exam score between 65 and 85	Analytic sample - Maximum English Exam score between 69 and 81
	(1)	**(2)**	**(3)**
Female	0.49	0.49	0.48
Black	0.29	0.31	0.31
Hispanic	0.39	0.41	0.43
Asian	0.17	0.15	0.14
Native Americans	0.01	0.00	0.00
Multiracial	0.00	0.00	0.00
English Native Speaker	0.55	0.54	0.54
Spanish Native Speaker	0.25	0.27	0.28
Other Native Language	0.20	0.19	0.18
Below Poverty Level	23.18	23.65	23.89
U.S. Born	0.75	0.74	0.74
College Now	0.22	0.23	0.22
College Now - College Credit	0.95	0.97	0.97
College Enrollment	0.63	0.70	0.71
College Enrollment - Two Year	0.28	0.42	0.45
College	0.34	0.28	0.26

Enrollment - Four-year			
Enrolled in CUNY	0.39	0.50	0.52
Enrolled in SUNY	0.10	0.10	0.10
Enrolled NYS Private College	0.08	0.07	0.07
Enrolled Out-of-state Private College	0.06	0.04	0.04
GPA - 10th grade	77.59	77.22	76.88
GPA - 11th grade	78.24	77.78	77.46
GPA - 12th grade	78.24	77.78	77.46

Sources: CUNY's College Now Database for College Now course enrollment; CUNY's Institutional Research Database (IRDB) for CUNY postsecondary enrollment and performance data; the NYCDOE data for background characteristics and secondary academic performance; the American Community Survey for median household income based on census tracts; and the National Student Clearinghouse (NSC) for non-CUNY post-secondary enrollments.

Table 2: Test for Baseline Equivalence on Either Side of the NYS English Regents Exam Score of 75 for the NYC Cohort of 2016

	+/- 3pts	+/- 5pts	+/- 10pts
	(1)	**(2)**	**(3)**
Female	0.0007	-0.0002	0.0053
	(0.0103)	(0.0082)	(0.0071)
Black	-0.0154	-0.0247	-0.0546***
	(0.0201)	(0.0179)	(0.0158)
Hispanic	-0.0189	-0.0188	-0.0274*
	(0.0211)	(0.0179)	(0.0149)
Asian	0.0264	0.0283	0.0187
	(0.0217)	(0.0187)	(0.0162)
Native	-0.1042	-0.1108*	-0.0456
	(0.0785)	(0.058)	(0.0417)
Multiracial	0.1037	-0.0335	-0.0228
	(0.1104)	(0.0967)	(0.0553)
Spanish Native Speaker	-0.0068	-0.0084	-0.0207**
	(0.0151)	(0.0136)	(0.0103)
Other Native Speaker	-0.041*	-0.0366*	-0.0416***
	(0.0218)	(0.0197)	(0.0150)
U.S. Born	0.0342**	0.0363***	0.0771***
	(0.0139)	(0.0109)	(0.0093)
Below Poverty Level	-0.0004	-0.0006	-0.0013***
	(0.0004)	(0.0004)	(0.0003)
College Now Student	0.0152	0.0308**	0.0515***
	(0.0132)	(0.0127)	(0.0123)
12th Grade GPA	0.0051***	0.0072***	0.0123***
	(0.0006)	(0.0005)	(0.0005)
Enrolled in College	0.0157	0.0696*	0.1556***
	(0.0467)	(0.0407)	(0.0347)
CUNY	0.0673	0.0170	-0.0508
	(0.0444)	(0.0388)	(0.0329)
SUNY	0.0667	0.0336	-0.0096
	(0.0446)	(0.0388)	(0.0333)

Out-of-State College	0.0582	0.0268	-0.0077
	(0.0520)	(0.0427)	(0.0343)
NYS Private College	0.0931**	0.0545	-0.0094
	(0.0475)	(0.0412)	(0.0341)
Constant	0.2490***	0.0243	-0.4279***
	(0.0553)	(0.0462)	(0.0414)
Observations	8,859	14,003	26,502
R^2	0.0276	0.0432	0.1171
Adjusted R^2	0.0257	0.042	0.1166
Residual Std. Error	0.4495	0.467	0.4578
F Statistic	14.7582***	37.1254***	206.6829***

Sources: CUNY's College Now Database for College Now course enrollment; CUNY's Institutional Research Database (IRDB) for CUNY postsecondary enrollment and performance data; the NYCDOE data for background characteristics and secondary academic performance; the American Community Survey for median household income based on census tracts; and the National Student Clearinghouse (NSC) for non-CUNY post-secondary enrollments.

*Notes: Robust standard errors in parentheses ; ***p<0.01, ** p<0.05, * p<0.1*

Table 3: The Effect of Eligibility for College Now on College Enrollment for the 2016 NYC Cohort

	Enrolled in College	RD – IV	Enrolled in Four-year College	Enrolled in NYS Private College	Enrolled Of-state C
Estimate without controls	0.0881***	0.2259***	0.1096***	0.0049	-0.0179*
	(0.012)	(0.0734)	(0.019)	(0.0063)	(-0.0098)
Observations	45,578	9,828	45,578	45,147	45,147
Estimate with controls	0.0706***	0.2045**	0.0860***	-0.0006	-0.0228**
	(0.0113)	(0.0948)	(0.0105)	(-0.0054)	(-0.009)
Observations	45,578	9,828	45,578	45,147	45,147

Sources: CUNY's College Now Database for College Now course enrollment; CUNY's Institutional Research Database (IRDB) for CUNY postsecondary enrollment and performance data; the NYCDOE data for background characteristics and secondary academic performance; the American Community Survey for median household income based on census tracts; and the National Student Clearinghouse (NSC) for non-CUNY post-secondary enrollments.
Notes: All regressions with controls include the following variables: distance from the threshold, interaction of distance and above threshold (a dummy variable for whether the student is above the specified threshold of 75), demographics, academic performance in senior year, poverty indicator. Robust standard errors in parentheses ; ***p<0.01, ** p<0.05, * p<0.1

Table 4: The Effect of Eligibility for College Now on Non- CUNY College Enrollment for the 2016 NYC Cohort

	Enrolled in College	RD – IV	Enrolled in Four-year College	Enrolled in NYS Private College	Enrolled of-state College
Estimate without controls	0.0916***	0.5276***	0.1384***	0.0378***	0.0029
	(0.0136)	(0.0789)	(0.0180)	25,034	4,034
Observations					
Estimate with controls	0.0713***	0.4472***	0.1070***	-0.0197**	0.0027
	(0.0107)	(0.0860)	(0.0103)	(0.0082)	(0.0026)
Observations	25,034	4,034	25,034	24,603	24,603

Sources: CUNY's College Now Database for College Now course enrollment; CUNY's Institutional Research Database (IRDB) for CUNY postsecondary enrollment and performance data; the NYCDOE data for background characteristics and secondary academic performance; the American Community Survey for median household income based on census tracts; and the National Student Clearinghouse (NSC) for non-CUNY post-secondary enrollments.
*Notes: All regressions with controls include the following variables: distance from the threshold, interaction of distance and above threshold (a dummy variable for whether the student is above the specified threshold of 75), demographics, academic performance in senior year, poverty indicator. Robust standard errors in parentheses ; ***p<0.01, ** p<0.05, * p<0.1*

Table 5: The Effect of Eligibility for College Now on College Enrollment for the 2016 NYC Cohort using Different Bandwidths

	Bandwidths around Regents Exam score of 75					
	+/-10	+/-9	+/-8	+/-7	+/-6	+/-5
	(1)	(2)	(3)	(4)	(5)	(6)
Eligibility	0.0563***	0.0659***	0.0624***	0.0685***	0.0757***	0.0937***
	-0.0134	-0.0127	-0.0151	-0.0133	-0.0179	-0.0143
Constant	0.625***	0.609***	0.615***	0.610***	0.605***	0.587***
	-0.0156	-0.0143	-0.0165	-0.0134	-0.0211	-0.0163
Observations	29,415	24,745	23,236	21,132	15,494	13,157
R-squared	0.072	0.061	0.058	0.054	0.046	0.042

Sources: CUNY's College Now Database for College Now course enrollment; CUNY's Institutional Research Database (IRDB) for CUNY postsecondary enrollment and performance data; the NYCDOE data for background characteristics and secondary academic performance; the American Community Survey for median household income based on census tracts; and the National Student Clearinghouse (NSC) for non-CUNY post-secondary enrollments.
*Notes: All regressions with controls include the following variables: distance from the threshold, interaction of distance and above threshold (a dummy variable for whether the student is above the specified threshold of 75), demographics, academic performance in senior year, poverty indicator. Robust standard errors in parentheses ; ***p<0.01, ** p<0.05, * p<0.1*
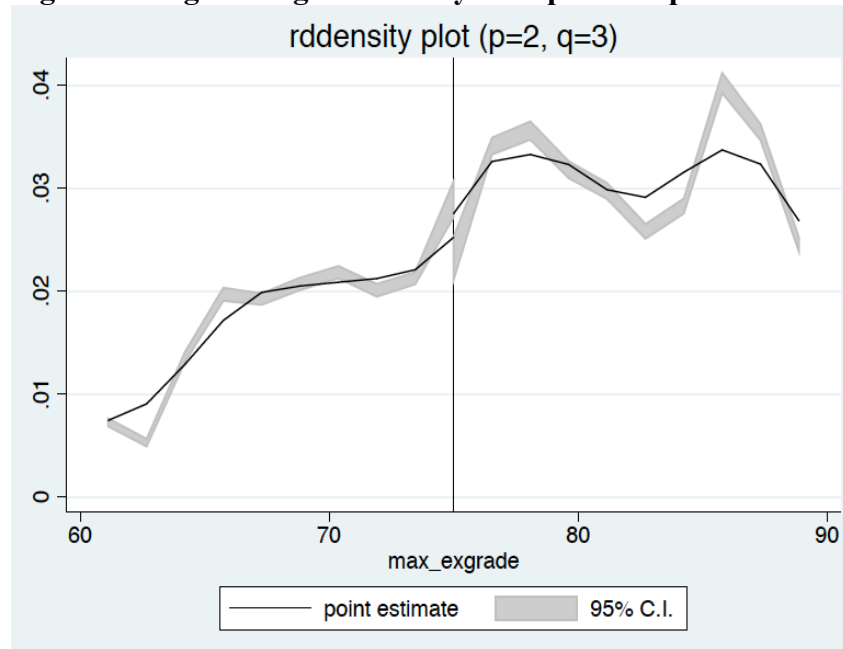
Figure 1: Relationship between English Regents exam score and college enrollment fitted by a fourth order polynomial on either side
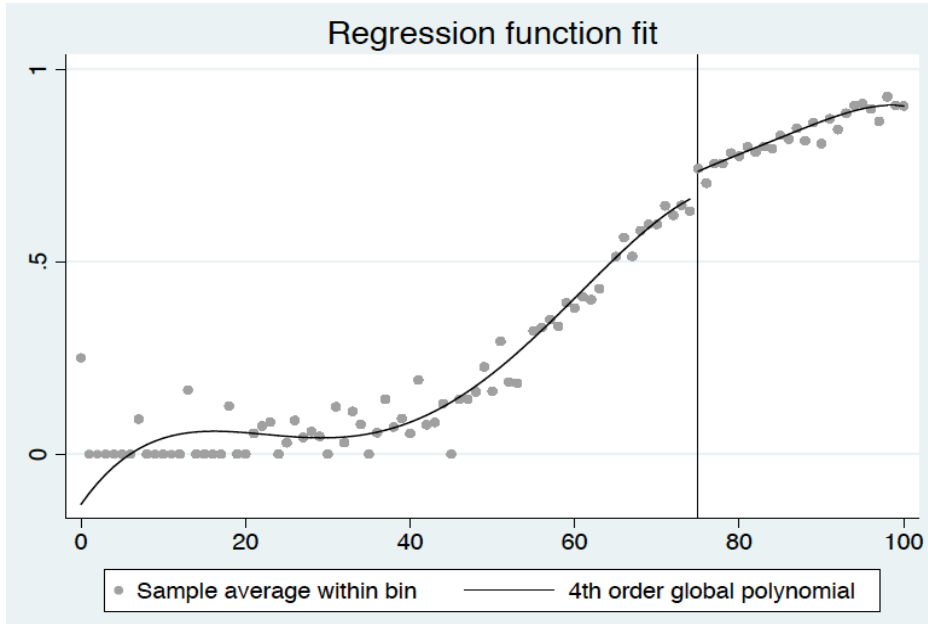
Figure 2: Histogram of English Regents exam scores from January 2015 to January 2016
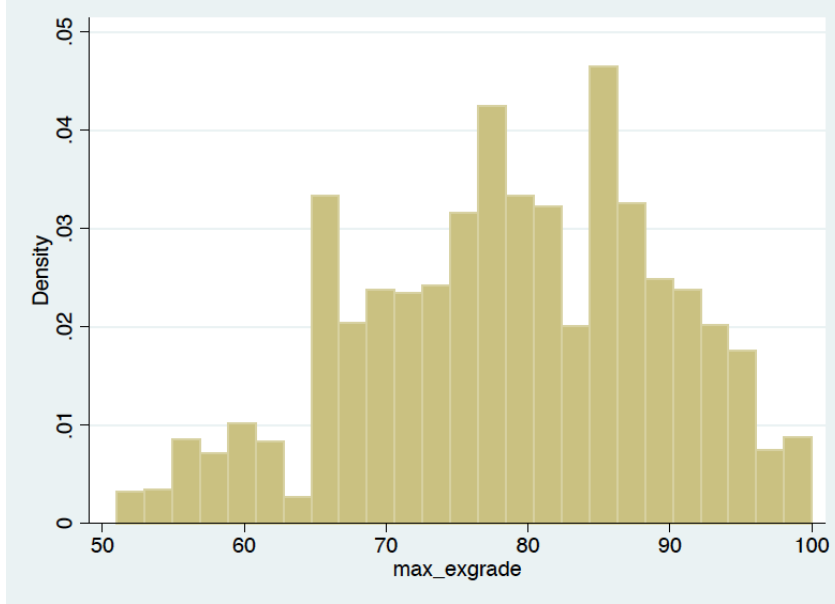
Figure 3: English Regents density manipulation plot

Figure 4: Relationship between English Regents exam score and cumulative credits earned after first year of college at CUNY fitted by a fourth order polynomial on either side