The Impact of Academic Probation: Do Intensive Interventions Help?

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Academic probation policies place restrictions on low-performing college students, incentivizing them to improve their performance or leave the program. We examine the effect of an intensive academic probation policy that includes mandatory study time. Using a regression discontinuity analysis and administrative data from the U.S. Air Force Academy, we find that placement on academic probation increases performance without increasing attrition and increases completion of STEM degrees. These impacts are surprising in light of research showing increased attrition and shifts towards easier courseloads at other institutions, suggesting that more intensive interventions may help low-performing college students without discouraging program completion.

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I. Introduction

College education is associated with higher wages and lifetime earnings for those who graduate. Despite some improvements in the college completion rates over the past decade, only about 60 percent of students entering college complete a degree within six years (Shapiro et al. 2019). Low completion rates raise the concern of an unequal distribution of the benefits of college education and the possibility of heavy student loan debt. Although many factors inevitably play a role in students' decisions whether or not to persist in their programs, a prominent explanation is that students are influenced by information about their academic abilities learned through their academic performance in early college courses (Stinebrickner and Stinebrickner 2012).

Many universities have responded to students at risk of academic failure through academic probation policies. These policies generally notify students falling below a threshold grade point average (GPA) or meeting other criteria for deficiency that they will be recommended for suspension or disenrollment if they do not correct their academic deficiencies. These policies may be intended to incentivize deficient students to work harder or to find the appropriate resources in order to improve their grades, thus avoiding disenrollment. They may also be intended to speed the process of students and universities learning about student academic abilities by laying out a clear path to disenrollment for students who do not improve their performance.

The motivations of probation policies lead the causal effect of these policies on students' academic trajectories to be theoretically ambiguous. The threat of dismissal may cause students to expend more effort studying and improve their study skills, leading to stronger academic performance and increased probability of degree completion. In contrast, the negative signal may discourage students, causing lower academic performance, increased attrition, or strategic

changes to the course of study to improve grades without real academic improvement (as in Arcidiacono, Aucejo, and Spenner 2012).

This paper uses a regression discontinuity (RD) framework to estimate the effects of academic probation on academic outcomes for students at the U.S. Air Force Academy (USAFA). Students who earn a GPA below 2.0 at the end of the semester or earn a failing grade in a class are placed on academic probation the following semester, so that there is a discontinuous change in the probability of probation as GPA crosses the 2.0 threshold. As long as GPA cannot be controlled precisely, we can infer the impact of probation on subsequent academic trajectories by comparing students who earn just below versus just above a 2.0 GPA at the end of a semester.

The USAFA is particularly interesting because its academic probation requirements reflect a substantial intervention. At other universities studied in the literature, probation primarily represents the formal threat of suspension and/or disenrollment, for example in Lindo, Sanders, and Oreopoulous (2010). USAFA students on probation must detail their plan for improvement, attend mandatory study hours, and adhere to additional restrictions on their ability to leave campus. Despite the substantially different probation policy, students have the same choices about academic trajectories as at other universities. At the end of the first semester, the focus of our analysis, USAFA students are in the process of selecting an academic major, and many students with low academic performance choose to leave the program.

We estimate that academic probation at the USAFA impacts academic trajectories much differently than analogous programs studied at other universities. Probation significantly increases GPA in the subsequent semester but does not affect attrition at any point in students' academic careers. Furthermore, we estimate that placement on academic probation actually increases the likelihood of graduating with a major in a science, technology, engineering, and

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mathematics (STEM) field. Although other studies have found increases in grades following placement on probation, these increases are often associated with higher attrition or selection into easier classes.

The impacts of academic probation at the USAFA highlight the potential benefits of intensive intervention for marginal students. Probation's additional requirements and threat of dismissal have the potential to deter students from completing college or incentivize a less rigorous academic path, decisions that are likely to reduce lifetime earnings. The fact that we observe probation *increases* the likelihood of completing a more rigorous STEM major suggests that probation policies have the potential to incentivize effort without strategic behavior to decrease rigor. The results suggest that probation has a role beyond encouraging a faster disenrollment decision, instead encouraging marginal students to improve performance.

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II. Background

The first paper to rigorously analyze the effects of academic probation on student academic performance is Lindo, Sanders, and Oreopoulous (2010). Applying RD methods to data on a sample of students from a large Canadian university, they found that academic probation increased attrition, but GPAs for remaining students increased by about 0.233. Although the increase in academic performance could be explained in part by the composition of students who chose to remain, they showed that the increased performance cannot be explained by selection alone. Interestingly, they found no change in probability of graduation, suggesting academic probation did not cause any permanent improvement in student performance. The authors followed a model of Benabou and Tirole (2000) to argue that the increased "performance

standards" associated with probation have both a discouragement effect that increases attrition and an encouragement effect that increases performance of remaining students.

Subsequent studies on academic probation policies have drawn similar conclusions. Probation at four Texas universities led to increased academic performance in the following semester but also higher rates of attrition and fading long-term effects (Fletcher and Tokmouline 2017). A difference-in-difference approach exploiting a 1993 implementation of academic dismissal in Dutch universities revealed that dismissal increased both first-year dropouts and four-year completion rate (Arnold 2015) while also decreasing student satisfaction and perceptions of program feasibility (Sneyers and Witte 2017). Additional RD evidence has indicated that non-minority students at a large U.S. public university responded to probation by taking fewer and easier courses (Casey et al. 2018), with similar behavior in course and major selection at a large Jamaican public university (Wright 2020). The consistent findings that academic probation policies improve academics in the short term but also increase attrition or induce shifts to easier courses raise a concern that these policies may be causing unintended consequences such as exacerbating low college completion rates. Furthermore, Ost, Pan, and Webber (2018) used an RD design to show that placement on academic probation lowers post-college earnings of students on the probation margin, challenging the idea that probation-induced dropouts reflect a beneficial correction to individuals' careers.

A separate strand of literature examines the impact of college remediation programs. These programs typically provide additional coursework or other academic services to students entering college without the preparation believed to be necessary for success. The intensive intervention mandated by the USAFA's academic probation policy is similar in many respects to these remediation programs, with the distinguishing feature that the probation intervention is mandated

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after a demonstrated failure in college rather than upon arrival on campus. Bettinger and Long (2009) used variation in college proximity to estimate that remediation programs in Ohio public universities increase college completion rates. Martorell and McFarlin (2011) cast doubt on Bettinger and Long's distance-based instrument and exploited a discontinuity to estimate that remediation had no impact on academic or labor market outcomes of marginal students in Texas public universities. Although the varied findings on remediation may be due to methodological differences, the intensity of the remediation programs may also play an important role. For example, Dobronyi, Oreopoulos, and Petronijevic (2019) found that "nudging" students to study more was ineffective but suggest that more comprehensive (and expensive) programs might be effective.

This paper analyzes the effect of academic probation at the USAFA. Although academic probation has been studied in other academic contexts, its application at the USAFA is particularly interesting for several reasons. Conditions for placement on academic probation are similar to what is seen at other universities, and although probation does have a punitive element, it is also an intensive intervention aimed at supporting under-performing students in much the same way that remediation programs are designed. Unlike many remediation programs, however, academic probation does not extend the college curriculum and therefore may avoid the delayed graduation associated with remediation programs (Martorell and McFarlin 2011). Various institutional characteristics also help to allay concerns about the applicability of the RD method, which we adopt similarly to much of the related literature.

The USAFA's conditions for academic probation are similar to what one might expect at other colleges and universities. Students are placed on academic probation if either semester or cumulative GPA falls below 2.0 (on a 4.0 scale) in any semester, or if they earn an 'F' or a

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Controllable Incomplete 'IC' in any class (including physical education). Students are also placed on probation after their fourth semester if their GPA in core classes falls below 2.0, and fourth-year students are placed on probation if their GPA in courses for their major falls below 2.0. Academic probation is most common in the first three semesters and is quite rare for third or fourth-year students. Students on probation must correct their deficiencies to return to good academic standing and risk disenrollment if they fail to do so.[i]

Academic probation at the USAFA is a more substantive treatment than what is found at other institutions studied in the literature. Similar to other institutions, academic probation is a step towards disenrollment and is presented to students as such.[ii] However, USAFA students on academic probation are also required to complete numerous steps to avoid further disciplinary action.[iii] Students on academic probation must submit a formal document outlining their plan to improve their grades, described as an "Academic Get Well Plan." Students must explain in writing the causes for their deficiencies and write actionable plans for improvement. Academic advisers must approve the plans for the form to be considered complete, and in the process the adviser generally provides guidance and referrals to campus agencies tailored to the student's difficulties. Additionally, commitments made in this plan such as seeking additional help in office hours are monitored and recorded. Furthermore, students on academic probation are required to attend supervised weekend study times, with a mandatory minimum weekly study time based on the severity of grade deficiency.[iv] Finally, students wishing to leave campus on non-class days require the permission of an Air Force officer with training in leadership and counseling formally in charge of a group of students who may elect to forbid passes for students not sufficiently addressing their academic deficiency. Because academic probation at the USAFA combines additional scrutiny, referrals, monitoring, and academic incentives, it may be

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more effective in encouraging academic improvement than what has been previously shown in the literature.

USAFA students are very unlikely to have precise control over their first semester GPA, the key determinant of academic probation as used in this study. First, students have less control over their courses, sections, and instructors than what is common at other institutions. Graduation requirements include 101 credit hours of "core" classes which all students must take. First-year students are enrolled almost exclusively in their core requirements and have little control over their academic schedule; a typical student will spend their first two semesters enrolled in Introduction to Behavioral Science, General Chemistry I, General Chemistry II, Introduction to Computing and Cyber Operations, Introductory Composition and Research, History of Modern Warfare, Calculus I, Calculus II, General Physics I, and two semesters of foreign language. Although students have some control, for example, over the foreign language they study, they cannot add elective courses or postpone core classes assigned to them. Students who receive "validation" credit for one or more of these courses are typically placed in mandatory courses otherwise taken in the second year, but again students have limited control over these courses. It is also worth noting that each core class is offered in multiple sections with several instructors, and that students cannot choose either the section time or instructor for their courses. The Registrar's office applies a scheduling algorithm to assign students to classes and sections in order to meet various constraints, and students cannot change their class times or instructors after they are assigned. Accordingly, students have very little ability to adjust the "difficulty" of their courses even if they had the ability to accurately forecast their end-of-semester grades. STEM courses are arguably the most challenging for students: there are five required courses frequently taken in the first year with more than a two percent failure rate and they are all STEM courses.[v]

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Despite some notable distinguishing characteristics, the USAFA's student body and academic curriculum is similar in many respects to other selective liberal arts colleges (USAFA 2015). Students complete a fully accredited academic program with 31 majors, and all graduates earn a Bachelor's of Science degree along with a commission in the United States Air Force. The average SAT math and verbal scores are 672 and 642, respectively, and the admission rate is 13 percent. Despite a regimented daily schedule, typical students have eight to nine hours of each weekday set aside for academics, so that they are free to complete academic work on their own schedule when they are not attending mandatory classes. All students attend and receive room and board at no monetary cost, instead performing military service after completion. Burton et al. (2007) found no statistical difference in the behavior of students at the USAFA and at Queens University in Belfast in an experimental study. Perhaps the larger challenge in generalizing research on academic probation is the heterogeneity of procedures across institutions more broadly. In combination with previous research, the uniquely substantive probation program at the USAFA offers insights into how this heterogeneity affects the impacts of probation.

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III. Data

Our study relies on administrative records provided by the USAFA's Registrar's Office, the Institutional Research and Assessment Division, and the Department of Mathematical Sciences. Our dataset includes observations from all students attending the USAFA during academic semesters fall 2000 through fall 2017 who were admitted as part of cohorts expected to graduate from 2004 to 2020. We observe all final grades earned in every course taken, as well as rich demographic and background information. Background variables used include gender, race (nonwhite or white), as well as the "academic composite," an index of high school GPA and standardized test scores that is used in the admissions process. Finally, we observe students'

responses to a survey about their intention to pursue a STEM major, which may influence their math course placement.

We focus on the treatment of academic probation beginning at the start of the second semester due to final grades earned during the first semester. This is done for several reasons. First, students are more likely to experience academic probation during their first three semesters (see Table 1). Second, first-semester students have the least control over their academic schedule, as they are automatically assigned to a set of "core" classes that can be altered only in extenuating circumstances. Third, probation based on first-semester (fall) grades takes effect at the start of a normal (spring) academic semester, whereas probation based on spring course performance may take effect during summer courses. Fourth, students face important academic decisions early in their academic careers: they must choose an academic major no later than the first half of their third semester, and they are permitted to disenroll from USAFA without penalty or military service commitment during their first two years. Finally, academic probation following first semester is also the simplest to analyze because these students are not subject to more complex rules about different GPA measures (core vs. major vs. overall) and because cumulative and semester GPAs are identical for most students.[vi] Focusing on probation following first semester grades also enables us to abstract from differential treatment effects for those on repeated spells of academic probation.

We make several additional restrictions on the dataset. Because the focus of this paper is the effect of academic probation, we exclude 581 students (2.8 percent) who withdrew before earning final grades for their first semester. Those excluded are students withdrawing during the first academic semester and before final exams or during basic military training during the summer of their arrival. Most specifications additionally restrict the sample to students staying at

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least two full semesters so that second-semester GPA can be observed. We also exclude summer terms from the sample because not all students participate and those that do typically take a single course. Therefore, for typical students graduating from the USAFA our sample will include observations over eight semesters which we will call 'Semester 1' - 'Semester 8' (Fall and Spring semesters in each of four years). We also exclude a small number of students with irregular course histories, including gaps of one or more semesters not explained by attrition. After these restrictions we have 19,712 students with reported final grades for the first semester, 18,853 of whom also earned final grades for the second semester. Analysis of graduation outcomes is limited to the 16,279 students in cohorts entering four years before the end of our dataset in fall 2017.[vii]. We observe 2,294 students (11.6 percent) on academic probation due to their first semester grades. Although students can be placed on academic probation without earning a semester GPA below 2.0 by failing individual courses, a GPA falling below the cutoff is highly predictive of academic probation status (see Figure 1).

Table 2 compares background characteristics and outcomes by academic probation status (based on first semester grades). Female and non-white students were more likely to be on probation, as were students with lower academic preparation as measured by the academic composite score. Consistent with the criteria for probation, students on probation had substantially lower first-semester GPAs on average, 1.66 compared to the overall mean of 2.82, and about half failed a course. Students on probation after the first semester continued to perform worse on average than their peers. They had lower GPAs in the second semester, although the gap with students not on probation narrowed. A greater proportion of students on probation attrited in the second semester, 11.6 percent compared to the overall average of 4.3 percent, and only about half graduated in four years.

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IV. Methods

This paper estimates the causal effects of academic probation using an RD design. This approach follows analyses of other academic probation policies (Lindo, Sanders, and Oreopoulous 2010; Fletcher and Tokmouline 2017; Casey et al. 2018; Ost, Pan, and Webber 2018; and Wright 2020) and many other policies throughout the economics literature. RD compares outcomes for students with first-semester GPA just above and just below the 2.0 threshold below which students are placed on probation. The approach posits that, conditional on first-semester GPA, the populations of students just above vs. just below the 2.0 GPA cutoff differ only in their academic probation treatment status. Unlike the non-experimental comparison of all students on probation versus all students not on probation as in Table 2, focusing on a sufficiently narrow range of GPAs around the cutoff avoids the underlying differences between the two groups being compared. Specifically, by estimating different relationships between first-semester GPA and subsequent outcomes on each side of the GPA cutoff, we attribute any discontinuity in outcomes at the cutoff to the difference in academic probation status.

A key assumption to the RD approach is that students have at best imprecise control over their first-semester GPA. Students can undoubtedly influence their GPA through the level of effort exerted in coursework and may also be motivated to adjust their studying to reduce the chances of academic probation. However, if students have precise knowledge and control over their GPA during the semester then the students just above vs. just below the 2.0 GPA cutoff may differ systematically in other ways. For example, perhaps students estimating their GPAs at 1.95 would exert additional effort to avoid academic probation compared to students estimating their GPAs at 2.05. We do not believe this strategic behavior is possible at the USAFA. First, students are unlikely to know their GPA before each semester ends because first-year courses generally

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conclude with final exams which are administered over a five-day period and must determine at least 25 percent of each course grade. Predicting performance on all exams and adjusting effort with sufficient precision is likely impossible. A related concern is that students might negotiate with specific instructors for an opportunity to improve a course grade after learning they are marginally destined for probation, leading to manipulation similar to that documented by Jepsen, Mueser, and Troske (2016). This is unlikely, however, as grades are submitted simultaneously across courses, and professors rarely go through the procedure for changing grades after submission. Our identifying assumption is not strictly testable, but we provide some supporting evidence both by demonstrating continuity of first-semester GPA (the forcing variable) as well as placebo tests to show that academic probation status is not predictive of previously determined characteristics.

A second analytic issue is incomplete compliance: being above or below 2.0 GPA is not perfectly predictive of academic probation status. Students are placed on academic probation when they fail a course regardless of their end-of-semester GPA, so it is possible for students to fall above the GPA cutoff but still be on probation the following semester. The comparison of outcomes of students just above versus just below the 2.0 GPA cutoff effectively dilutes the estimated effect of probation because students who failed a course are unaffected by the GPA cutoff. Accordingly, our analysis scales up the estimated impact by treating the 2.0 cutoff as a 'fuzzy' rather than a 'sharp' discontinuity. The fuzzy RD estimates the effect of falling below the 2.0 cutoff on later academic outcomes and then attributes the observed effect to the fraction of marginal students whose probation status would be affected by the GPA. In other words, the fuzzy RD estimates the impact of probation for students who were near the 2.0 GPA cutoff but did not fail a course.

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In the fuzzy RD, we must first establish that earning a GPA below 2.0 is indeed predictive of academic probation. This is accomplished most simply using a linear probability model regression of the form:

(1) $AcPro_i = \beta_0 + \beta_1 I(GPA < 2.0) + \beta_2 GPA_i + \epsilon_i$.

In Equation 1, the dependent variable is $AcPro_i$, an indicator variable equal to 1 if student *i* is placed on academic probation based on grades at the end of the first semester. Independent variables include an indicator for the student's first-semester GPA being below 2.0 as well as the GPA itself. However, it is not clear whether Equation 1should be estimated over all observations or over a narrower range of the forcing variable, GPA. For this reason, estimates reported throughout are calculated using local linear regressions on each side of the threshold with mean squared error optimal bandwidths (as in Calonico, Cattaneo, and Titiniuk 2014) and triangular kernel weights, although we will refer to the single linear equation for ease of exposition.

If having a GPA below 2.0 is indeed predictive of academic probation, then the effects of academic probation can be estimated via fuzzy RD design with a regression of the form:

(2) $Y_i = \beta_0 + \beta_1 \widehat{AcPro}_i + \beta_2 GPA_i + \epsilon_i$,

where Y_i is an outcome of interest and $\widehat{AcPro}_i$ is estimated as in Equation 1. Using local linear estimations analogous to this equation on each side of the threshold, we estimate the effect of academic probation due to having first semester grades below the 2.0 cutoff on the GPAs observed in subsequent semesters. Once again, we use mean squared error optimal bandwidths and triangular kernel weights. We use the same framework to analyze effects on attrition, graduation, and major completion.

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V. Results

We begin by showing that the administrative data are consistent with the probation policy, and a variety of tests support our identifying assumption. We then turn to our main results, where we show that probation based on first-semester grades increases second-semester grades and that it increases the likelihood of STEM degree completion. We also explore possible mechanisms for these effects and differences in impacts across groups.

A. GPA and Probation

The distribution of first-semester GPA and probation status is consistent with the probation policy. A simple histogram (Figure 1) shows a wide range of first-semester GPAs with approximately 11 percent of students falling below 2.0. Nearly all students with GPAs below 2.0 are indeed placed on academic probation, although there are 20 students (0.1 percent of the sample) who were not recorded as being on probation despite having a GPA below 2.0. Strictly speaking this is inconsistent with the written probation policy, and we suspect that grade changes not reflected in our data most likely explain the discrepancy. However, 202 students (1.0 percent of the sample) were recorded as being on probation despite have a GPA of 2.0 or higher. Consistent with their placement on probation, the majority of these students had a failing grade in one or more classes, but we cannot explain why 20 of these students were on probation despite not have a failing grade. Although we cannot explain the probation status for 40 students in our dataset (0.2 percent of the sample), the fact that equal numbers were inconsistently recorded as being on probation and not being on probation supports the view that they are idiosyncratic rather than a systematic attempt at manipulating probation status.

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B. Identifying Assumption

Our identification rests on the assumption that students have little control over their semester GPA around the cutoff. Figure 1 provides some visual evidence of this assumption: the distribution appears to vary smoothly around the 2.0 GPA cutoff, whereas a precise effort by marginal students to avoid probation would have resulted in a sharply higher density just above the cutoff compared to just below. We examine potential manipulation of GPA more formally in Figure 2, which uses local quadratic approximations for the density around the 2.0 GPA cutoff (Cattaneo, Jannson, and Ma 2018). We do not detect any discontinuity at the cutoff, as the density to the right of the 2.0 GPA cutoff falls within the 95 percent confidence interval of the density found to the left of the 2.0 cutoff (Cattaneo, Jansson, and Ma 2020).

Falsification tests further support the assumption of imprecise control over GPA. To the extent that certain types of students are better able to adjust their effort or otherwise precisely manipulate their GPA near the cutoff, we would expect to see different types of students with GPAs just above versus just below the 2.0 cutoff. Table 3 shows estimates analogous to Equation 2 using predetermined exogenous characteristics as the outcomes. As expected, academic probation status is not predictive of race or gender. We also find that academic probation is not predictive of students' high school preparation (as summarized in the academic composite) or their attendance at the Air Force Academy Preparatory School, a preparation program that occurs before matriculation as a student at the USAFA.

One falsification test raises some concerns, but further investigation supports our identifying assumption. Recruited athletes are slightly less likely to fall just below the 2.0 GPA cutoff, although this difference is only significant at the 10 percent level. Although this difference could be caused by random chance, it may raise the concern that athletes are treated differently with

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respect to academic probation. However, we find evidence supporting an alternative explanation, that apparent discontinuities in the GPA distribution are driven by the discreteness of the distribution introduced by the GPA calculation. GPA is an average of grade points (4.0 for 'A' grades, 3.0 for 'B' grades, etc.) weighted by the credit hours for each class. 74 percent of first-semester students take a standard course load of 15.5 graded credit hours, but special circumstances - including but not limited to accommodations for athletic practice time - may result in a different number of credit hours. Students with different numbers of credit hours also have a different set of discrete values that GPA could take on, possibly leading to apparent differences in the types of students on each side of the 2.0 cutoff. Indeed, restricting the sample to the 74 percent of students who have the standard 15.5-credit hour course load in their first semester eliminates the significant relationship with athletes but does not change the overall pattern of results that follow.[viii] We conclude that there is little evidence that academic probation is nonrandom for students with first-semester GPA near the probation cutoff, and so subsequent results use the full sample of students.

C. Main Results

The first-stage results are consistent with the academic probation policy. Column 1 of Table 4 estimates a local linear regression analogous to Equation 1 and shows that students just below the 2.0 GPA threshold are 84.6 percentage points more likely to be placed on academic probation than those with GPA just over 2.0.[ix] This relationship is shown visually in Figure 3, which is consistent with the probation policy: nearly all students below the 2.0 GPA cutoff are recorded as being on probation, but some students just above the 2.0 GPA cutoff are still on probation due to failing a course. Note that the same pattern is also visible in Figure 1. The size of the

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discontinuity reflects that the 2.0 GPA threshold is the binding constraint for placement on academic probation for most students near the cutoff.

Probation increases subsequent grades in the short term. Column 2 of Table 4 estimates a local linear regression analogous to Equation 2 and shows that placement on academic probation at the end of the first semester increases GPA in the second semester by 0.12, an effect significant at the 1 percent level. Figure 4 shows the identifying discontinuity graphically: as first-semester GPA falls below the 2.0 cutoff, the second-semester GPA increases discontinuously. The fuzzy RD attributes this discontinuous increase to the 84.6 percentage point increase in the likelihood of academic probation upon dropping below the 2.0 GPA cutoff. This GPA effect is 0.19 standard deviations, which is comparable to the impact in Lindo, Sanders, and Oreopoulos (2010) and is enough to remove at least one quarter of students from academic probation in the following semester assuming an otherwise flat GPA trajectory. However, the treatment effect on grades fades quickly: academic probation based on first-semester grades is associated with approximately zero change in GPA for semesters 3-8 (see Figure 5). Despite the significant one semester increase in GPA, there is no effect of academic probation on cumulative GPA at graduation (see Column 3 and the top panel of Figure 6).

We find no impact of academic probation on attrition. Column 4 of Table 4 estimates a local linear regression analogous to Equation 2 with attrition during the second semester as the dependent variable. We do not detect any significant effect of probation on attrition during the second semester, although the point estimate suggests a slight decrease in disenrollment following probation. Similar results appear in the middle panel of Figure 6. That slight negative coefficient means that our observed positive effect of academic probation on GPA cannot be attributed to probation encouraging disenrollment among weaker students on the probation

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margin. In fact, probation does not affect attrition during any subsequent semester (Figure 7), nor does it affect the probability of graduation in four years (Column 5 of Table 4 and bottom panel of Figure 6), and all point estimates are consistent with probation encouraging program completion. The lack of attrition effect is notable considering that other probation policies have been found to improve academic performance at the cost of discouraging program completion. This result might reflect the intensive intervention that provides resources to struggling students despite the fact that it is also a punitive measure.

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D. Mechanisms for the Effect of Academic Probation

Probation has the potential to induce strategic decisions in course selection. For instance, students might adjust their course enrollments or academic major in part based on the perceived difficulty of each option or their perceived ability to succeed in a given course of study, as Arcidiacono, Aucejo, and Spenner (2012) found with a group of disadvantaged students. A similar effect of probation on the subsequent area of study would reflect a long-term impact on students despite the above finding that effects on grades are limited to one semester. To test this hypothesis, we estimate the effect of academic probation on graduating with a STEM major.[x] Results in Table 5 show that academic probation following first semester grades increases the probability of graduating with a STEM major by 6.9 percentage points, with a corresponding but statistically insignificant decrease in selection of a social science major.[xi] Figure 8 shows these estimates graphically.

The effect of academic probation on major choice could operate through two channels. Probation could have a direct impact on students' choice of major, or it could deferentially reduce the likelihood of attrition for students who intended to study a STEM field compared to a non-STEM field. The attrition mechanism is difficult to test due to the endogeneity of major choice, but we

do not find evidence that probation affects attrition for students who indicated that they "definitely plan to pursue" or "will most likely pursue" a STEM major in a pre-college survey.[xii] We hypothesize that a direct impact of probation on major choice would operate through second semester classes, as students must declare their major during or shortly after the second semester. Accordingly, Table 6 tests this mechanism in two ways. First, we estimate the effect of probation on second semester GPA calculated for STEM classes (Column 1) and non-STEM classes (Column 2). We find notably larger impacts on the STEM GPA, perhaps because the study skills developed through the probation program or the associated higher grades increased students' confidence in pursuing majors that are perceived as being more rigorous and requiring better technical preparation.[xiii] Second, Columns 3-7 estimate the effects of probation on grades in the five first-year courses with the highest failure rate, all of which are STEM classes. Although these estimates are noisier due to the larger variation in individual course grades, we find that probation significantly increases grades in two of the five courses, Chemistry I and Physics I. Although we are reluctant to conclude that these two courses are entirely responsible for the STEM major impact, the finding is consistent with probation helping students succeed in challenging STEM courses.

We might be concerned that academic probation affects other aspects of student performance. On one hand, the additional time associated with the probation requirements might detract from students' non-academic requirements. On the other hand, the increased requirements and scrutiny may provide incentives for better performance even outside of coursework. We test these potential cross-effects using another unique aspect of the USAFA: athletic performance is measured and scrutinized in a manner parallel to academic performance. Each semester students receive a Physical Education Average (PEA), an index of their grades in physical education

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classes and their fitness test scores on a 4.0 point scale. Students scoring below 2.0 PEA are placed on athletic probation which requires students to meet additional requirements intending to improve their fitness including mandatory reconditioning hours. With this is mind, we can estimate the effects of Athletic Probation using a local linear regression analogous to Equation 2 but using the 2.0 cutoff in PEA rather than GPA. Table 7 estimates the effect of academic and athletic probation at the end of the first semester on second semester GPA and PEA, using a common sample where all data are available. Academic probation improves subsequent GPA but does not affect PEA. Similarly, athletic probation does not affect GPA but does improve subsequent PEA by 0.19 on a 4.0 scale. Plots for all four estimates are found in Figure 9. These results suggest that each type of probation is well-targeted: one probation neither improves nor detracts from performance outside of the area for which the probation was designed.

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E. Subgroup Analysis

Next, we consider whether the effects documented above are concentrated on specific groups. Table 8 uses a local linear regression analogous to Equation 2 to estimate the effect of academic probation at the end of the first semester on four previously analyzed outcomes for three pairs of subgroups. Subgroups are defined by high school preparation (as measured by the academic composite summary measure), gender, and race. We estimate positive effects of probation on second-semester GPA that are larger than the overall sample for students with below-median high school preparation, males, and non-whites. Once again this higher performance is not explained by increased attrition, as both second-semester attrition and graduation are unaffected by probation for each subgroup. We also find heterogeneity in the effect of probation on the likelihood of completing a STEM degree, with the largest statistically significant positive effects for non-whites.

Although some caution is warranted in interpreting these results due to the quantity of statistical tests performed, a comparison with similar subgroup analysis from Lindo, Sanders, and Oreopoulos (2010) is informative. Consistent with our results, they found greater positive short-term GPA impacts on students with lower high school preparation. However, they also found that native English speakers experienced a larger increase in attrition, with mixed results for short-term GPA improvement. In contrast, we found that non-whites experienced a larger GPA boost due to probation with no increase in attrition, and that same group also became more likely to complete a STEM major.[xiv] Although necessarily speculative, one possible explanation of the difference is that students with access to more resources before college are more responsive to a stand-alone threat of disenrollment (native English speakers at the Canadian university studied by Lindo, Sanders, and Oreopoulos 2010), but students with access to fewer resources before college are more responsive to a mandatory, intensive intervention (non-whites at the USAFA). In support, Luppino and Sander (2015) find that non-minority students are more strongly deterred from STEM majors by strong peers in those fields, consistent with our finding that minority students are more strongly influenced by an intervention focused on their own personal development.

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F. Robustness Checks

Our primary results focus on the immediate effects of probation following first-semester grades. Although we argued that these immediate impacts yield the most credible estimates due to the limited course choices in the first semester, we also estimated the effect of probation following subsequent semesters' final grades. These subsequent academic probation incidences led to a similar increase in grades earned in the semester following immediately, although with less statistical confidence (Table A.1 of the online appendix, Column 1). Once again, that increase in

grades does not appear to be driven by increases in attrition (Column 2). Furthermore, the lack of long-term effects on GPA raises a question of whether early probation might actually lead to recidivism later in students' college careers. However, we find no evidence that probation following first semester grades impacts the number of subsequent probations (Column 3).

Another concern is that the results may be unique to the population studied due to the desire of students to pursue a military career. Although the scope of this paper is limited to the USAFA, we consider whether the estimated effects are driven by students who have prior military experience or a family member who served in the military. We hypothesize that students with a previous military exposure are more likely than those without to be propensed to military service, and indeed their graduation rate is 2.5 percentage points higher. However, Table A.2 of the Online Appendix shows little evidence that the impacts of probation are driven by this group. Although smaller sample sizes make the estimates less precise, probation appears to have similar effects for the two groups, and probation significantly improves subsequent grades even for students with no previous military exposure.

Our primary specification for each outcome uses mean squared error optimal bandwidths and a local linear estimation with triangular kernel weights. Tables A.3, A.4, and A.5 of the Online Appendix repeat the estimates from Tables 4, 5, and 7, respectively, using alternative RD parameters. The results are broadly consistent across alternative fixed bandwidths, higher-order local polynomial models, and a uniform weighting kernel. In fact, our primary STEM impact estimate appears to be rather conservative compared to those from alternative specifications (Table A.4).

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VI. Conclusions

Academic probation at the USAFA is a significant intervention designed to help under-performing students increase their subsequent academic performance. We find evidence that this treatment successfully improved grades during the semester in which the intervention was applied. We use an RD model that exploits a sharp cutoff of a 2.0 GPA from the previous semester to estimate that academic probation after the first semester increases second-semester GPA by 0.12. Although the measured academic improvement only persists for the semester of probation, this academic improvement is not explained by increased attrition, as we find no evidence that probation affects attrition or graduation rates. We also show that the immediate gains are concentrated in STEM classes and that academic probation increases the likelihood of students completing a STEM major, a choice associated with stronger prior academic performance. Together, the attrition and major completion results suggest that the USAFA's academic probation policy does not induce the discouragement effect that led students at other institutions to disenroll and arguably has a lasting positive impact in terms of future achievement.

We believe our study provides unique evidence on the potential effects of a particularly substantial academic probation policy. Although the strong intervention at the USAFA is quite naturally implemented at a military academy, other institutions could plausibly adopt similar requirements by using the threat of disenrollment as a means to enforce terms of the policy. That type of intensive intervention has the potential to play a role in incentivizing improvement for academically vulnerable students without causing a subsequent increase in attrition or a strategic response in course of study. The fact that probation increases STEM degree completion challenges the idea that students with marginal academic performance at the start of college

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necessarily need to seek an easier course of study or end their program entirely. The stronger impacts among minorities may highlight the potential benefits of targeted remediation for students who may be less familiar with the college environment, although more work is needed to understand this mechanism. Despite the promising effects of academic probation, such policies are unlikely to be a panacea for weak academic performance. The lack of long-term effects on GPA should highlight the limits of even a very intensive but time-limited intervention to improve the academic outcomes of low-performing students. Furthermore, this study's methodology necessarily focuses on marginal students, but the low GPAs and high attrition rates of inframarginal students suggest that even this intensive treatment may be insufficient to guarantee academic success to most students.

More research on the mechanisms behind the observed effects would be informative. One hypothesis is that the threat of disenrollment increases the inclination to disenroll as at other institutions, but the intensive interventions mirroring remediation efforts counteract that discouragement effect. The improvement in STEM course grades and the shift towards STEM degree completion are consistent with the intervention boosting confidence from the study and test-taking skills taught during probation. Better methods to address the endogeneity of course and major selection would help to shed light on the mechanism for the observed effects, and evidence from student surveys on attitude or study habits may also be warranted. Finally, the results offer a reminder that probation and remediation are heterogeneous educational interventions whose impacts are likely to depend on the intensity of the intervention. Research on probation policies at other institutions and different populations would be informative, especially if probation policies changed notably within an institution.

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Tables and Figures

Table 1

Academic Probation Status, by Semester

Semester	Portion Probation	Obs
1	0.116	19,712
2	0.136	18,853
3	0.106	17,970
4	0.088	16,406
5	0.057	15,522
6	0.039	14,495
7	0.031	13,988
8	0.013	13,338

Notes: Table shows the proportion of students completing each semester whose end-of-semester grades placed them on academic probation, which took effect the following semester.

Table 2

Summary Statistics, By Probation Status

	Mean by probation status		
Variable	No	Yes	All
Female	0.200	0.239	0.205
Nonwhite	0.422	0.538	0.436
Academic Composite	3285	2981	3250
	(306)	(262)	(316)
GPA Semester 1	2.971	1.659	2.818
	(0.511)	(0.374)	(0.651)
Failed Course Semester 1	0.002	0.530	0.063
GPA Semester 2	2.862	2.03	2.772
	(0.577)	(0.474)	(0.623)
Attrited Semester 2	0.034	0.116	0.043
Graduated in 4 Years	0.858	0.504	0.814

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Notes: Table shows the mean of the indicated characteristic (first column) by academic probation status based on first-semester grades (header rows). All characteristics are binary except academic composite (an index of high school academic performance measures) and the two GPA measures. Standard deviations in parentheses for non-binary variables.

Table 3

Placebo Tests

	(1) Female	(2) Nonwhite	(3) Ac Comp	(4) Prep School	(5) Athlete
Probation	0.0114	0.0551	1.8950	0.0385	-0.0777*
	(0.0380)	(0.0425)	(20.7363)	(0.0413)	(0.0416)
Observations	19,395	19,712	19,455	19,712	19,712
Obs L	1,167	1,344	1,341	1,182	1,234
Obs R	2,292	2,950	2,944	2,443	2,623
Bandwidth	0.339	0.403	0.401	0.346	0.362
Dep Var Mean, All	0.205	0.436	3250	0.139	0.240
Dep Var Mean, Near 2.0	0.214	0.504	3028	0.274	0.371

Notes: Each column shows placebo tests estimating the effect of academic probation following first semester grades on the indicated background characteristic using local linear RD analogous to Equation 2. Total observations and effective observations below (L) and above (R) of the GPA cutoff are shown as well as bandwidth. Means of dependent variables are provided both for the entire sample, as well as observations very close to the cutoff (GPA between 1.9 and 2.1). Observations vary across columns due to small numbers (<2%) of missing values of each characteristic. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4

Baseline Results

	(1)	(2)	(3)	(4)	(5)
Dependent:	Probation	Sem 2 GPA	Overall GPA	Sem 2 Attrition	Graduation
Independent:	GPA<2.0	Probation	Probation	Probation	Probation
Impact estimate	-0.8459***	0.1192***	-0.0074	-0.0243	0.0026

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	(0.0169)	(0.0359)	(0.0264)	(0.0159)	(0.0425)
Observations	19,712	18,853	13,338	19,712	16,279
Obs L	1199	1162	627	1398	1165
Obs R	2555	2524	1659	3295	2588
Bandwidth	0.356	0.368	0.361	0.447	0.412
Dep Var Mean, All	0.1164	2.7723	2.9733	0.0435	0.8142
Dep Var Mean, Near 2.0	0.4522	2.1044	2.4773	0.0416	0.6675

Notes: Each column shows RD estimates for the indicated dependent and independent variables. Column (1) shows the first stage estimate from a local linear regression analogous to Equation 1, while Columns (2)-(5) show the RD estimates analogous to Equation 2. Column (2) is limited to students completing their second semester, Column (3) is limited to students completing eight semesters, while Column (5) is limited to students with expected graduation date before the end of our panel. Total observations and effective observations below (L) and above (R) of the GPA cutoff are shown as well as bandwidth. Means of dependent variables are provided both for the entire sample, as well as observations very close to the probation cutoff (GPA between 1.9 and 2.1). Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 5

Probation Impacts on Major Completion

	(1)	(2)	(3)
Major:	STEM	Soc-Sci	Humanities
Probation	0.0688**	-0.0511	-0.00773
	(0.0332)	(0.0460)	(0.0211)
Observations	16,279	16,279	16,279
Obs L	1067	1100	1278
Obs R	2265	2310	3101
Bandwidth	0.377	0.381	0.484
Dep Var Mean, All	0.4043	0.3510	0.0525
Dep Var Mean, Near 2.0	0.1305	0.4384	0.0776

Notes: Each cell shows the estimated impact of academic probation following first semester grades on graduation with the specified academic major using local linear RD estimates analogous to Equation 2. The outcomes reflect the most recently declared primary major, and the sample is limited to students entering at least eight semesters before the end of our panel. Total observations and effective observations below (L) and above (R) of the GPA cutoff are shown as

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well as bandwidth. Means of dependent variables are provided both for the entire sample, as well as observations very close to the cutoff (GPA between 1.9 and 2.1). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6

STEM Impact Mechanism

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Outcome:	STEM	Non-STEM	Calc I	Calc II	Chem I	Chem II	Phys I
Impact Estimate	0.1597***	0.0720*	0.1744	0.0732	0.3842**	0.1083	0.3481**
	(0.0529)	(0.0429)	(0.2691)	(0.0848)	(0.1640)	(0.1162)	(0.1429)
Observations	18,836	18,912	1,143	10,385	4,322	7,524	10,975
Obs L	1109	1269	148	761	325	325	240
Obs R	2342	2850	228	1848	631	635	701
Bandwidth	0.342	0.409	0.365	0.361	0.284	0.246	0.240
Dep Var Mean, All	2.719	2.834	2.241	2.404	2.353	2.516	2.767
Dep Var Mean, Near 2.0	1.936	2.318	1.608	1.609	1.740	1.548	1.713

Notes: Each cell shows the estimated impact of academic probation following first semester grades on the second semester grade average (Columns 1 and 2) or individual course grade (Columns 3-7) indicated in the column heading using local linear RD estimates analogous to Equation 2. All grades are measured on a 4.0 scale. Total observations and effective observations below (L) and above (R) of the GPA cutoff are shown as well as bandwidth. Means of dependent variables are provided both for the entire sample, as well as observations very close to the cutoff (GPA between 1.9 and 2.1). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

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Table 7

Athletic and Academic Probation Cross Effects

	(1)	(2)	(3)	(4)
Dependent:	GPA	PEA	GPA	PEA
Probation Type:	Academic	Academic	Athletic	Athletic
Impact estimate	0.1507***	0.0244	-0.0704	0.1875**
	(0.0444)	(0.0527)	(0.1006)	(0.0802)
Observations	15,432	15,432	15,432	15,432

Obs L	779	944	439	372
Obs R	1,637	2,478	1,482	1,163
BW	0.332	0.457	0.232	0.191
Dep Var Mean, All	2.7723	2.6076	2.7723	2.6076
Dep Var Mean, Near 2.0	2.1044	2.2387	2.1044	2.2387

Notes: Each column shows estimates from local linear RD analogous to Equation 2 for the indicated dependent variable (measured in the second semester) and the indicated probation type (taking effect at the end of the first semester) as the independent variable. GPA = grade point average, PEA = physical education average. All regressions are limited to observations with non-missing GPA and PEA for the first and second semesters. Total observations and effective observations below (L) and above (R) of the GPA cutoff are shown as well as bandwidth. Means of dependent variables are provided both for the entire sample, as well as observations very close to the relevant cutoff (GPA or PEA between 1.9 and 2.1). Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

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Table 8

Probation Impacts by Subgroup

Outcome	(1) All	(2) < Median HS	(3) ≥ Median HS	(4) Male	(5) Female	(6) White	(7) Nonwhite
GPA	0.1192***	0.1702***	-0.0502	0.1639***	0.0192	0.1010*	0.1597***
	(0.0359)	(0.0401)	(0.0985)	(0.0447)	(0.0751)	(0.0542)	(0.0529)
Obs.	18,853	9,300	9,553	14,925	3,861	10,832	8,021
Attrition	-0.0243	-0.0174	-0.0455	-0.0341	0.0034	-0.0270	-0.0282
	(0.0159)	(0.0163)	(0.0394)	(0.0211)	(0.0253)	(0.0216)	(0.0251)
Obs.	19,712	9,717	9,995	15,428	3,967	11,125	8,587
Graduation	0.0026	0.0130	-0.0519	0.0073	0.0106	0.0100	-0.0035
	(0.0425)	(0.0483)	(0.0984)	(0.0488)	(0.0872)	(0.0601)	(0.0576)
Obs.	16,279	8,199	8,080	12,988	3,131	9,128	7,151
STEM	0.0705**	0.0651**	0.1496	0.0768**	0.0528	0.0593	0.1016**
	(0.0325)	(0.0323)	(0.1210)	(0.0389)	(0.0644)	(0.0577)	(0.0501)
Obs.	15,192	7,542	7,650	12,194	2,991	8,669	6,523

Notes: Each cell shows the estimated effect of academic probation following first semester grades on the indicated outcome (row) and subgroup (column) using local linear RD analogous to Equation 2. The GPA and attrition outcomes are measured in the second semester, when the probation takes effect. GPA regressions are limited to students completing their second semester;

graduation and STEM regressions are limited to students entering at least eight semesters before the end of our panel. Columns (2) and (3) represent students below and above median high school performance as measured by the USAFA's index of grades and standardized tests. Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

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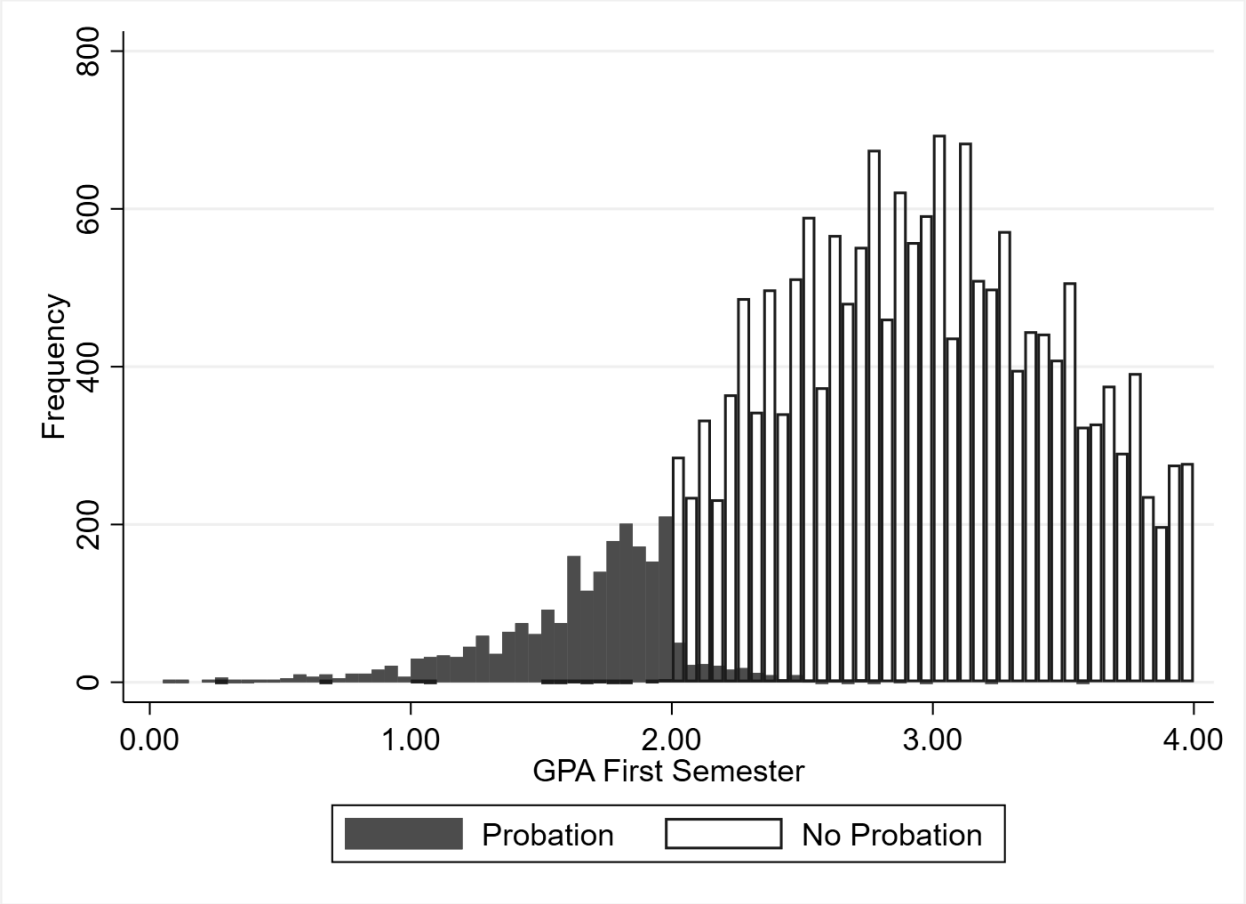

Figure 1

Distribution of First Semester GPA

Notes: The histogram shows the distribution of first semester GPA, separately by students recorded as being on academic probation based on their first semester GPA and those not on probation, with width of 0.05 GPA points.

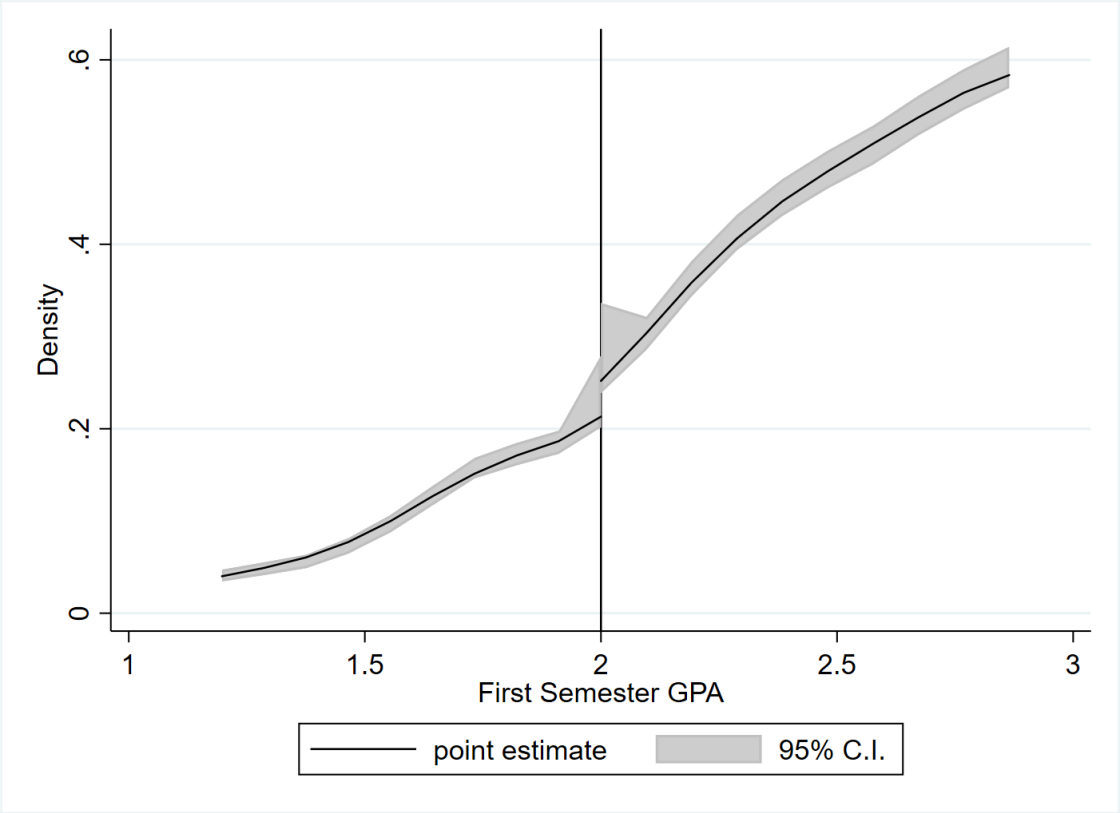

Figure 2

Density Test: First Semester GPA

Notes: The graph shows a local quadratic density estimation of first semester GPA, with a potential break at the 2.0 cutoff for academic probation. Bandwidth is 0.265 on the left and 0.287 on the right.

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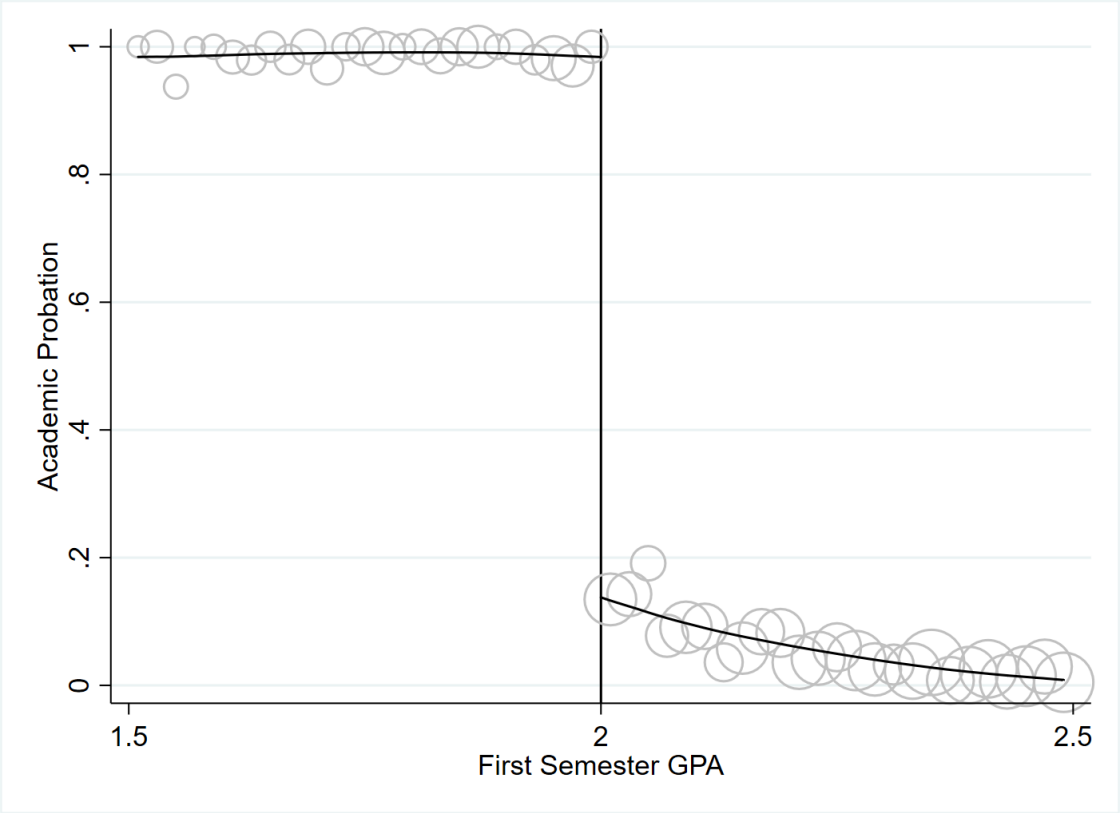

Figure 3

Discontinuity in Probation

Notes: The graph shows a local linear fit of the relationship between academic probation based on first semester grades and first semester GPA. Circles represent average probation rates for bins of first semester GPA, with size proportional to number of observations. Bandwidth is 0.356.

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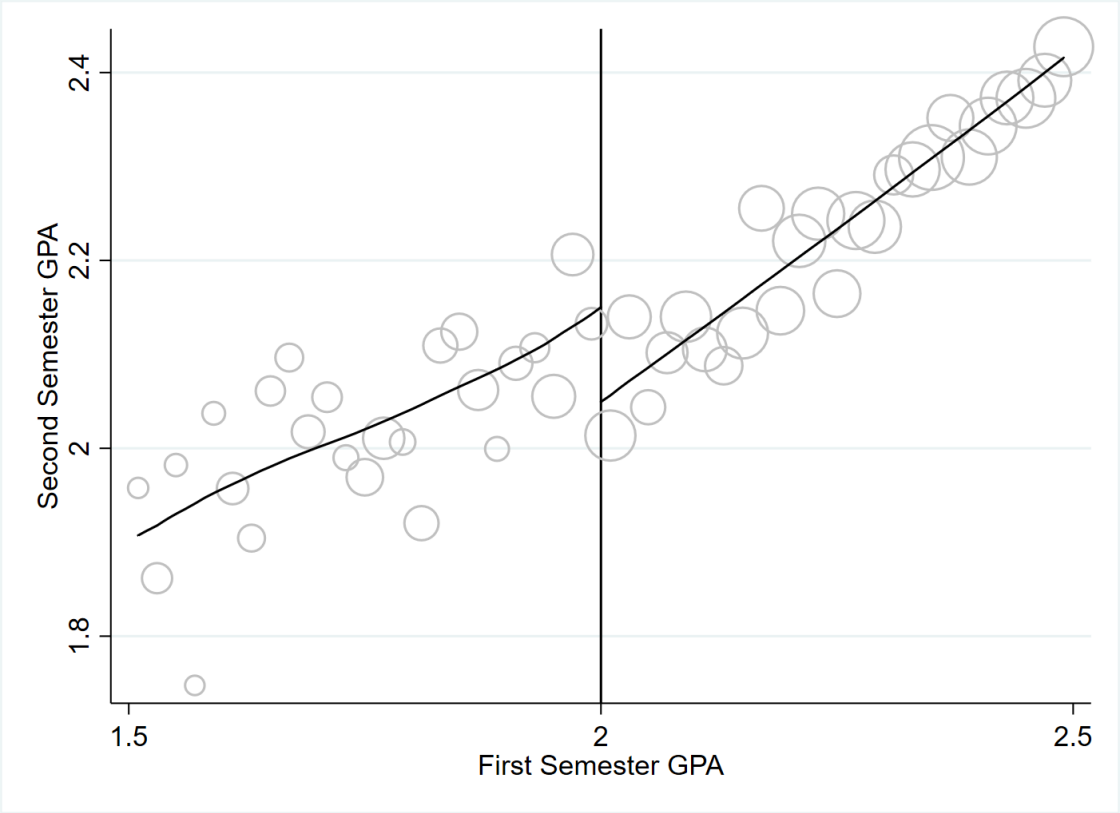

Figure 4

Discontinuity in Second Semester GPA

Notes: The graph shows a local linear fit of the relationship between GPA in the second semester (when probation based on first semester grades takes effect) and first semester GPA. Circles represent average second semester GPA for bins of first semester GPA, with size proportional to number of observations. Bandwidth is 0.368.

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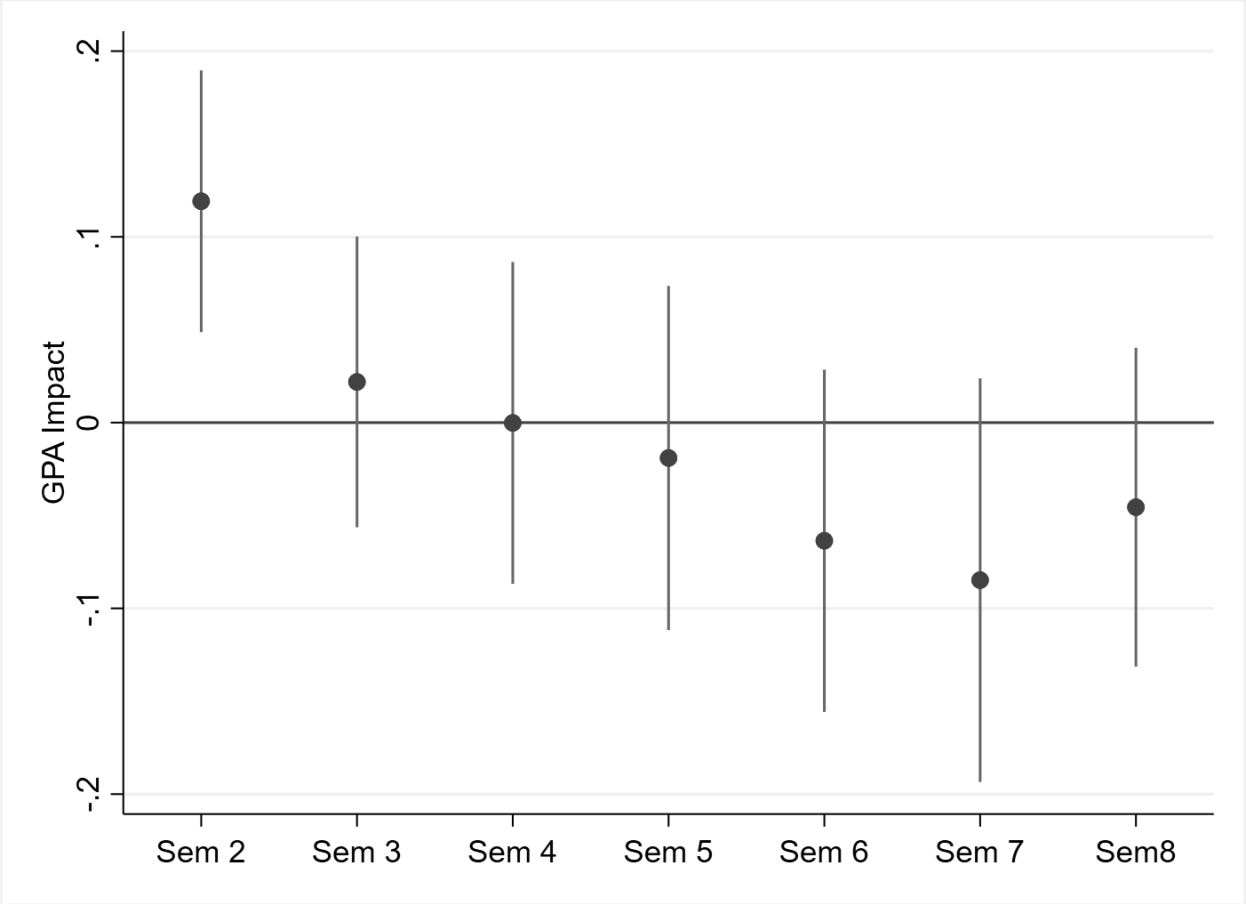

Figure 5

GPA Impacts by Semester

Notes: The graph shows point estimates and 95 percent confidence intervals for the impact of academic probation based on first semester grades on GPA in subsequent semesters, as estimated in a local linear regression analogous to Equation 2.

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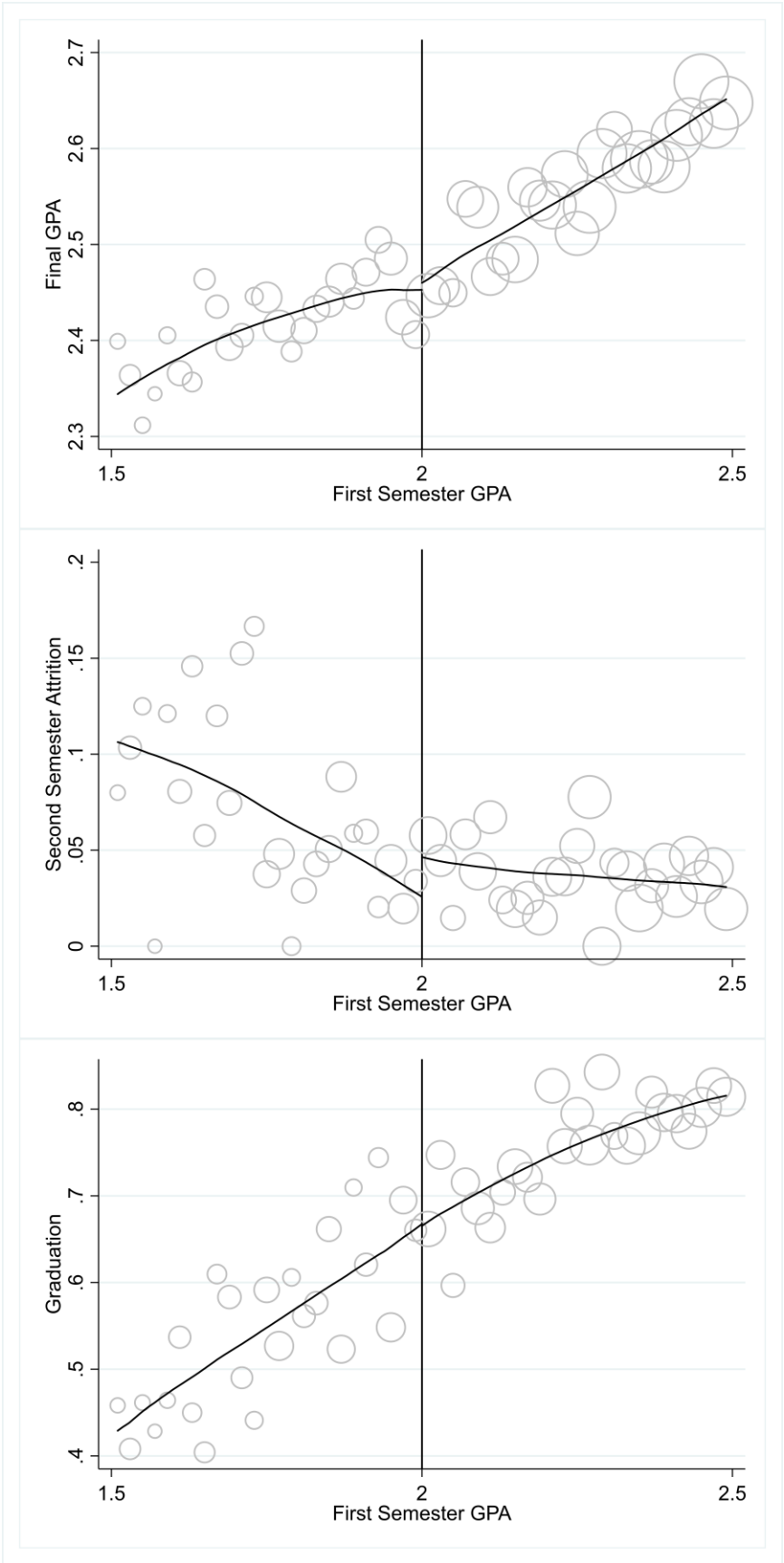

Figure 6

Discontinuity in Other Benchmark Outcomes

Notes: The graphs above show a local linear fit of the relationship between GPA at graduation, second semester attrition, or 4 year graduation rate and first semester GPA. Circles represent mean outcome for bins of first semester GPA, with size proportional to number of observations. Bandwidths are 0.0361, 0.447, and 0.412 respectively.

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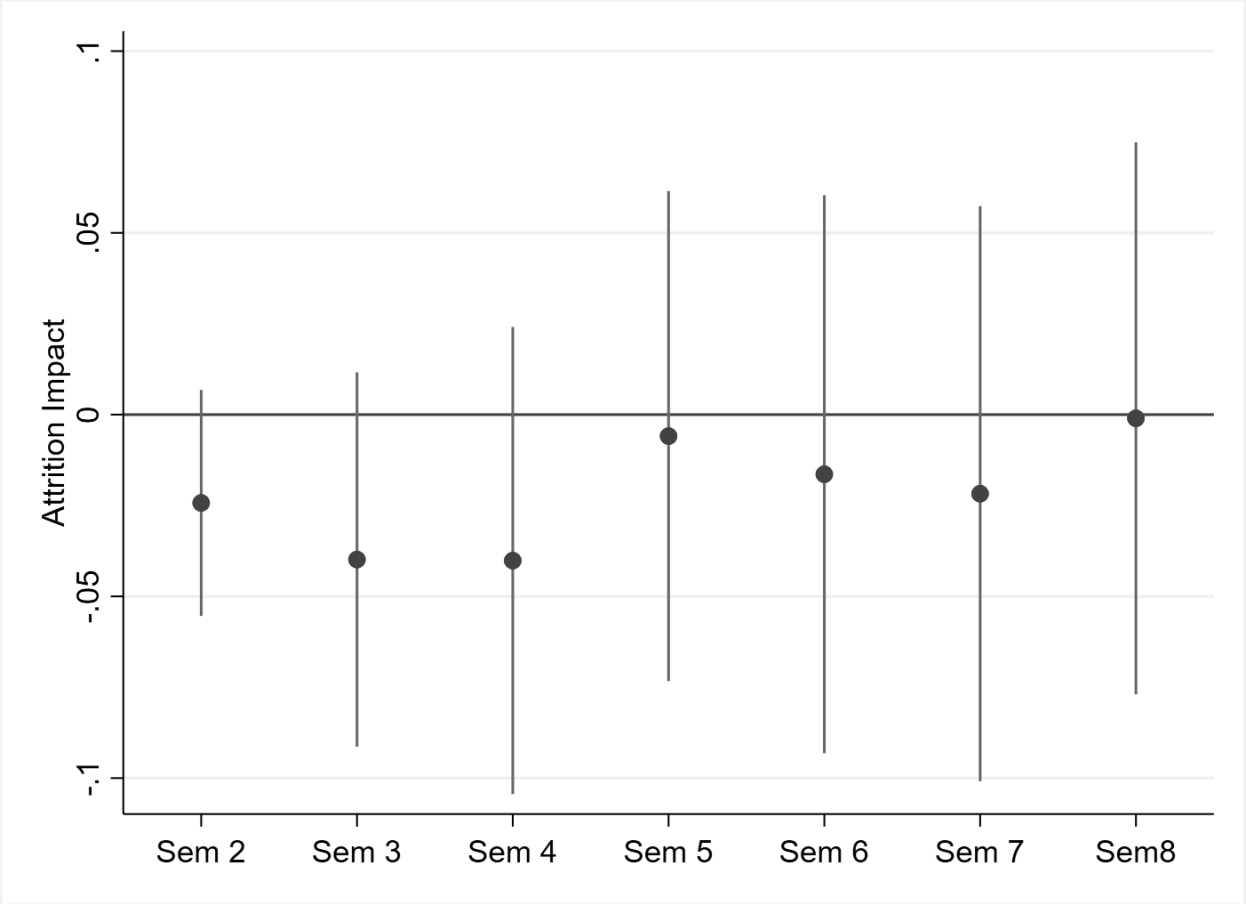

Figure 7

Attrition Impacts by Semester

Notes: The graph shows point estimates and 95 percent confidence intervals for the impact of academic probation based on first semester grades on cumulative attrition in subsequent semesters, as estimated in a local linear regression analogous to Equation 2.

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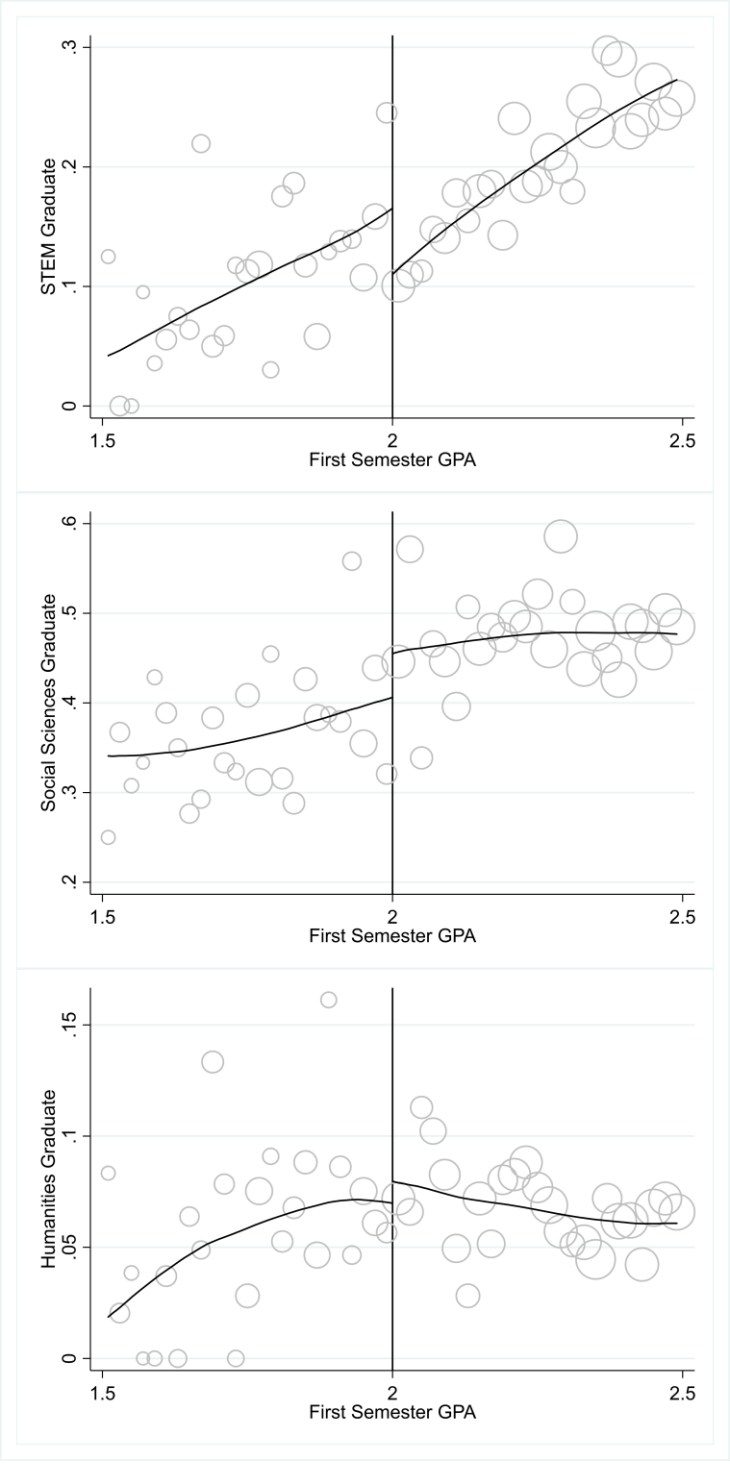

Figure 8

Discontinuity in Major and Graduation

Notes: The graphs above show a local linear fit of the relationship between graduating with a STEM, social sciences, or humanities major and first semester GPA. Circles represent mean

outcome for bins of first semester GPA, with size proportional to number of observations. Bandwidths are 0.377, 0.381, and 0.484 respectively.

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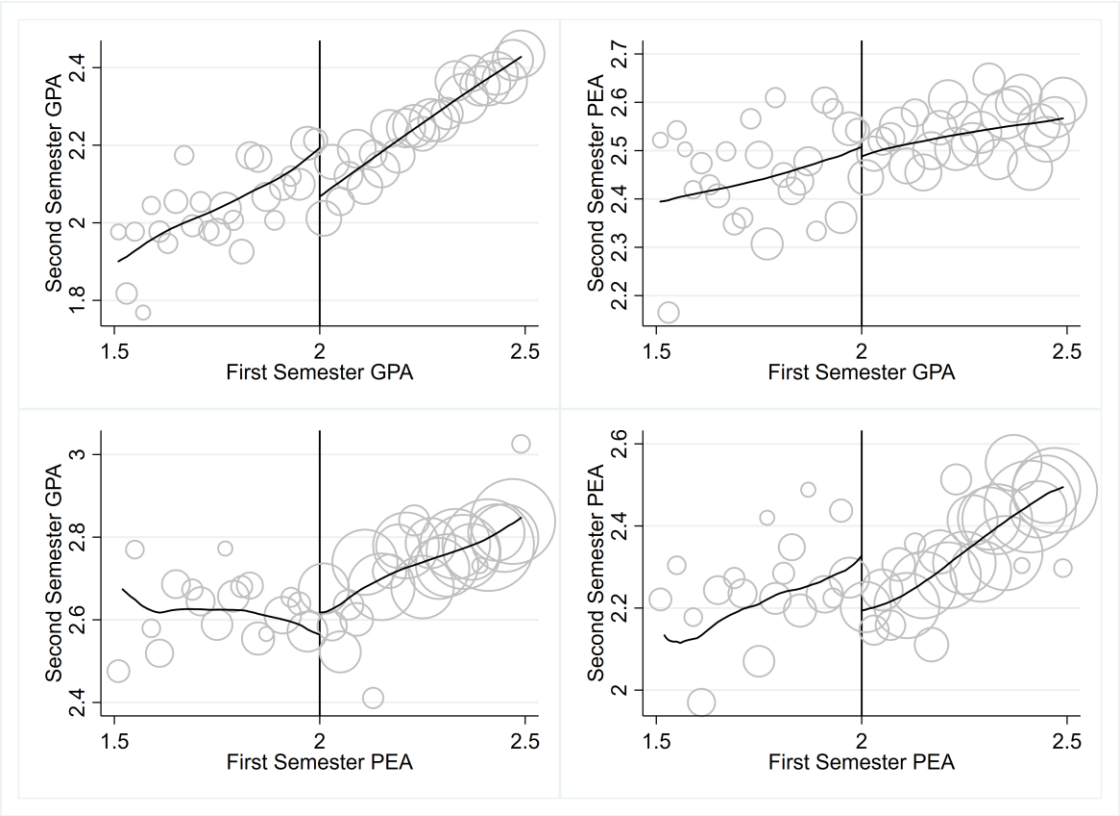

Figure 9

Athletic vs. Academic Probation

Notes: The graphs above show a local linear fit of the relationship between Grade Point Average (GPA) or Physical Education Average (PEA) in the second semester and first semester GPA or PEA. PEA is intended as a GPA-like score measuring physical fitness based on an index of physical education course grades as well as fitness test scores. PEA is based on a 4.0 scale and students below 2.0 are put on athletic probation. Circles represent mean outcome for bins of first semester GPA or PEA, with size proportional to number of observations. Bandwidths are 0.332, 0.457, 0.232, and 0.191 respectively.

[i] Grades are checked at both midterm and end-of-semester, and students are removed from probation if grades are improved by next midterm or final grade release. This means, in practice, that students able to address their deficiencies should only be on probation for half of one semester.
[ii] Disenrollment decisions are made by a faculty body with wide latitude in the directives provided to students. That body pays close attention to repeated probations or very low GPAs, but they are unlikely to alter the standard procedures described here for first-semester students slightly below the 2.0 GPA threshold.
[iii] Two of the four institutions described by Fletcher and Tokmouline (2017) require all students on academic probation to seek remedial advising, but this requirement does not appear to be as comprehensive as the USAFA's probation program.
[iv] Students are assigned three hours of study time for each 'F' grade earned, two hours for each 'D', and one hour for each 'C-.'
[v] These courses are Calculus I, Calculus II, Chemistry I, Chemistry II, and Physics I.
[vi] Only students with previous academic coursework such as transfer credit for Calculus will have different semester and cumulative GPAs after their first semester.
[vii] Graduation beyond four years is uncommon at the USAFA, as special permission is required to continue beyond the fourth year.
[viii] Moreover, restricting the sample to the 26 percent of students with irregular schedules also eliminates the marginally significant relationship with athletes and does not change the overall pattern of results.
[ix] We estimate this first stage model on our full analytic sample even though some outcomes are conditioned on completion of subsequent semesters. Results are similar when estimated on these smaller samples.
[x] STEM is defined to include all engineering majors, as well as math and physical and life sciences. If students graduate with more than one major, we use the major listed as primary.
[xi] The effects do not sum exactly to zero because some students graduate with a general studies major or do not graduate. The decrease in social science and humanities majors is not statistically significant even when combined for the same reason.
[xii] This survey question is highly predictive: 62 percent of students intending to pursue STEM graduate with a STEM degree, compared to 21 percent who do not intend to pursue STEM or are undecided. Regression results are available from the authors.
[xiii] Without a valid instrument for major choice, we cannot estimate students' GPA had they declared a different major. However, students graduating with STEM majors have average first-semester GPAs of 3.11, compared to an average of 2.68 for students graduating with other majors. This suggests that STEM majors are at least more common among students with stronger observable academic performance early in college.
[xiv] Although not recorded in our data, most USAFA students are likely to speak English as their first language due to citizenship requirements. Of course, non-native English speakers and non-whites may differ in other ways.

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