The Time Costs of Academic Credit Hours: Evidence from USAFA *

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Abstract

The time costs of academic credit hours are not well understood due to data limitations and endogenous course selection. Using administrative computer logs of campus departures linked to academic records, we show each credit hour reduces high value leisure by 7 hours per semester among United States Air Force Academy cadets who face uniquely large administrative barriers to schedule changes. Leveraging significant and unexpected changes to graduation requirements, we find the cost may exceed 17 leisure hours per credit. These results account for 17-50% of the time cost imposed by a 3 hour course. Extra credits also depress performance in academics, athletics, and military duties, suggesting significant time constraints prevent students from fully absorbing shocks to course loads.

Keywords: Higher Education, Leisure Choice, Credit Hours

JEL Classification Numbers: I2, J2, D12

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1 Introduction

Facilitating on-time college graduation is incredibly important: students that fail to finish on time must pay additional tuition and forego wages for another academic term or more. With nearly 8 million new undergraduate students enrolling each year,[1] current estimates suggest that only half graduate in four years and only 60 percent within six.[2] University administrators have encouraged students to enroll in more credit hours per term in hopes that this will accelerate degree completion (Adelman, 1999, 2006; Attewell et al., 2012), but more credit hours could exacerbate delays by reducing average class performance or increasing course failures. It is difficult to anticipate the effects of adjusting course loads because doing so necessarily induces students to reallocate their time. Where students find the time for more class meetings or homework determines whether higher course loads achieve their goals. Study time has been falling (Babcock and Marks, 2011) nationwide and leisure time increasing,[3] implying that students may have more ability than previously assumed to absorb credit hour shocks by reducing leisure. Without clear evidence of leisure choice, how students react to high course loads remains an open question. We fill this gap by estimating the effect of larger undergraduate course loads on student leisure time.

The effect of an additional credit hour on student time allocation is theoretically ambiguous. An increase in academic responsibilities increases the opportunity cost of leisure; therefore, students may decrease their leisure time to study more and achieve some target GPA. Alternatively, students could adjust future term course loads and difficulty to smooth their leisure. Students may also adjust time spent on different types of activities with different levels of marginal utility, dispensing first with low-value activities such as scrolling social media before cutting back on high-value weekend trips, for example. Estimating the net effect of these competing incentives is further complicated by students endogenously choosing when to graduate with no limit on their tenure.

To our knowledge, we are the first to demonstrate the causal effect of additional credit hours on leisure time. To do this, we link computer logs of campus departure and arrival times of all U.S. Air Force Academy (USAFA) cadets to their academic records in four consecutive semesters. Unlike other undergraduate students, cadets cannot set their own schedules; course enrollment is managed by their academic advisors and many

1. U.S. Department of Education, National Center for Education Statistics. Digest of Education Statistics 2023: Table 303.70.
2. Integrated Postsecondary Education Data System (IPEDS), Graduation Rates component final data (2002-2022) and provisional data (2023)
3. National Survey of Student Engagement (2024). NSSE Summary Tables - Core Survey. NSSE Interactive Reports. Retrieved from nsse.indiana.edu.

students do not pursue any changes after initial declaration. Cadets must also graduate in eight semesters without exception. Thus, there is limited opportunity for endogenous course load selection or smoothing. Conditional on cadet fixed effects to account for any remaining idiosyncratic bias, an additional credit hour reduces high-value leisure time spent off-campus by 6.9 hours, on average. Still, our estimates could be biased by semester-varying, cadet-specific factors which drive a student to surmount the high barriers to course rescheduling to accommodate their travel preferences. To combat this potential bias, we additionally exploit a natural experiment in which USAFA unexpectedly reduced the number of credit hours required to graduate by class year relative to an unaffected cohort. Using graduation year as an instrument for semesterly course enrollment, we find the cost of higher course loads exceeds 17.4 hours per credit hour. We rationalize our findings using a simple labor-leisure model and show cadets exhibit a labor supply elasticity of 0.3, similar to those found in other studies of the broader labor market.

Despite the apparent substitution towards labor, higher course loads impose substantial burden to cadets in other domains. An additional 3 credit hour course reduces term GPA by 0.15-0.24 SD, military performance by almost 1 SD, and physical fitness by 0.09-0.24 SD. Thus, cadets seem to choose a new utility-maximizing bundle at a lower level of production. Although an increase in credit hours slightly increases the likelihood of academic probation, the effects are not large enough to attribute the leisure reductions to accompanying sanctions restricting cadets to campus. These secondary findings instead suggest the reduction in high-value leisure is indeed students reallocating time to academics and not to exercise or military duties.

We contribute to course scheduling literature in two important ways. First, we are the first paper to study the effect of additional credit hours on an objective measures of leisure time for an entire student body. Much work has been done to understand the impacts on student performance such as GPA, completion rates and timing, and academic probation (Aina et al., 2024; Attewell and Monaghan, 2016; Bostwick et al., 2022; Huntington-Klein and Gill, 2021) but the welfare effects cannot be determined without understanding how students adjust their leisure in response. The few studies that can examine student time-use rely on self-reported time diaries (Barrow and Rouse, 2018; Stinebrickner and Stinebrickner, 2008) which are prone to recall bias and measurement error (Te Braak et al., 2023). Our study improves upon existing efforts by using computerized logs of cadets' campus departures and arrivals as a systematic and objective measure of high-value leisure time.

Second, we contribute by credibly estimating the causal effect of increasing academic credit hours. While some studies potentially avoid endogenous student behavior by leveraging natural experiments (Aina et al.,

2024; Bostwick et al., 2022), most rely on student fixed effects alone with conflicting results (Belanger et al., 2019; Darolia, 2014; Huntington-Klein and Gill, 2021; Kramer et al., 2018). We address these limitations directly with both fixed effects and quasi-experimental methods in combination with cadets' limited control over their schedule and required eight semester tenure. Phipps and Amaya (2023) similarly provide strong evidence that randomly assigning West Point cadets additional military training courses (hand-to-hand combat or survival swimming, for example) reduces GPA and increases course failure rates. Our work substantially differs, however, in that we examine the impact of additional *academic*—rather than military—credit hours, which are more representative of a typical post-secondary experience.

2 Background

Student life at USAFA is, in many ways, similar to what is experienced at other competitive Liberal Arts Colleges. USAFA is regionally accredited by the Higher Learning Commission (HLC) and offers 27 academic majors in subjects such as History, Mathematics, Biology, and Economics. To meet degree requirements, students spend the bulk of their time dedicated to academic courses similar to those offered by other colleges. USAFA is, however, different in some important ways. After the successful completion of exactly eight semesters of studies,[4] students are awarded a Bachelor of Science in their chosen field, as well as a commission into the United States Air or Space Force. In preparation for their military careers, students must also meet requirements for athletic and military training and obey a strict behavioral code of military discipline.

USAFA is also unique in that cadets have less control over their academic time than a typical student. Class attendance is mandatory and the USAFA degree program is quite demanding with around 93 credit hours of required core curriculum. To facilitate timely completion, cadets are not able to make changes to their schedule without approval from their faculty academic advisor. Moreover, cadets' academic requirements have often changed without cadet input or notice. Most dramatically, USAFA underwent a series of significant curricular changes that adjusted graduating course requirements for several cohorts of students which provides exogenous variation in cadet academic credit hours.

Although USAFA imposes stricter rules governing student life than a typical university, cadets appear to spend their time in similar ways to the average post-secondary student. In January 2014, USAFA conducted a detailed time-use survey of 25% of students across all class years in which cadets recorded their time spent

4. Additional semesters are rarely granted and only in extenuating circumstances.

on various categories of activities such as sleeping, eating, and studying during a two-week period. Figure 1 compares the average weekday and weekend for USAFA cadets to students in the American Time-Use Survey (ATUS).[5] Cadets tend to spend less time sleeping, attending to meals and grooming, and at leisure, but more time in class, studying, and exercising. These differences are not surprising: USAFA cadets uniformly take classes at a college more competitive than the national average, have a uniformly high course load of 5-6 classes per semester, and are required to pass periodic physical fitness assessments. Cadets also spend a fair amount of their day on military duties (the "work" category) which are roughly analogous both in time and scope to a part-time job or extracurricular affinity groups. But, unlike a traditional university student, these duties are not optional which restricts a cadet's ability to optimize their daily schedule.

Figure 1 also shows cadets tend to spend relatively more leisure time away from home i.e. off-base. While the USAFA campus offers some amenities such as a coffee shop and food court, the options are limited and operate shorter hours than on a typical university campus. Although there are a wide variety of amenities off-base, leaving base requires non-trivial travel by car and cadets are not always authorized to leave the base area. Because off-base recreation is costly and cadets still so routinely seek it, we define their time away as high-value leisure – higher value than low-value leisure activities on-base such as reading or watching TV. The sign out logs give us an objective and systematic way to measure this high-value leisure time. We describe the sign out system and these curricular changes in detail in the sections below.

Cadets must maintain accountability for their whereabouts at all times during the academic year. The academic duty day follows a set schedule Monday to Friday beginning around 5 AM and concluding mid-afternoon. Compliance with this schedule (e.g. attending class or noon meal) is considered a cadet's military duty and therefore not optional. Any non-emergency absence from academic time must be approved beforehand by a committee of commissioned Air Force officers and is generally granted only for official cadet duties like military events or intercollegiate athletic competitions.

After their duty day has ended, cadets are free to spend their time how they choose but may not leave base without permission. Cadets are granted standing permission during certain days and times depending on their class rank. For example, freshmen are only permitted to leave on some weekends, sophomores are allowed to leave Friday-Sunday, and juniors and seniors may leave at any time after the duty day but must return by 8 P.M. and 11 P.M., respectively. In addition to standing entitlements, cadets are granted passes ranging from

5. We use the 2012-2019 ATUS sample of full-time students aged 17-23 with no dependents during the academic months of September to April.

1-3 trips per week to spend on trips outside their current privileges. For example, a freshman is granted 1 trip any day of the week provided they return by 8 P.M. Higher class ranks receive more and longer passes: for example, sophomores receive 1-3 8 p.m. passes per week, while seniors are permitted 1-3 overnights per week.[6] The within-rank pass budget increases as cadets complete phases of military training during the progression of the academic year. For example, a freshman cadet does not begin accumulating passes until the middle of their Spring semester. The entire cadet body progresses through training phases simultaneously, regardless of rank. Hence, the pass budget for cadets in good standing is almost entirely a function of rank and time-in-rank. In summary, upperclassmen are allowed a greater number of passes with greater flexibility in their use and thus we expect them to be more responsive to changes in time costs as detailed below.

Cadets record their time off campus and pass usage in a computerized sign out system. A cadet first records their departure time and whether an official or recreational pass is to be used.[7] Upon return, they log their arrival time and the system calculates the elapsed time off base and deducts the appropriate number of passes from the cadet's budget. Departing base without signing out is considered a serious offense known as "over the fence" (OTF). Because OTF is considered absence without leave (AWOL) by USAFA, cadets caught off-base without approval face considerable discipline ranging from loss of privileges (including sign out allowances), loss of rank and/or position in their squadron, to disenrollment (USAFA, 2023). An AWOL cadet could also face general court-martial (U.S. Congress, 2023) which could result in loss of monthly stipend, confinement to quarters, or dishonorable discharge. Cadets punished for OTF are highly visible in their squadron-year (roughly 30-person peer group) and the entire cadet body[8]: restricted cadets typically would not be allowed to travel for intercollegiate competitions, might be required to march around common areas in their highly-conspicuous service dress uniform, and, in some cases, must lead other probationary cadets through the same disciplinary process they experienced. Furthermore, the chances of being caught are high; the nearest off-base amenities are at least 30-minute round trip by car. Although a cadet could, for example, secretly leave base to quickly purchase food and return, anything more than that would very likely result in an OTF. Because of the severity of punishment and likelihood of detection, cadets use the sign out system to track most significant trips off-base.[9]

6. No cadet is allowed more than 72 hours absence nor allowed to travel outside a 150 mile radius around USAFA without special approval.
7. The logs also include a destination field, but is defined by the cadet and not required. Hence, it is often incomplete or non-specific, e.g. "Colorado Springs."
8. Cadet disciplinary actions are also publicized in an email bulletin sent to the entire USAFA organization.
9. Current and former cadets have corroborated the very high perceived costs of OTF.

3 Data

Our dataset includes academic and demographic records for the entire population of students attending USAFA between Fall 2000 until Spring 2021, covering CYs 2004-2021. These data include information on outcomes such as courses completed and grades earned as well as background factors such as pre-college standardized test scores and demographic attributes. The administrative sign out logs overlap with the academic panel for four semesters: Fall 2016, Spring 2017, Fall 2017 and Spring 2018 which covers CYs 2017-2020. We observe sign out logs for 4,233 individual cadets during these four semesters for a total of 15,168 semester-by-cadet observations.[10] Combining datasets, 13,876 of these cadet-semesters of sign out data can be linked to academic records resulting in joint data for 4,018 unique students. The majority of student-semesters that cannot be linked can be attributed to students with irregular schedules due to early disenrollment, studying abroad, etc. Of these students, our analytical sample contains 3,758 students with complete records of all variables necessary for analysis.

We then link academic records to the sign out logs using a unique cadet identifier. We are able to link to 264,406 unique trips during the Fall 2016-Spring 2018 period. Almost 90% of sign outs (235,028) are reported as strictly recreational, 428 passes are explicitly non-recreational reasons such as medical emergencies or bereavement. The remaining 29,350 sign outs were considered official travel with prior approval, often related to travel for collegiate sports but also including travel for class field trips, club activities, or other academic or military duties. Whether this official travel should be considered labor or leisure is ambiguous. While we may wish to exclude from our sample intercollegiate athletes traveling with official approval to weekend competitions, we may also wish to include non-athletes traveling to spectate those competitions which also requires the same official approval. Required sport or class activities may not seem particularly recreational, but even these required travel events likely include recreation as cadets socialize in and around their scheduled travel. Moreover, students may decrease or increase their participation in sports and other activities in response to variation in their academic obligations, and excluding official travel would preclude estimating the magnitude of these adjustments. To accurately portray the effects of varying credit hours on different types of student time we show separate estimates for all non-emergency sign outs (including officially-approved travel) and purely recreational sign outs (excluding official travel). We further investigate the potential heterogeneity of travel type by showing results for recruited athletes and

10. Some clearly erroneous records were removed e.g. sign outs with negative duration or lasting for several week.

non-athletes separately.[11]

Figure 2 shows the relationship between the number of credit hour units and sign out activity. The first panel shows a histogram of credit hours for our sample. The vast majority of student-semesters feature between 15 and 22 credit hours, with very few ever taking fewer than 15 credits or more than 22. Semester credit hour load is negatively correlated with the total time spent off-base, the total recreational time spent off-base, the total number of trips off-base, and the total number of strictly recreational trips off-base trips. This suggests that coursework indeed serves as an obstacle to high-value recreation. Furthermore, the substitution effect between sign outs and course load appears to be increasing in credit hours for number of trips: the duration is somewhat flat until approximately 18 units. Interestingly, the relationship between credit hours and total number of sign outs is quite steep at low credit hours but levels off around 20 units: students increasing from 4 to 5 courses show large changes in their sign out activity, but adding a sixth or seventh class appears to be correlated with very little change to the total number of sign out events.

4 Curricular Changes

Beginning in April 2016, USAFA underwent a period of substantial changes to the core curriculum that resulted in different required course loads by graduating class year (CY). Effective Fall 2018, the core curriculum for CY 2021 and beyond was revised to reduce the total credit hours needed to graduate and increased freedom of choice through basket options and increasing some lab courses to four credit hours (USAFA, 2017c).[12] Basket options allowed cadets to choose two of three science options, for example, and tailor some of the core curriculum to their desired degree path. The overhaul reduced the number of required courses from thirty-two to twenty-nine while maintaining ninety-three credit hours with the goal of eliminating the need for semester overloads for all cadets in all majors (USAFA, 2016).[13] Under the previous regime, some majors required as much as 149 credit hours to graduate and cadets needed to enroll in six courses every semester to complete degree programs in Mechanical Engineering or Astronautical Engineering, for example. After these curricular changes, even students selecting majors with the highest course load would only need at most five semesters with six courses (including one-hour military education

11. To prevent endogenous selection in and out of athlete status we define athletes as students recruited by an intercollegiate sports team prior to enrolling at USAFA.
12. All curriculum handbooks and change proposals are available upon request from the U.S. Air Force Academy Office of Student Academic Affairs and Academy Registrar.
13. The core curriculum change was also part of broader re-alignment of academics with USAFA institutional learning and mission outcomes on the recommendation of an external curriculum review.

courses) which reflects a significant change to credit hour requirements.

The following April 2017, one of the planned basket options was accelerated to include CYs 2018-2020, effective Fall 2017. The result was an unanticipated and under-publicized reduction of three credit hours in graduation requirements. The basket option combined two required courses—a senior-level literature course and senior-level geopolitics course—into a single sociocultural choice (USAFA, 2017c) from a basket of seven courses. This relieved staffing pressure in the English and Geosciences departments which had severe faculty shortages that limited the ability to offer majors and core classes at the typical seat cap of twenty-five students (USAFA, 2017a). Communication of the change was not widespread and, as a result, many advisors late-dropped one or both of the old requirements from course schedules without involving the affected cadet.

The final relevant change made simultaneously (April 2017) reduced the amount of Military & Strategic Studies (MSS) by 1.5 credit hours for CYs 2019 and 2020. Anticipating the new core requirement of only 4.5 hours of MSS (down from six), the MSS department offered a stop-gap course to ensure continuity of commissioning education across CYs (USAFA, 2017b). Beginning in Fall 2018, CYs 2019 and 2020 would take a temporary 1.5 credit hour MSS course (USAFA, 2018) rather than the 3 credit hour course CYs 2017 and 2018 previously completed.

In summary, the whole of changes between March 2016 and April 2017 created three distinct cohorts: (1) CY 2017 which experienced the original requirements of 96 credit hours in 32 courses, (2) CY 2018 which only needed 93 hours in 31 courses after implementing the sociocultural option early, and (3) CYs 2019 and 2020 which had 31 courses and only 91.5 credit hours after both the sociocultural and MSS reductions. Because the changes were imposed by graduation year for cadets who were already enrolled, the fluctuations in course load and credit hour requirements are exogenous. Figure 3 shows CYs 2018-2020 attempted fewer credit hours than previous years in almost every semester of their tenure at USAFA. After the curriculum overhaul went into effect, course enrollments returned to the historical average with CY 2021 completing roughly similar credit hours per semester as CYs 2017 and prior (with perhaps fewer courses taken in their graduating year as was the intent).

Our sample consists of students in CYs 2017, 2018, 2019, and 2020 because we observe sign out logs between August 2016 and May 2018 which fortuitously overlaps with the above-described curriculum changes. The top panel of Figure 3 shows the average credit hours taken by each cohort in each semester. CY 2017 completed similar levels of credit hours each semester as all previous CYs. CY 2018 diverged from previous cohorts in semesters 7 and 8 (their graduating year) by roughly five credit hours which coincides with

one fewer sociocultural requirement effective Fall 2017 and the ability to frontload their academic schedules by two semesters. CYs 2019 and 2020 completed about half a credit hour less than CY 2018 in semesters 5-6 and 3-4, respectively, after their MSS requirement was reduced. The new core was implemented in Summer 2017 as CY 2021 was entering USAFA and returned to the typical average semester load of CYs 2004-2017 which supports our claim that CYs 2018-2020 experienced a temporary and cohort-specific shock to their course loads. Although the Spring 2020 semester does not appear in our sign out data and is not used to identify the effects of sign outs below, one may also notice the CY 2020 graduates took about 2 credits fewer than would be predicted by the preceding cohorts. This was not due to planned curricular changes but was a response to the Covid-19 pandemic. Seniors were granted granted early completion at reduced credits for many of their core required courses during the Spring 2020 semester to allow for their early graduation and thus early departure from USAFA.

The lower panel of Figure 3 highlights the cohort-semesters used in our analysis. There is significant variation in semester course loads across CYs induced by curricular changes between March 2016 and April 2017. Younger cohorts may have been able to smooth their course loads in future semesters—e.g. CY 2020 seems to converge with CY 2018 in semesters 6-8—but we do observe same-semester differences across cohorts that coincide with the effective dates of graduation requirements.

5 Causal Identification

Despite the strong and intuitive correlations between sign outs and credit hours, the choice of labor-leisure allocation is clearly endogenous to a host of unobserved student characteristics and preferences. Although Figure 2 shows a negative correlation between course load and sign outs we cannot account for other unobserved factors that determine how cadets choose to spend their time on academics versus recreation. To combat potential selection bias in our estimates, we use two complementary identification strategies to corroborate our findings: cadet fixed effects and instrumenting enrollments with curricular changes by graduation year.

5.1 Cadet Fixed Effects

The negative correlation between course load and leisure found above could be driven by student-specific factors. For instance, some students place higher priority on their studies, causing them to both take more

classes and spend less time off base. Alternately, some students may have less opportunity for recreation off-base and therefore choose to take more classes. Hence, we include student fixed-effects to address concerns of bias from unobserved, time-invariant student-specific factors in the following panel model:

$$Y_{ist} = \alpha + \beta \text{Credit Hours}_{ist} + \mu_i + \mu_s + \mu_y + \varepsilon_{ist} \tag{1}$$

Y_{ist} are again sign out outcomes for student i with s semesters of tenure. The estimated effect of credit hours per semester on sign outs, β, is additionally conditioned on student fixed effects μ_i to account for any time-invariant, cadet-specific preferences for sign out leisure time. We also include tenure fixed effects, μ_s, to control for sign out allowances increasing with seniority and calendar year fixed effects, μ_y, to account for any changes to sign out policies that are common to all cadets. Notably absent from our model are additional cadet-level covariates to satisfy conditional independence. While we observe many demographic and academic attributes of cadets, all that vary by semester seem overwhelmingly likely to be endogenous to course enrollments, such as academic major.

Our estimates of β give the casual effect of credit hours on sign outs if there are no time-varying, student-specific shocks correlated with both course load and sign out behavior. Although this may seem unrealistic at most institutions, this assumption is more likely to hold at USAFA. First, it is hard for students to significantly modify their schedule because of the large curricular requirements. Students must complete 91-96 credit hours of required core curriculum which does not leave much room for variation in any individual semester. Second, beyond total curricular requirements, the strict requirements on timing and sequence further restrict students' ability to make meaningful changes to their schedules. For example, two semesters of core calculus and science classes must be taken in sequence during first year, while a semester each of Econ and Law must be completed during the second year. Third, rescheduling some core courses within an academic year is often impossible because many course are only offered either fall or spring and many core classes have so many students that they are over-enrolled in alternate semesters and therefore closed to any changes in registration. Academic majors are also quite large, requiring around 45 credit hours on average mirroring both the size and sequencing limitations found in the core curriculum. Within each major, most students are only allowed 3-4 elective courses, which themselves may have prerequisites limiting the semesters a student would be eligible to enroll. Students are usually enrolled in 5-6 courses per semester at a minimum to meet requirements—even in their senior year—leaving little room for additional course enrollments or rearranging required courses.

Lastly, in addition to the core and major requirements, students must satisfy semester course registration minimums. Even students with many credit transfers and validations must still take at least 4-5 classes every semester to meet minimum registration. This means students stand little to gain by strategically scheduling courses; for example, front-loading their schedule by overloading classes in early semesters would only result in having to take additional classes later on to meet minimums. In sum, because of the large number of core, major, and semester registration requirements students typically stand to gain very little from any changes to the default prescribed four-year academic schedule.

There are also significant procedural obstacles to students modifying their course enrollment in a given semester. Unlike most colleges, students at USAFA are not allowed to register for classes nor independently change their academic enrollment. Initial courses are set for first-year students during matriculation and changes for undeclared students can only be made in coordination with their faculty advisor with approval of the lead advisors for undeclared students. For upperclassmen, academic courses are set at major declaration by the department lead advisor and future changes can only be made in coordination with their assigned major advisor and then approved by the major's lead advisor. Although advisors can and do make changes at an advisee's request, it is still a more regimented process than is found at other institutions. Pre-registration is set electronically in April and October for the Fall and Spring semesters, respectively—3-5 months ahead of class start. After this deadline, schedule changes require a schedule change request form hand-delivered to the Registrar with physical signatures by the student, advisor, lead major advisor, and the lead advisor of any courses being added or dropped. Any changes requested after the first week of classes also require signatures from the affected academic department(s) head or Vice Dean (depending on the date). This presents a major obstacle to schedule changes by the student. Because of the curricular inflexibility mentioned above and tedious process to request changes, we observe that students largely accept their schedule as dictated by the first-year and then major template. One notable exception is that athletes may attempt to lighten course loads in-season when they declare their major. Fortunately, we can explicitly test for this strategic scheduling by subsetting our results by athlete status.

5.2 Fixed Effects Results

Table 1 shows the effect of credit hours on student sign outs with individual fixed effects estimating as in Equation 1. Each additional credit hour leads to 6.9 fewer hours spent off-base (4 percent) and 0.24 fewer trips of any length (1.5 percent), both statistically significant at the 1% level. To put this in context, a typical 3

credit hour class leads to 20.7 fewer hours off base per semester. Since the modal course at USAFA consists of 40 one-hour lessons, the full time cost of an additional course is at least 40 hours per semester and potentially 120 hours if we assume the recommended class to study time ratio of 1:2 (U.S. Department of Education, 2010). This means that the roughly 21 hour reduction in time off base reflects about half of the mandatory class time. If each class costs students around 120 hours, 17.25% of this time necessary to complete an additional course comes from reducing high-value leisure while the remaining 100 hours must come from a reduction in time spent on mandatory activities or low-value leisure time such as sleeping or socializing on base. Because we include individual fixed effects, these results cannot be attributed to individual differences in preferences for time spent off-base or other factors collinear with the individual including academic major, squadron, cohort, or demographic factors. Interestingly, the effect on strictly recreational hours spent off-base is insignificant for the full sample and the effect on the number of strictly recreational sign outs is statistically significant at 10% but about half as large; an additional credit hour taken reduces time spent off-base by a statistically insignificant 2.36 hours and the number of recreational trips by 0.16 (significant at the 5% level). This suggests that changes in official travel may explain some of these results. Columns 1 and 3 in Appendix Table A1 show that results are similar for cadets crossing an 18 credit threshold as a student would experience going from five to six academic courses. This suggests that the estimates above are driven primary by changes for somewhat representative students not, for instance, highly motivated students moving from 22 to 25 credits. Odd-numbered columns in Appendix Table A2 compares similar fixed effect estimates across quartiles of academic composite. Estimates throughout are similar by academic composite, suggesting that previous academic experience does not drastically influence students' ability to adjust to credit hours changes.

We show heterogeneous effects by class rank and athlete status in Table 2. Columns 1 and 2 of Panel A show the effect of an additional credit hour for upperclass non-athletes and athletes is approximately 10.1 ($p < 0.01$) and 12.9 ($p < 0.05$) fewer hours spent off-base, respectively. This suggests that athletes' competition travel alone does not explain the effects found in Table 1. We find no effects for underclass non-athletes as expected given the restrictions they face, while underclass athletes spend 13.23 fewer hours off-base per credit hour (significant at the 1% level). Panel B shows upperclassmen allocate their time slightly differently by athlete status. Both groups reduce their leisure hours but non-athlete upperclassmen take 0.43 fewer trips in response to an additional credit hour (significant at the 1% level) while their athlete counterparts reduce the number of trips taken by half as much (-0.25), and the effect is noisily estimated. Taking columns

1 and 2 of Panels A and B together, it seems both groups spend less time off-base, but athletes tend to take the same number of now-shorter trips. Panel B again shows underclass non-athletes sign outs are unaffected by additional credit hours (column 3) while underclass athletes take a statistically significant 0.24 fewer trips per credit hour ($p < 0.05$).

Panels C and D of Table 2 show the effects are driven by recreation for less-constrained non-athletes and official travel for more-constrained athletes. We estimate non-athlete upperclassmen spend 8.5 fewer hours and take 0.39 fewer trips per credit hour, or 24 fewer hours and one fewer trip per academic course, both significant at the 1% level. This means the sizable effect for non-athletes is mostly explained by recreational travel. On the other hand, upperclass athletes' recreational travel is largely unaffected by additional credit hours (column 2 of Panels C and D). Given that these athletes spend so much time on official travel for competition, it is unsurprising that athletes have little time left to spend on off-base leisure. We find no or noisily estimated effects on recreational hours and trips for either type of underclassmen who have little opportunity to leave base.

5.3 Cohort Instrumental Variables

Our fixed effect estimates likely reflect the causal effect (at least for non-athletes) of credit hours on high-value leisure time spent off base because of the enormous barriers to rescheduling courses discussed in Section 5.1. Nonetheless, it is still possible for cadets to convince their advisor to adjust their schedule to allow more leisure time, potentially biasing our results if their idiosyncratic efforts vary by semester. For example, some students could move courses to the Fall semester to make their Spring enrollment lighter and allow for more ski weekends. To alleviate concerns that time-varying, student-specific factors threaten our identification, we estimate an instrumental variables model exploiting changes to the core curriculum that occur across graduating year cohorts (CY) (see Section 4). In short, CYs 2018-2019 were required to complete fewer total credit hours to graduate than CY 2017, and CY 2020 had an even lighter requirement than all three. By CY 2021, the graduation requirement returned to the long-run average, implying the changes were unexpected and temporary (see Figure 3).

To estimate explicitly the effect of these curricular changes on classes taken and then sign out activity we estimate via two-stage least squares:

$$\text{Credit Hours}_{ist} = a + b_1\,\text{CY 2018}_i + b_2\,\text{CY 2019}_i + b_3\,\text{CY 2020}_i + \mathbf{X}_i c + \mu_s + \mu_t + u_{ist} \tag{2}$$

$$Y_{ist} = \alpha + \beta^{\text{IV}}\widehat{\text{Credit Hours}}_{ist} + \mathbf{X}_i\gamma + \mu_s + \mu_t + \varepsilon_{ist} \tag{3}$$

In the first stage, we instrument $\text{Credit Hours}_{ist}$ with a set of indicators for graduating in 2018, 2019, or 2020, relative to the cohort graduating 2017. We further condition on vector of student-specific factors, $\mathbf{X}_i$, namely, academic composite (a measure of pre-USAFA academic ability including standardized high school test scores) and the interaction of semesters of tenure, non-white, female, and recruited athlete. Last, we include fixed effects for semesters of tenure, μ_s and calendar year, μ_t. Our instruments leverage the reduction in required courses by graduation year relative to the status quo of CY 2017 (see Section 4). The second stage uses the predicted number of credit hours as an exogenous determinant of sign out behavior, Y_{ist}, conditional on student characteristics and tenure and calendar year fixed effects.

The causal effect of credit hours on signouts β^{IV} is identified by two-stage least squares if our graduation year cohort instruments satisfy the relevance and exclusion restriction assumptions. Table 3 shows the first stage F-statistic of 275 is quite large so the relevance assumption is likely satisfied. We anticipate cohort to be strongly correlated with credit hour loads because each CY has a default template for both core and majors courses. Although students may choose to deviate from the typical course load each semester, this will not bias our estimates so long as cohort is still correlated with credit hours in each semester.

We also argue that graduating class year only affects sign out behavior through semester credit hour loads. The first threat to this assumption is students' strategic selection of USAFA cohort based on knowledge of coming curricular changes and their propensity to sign out. Most students begin college immediately after high school, so our cohort instrument is heavily influenced by birth year. We have no evidence that birth year alone significantly influences propensity to sign out and are not aware of any reason for students born in different years to have significantly different propensities to sign out. Importantly, we show that the differences in sign out behavior are specific to semesters where cohorts differ in average credits, so an alternate explanation driven by cohorts' differential propensity to sign out seems extremely unlikely. Some USAFA students do not come straight from high school and enter USAFA either as previously enlisted or as a transfer from some other university. It seems exceedingly unlikely for students to change their enlistment of transfer plans to take advantage of USAFA's changing core curriculum. The fact that these changes were

implemented suddenly and without communication outside the USAFA community casts even more doubt. We address concerns of strategic enrollment timing by showing estimates after removing cadets with prior military service, experience at the USAFA prep school,[14] or a large number of transfer credits from other universities. The similarity of the results excluding these students with unusual schedules suggests that the behavior of these students does not explain the results shown. Lastly, there could be some unobserved variable correlated with cohort that is also correlated with sign outs in a given semester. However, all results are conditioned on academic year as well as semesters of tenure. This means that any sort of year-to-year or tenure-specific variation in pass budgets will not bias our results. It is still theoretically possible that, for instance, cohorts with lower course requirements were also systematically granted a larger sign out allowance. This runs contrary to how pass budgets are usually allocated, and we find no evidence of cohort-specific variation in pass allowances based on cadet military standards documents.

5.4 IV Results

Table 3 displays the results from estimating Equation 3 using two-stage least squares. Column 1 shows the first-stage estimates of predicting credit hour loads by CY conditional on student characteristics and fixed effects for tenure and calendar year. CYs 2018-2020 completed between 2.1 and 2.5 fewer credit hours per semester on average than CY 2017 which coincides with the average course loads by cohort shown in Figure 3. The first stage IV estimates do not exactly match differences in stated credit hour requirements for graduation because curricular changes were binding in different semesters for different cohorts due to required sequencing. In addition, younger cadets had more notice of these changes and likely smoothed their course loads across semester more than earlier-graduating cohorts. There is some evidence of monotonicity in graduation year, although statistically we cannot reject the null hypothesis that the effect is the same across cohort at the 10% level. Columns 2-5 show the second stage IV estimates of the effect of credit hours on sign out behavior. We find that an additional credit hour reduces students' time spent off-base by 17.4 hours on average, significant at the 1% level. This estimate is much larger than what was found in our using fixed effects. Intuitively, students may try to balance their semester course loads to leave space for recreation, but the exogenous and unexpected curricular changes meant that many students could not smooth as effectively. Column 3 shows that each additional credit hour of enrollment causes cadets to take .52 fewer trips off

14. Typically reserved for people who do not meet academic admission standards but are admitted contingent on passing a remedial year of instruction.

base, although this effect is noisily estimated. Columns 4 and 5 show similarly negative impacts on strictly recreational sign outs. Unlike our fixed effects results, reductions in sign outs induced by curricular changes are almost entirely driven by recreational leisure: cadets reduce time off-base by 12.5 hours and 0.34 trips per semester for every additional credit hour taken. This suggests that cadets may be more willing and able to adjust their recreational sign out behavior than their officially-sanctioned time off-base. Columns 2 and 4 in Appendix Figure A1 show that IV results are similar using crossing an 18 credit threshold as our treatment rather than just adding one additional credit. Even-numbered columns in Appendix Table A2 compares similar IV estimates across quartiles of academic composite. As with our fixed effect estimates, We find mostly similar IV estimates across the spectrum of previous academic experience.

Table 4 shows second stage estimates for upperclass students by athlete status. We cannot estimate Equation 3 using 2SLS for underclass cadets separately because we do not observe enough semesters of sign outs for older cohorts during their first four semesters to estimate all of the first stage cohort effects along with semester and year fixed effects. Panel A shows the instrumented effect of an additional credit hour on any time spent off-base. Non-athletes and athletes reduce sign out duration by 14.4 ($p < 0.05$) and 28.6 hours ($p < 0.01$), respectively. The IV estimates exhibit a similar pattern as fixed effect estimates but the magnitude is larger. Unsurprisingly, upperclass athletes seem especially time-constrained such that they cut almost 90 hours off-base per semester for every additional three credit hour course. Column 1 of Panel B shows non-athletes reduce sign outs by a statistically insignificant 0.4 trips per credit hour while column 2 shows athletes take 1.32 fewer trips, significant at the 1% level. Unlike previous estimates, Panels C and D show our IV estimates for upperclass cadets are driven by recreational trips: non-athletes spend 12.87 fewer recreational hours off-base (column 1, Panel C, $p < 0.05$) and take 0.29 fewer recreational trips off base (column 1, panel D). The effect on recreational hours for athletes is insignificant and about half as large for any hours signed out (-14.77) but much larger than was found estimating the same relationship using fixed effects. Finally, column 2 of Panel D shows the effect of more credit hours on trips for athletes is almost entirely cutting back on recreational departures; 0.95 fewer recreational trips per credit hour, significant at 5% level. These instrumental variable estimates provide further evidence that higher course loads causally reduce high-value leisure for college students.

6 Elasticity of Leisure Substitution

To further contextualize our findings, we estimate the elasticity of leisure substitution cadets exhibit in response to larger course loads. To do this, we adapt a simple model of intertemporal labor supply as found in Keane (2011) to our context. Cadet preferences are given by $U(G_s, L_s, \mathbf{X})$ where G_s is total grade points earned in semester s,[15] L_s are hours spent leisuring off-base, and $\mathbf{X}$ is a vector of taste shifters. Cadets divide their total hours in a semester, T, between study hours, h_s, and leisure hours, L_s with the remainder $(T - h_s - L_s)$ being exogenously allocated to sleep and low-value leisure on base. We use grade points rather than consumption because students generate grades rather than income with their labor.[16] Assuming CRRA preferences that are increasing in leisure[17] and zero non-labor income, the empirical log-leisure equation is,

$$\ln L_{is} = \eta_0 + \eta_1 \ln w_{is} + \mathbf{X}_i\theta + \mu_s + \mu_t + \varepsilon_{is} \tag{4}$$

where η_1 is the Frisch elasticity of substitution from a temporary wage shock, $d \ln w$. To estimate this equation, we measure L_{is} using total hours signed out[18] by cadet i during semester s, $\mathbf{X}_i$ is the vector of cadet-specific covariates used in Equation 3, and μ_s and μ_t are semester and year fixed-effects, respectively.

Since utility is based on grade points earned rather than goods consumption, cadets' wage rate would be in units of grade points earned per study hour. Unfortunately, we do not observe study hours in our analytical sample. Instead, we use the January 2014 time-use survey to construct individual wage rates during the Spring 2014 semester as grade points earned divided by total study hours. We then predict out-of-sample the cadet-by-semester wage, w_{is}, for students enrolled during the Fall 2016-Spring 2018 semesters (our analytical sample) using a linear function of their demographics, academic composite, class rank, major division,[19] and the moving average grade points earned in the previous three semesters by students with the same course schedule. Importantly, this predicted wage rate is based on a separate student sample taking courses of similar difficulty and thus entirely unaffected by students in our analytical sample. Thus, we consider this the exogenously-determined "market" wage for all cadets with a particular set of observable attributes taking the

15. Defined as credit hours times grade received out of 4.0.
16. Cadets with higher GPAs are more likely to receive their preferred USAF/USSF career assignment during their 5-year minimum service commitment so the primary incentive is to perform well in academics. Additionally, cadets are considered employed by the U.S. Air Force which legally prevents them from seeking outside employment to increase their goods consumption. For these reasons, we believe defining consumption from academic performance as the primary source of utility is reasonable.
17. Replacing labor hours—which we do not directly observe—with leisure hours merely changes the sign of the Frisch elasticity.
18. We use the predicted total hours signed out from our 2SLS model to avoid reverse causality, though results are similar using observed sign out time.
19. Basic Sciences, Engineering, Humanities, or Social Sciences.

same set of courses in any given semester. While cadets could strategically design a schedule to increase their wage rate, we do not believe this is the case for the same reasons described in Section 5.1. Furthermore, if cadets did manipulate their schedule it would likely be to smooth effort over time which would at worst bias our estimate of η_1 towards zero.

Panel A of Table 5 shows cadets exhibit an elasticity of leisure substitution -0.17, significant at the 1% level, conditional on taste-shifters and any semester- or year-specific trends across cohorts. Intuitively, estimates suggest that every 1% increase in grade points earned per study hour is associated with a 0.17% decrease in leisure time. We find a similar elasticity of -0.149 using instead strictly recreational sign out hours as our measure of leisure, also significant at the 1% level. To further combat the potential for idiosyncratic demand-shocks to wages, we include cadet fixed effects in Panel B and find even larger elasticities of -0.377 (any sign outs) and -0.322 (strictly recreational), both significant at the 1% level. This suggests that the substitution effect dominates for the average student: students spend less time leisuring off-base and presumably more time studying during semesters in which they are most productive, rather than achieving some GPA threshold with less effort and allocating the balance of their time to leisure. Although our "consumption" good of grade points is somewhat unusual and our population younger than the labor market's average, the Frisch elasticities themselves are generally in line with previous research (Elminejad et al., 2023; Keane, 2022; Orr, 2023).

7 Effects on Performance

While estimates above show that students adjust to additional time constraints by reducing their high-value leisure time, they also may reduce their effort assigned to required tasks. To investigate the magnitude of this adjustment, we estimate below how student performance changes in response to additional credit hours. In addition to typical grade point average (GPA), USAFA records a cadet's military performance average (MPA) and physical performance average (PEA) each semester, all measured on an analogous 0-4.0 point scale. MPA is a weighted average of instructors' and squadron commander's[20] subjective ratings of a cadets professionalism and leadership skills based on classroom interactions and duties performed in squadron.[21] While these scores are subjective, they are intended to measure cadet executive functioning skills, such as

20. Typically an active duty Air Force Major or Lieutenant Colonel whose full time assignment is leading a squadron of approximately 100 cadets.
21. The closest analogue to these duties in a typical university setting would be extracurricular club officers, such as a treasurer.

organization or time management, and likely to increase from additional time dedicated to required tasks for students' academic classes and military squadrons.[22] Finally, PEA is a weighted average of physical education (PE) course grade and Air Force physical fitness test score.[23] Unfortunately, we do not observe physical fitness test scores directly so we instead use the residuals from the regression of PEA on PE grade points to isolate the variation in PEA due to physical fitness tests alone. PE grades reflect competence in specific athletic skills such as the ability to accurately serve in tennis, and athletes are automatically awarded an A for varsity practice hours during one semester per year during their sports' primary season. Although PEA gives some measure of dedication to fitness, we believe residual PEA better reflects the student's actual physical fitness throughout the semester.

Table 6 shows the effect of an additional credit hour on the three measures of performance using both our fixed effects and IV models. Columns 1 (fixed effects) and 2 (IV) show each additional credit hour course reduces a cadet's semester GPA by 0.054 to 0.084 standard deviations, both significant at the 1% level. This translates to an additional three credit hour course reducing GPA by between one-third and one-half of a letter grade; the distance between a B (3.0) and B+ (3.3), for example. Lower GPA could lead to academic probation and estimates in Appendix Table A3 shows more credit hours do slightly increase the probability of probation.[24] Column 3 shows no effect of credit hours on MPA in our fixed effects model but isolating the variation from our cohort-based instrument reveals an effect of -0.35 ($p < 0.01$) standard deviations. While subjective, it is no surprise that busier students might appear less engaged in class or forget to accomplish all of their required military duties, leading to a lower MPA rating. Lastly, columns 5 and 6 show negative impacts on standardized physical fitness test scores of 0.027 (FE) and 0.08 (IV) per credit hour, both significant at the 1% level. Although students can somewhat accommodate additional credit hours by reducing their leisure time, we also find that students make significant compromises in their academic, military, and physical performance when faced with the additional time requirements of added academic coursework.

Table 6 shows that higher course loads not only worsen academic performance but also hinder physical fitness and personal development of soft skills like time management. These results further imply two important points: first, cadets do not seem to reallocate the lost off-base leisure time to military duties or

22. The unconditional correlation between term GPA and MPA is 0.29.
23. Points are earned by performing push-ups, sit-ups, time in a 1.5-mile run, and an abdominal measurement.
24. Cadets on academic probation are restricted from leaving campus which, in theory, could be one explanation for why we observe sign outs decreasing in academic credit hours. Importantly the effect size that we find (0.005 percentage points per credit hour, $p < 0.01$), is very small - certainly not large enough to explain the impact a credit hour has on sign outs.

exercise given the lower MPA and physical fitness scores observed. Instead, they may spend those saved hours studying, though we do not observe time in academic preparation. Part of the time is likely attending additional class meetings; but, one might expect attenuated impacts on GPA if cadets devoted the remainder to studying. They may indeed study more as course loads rise to avoid even deeper GPA losses and, potentially, academic probation, but most cadets evidently prioritize academic success over squadron accolades or physical fitness.

8 Conclusion

By estimating the causal effects of credit hours on time spent off campus for college students, this paper presents new evidence on the time costs of higher education. We combine academic history with records from a mandatory sign out log to find that, on average, each additional credit hour taken is associated with about 6.9 fewer hours of off-campus recreation for USAFA students. During our sign out history USAFA underwent several revisions to its core curriculum which induces several exogenous changes to student course loads. Exploiting this exogenous variation we estimate a cohort-based IV and find the causal effect of each credit hour on high value leisure to be 17.4 hours off base per semester. Attaching to our dataset exogenous wage rates estimated from separate untreated cohorts we find the effects of wages on the leisure hours suggests a labor supply elasticity 0.377 which is similar to what has been found elsewhere in the labor literature. We also find that students respond to credit hour increases by decreasing their academic, military, and athletic performance.

Our study is particularly unique in that it examines how student leisure choice interacts with academic and extracurricular performance. A detailed panel of cadets allows us to observe a broad set of outcomes over time, characterizing credit hour effects not only on leisure and academics but also on soft skills development through leadership training and on physical fitness. Despite significant cutbacks to leisure time, cadets with additional credit hours have worse GPA, worse military performance ratings, and lower physical fitness scores. Unlike previous studies that focus on a narrow set of outcomes, we show how an added course affects a student's college experience holistically.

This paper provides the first credible estimates of the time costs of credit hours in higher education. College students at most schools exert great control over their course loads so choosing the right level of enrollment is very important for both their happiness and success. In addition, college leadership can

influence these scheduling decisions through registration policy. Better understanding these time costs could better inform the decisions by both students and college administrators.

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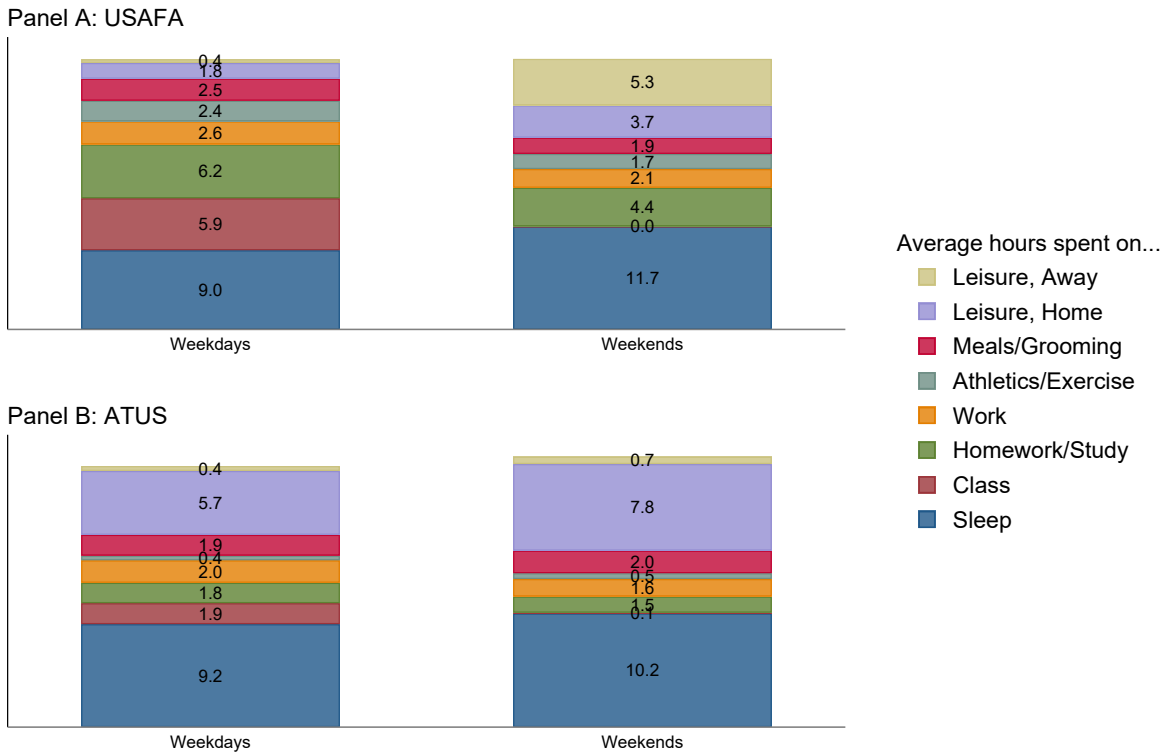
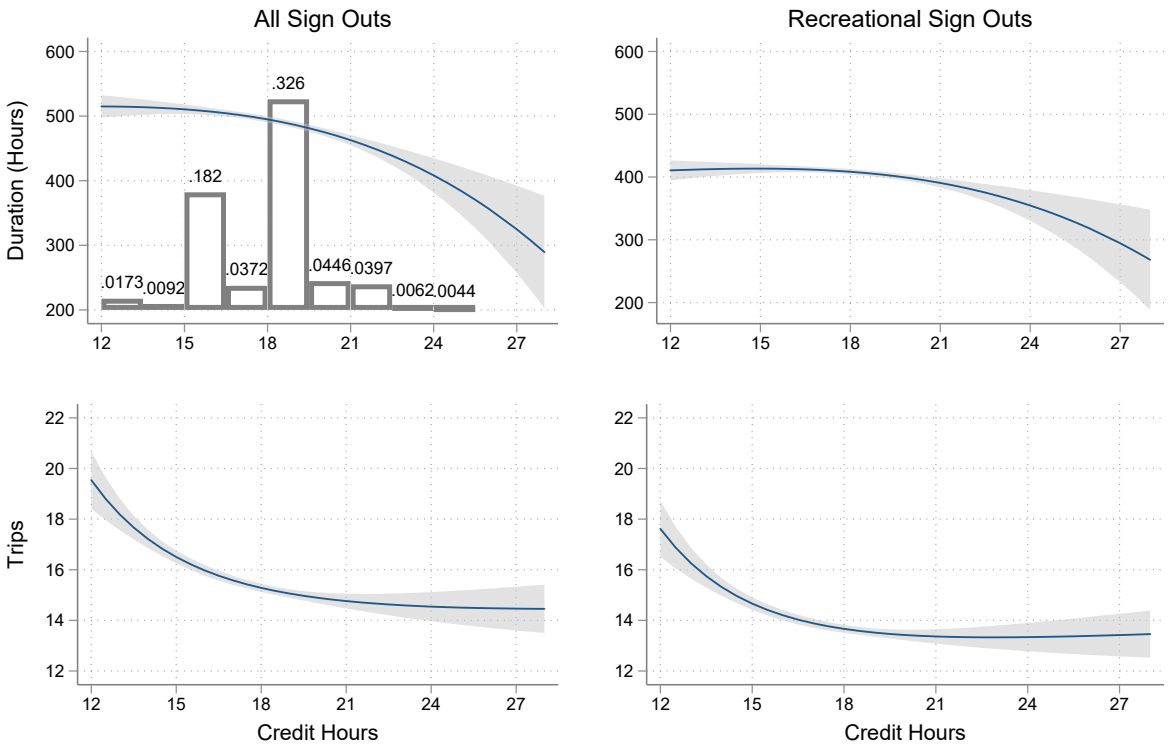
Figures and Tables

FIGURE 1 — DETAILED TIME USE BY CADETS VS OTHER POST-SECONDARY STUDENTS



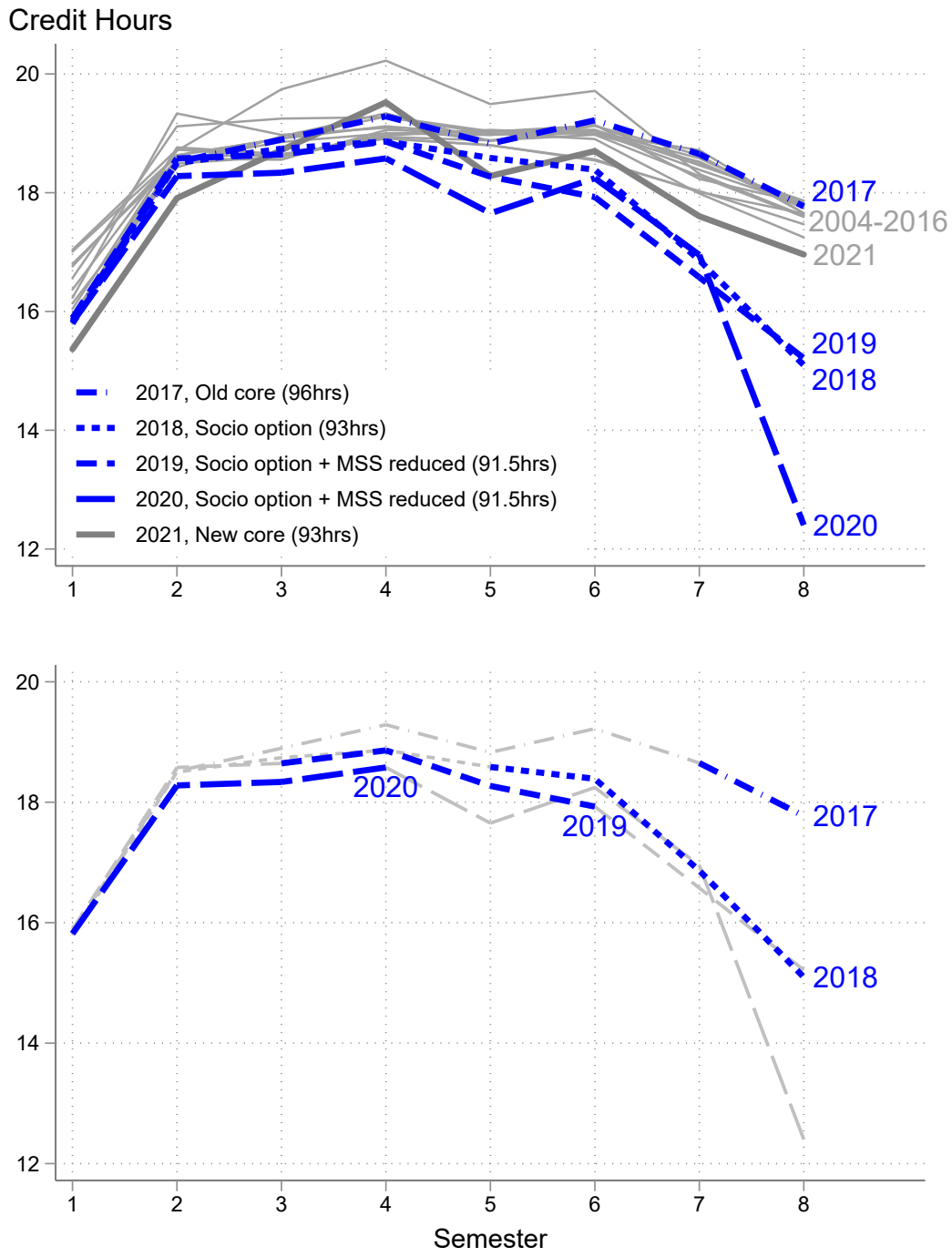
Notes: This figure compares the average time spent on various activities during weekdays versus weekends by USAFA cadets in January 2014 (Panel A) compared to any post-secondary full-time student aged 17-23 with no dependents during September-April as measured in the 2012-2019 American Time-Use Survey (ATUS). Totals do not add up to 24 hours given activities irrelevant to this study are omitted.

FIGURE 2 — CREDIT HOURS AND SEMESTER SIGN OUT ACTIVITY



Notes: This figure shows the relationship between credit hours completed in a given semester and sign out duration in hours (upper row) and number of trips of any length taken (lower row) is decreasing regardless of the reason for signing out (any, left column, and strictly recreational, right column). The density of credit hours is shown in the top left panel (bar labels). 95% confidence interval in gray.

FIGURE 3 — SEMESTER COURSE LOADS BY COHORT



Notes: This figure shows the average credit hours completed in each semester was consistent across cohorts except 2018-2020 when the curricular redesign was phased in, returning to the average historical trend in 2021. The upper panel of this figure shows the average number of credit hours a cadet attempted in each semester by cohort net of validation and transfer credit. The lower panel shows the same information for our analytic sample of cohorts. The bolded lines denote cohort-semesters with available sign out data while the softened lines show cohort-semesters without sign out data.

TABLE 1 — CADET FIXED EFFECTS: CREDIT HOURS AND SEMESTER SIGN OUT ACTIVITY

	All Sign Outs		Recreational Sign Outs	
	Duration (Hours)	Trips	Duration (Hours)	Trips
	(1)	(2)	(3)	(4)
Credit Hours	-6.910	-0.238	-2.355	-0.163
	(1.757)**	(0.058)**	(1.993)	(0.059)*
Mean of Dep. Var.	497.48	15.72	409.94	14.06
Number of Cadets	3608	3608	3608	3608
Obs	12654	12654	12654	12654

Notes: ** p<0.01, * p<0.05, + p<0.10. This table shows a negative relationship between a cadet's time spent off-base per semester and credit hours completed from estimating Equation 1 that includes individual, semesters of tenure and calendar year fixed-effects. Standard errors are clustered at the squadron group by cohort level.

TABLE 2 — CADET FIXED EFFECTS: BY CLASS RANK & ATHLETE STATUS

	Upperclass		Underclass	
	Non-Athlete	Athlete	Non-Athlete	Athlete
	(1)	(2)	(3)	(4)
Panel A: All Sign Outs, Duration (Hours)				
Credit Hours	-10.057	-12.882	-0.773	-13.231
	(1.859)**	(5.117)*	(1.693)	(3.610)**
Mean of Dep. Var.	560.08	649.71	375.52	460.85
Panel B: All Sign Outs, Trips				
Credit Hours	-0.428	-0.248	0.032	-0.238
	(0.061)**	(0.176)	(0.057)	(0.110)+
Mean of Dep. Var.	18.64	18.27	12.20	12.18
Panel C: Recreational Sign Outs, Duration (Hours)				
Credit Hours	-8.552	3.861	1.444	6.376
	(1.759)**	(5.454)	(1.070)	(3.524)
Mean of Dep. Var.	486.64	483.72	316.01	314.59
Panel D: Recreational Sign Outs, Trips				
Credit Hours	-0.399	0.051	0.057	0.095
	(0.062)**	(0.184)	(0.045)	(0.117)
Mean of Dep. Var.	17.30	15.27	10.98	9.32
Number of Cadets	2041	609	1434	425
Obs	5426	1597	4326	1258

Notes: ** p<0.01, * p<0.05, + p<0.10. This table shows the relationship between a cadet's time spent off-base per semester and credit hours completed from estimating Equation 1 that includes individual, semesters of tenure and calendar year fixed-effects separately by class rank and athlete status. Standard errors are clustered at the squadron group by cohort level.

TABLE 3 — COHORT INSTRUMENTAL VARIABLES: CREDIT HOURS AND SEMESTER SIGN OUT ACTIVITY

		All Sign Outs		Recreational Sign Outs	
	Credit Hours	Duration (Hours)	Trips	Duration (Hours)	Trips
	(1)	(2)	(3)	(4)	(5)
$\widehat{\text{Credit Hours}}$		-17.409	-0.522	-13.064	-0.356
		(6.065)**	(0.377)	(5.396)*	(0.360)
CY 2018	-2.098				
	(0.075)**				
CY 2019	-2.328				
	(0.149)**				
CY 2020	-2.471				
	(0.191)**				
Means of Dep. Var.					
CY 2017	18.21	654.05	20.53	559.91	18.96
CY 2018	17.23	587.90	18.55	494.02	16.85
CY 2019	18.43	472.21	14.15	386.04	12.54
CY 2020	17.75	366.69	12.38	287.03	10.68
F-stat	275.666				
Obs	12653	12653	12653	12653	12653

Notes: ** p<0.01, * p<0.05, + p<0.10. This table shows a negative instrumented effect of additional credit hours on cadets' time spent off-base per semester using graduating cohort as the first-stage instrument. All models include controls for semesters of tenure, calendar year fixed effects, academic composite, and interactions of semester, non-White, female, and athlete. Means of the outcome are show separately by graduation year. Standard errors are clustered at the squadron group by cohort level.

TABLE 4 — COHORT INSTRUMENTAL VARIABLES: UPPERCLASSMEN BY ATHLETE STATUS

	Upperclass	
	Non-Athlete	Athlete
	(1)	(2)
Panel A: All Sign Outs, Duration (Hours)		
$\widehat{\text{Credit Hours}}$	-14.398	-28.640
	(7.199)*	(10.934)**
Mean of Dep. Var.	559.74	648.69
Panel B: All Sign Outs, Trips		
$\widehat{\text{Credit Hours}}$	-0.404	-1.321
	(0.496)	(0.431)**
Mean of Dep. Var.	18.63	18.24
Panel C: Recreational Sign Outs, Duration (Hours)		
$\widehat{\text{Credit Hours}}$	-12.869	-14.770
	(5.943)*	(9.274)
Mean of Dep. Var.	486.36	482.98
Panel D: Recreational Sign Outs, Trips		
$\widehat{\text{Credit Hours}}$	-0.292	-0.950
	(0.480)	(0.396)*
Mean of Dep. Var.	17.30	15.24
Obs	5453	1601

Notes: ** p<0.01, * p<0.05, + p<0.10. This table shows the instrumented effect of credit hours on cadets' time spent off-base per semester using graduating cohort as the first stage instrument, separately for upperclass non-athletes and athletes. All models include controls for semesters of tenure, calendar year fixed effects, academic composite, and interactions of semester, non-White, and female. Means of the outcome are show separately by graduation year. Standard errors are clustered at the squadron group by cohort level.

TABLE 5 — ELASTICITY OF LEISURE SUBSTITUTION

	ln(Sign Out Duration (Hours))	
	All	Recreational
	(1)	(2)
Panel A: Demographic Controls		
ln(Wage)	-0.170	-0.149
	(0.009)**	(0.008)**
Panel B: Cadet Fixed Effects		
ln(Wage)	-0.377	-0.322
	(0.018)**	(0.016)**
Number of Cadets	3540	3540
Obs	12422	12422

Notes: ** p<0.01, * p<0.05, + p<0.10. This table shows Frisch elasticities found by estimating Equation 4. Panel A includes controls for semesters of tenure, calendar year fixed effects, academic composite, and interactions of semester, non-White, female, and athlete. Panel B replaces individual controls with cadet fixed effects. Standard errors are clustered at the squadron group by cohort level.

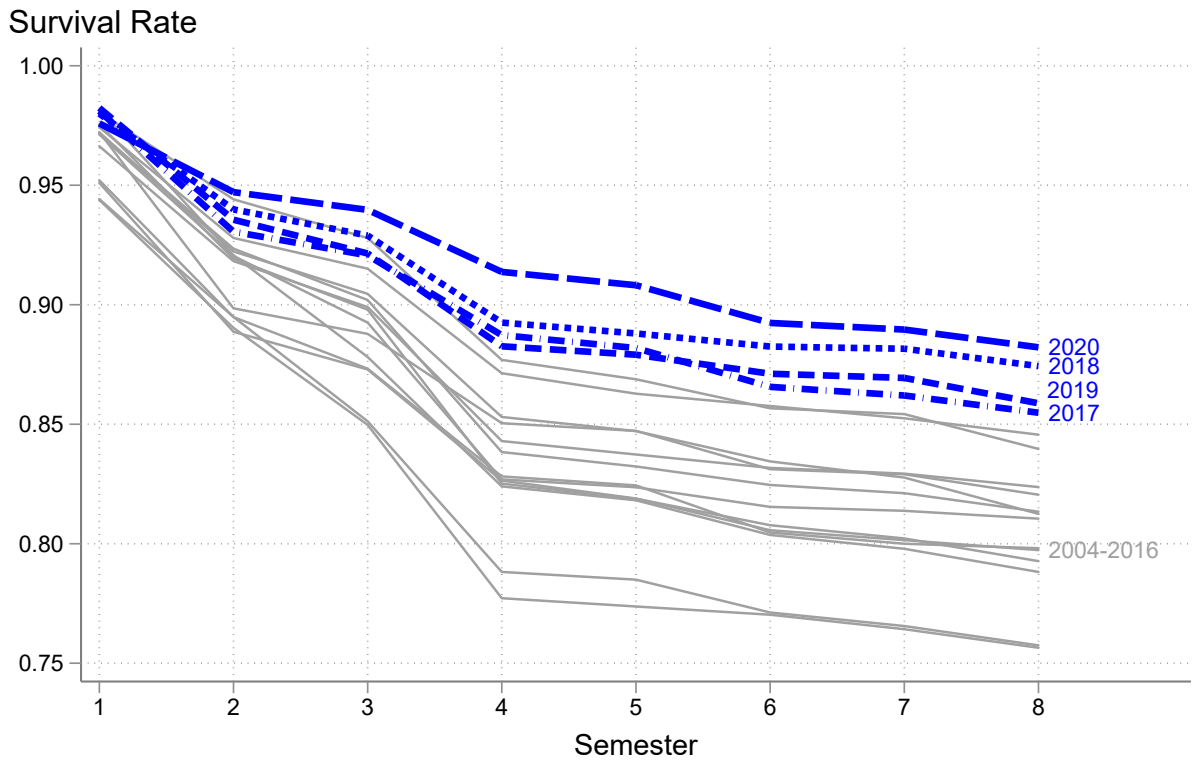
TABLE 6 — CREDIT HOUR EFFECTS ON STANDARDIZED GPA, MILITARY PERFORMANCE, AND PHYSICAL FITNESS

	GPA		Military Performance		Physical Fitness Test	
	FE	IV	FE	IV	FE	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Credit Hours	-0.084	-0.054	-0.002	-0.350	-0.027	-0.080
	(0.009)**	(0.019)**	(0.005)	(0.013)**	(0.006)**	(0.029)**
Number of Cadets	3608	3619	3591	3610	2757	3488
Obs	12654	12653	12589	12608	9329	10060

Notes: ** p<0.01, * p<0.05, + p<0.10. This table shows additional credit hours reduce cadets term GPA, performance in military duties, and physical fitness. All outcomes are internally standardized by the sample mean and standard deviation. Physical Fitness Test is the residual variation (before standardizing) in a cadet's Physical Education Average (PEA) to isolate the contribution of physical fitness scores. Odd-numbered columns include cadet fixed effects (see Section 5.1) while even-numbered columns estimate the effect using a cohort IV (see Section 5.3) conditional on semesters of tenure, calendar year fixed effects, academic composite, and interactions of semester, non-White, and female. Standard errors are clustered at the squadron group by cohort level.

Appendix A Appendix Figures and Tables

FIGURE A1 — COHORT SURVIVAL RATE BY SEMESTER OF TENURE



Notes: This figure shows the proportion of cadets that finished each semester by graduating class year.

TABLE A1 — EFFECT OF COURSE OVERLOAD ON SEMESTER SIGN OUT ACTIVITY

	Duration (Hours)		Trips	
	FE	IV	FE	IV
	(1)	(2)	(3)	(4)
>18 Credit Hours	-17.634	-81.238	-0.635	-3.198
	(6.561)*	(26.109)**	(0.211)**	(1.620)*
Mean of Dep. Var. Among ≤18 Hours	501.91	502.40	16.26	16.27
Number of Cadets	3608	3619	3608	3619
Obs	12654	12653	12654	12653

Notes: ** p<0.01, * p<0.05, + p<0.10. This table shows the effect of an overloaded semester—defined as more than 18 credit hours—on cadets' time spent off-base per semester. Odd-numbered columns include cadet fixed effects (see Section 5.1) while even-numbered columns estimate the effect using a cohort IV (see Section 5.3) conditional on semesters of tenure, calendar year fixed effects, academic composite, and interactions of semester, non-White, and female. Standard errors are clustered at the squadron group by cohort level.

TABLE A2 — COURSE LOAD EFFECTS ON SEMESTER SIGN OUT ACTIVITY BY ACADEMIC COMPOSITE QUARTILES

	Bottom 25%		Second 25%		Third 25%		Top 25%	
	FE	IV	FE	IV	FE	IV	FE	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: All Sign Outs, Duration (Hours)								
Credit Hours	-8.230	-21.769	-8.989	-14.484	-4.357	-7.890	-6.408	-23.115
	(2.370)**	(9.451)*	(2.128)**	(10.967)	(1.965)*	(12.423)	(2.431)**	(15.689)
Mean of Dep. Var.	516.19	516.61	503.12	503.28	493.90	494.26	476.47	476.47
Panel B: All Sign Outs, Trips								
Credit Hours	-0.204	-0.271	-0.321	-0.411	-0.103	-0.242	-0.286	-1.220
	(0.083)*	(0.403)	(0.087)**	(0.498)	(0.074)	(0.556)	(0.089)**	(0.700)+
Mean of Dep. Var.	14.94	14.95	15.70	15.71	16.17	16.17	16.07	16.07
Panel C: Recreational Sign Outs, Duration (Hours)								
Credit Hours	1.614	-13.444	-3.816	-14.242	-1.893	-6.039	-4.830	-13.761
	(2.275)	(8.259)	(2.095)+	(10.428)	(1.960)	(12.714)	(2.155)*	(15.477)
Mean of Dep. Var.	419.32	419.50	413.53	413.64	412.63	413.01	394.30	394.30
Panel D: Recreational Sign Outs, Trips								
Credit Hours	-0.051	-0.068	-0.226	-0.304	-0.057	-0.139	-0.266	-0.911
	(0.084)	(0.384)	(0.088)*	(0.477)	(0.075)	(0.547)	(0.086)**	(0.692)
Mean of Dep. Var.	13.19	13.20	13.97	13.98	14.62	14.63	14.47	14.47
Number of Cadets	913	911	908	907	904	903	898	898
Obs	3173	3165	3195	3191	3177	3173	3124	3124

Notes: ** p<0.01, * p<0.05, + p<0.10. This table shows the effect of additional of credit hours on cadets' time spent off-base by academic composite quartile which aggregates pre-admission academic ability using measures such as standardized test scores, high school GPA, and class rank. Odd-numbered columns include cadet fixed effects (see Section 5.1) while even-numbered columns estimate the effect using a cohort IV (see Section 5.3) conditional on semesters of tenure, calendar year fixed effects, academic composite, and interactions of semester, non-White, and female. Standard errors are clustered at the squadron group by cohort level.

TABLE A3 — COURSE LOAD EFFECTS ON ACADEMIC PROBATION STATUS

	Full Sample		Upper, Non-Athletes		Upper, Athletes	
	FE	IV	FE	IV	FE	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Credit Hours	0.001	0.005	-0.002	0.005	-0.003	0.004
	(0.001)	(0.002)**	(0.001)	(0.002)*	(0.003)	(0.004)
Number of Cadets	3623	3619	2068	2068	613	613
Proportion on probation	0.022	0.022	0.013	0.013	0.015	0.015
Obs	12669	12653	5453	5453	1601	1601

Notes: ** p<0.01, * p<0.05, + p<0.10. This table shows additional credit hours do not meaningfully impact the probability a cadet is placed on academic probation and consequently restricted from signing out. Odd-numbered columns include cadet fixed effects (see Section 5.1) while even-numbered columns estimate the effect using a cohort IV (see Section 5.3) conditional on semesters of tenure, calendar year fixed effects, academic composite, and interactions of semester, non-White, and female. Standard errors are clustered at the squadron group by cohort level.