

The Effect of Academic Probation On Academic Outcomes: Evidence from the U.S. Air Force Academy

Aaron Albert^{*†} Nathan Wozny[‡]

July 30, 2019

Abstract

Academic probation policies place restrictions on low-performing college students and represent a step towards their disenrollment. Previous research has found that academic probation policies increase attrition while improving the average grades of remaining students. We examine the effect of an academic probation policy that requires an intensive response from students, including mandatory study time. Using a regression discontinuity analysis and administrative data from the U.S. Air Force Academy (USAFA), we find that placement on academic probation increases academic performance without increasing attrition. Probation increases subsequent semester grade point average (GPA) by 0.12 on a 4-point scale with no effect on attrition and a slight increase in completion of STEM majors. There is, however, no significant long-term effect of academic probation on either GPA or attrition. Our findings coupled with the setting of USAFA suggest that more intensive interventions may help low-performing college students without creating a noticeable discouragement effect which other institutions found may lead students on academic probation to disenroll.

Keywords: Education, Attrition, Regression Discontinuity, Academic Probation

JEL Classification Numbers: I23, I21

^{*}U.S. Air Force Academy, CO 80841, USA, e-mail:aaron.albert@usafa.edu

[†]The authors thank Kerry McCaig and participants at the American Educational Research Association 2019 Annual Meeting for comments that strengthened this paper. The views expressed in this article are those of the authors and not necessarily those of the U.S. Air Force Academy, the U.S. Air Force, the Department of Defense, or the U.S. Government.

[‡]Air Force Academy, CO 80841, USA, e-mail:nathan.wozny@usafa.edu

1 Introduction

College education is associated with higher wages and lifetime earnings for those who graduate. Unfortunately, the six-year completion rate for those entering college in the United States has remained around 55 percent for the last decade (Shapiro et al. 2016). The other 45 percent leave school without a degree and often with heavy student loan debt. Many colleges and universities take steps to identify struggling students and encourage them to either improve or quit through policies such as ‘academic probation’ or ‘academic dismissal.’ 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.

Institutions may adopt academic probation policies for a variety of reasons. Policies may be intended to incentivize deficient students to work harder or find the appropriate resources in order to improve their grades. Alternately, policies may serve as a first step towards dismissal, which serves to increase an institution’s quality by removing students with poor academic performance. These motivations lead the causal effect of these policies on individuals students’ academic performance and attrition 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 framework to estimate the effects of first semester academic probation on academic outcomes for students at the U.S. Air Force Academy (USAFA).

Although academic probation has been studied under different contexts, the USAFA is particularly interesting because its academic probation requirements are more substantial than what is found at most institutions. At other universities, probation mostly represents the formal threat of suspension and/or disenrollment (as 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. As found in studies at other institutions, US-AFA students increase their GPA significantly while on probation, but do not show increased GPA in any of the following semester despite the more intensive intervention. Unlike studies at other institutions, however, academic probation is not found to be associated with increased attrition. Furthermore, we estimate that placement on academic probation if anything increases the likelihood of graduating with a major in a science, technology, engineering, and mathematics (STEM) field, which further suggests that students are not discouraged by this treatment. To further explore the mechanism of the effect, we show that an analogous athletic probation policy causes temporary improvement to student's athletic performance, with no cross effects of one type of probation on performance in the other area.

2 Related Literature

The first paper to rigorously analyze the effects of academic probation on student academic performance is Lindo, Sanders, and Oreopoulos (2010). Applying regression discontinuity 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. While the increase in academic performance could be explained in part by the composition of students who chose to remain, they show 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 follow a model of Bénabou 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. Fletcher and Tokmouline (2017) performed similar analysis using data from four Texas Universities. They

found that students placed on academic probation after their first semester had better second semester academic performance but higher rates of attrition in subsequent semesters, with academic improvements fading in subsequent semesters. Two papers applied difference-in-difference estimators to analyze changes in the Dutch universities after the nation introduced academic dismissal in 1993. Arnold (2015) found academic dismissal was associated with a 6 percent increase in first-year dropouts and about a 5 percent increase in 4-year completion rate. Sneyer and Witte (2014) had similar findings regarding first-year attrition and graduation rates, but they also found that student satisfaction fell while student perceptions of program feasibility increased after the introduction of academic dismissal. The consistent findings that academic probation policies improve academics in the short term but also increase attrition raise a concern that these policies may be exacerbating the problem of low college completion rates. The results of this study suggest that the effects of academic probation policies may depend importantly on their design.

2.1 Institutional Background

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 other universities, and while probation does have a punitive element, it is also an intensive intervention aimed at supporting underperforming students. Various institutional characteristics also help to allay concerns about the applicability of the regression discontinuity method, which we adopt similarly to much of the related literature.

USAFA's conditions for academic probation are similar to what one might expect at other colleges and universities. Students are also 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 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.¹

Academic probation at the USAFA is a more substantive treatment than what is found at most institutions. Similar to other institutions, academic probation is a step towards disenrollment and is presented to students as such.² Unlike most other universities, students on academic probation are required to complete numerous steps to avoid further disciplinary action.³ Students on academic probation must submit a formal document outlining their plan to improve their grades, described as an “Academic Get Well Plan.” In order to complete this requirement, students must explain in writing the causes for their deficiencies and write actionable plans for improvement. This may force further planning and introspection than would be caused by the threat of dismissal alone. 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 providing support for issues related to e.g. mental health or study skills. Additionally, commitments made in this plan such as seeking additional help in office hours are monitored and recorded. Lastly, students on academic probation are required to attend supervised weekend study times. These mandatory study periods are prescribed according to the severity of grade deficiency. All students on probation attend one hour per week plus an additional three hours per week for each ‘F’ grade earned and two additional hours for each ‘D’ or ‘C-.’ In addition, 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. This increases students’ time on campus and adds strong

¹Grades 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.

²Disenrollment 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.

³Two of the four institutions described by Fletcher and Tokmouline (2017) requires all students on academic probation to seek remedial advising, but we suspect that this requirement is small compared to those described here.

incentives for students to address their academic deficiency (USAFA 2016). Because academic probation at the USAFA combines additional study requirements with strong academic incentives it may be 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. Some choices remains, for instance students are placed into foreign languages based on their preferences and performance on a placement test. First-year students are not, however, able to fill their schedule with classes based on either their individual interests or perceptions of their individuals strengths and weaknesses. It is also worth noting that each core class is offered in several 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. Possible constraints, such as some athletic teams being excluded from late afternoon classes to allow time for team athletic practice, mean that class assignment is not truly random, but class schedules are determined with far less student control than may be found elsewhere. 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.

The military setting of the USAFA might raise concerns about the applicability of findings to other institutions; however, the USAFAs 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 Bachelors 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.

3 Data

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 2004-2020. 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 used in the admissions process. 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. Third, a policy enabling students to end academic probation based on summer course performance is not applicable immediately after the first (fall) semester. 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.⁴ Focusing on probation after first semester also allows us to abstract from differential treatment effects for those on repeated spells of academic probation.

⁴Only students with previous academic coursework such as transfer credit for Calculus will have different semester and cumulative GPAs after their first semester.

Because the focus of this paper is the effect of academic probation, we exclude all students who withdrew before earning final grades for their first semester. This includes some 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 least two full semesters so that second-semester GPA can be observed. We also exclude summer semesters from the sample because not all students participate and those that do typically take a single course. Therefore, for typical students graduating from 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. 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 near the cutoff is highly predictive of academic probation status (see Figure 1).

Table 2 compares background and outcomes for second-semester students by academic probation status (based on their first semester grades). Around 24 percent of students on academic probation are female, slightly higher than what is seen in the full sample (21 percent). About 54 percent of non-white students appear on academic probation, which is higher than their representation in the full sample (44 percent). Students on academic probation entered USAFA with lower academic preparation as indicated by their academic composites averaging 2,981, which is below the mean of 3,250.

Table 3 compares across all eight semesters the semester GPA and cumulative attrition rates of students on academic probation at the end of their first semester due to grades earned during the first semester. Those not placed on academic probation after first semester slightly increase their semester GPA, from 3.0 to 3.2 by their last semester, although these samples differ slightly due to attrition. Meanwhile, students put on academic probation increase their GPAs from 1.7 to 2.7 by

their eighth semester, closing the gap from about 1.3 to 0.4 points over the eight semesters. Some of this GPA convergence may be explained by differential rates of attrition. Overall, attrition after the first semester at the USAFA is fairly low - with only 18 percent of students departing before the end of the final semester. The attrition rates are much higher (49 percent) for those put on academic probation during their first semester. Both groups show a notable increase in attrition in between the second and third semesters, with many students departing during summer after their first year.

4 Methods

This paper estimates the causal effects of academic probation using a regression discontinuity design, which has been used to estimate treatment effects in many economic contexts (for example, see Cook 2008 or Lee 2008). This is accomplished by comparing outcomes for students with first-semester GPA above and below the 2.0 threshold below which students are placed on probation. Causal inference from such comparisons is difficult because students above and below the 2.0 cutoff are different in many ways. Most obviously, students' first-semester GPAs are directly predictive of outcomes such as second-semester GPAs. Although bias due to observable student differences can be limited by conditioning on the correct control variables, possible differences across unobservable factors are particularly problematic. For instance, although it is possible to condition on first-semester GPA, it is impossible to control for student differences in ambition, aptitude, etc. which may influence grades in later semesters. Unobservable differences, however, are likely to be small or non-existent when comparing populations of students with very similar first semester GPA. While we would not assume the population of students earning 3.0 GPA in their first semester to be mostly similar to students earning 1.0, students earning a 1.99 GPA vs. a 2.01 GPA are likely to be quite similar. While 1.0 and 3.0 GPA likely require very different levels of effort and aptitude throughout the semester, students just above and just below the 2.0 cutoff may be separated by as little as performance on one minor assignment. Our identifying assumption

therefore is that, conditional on first-semester GPA, the population of students just above vs. just below the 2.0 GPA cutoff differ only in their academic probation treatment status.

It is important to note that being above or below 2.0 GPA is not perfectly predictive of academic probation status. Several students are on academic probation for failing a course but have a GPA over 2.0, and a small number of students report GPA below 2.0 without academic probation status.⁵ In this way, our analysis must treat the 2.0 cutoff as a ‘fuzzy’ rather than a ‘sharp’ discontinuity. For this reason, 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:

$$AcPro_i = \beta_0 + \beta_1 I_i(GPA_i < 2.0) + \beta_2 GPA_i + \varepsilon_i. \quad (1)$$

In Equation (1) the dependent variable is $AcPro_i$, an indicator variable equal to 1 if a student is on academic probation. Independent variables include an indicator for student’s previous semester GPA being below 2.0 as well as the student’s previous semester GPA. Results from this regression may be biased if the relationship between GPA and probability of academic probation is nonlinear. In addition, it is not clear whether equation (1) should 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-polynomial regressions (as in Calonico et al. 2014), although we will refer to the linear specification 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 regression discontinuity design with a regression of the form:

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

where \widehat{AcPro}_i is estimated as in Equation (1). Using this equation, we estimate the effect of academic probation due to having first semester grades below the 2.0 cutoff on the GPAs observed in

⁵Strictly speaking all students with below 2.0 semester GPA should be on academic probation so these students’ status cannot be explained. One possibility is inconsistency in reporting due to either dropped classes or grade changes after the semester ends.

subsequent semesters. We use the same framework to analyze effects on attrition, graduation, and major completion.

Estimates via Equation (2) are unbiased if GPAs near the 2.0 cutoff are distributed at random. This assumption is not likely to hold if students have complete knowledge and precise control over their GPA during the semester. For instance, one can imagine students who estimate their GPAs at approximately 1.95 to exert additional effort on their assignments to avoid academic probation compared to students estimating their GPAs at approximately 2.05. We do not believe this strategic behavior is possible at USAFA. First, we do not believe students can precisely predict their GPA before each semester ends. Because GPA is computed as a weighted average of all classes taken, students would need to be able to accurately predict each of their course's grade. Predicting individual course grades would be difficult because at least 25 percent of the final grade in each class is required to be determined by a final exam or final project. Therefore, without advance knowledge of exam questions or grading standards it is unlikely that students can control their academic probation status if their GPA will be near the 2.0 cutoff. Our identifying assumption is not strictly testable, but we provide some supporting evidence both by demonstrating continuity of the forcing variable as well as estimating via Equation (2) with various background characteristics as the dependent variable to show that academic probation status is not predictive of these previously determined variables.

5 Results

We begin by showing that first-semester GPA has the expected relationship to academic probation status. A simple histogram (Figure 1) of first-semester GPA suggests that nearly all students with GPAs below 2.0 are indeed placed on academic probation, but probation is much less common immediately above the cutoff. Importantly, the distribution appears to vary smoothly around the 2.0 GPA cutoff, suggesting that students do not have the ability to control their GPA precisely to avoid probation. We examine potential manipulation of GPA more formally in Figure 2, which

uses local linear approximations for the density around the 2.0 GPA cutoff. 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 2018). Also consistent with the sharp change in probation status around the 2.0 GPA cutoff in Figure 1, Figure 3 shows that the probability of academic probation falls from nearly 1 just below the 2.0 GPA cutoff to under 0.2 for GPAs just above the cutoff. The fraction of students just above the GPA cutoff who are on academic probation is consistent with the policy that a grade of ‘F’ in any class results in probation even if GPA is above 2.0.

Our identification rests on the assumption that students have little control over their semester GPA around the cutoff. Although this assumption cannot be tested directly, empirical evidence does not suggest that students have the ability to control their GPA precisely around the 2.0 cutoff. In addition to the continuity of the GPA distribution from Figure 2, students’ covariates are not significantly different above and below the 2.0 cutoff. Table 4 shows estimates of Equation (2) using background variables as the outcome. Indeed 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 USAFA. 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. While this difference could be caused by random chance, another possible explanation is that athletes are often assigned classes that result in a different number of credit hours contributing to their GPAs. It is conceivable that the different denominator in the GPA calculation leads to a slightly different distribution of GPA, which is discrete on a sufficiently fine scale. 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. 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.

Next we turn to the formal estimation of our models. Column 1 of Table 5 estimates Equation (1), showing 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. This difference is statistically significant at the 1 percent level and is analogous to Figure 3.⁶ The effect of academic probation can then be estimated as the discontinuity of second-semester GPA as predicted by placement just above vs. below 2.0 GPA in the first semester. Figure 4 shows a discontinuous increase in second-semester GPA as first semester GPA falls below the 2.0 cutoff, indicating a positive effect of academic probation. Column 2 of Table 5 estimates 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. Moreover, the 75th percentile of first-semester GPA for students placed on academic probation is 1.9, so a GPA increase of 0.12 would be enough to get at least one quarter of students off of academic probation assuming an otherwise flat GPA trajectory. However, the treatment effect of academic probation due to first semester grades appears to fade quickly: academic probation is associated with approximately zero change in GPA for semesters 3-8 (see Figure 5).

Next we estimate the effect of academic probation on attrition. Column 3 of Table 5 estimates Equation (1) 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. 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 probation. In fact, probation does not effect attrition during any subsequent semester (Figure 6), nor does it affect the probability of graduation in four years (Column 4 of Table 5), and all point estimates are consistent with probation encouraging program completion.⁷ The lack of attrition effects might reflect the intensive intervention

⁶We 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.

⁷Estimation on longer-term outcomes requires limiting the sample to students for whom that outcome could be realized by the end of our panel in fall 2017. Graduation beyond four years is

that provides resources to struggling students despite the fact that it is also a punitive measure.

5.1 Mechanisms for the effect of academic probation

The results above suggest that academic probation increases GPA for one semester with no associated increase in attrition. One explanation is that the intensive intervention associated with placement on probation is effective in improving study habits, but only while the intervention takes place. However, other effects of academic probation could potentially counteract a long-term effect on grades. For instance, students may 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. If academic probation discouraged students from enrolling in majors that lead them to earn a lower GPA than they would have under a different curriculum, then finding no long-term effect of probation on grades would be more concerning because of the collateral effects on course of study. To test this hypothesis, we estimate the effect of academic probation on graduating with a STEM major.⁸ Results in Table 6 show that academic probation following first semester grades increases the probability of graduating with a STEM major by 7.1 percentage points, with a corresponding decrease in selecting a social science major.⁹ Although the decrease in social science and humanities majors is not statistically significant, the results suggest that academic probation does not discourage students from pursuing majors that are perceived as being more rigorous and requiring better technical preparation. In fact, an increase in STEM majors without

uncommon at USAFA, as special permission is required to continue beyond the fourth year.

⁸Without 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 the 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.

⁹STEM is defined to include all engineering majors, as well as math and physical and life sciences. Students must declare a major by their third semester, although students can change their majors throughout their studies subject to ability to complete coursework. If students graduate with more than one major, we use the major listed as primary.

a corresponding decrease in GPA is arguably a long-term positive effect of probation at the end of the first semester.

Next, we consider whether academic probation has effects on 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 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 classes and their fitness test scores. 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 in mind, we can estimate the effects of Athletic Probation similar to what was done in Equation (2) 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 effect PEA. Similarly, athletic probation does not effect GPA but does improve subsequent PEA by 0.19 on a 4.0 scale. This suggests 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.

Finally, we consider whether the effects documented above are concentrated on specific groups. Table 8 uses 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. We also find heterogeneity in the effect of

probation on the likelihood of completing a STEM degree, with the largest positive effects for students with above-median high school preparation and for non-whites. While 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 greater GPA increase at the cost of higher attrition for that group. 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 become more likely to complete a STEM major.¹⁰ One possible interpretation of these results is that the intensive probation intervention at USAFA is particularly well-suited to students who may not have had the same level of resources as their peers before college.

6 Conclusions

Academic probation at USAFA is a significant intervention designed to help underperforming students increase their subsequent academic performance. We find evidence that this treatment successfully increased grades during the semester in which the intervention was applied. We use a regression discontinuity 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. Interestingly, we find evidence 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

¹⁰Although 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.

other institutions to disenroll.

We believe our study provides unique evidence on the potential effects of a particularly substantial academic probation policy. While 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 an resulting increase in attrition or a strategic response in course of study. Despite some promising impacts of academic probation, the lack of long-term effects on GPA should serve as a caution on 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 is insufficient to guarantee academic success to most students. Our study did suggest one potential lasting benefit of probation: an increase in the likelihood of graduating with a STEM major.

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 counteract that discouragement effect. While probation would ideally teach students the study and test-taking skills necessary to succeed throughout their college careers, the lack of statistically significant academic impacts may suggest that even this intensive intervention is short-lived. Although the study did not find statistically significant effects on retention beyond the second semester, the pattern of point estimates for retention outcomes and statistically significant graduation effects for a subset of the population provide suggestive evidence that probation may have encouraged some students to persevere through a challenging time in their academic careers, and major choice results further support that probation did not discourage students from accepting a challenge. Research on probation policies at other institutions and different populations would be informative, especially if probation policies changed notably within an institution. Evidence from student surveys on attitude or study habits may also be warranted.

Finally, better methods to address the endogeneity of course and major selection would help to shed light on the mechanism for the observed effects.

7 References

- Arcidiacono, P., Aucejo, E., & Spenner, K. (2012). What happens after enrollment? An analysis of the time path of racial differences in GPA and major choice. *IZA Journal of Labor Economics*, 1(5): 1-24.
- Arnold, I. J. (2015). The effectiveness of academic dismissal policies in Dutch university education: an empirical investigation. *Studies in Higher Education*, 40(6), 1068-1084.
- Burton, Anthony C., Katherine S. Carson, Susan M. Chilton, & W. George Hutchinson (2007). "Resolving questions about bias in real and hypothetical referenda." *Environmental and Resource Economics*, 38(4), 513-525.
- Calonico, S., Cattaneo, M. D., & Titiunik, R. (2014). Robust data-driven inference in the regression-discontinuity design. *Stata Journal*, 14(4), 909-946.
- Cattaneo, M. D., Michael Jansson, and Xinwei Ma. 2018. Manipulation Testing based on Density Discontinuity. *Stata Journal* 18(1): 234-261.
- Cook, T. D. (2008). Waiting for life to arrive: a history of the regression-discontinuity design in psychology, statistics and economics. *Journal of Econometrics*, 142(2), 636-654.
- Fletcher, J. M., & Tokmouline, M. (2010). The Effects of Academic Probation on College Success: Lending Students a Hand or Kicking Them While They Are Down?.
- Lee, D. S. (2008). Randomized experiments from non-random selection in US House elections. *Journal of Econometrics*, 142(2), 675-697.
- Lindo, J. M., Sanders, N. J., & Oreopoulos, P. (2010). Ability, gender, and performance standards: Evidence from academic probation. *American Economic Journal: Applied Economics*, 2(2), 95-117.
- Shapiro, D., Dundar, A., Wakhungu, P.K., Yuan, X., Nathan, A. & Hwang, Y. (2016, November). Completing College: A National View of Student Attainment Rates Fall 2010 Cohort (Signature Report No. 12). Herndon, VA: National Student Clearinghouse Research Center.
- Sneyers, E., & De Witte, K. (2017). The effect of an academic dismissal policy on dropout, graduation rates and student satisfaction. Evidence from the Netherlands. *Studies in Higher Education*,

42(2), 354-389.

United States Air Force Academy (USAFA) (2015). "USAFA Quick Facts." Accessed December 21, 2016. <http://www.usafa.af.mil/AboutUs.aspx>.

United States Air Force Academy (USAFA) (2016). "Curriculum Handbook 2016-2017." Accessed July 26, 2019. <https://www.usafa.edu/app/uploads/CHB-2016-2017.pdf>.

8 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, First Semester

Variable	Mean by probation status		
	No	Yes	All
Failed a course	0.002	0.530	0.063
Female	0.200	0.239	0.205
Nonwhite	0.422	0.538	0.436
Academic composite	3,285	2,981	3,250

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, which is an index of high school academic performance measures. Failing a course is measured based on first semester grades.

Table 3: Average GPA and Attrition

Semester	No Probation		Probation		All	
	GPA	Attrition	GPA	Attrition	GPA	Attrition
1	2.971	n/a	1.659	n/a	2.818	n/a
2	2.862	0.034	2.030	0.116	2.772	0.043
3	2.900	0.064	2.109	0.270	2.826	0.088
4	2.938	0.083	2.243	0.368	2.880	0.116
5	3.003	0.118	2.461	0.449	2.961	0.157
6	3.046	0.123	2.521	0.463	3.005	0.164
7	3.109	0.132	2.631	0.475	3.072	0.174
8	3.151	0.138	2.740	0.489	3.119	0.181

Notes: Table shows the mean of grade point average (GPA) for each semester conditional on completing that semester and the cumulative proportion of students attriting by the end of each semester conditional on completing the first semester. Each mean is presented separately by academic probation status based on first semester grades.

Table 4: Placebo Tests

	(1) Female	(2) Nonwhite	(3) Ac Comp	(4) Prep School	(5) Athlete
Probation	0.0114 (0.0380)	0.0551 (0.0425)	1.8950 (20.7363)	0.0385 (0.0413)	-0.0777* (0.0416)
Observations	19,395	19,712	19,455	19,712	19,712
Obs L	2,103	2,112	2,107	2,112	2,112
Obs R	17,292	17,600	17,348	17,600	17,600

Notes: Each column shows placebo tests estimating the effect of first semester academic probation on the indicated background characteristic using RD as in equation (2). Total observations and observations below (L) and above (R) of the GPA cutoff are shown. 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 5: Baseline Results

	(1)	(2)	(3)	(4)
Dependent:	Probation	Sem 2 GPA	Sem 2 Attrition	Graduation
Independent:	GPA<2.0	Probation	Probation	Probation
Impact estimate	-0.8459*** (0.0169)	0.1192*** (0.0359)	-0.0243 (0.0159)	0.0026 (0.0425)
Observations	19,712	18,853	19,712	16,279
Obs L	2,112	1,844	2,112	1,842
Obs R	17,600	17,009	17,600	14,437

Notes: Each column shows RD estimates for the indicated dependent and independent variables. Column (1) shows the first stage estimate as in equation (1), while columns (2)-(4) show the RD estimates from equation (2). Column (2) is limited to students completing their second semester, while column (4) is limited to students entering at least eight semesters before the end of our panel. Total observations and observations below (L) and above (R) of the GPA cutoff are shown. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Probation Impacts on Major Completion

	(1)	(2)	(3)
Major:	STEM	Soc-Sci	Humanities
Probation	0.0705** (0.0325)	-0.0611 (0.0470)	-0.0121 (0.0252)
Observations	15,192	15,192	15,192
Obs L	1,434	1,434	1,434
Obs R	13,758	13,758	13,758

Notes: Each cell shows the estimated impact of first semester academic probation on graduation with the specified academic major using RD as in 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 observations below (L) and above (R) of the GPA cutoff are shown. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

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*** (0.0444)	0.0244 (0.0527)	-0.0704 (0.1006)	0.1875** (0.0802)
Observations	15,432	15,432	15,432	15,432
Obs L	1,273	1,273	1,199	1,199
Obs R	14,159	14,159	14,233	14,233

Notes: Each column shows RD estimates from equation (2) for the indicated dependent variable (measured in the second semester) and the indicated probation type (taking effect at the start of the second 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.

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

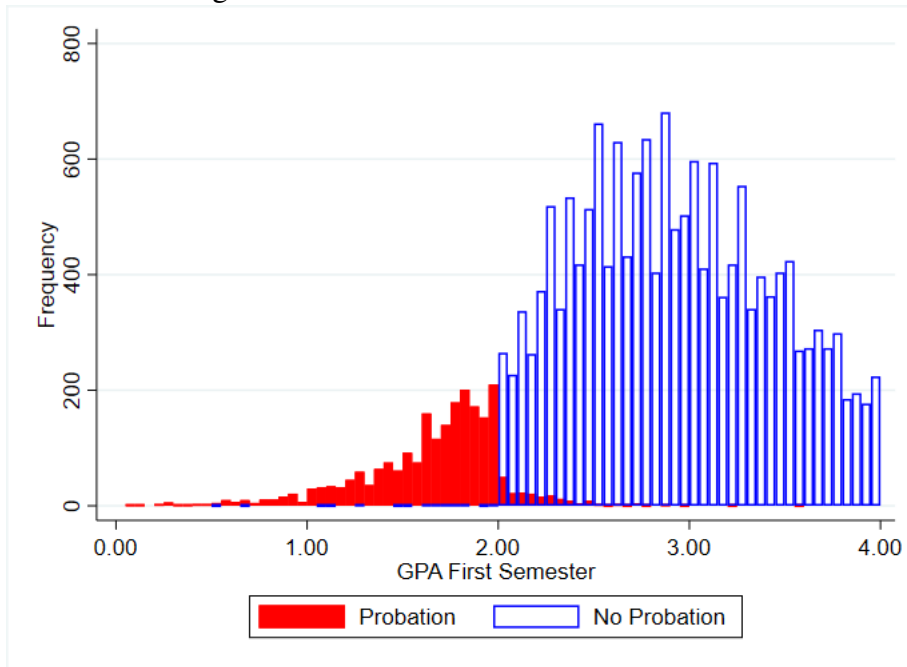
Table 8: Probation Impacts by Subgroup

Outcome	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All	< Median HS	≥ Median HS	Male	Female	White	Nonwhite
GPA	0.1192*** (0.0359)	0.1702*** (0.0401)	-0.0502 (0.0985)	0.1639*** (0.0447)	0.0192 (0.0751)	0.1010* (0.0542)	0.1597*** (0.0529)
Obs.	18,853	9,300	9,553	14,925	3,861	10,832	8,021
Attrition	-0.0243 (0.0159)	-0.0174 (0.0163)	-0.0455 (0.0394)	-0.0341 (0.0211)	0.0034 (0.0253)	-0.0270 (0.0216)	-0.0282 (0.0251)
Obs.	19,712	9,717	9,995	15,428	3,967	11,125	8,587
Graduation	0.0026 (0.0425)	0.0130 (0.0483)	-0.0519 (0.0984)	0.0073 (0.0488)	0.0106 (0.0872)	0.0100 (0.0601)	-0.0035 (0.0576)
Obs.	16,279	8,199	8,080	12,988	3,131	9,128	7,151
STEM	0.0705** (0.0325)	0.0651** (0.0323)	0.1496 (0.1210)	0.0768** (0.0389)	0.0528 (0.0644)	0.0593 (0.0577)	0.1016** (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 first semester academic probation on the indicated outcome (row) and subgroup (column) using RD as in 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 USAFA's index of grades and standardized tests.

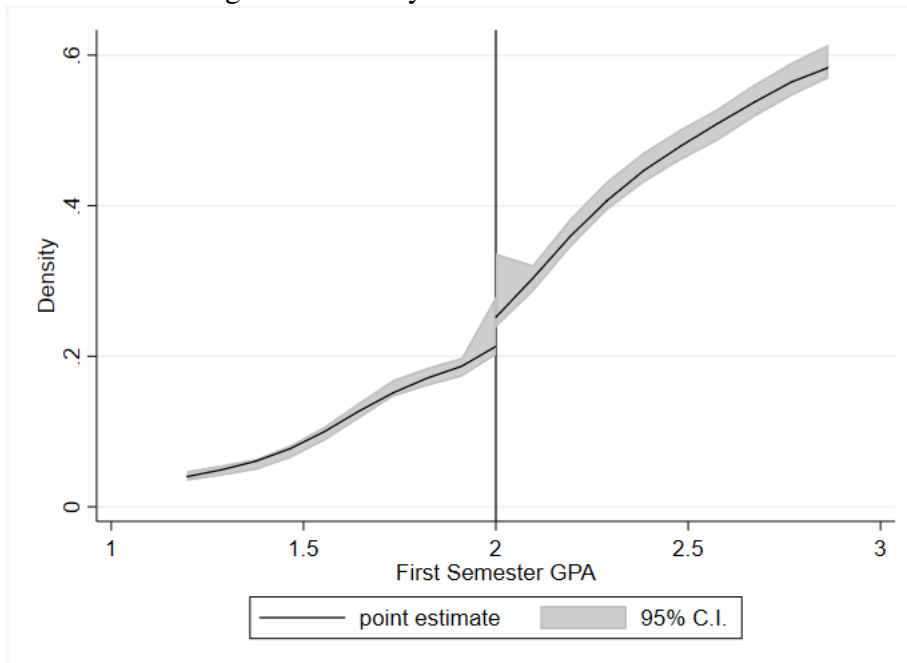
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Figure 1: Distribution of first semester GPA



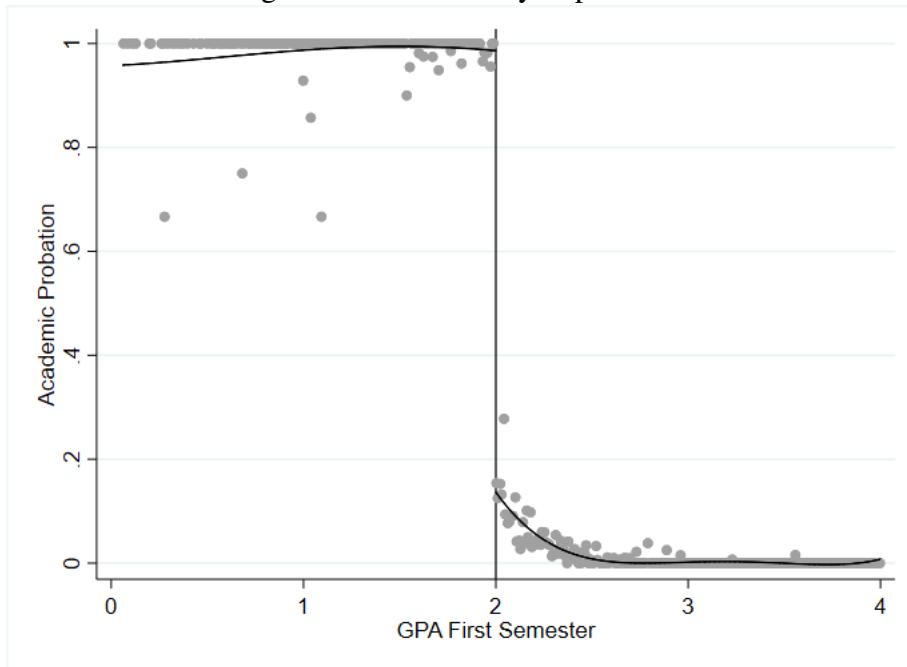
Notes: The histogram shows the distribution of first semester GPA, separately by students recorded as being on academic probation based on their first semester GPA and those not on probation.

Figure 2: Density test: first semester GPA



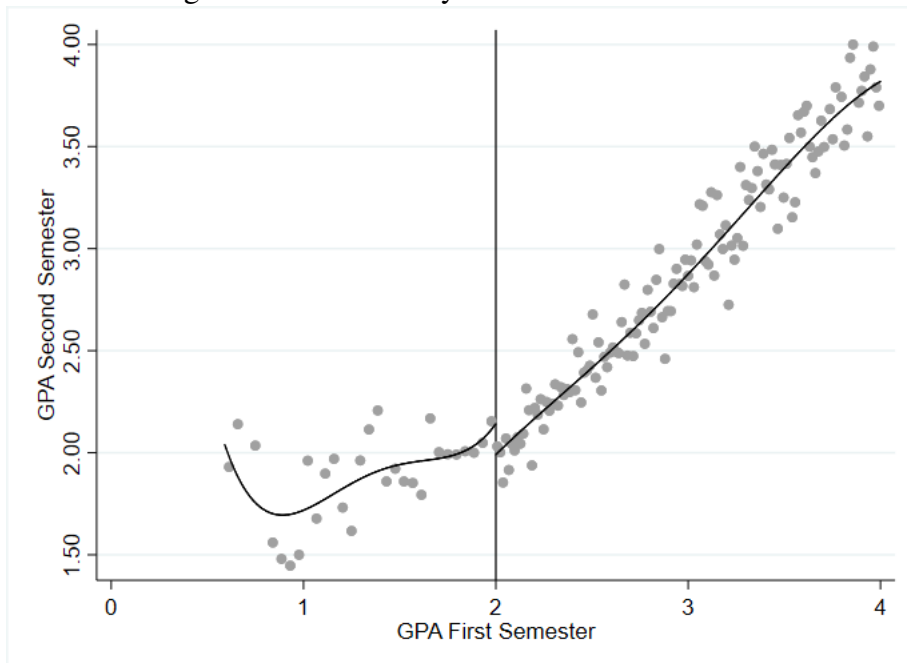
Notes: The graph shows a local polynomial density estimation of first semester GPA, with a potential break at the 2.0 cutoff for academic probation.

Figure 3: Discontinuity in probation



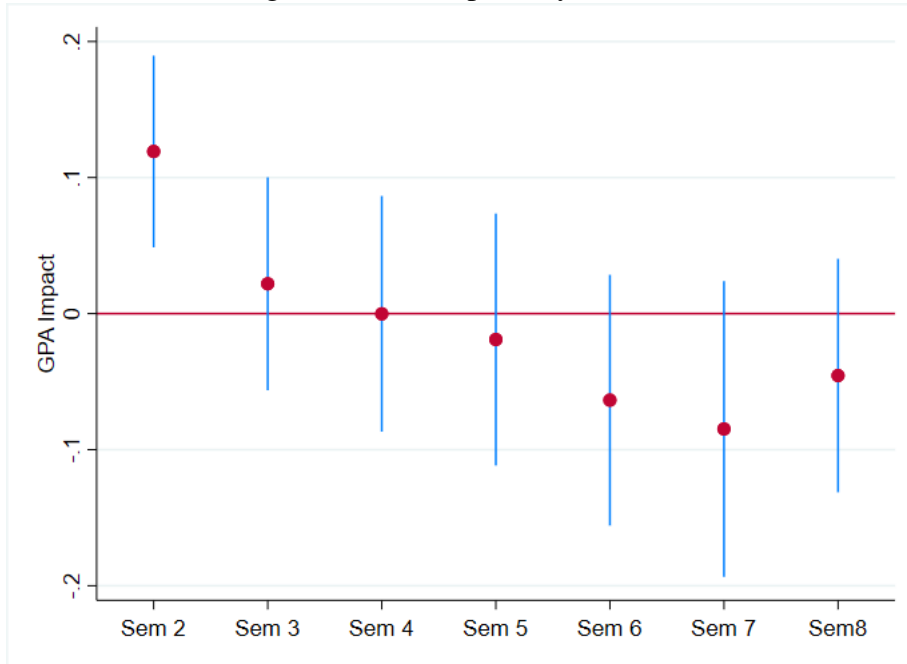
Notes: The graph shows a local polynomial fit of the relationship between academic probation based on first semester grades and first semester GPA.

Figure 4: Discontinuity in second semester GPA



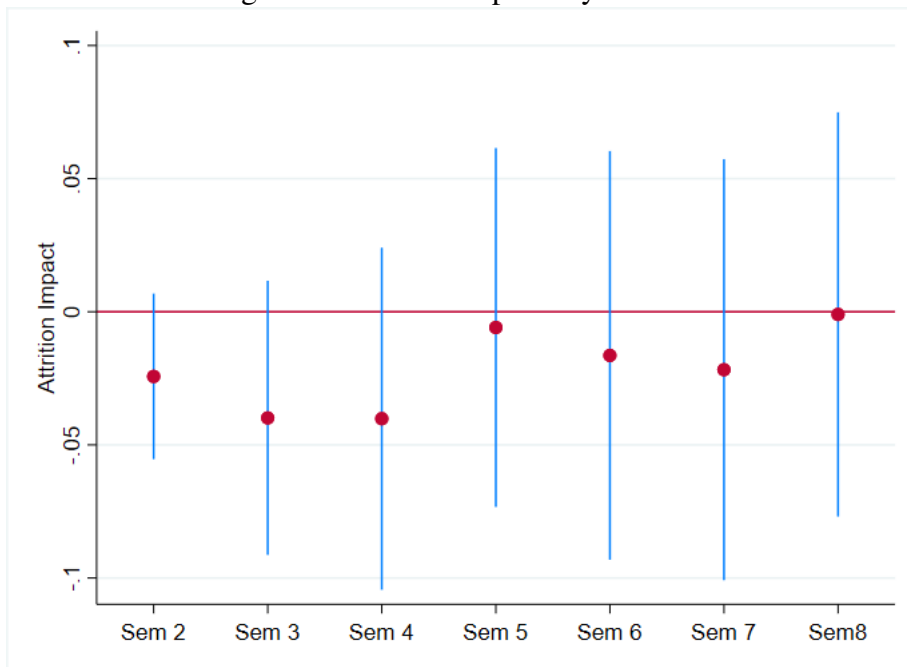
Notes: The graph shows a local polynomial fit of the relationship between GPA in the second semester (when probation based on first semester grades takes effect) and first semester GPA.

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 equation (2).

Figure 6: 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 equation (2).