REDSHIRTING AND ACADEMIC PERFORMANCE:

EVIDENCE FROM NCAA

STUDENT-ATHLETES

by

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ABSTRACT

Redshirting is common in National Collegiate Athletic Association (NCAA) athletics. Many student-athletes forgo playing time as true freshmen and extend their eligibility in order to develop physically before they suit up for their first game the following year. Although redshirting is widely used for athletic reasons, the academic effects of redshirting are unknown. Academic achievement is an area of interest for the NCAA. Student-Athletes in the 2007 cohort achieved a federal graduation rate (FGR) of 66 percent compared to the general student body's rate of 65 percent. Although student-athletes have a higher FGR than the general student body, athletes in the major revenue producing sports lag behind. Football players that attended Football Bowl Subdivision (FBS) schools reached a FGR of 62 percent and athletes that played men's basketball at NCAA Division I schools earned an FGR of 47 percent. This paper uses individual-level data from SuperPrep Magazine and Montana State University (MSU) to examine the relationship between redshirting and academic performance. To address potential endogeneity, this thesis considers a propensity score matching (PSM) approach when using data from SuperPrep Magazine. PSM results indicate that selection bias is present in ordinary least squares (OLS) estimates, but that there are still substantial positive impacts of redshirting on graduation. OLS estimates using MSU data indicate there may be lagged benefits of redshirting on academic performance, although these results are not robust when a fixed-effects analysis is applied.

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INTRODUCTION

The National Collegiate Athletic Association (NCAA) is the entity that oversees major collegiate athletic programs in the United States. One issue of concern to the NCAA is the educational success of student-athletes in NCAA-monitored universities. In 2014, the NCAA released a report that compares the Federal Graduation Rates (FGRs) of Division I student athletes to the general student body at Division I schools using data from the 2005 freshman class (Trends 2014). FGRs measure the percentage of students that graduate in six years from the same institution that they first enroll in. Although the FGR of all student-athletes in the 2005 cohort is 65 percent, compared to a general student body FGR of 66 percent, athletes in the main revenue-producing sports lag behind non-athletes. Men's basketball players had a FGR of 47 percent and FBS football players in the 2005 cohort had an FGR of 62 percent. The NCAA has been proactive is increasing the FGRs in these sports over the last twenty years, but there is more work to be done to improve the academic performance of student-athletes that participate in these sports.[1]

To prepare a student-athlete for collegiate competition, college programs often give players a year to practice with their team, learn the playbook, and develop physically without seeing game action. This is known as redshirting and is a practice that is commonly employed by NCAA athletic programs. The redshirt player does not see game action during his or her redshirt season and still has four years of athletic eligibility after the redshirt year. Although redshirting is widely used for athletic reasons, it may also have

[1]The FGRs for men's basketball and FBS football players in the 1984 cohort were 38 percent and 47 percent, respectively.

academic benefits. This possibility, which has received almost no attention from researchers, is the primary focus of this thesis.

There are reasons to expect a positive relationship between redshirting and academic performance. Most importantly, redshirting encourages student-athletes to plan for a five-year collegiate career. Planning on using five years of eligibility may allow redshirts to spread out their more difficult classes, and may induce them to take more difficult classes during the redshirt year. During the redshirt year, the redshirt practices and attends class but does not participate in games and normally does not travel with the team. This extra time can be allocated to other activities like studying or socializing. Social connectedness and first year GPA have been shown to increase the probability of retention (Allen et al. 2008). Because redshirts do not see game time, they may also have a lower probability of injury in the redshirt year. In addition to the health benefits in the redshirt year, the additional training during the redshirt year may reduce their probability of injury in the following years, as well. Singell (2004) provides evidence that problems with health influence the dropout decision. In addition, a redshirt year may allow athletes to form realistic expectations about future academic performance before they are required to travel with the team. Stinebrickner and Stinebrickner (2012) found that expectations of future academic performance are positively correlated with retention.

To estimate the impact of redshirting on academic performance, this study uses two separate datasets. The first is a dataset composed of elite high school football players that were featured in SuperPrep Magazine, a popular recruiting magazine, from 2000-2004. These data will be used to examine the impact of redshirting on graduation.

Propensity score matching (PSM) is utilized to account for potential selection bias in the ordinary least squares (OLS) estimates. Our PSM estimates indicate that OLS estimates are biased upwards, but provide strong evidence that redshirting has a positive and significant influence on graduation for elite football players after accounting for this selection bias.

The second dataset consists of semester-level panel data from Montana State University (MSU) football, volleyball, and men's and women's basketball players. Academic, athletic, and personal characteristics are included and the dependent variables *Hours Earned* and *GPA* are examined. OLS results indicate that redshirting may provide lagged benefits to GPA for football players, men's basketball players, and volleyball players. The results are not robust when student fixed effects are implemented, indicating that unobserved student-level characteristics may be biasing the OLS estimates. The MSU data are relatively incomplete and these results should be used to motivate future analysis of how redshirting influences academic performance during the redshirt year and following years, not as strong evidence of lagged benefits of redshirting to GPA.

This thesis makes several important contributions to the limited literature on redshirting. First, it provides an in-depth empirical analysis of the academic impacts of redshirting. This topic has only been examined empirically, to the author's knowledge, in two previous studies. McArdle and Hamagami (1994) included redshirting as an independent variable in a logit model with an intercept and the single variable *REDSHIRT* to assess the impact of redshirting on graduation. Redshirting is estimated in that study to have a positive and significant influence on graduation, but the results are not likely to

reflect the true impact of redshirting on graduation due to selection bias and omitted variable bias. An unpublished NCAA report also examines the impact of first-year redshirting on first-semester credits, year-end credits, first-semester GPA, and year-end GPA for NCAA Division I football and men's basketball players (NCAA Research, personal communication, September 17, 2014). After controlling for high school GPA and test score, they estimate negative and significant effects of redshirting on retention, first-semester credits, and year-end credits for Division I football players. Redshirting is also estimated to have a positive and significant effect on first-semester and year-end GPA for Division I football players. Possibly due to data limitations, the linear regressions in the NCAA study only include two controls, high school GPA and test score. Omitted variable bias and selection bias are likely present in these estimates as well. The present study uses propensity score matching to account for potential selection bias and includes a variety of controls to more accurately assess the impacts of redshirting on graduation.

Second, this study uses a unique dataset of top recruits to examine how redshirting influences high-opportunity cost players in NCAA football. Athletes in the NCAA's revenue producing sports lag behind the general student body academically. This could be due to the higher opportunity cost of schoolwork because of the perceived opportunity to pursue a post-collegiate athletic career, or it could reflect time allocation differences because of the large time investment that is required to play in the NCAA. The athletes in the SuperPrep dataset represent players that likely invest considerable time in their football careers, and have potential to excel and possibly pursue a career in professional football. These athletes may be less likely to succeed academically than other players, and

improving their academic performance could be crucial in improving academic performance of NCAA football players as a whole. Third, this study provides an empirical strategy for examining the mechanism through which redshirting influences academic performance in future research. Results that include lagged effects of redshirting on GPA and hours earned are presented and can be used as a foundation for future studies that examine this subject.

BACKGROUND

This study focuses on the relationship between athletic redshirting and academic achievement of student-athletes in the National Collegiate Athletic Association (NCAA). Redshirting allows a student-athlete to practice and receive athletic financial aid in a season without seeing game-time in return for a fifth year of eligibility. Redshirting, in some fashion, has been practiced since eligibility rules were implemented in college football (Telander 1978). Until 1961, the NCAA required that a student-athlete complete his seasons of competition in 10 semesters of school. This means that a student could drop out of school and practice and train for as long as they needed to complete ten nonconsecutive semesters.

In 1961, this regulation was changed to allow students five years to complete their eligibility; freshmen were not permitted to redshirt and players could only participate in the postseason in their first four seasons. The rules that were adopted in 1961 were implemented to allow an extra year of eligibility to players that were injured. Although this was the intent of the policy, coaches soon expanded the use of redshirting to give promising backups an extra year to develop.[2] In 1978, the NCAA adopted a rule to allow freshman to redshirt and relax postseason eligibility to extend to all years of eligibility, creating redshirting as we know it today. This chapter will outline rules and rationale surrounding redshirting, NCAA academic requirements and penalties for players and teams, and aspects of the recruiting process that may influence the redshirt outcome.

[2]Freshmen were still not allowed to redshirt.

NCAA Redshirting Regulations

NCAA bylaw 14.2 provides official regulations for redshirting. Bylaw 14.2.1, the "Five-Year Rule" states,

> A student-athlete shall complete his or her seasons of participation within five calendar years from the beginning of the semester or quarter in which the student-athlete first registered for a minimum full-time program of studies in a collegiate institution, with time spent in the armed services, on official religious missions or with recognized foreign aid services of the U.S. government being excepted. For international students, service in the armed forces or on an official religious mission of the student's home country is considered equivalent to such service in the United States (Division I 2013).

A student-athlete can gain a sixth year of eligibility for seasons that were missed due to pregnancy or international events such as official Pan American, World Championships, or Olympic training, tryouts and competition. A sixth year can also be granted for seasons missed due to "Circumstances Beyond Control" (Division I 2013). In 2016, the NCAA will implement the "Academic Redshirt," which will be discussed below.

Circumstances Beyond Control

NCAA bylaw 14.2.1.5.1.1 outlines "Circumstances Beyond Control," the most common being the "Medical Redshirt." A student can receive a sixth year of eligibility for seasons missed due to her own health, the health of immediate family, poor advice from "a specific academic authority," natural disaster, or "extreme financial difficulties as a result of a specific event" involving the student-athlete or an individual upon whom he or she is dependent. The circumstances must result in ineligibility when the student-athlete would

have been eligible, otherwise.[3] NCAA bylaw 14.2.4 allows for a "Hardship Waiver," also known as a medical redshirt, that awards an additional year of eligibility if a student-athlete plays but, due to injury, competes in less than 30 percent of contests, and the injury occurs before the first game of the second half of the season and results in the inability to play for the rest of the season (Division I 2013).[4]

Academic Redshirt

In 2011, the NCAA introduced bylaw 14.3.1.2 that provides an "Academic Redshirt" option that will take effect coinciding with the implementation of stricter academic requirements in 2016. Standards before and after the change are shown in Table 1. Columns 1-3 show the standards before the change takes place, and columns 5-7 show the standards to compete in NCAA contests after the change. Column 4 shows the required GPA to utilize the academic redshirt. The academic redshirt allows players to receive aid that would otherwise be non-qualifiers, and it relaxes restrictions for aid for student athletes who do not meet mathematics requirements (Division I 2013). An academic redshirt may receive athletic financial aid during his first academic year in residence and must meet the qualifications of an academic qualifier except for the minimum math course requirement (Algebra I) and the minimum cumulative GPA and test score from Table 1, columns 4, 6, and 7. As shown in bylaw 14.4.2.1, an academic redshirt must complete 9 semester hours or 8 quarter hours to practice after his first semester. After the academic redshirt year, normal NCAA eligibility requirements must be met.

[3]This is decided by The Committee on Student-Athlete Reinstatement.

[4]The player must compete in less than 30 percent of contests or three contests, whichever is greater.

NCAA Academic Standards

The NCAA academic standards motivate why using redshirting to improve academic performance is important to players and teams. Players have academic goals that must be met in order to participate and receive aid. Each team must also meet NCAA standards to avoid being penalized. Penalties against teams that do not meet the NCAA's academic standards can include losing scholarships, bowl games, and, in extreme cases, the privilege of participating in any NCAA events. Although this provides ample reason for teams to promote their athletes' academic performance, there can be clear tradeoffs when building a recruiting class. Some elite players may struggle in the classroom but can improve the team's performance substantially. Large programs that recruit players who do not meet the initial eligibility standards often must send the players to junior colleges to become eligible. Much of the time, student-athletes that meet eligibility standards but struggle in college courses are provided resources by the team to help improve their academic performance. Redshirting could potentially be used as a tool to aid in this, and the implementation of the academic redshirt in 2016 will allow academically struggling student-athletes that would not otherwise be eligible to utilize the benefits of the redshirt year instead of attending junior college.

Player Standards

Freshman academic requirements are outlined by NCAA bylaw 14.3. In order to qualify for athletic competition, an incoming freshman must be a high school graduate,

meet the requirements of a sliding scale (see Table 1), and must have taken four years of English, three years of mathematics that are Algebra I level or higher, two years of science, and seven credits from a variety of other specified classes (Division I 2013).[5]

To remain eligible for competition, at the beginning of his second year, a student-athlete must achieve a minimum GPA of 90 percent of the institution's overall cumulative GPA required for graduation and must have completed 24 semester hours or 36 quarter hours. At the beginning of the third year, the student-athlete must maintain a GPA of 95 percent of the required GPA and must have completed 18 semester hours or 27 quarter hours of academic credit since the beginning of the previous fall term; at the beginning of the fourth year, the player must have a GPA that meets the institution's graduation requirement and must have completed 18 semester hours or 27 quarter hours since the beginning of the previous fall semester. Additionally, a student that transfers from one Football Bowl Subdivision (FBS) member institution to another must complete one full academic year of residence at new institution before participating in athletic competition. One exception to this rule is made if a player plans on attending graduate school in a program that is not offered at their current institution. A player may also transfer to a Football Championship Subdivision (FCS) or DII team and be eligible for competition (Division I 2013).

If a student-athlete fails to meet the freshman academic requirements or the progress-toward-degree requirements, he has a few options. Attending a junior college (JC) is a popular option; according to NCAA bylaw 14.5.4.2, an athlete that was not a

[5] Academic standards are changing in 2016 and are also shown in Table 1.

qualifier in his freshman year and went to a junior college may transfer and play in his first academic year at the NCAA institution if he graduated from the junior college, completed a minimum of 48-semester or 72-quarter hours of transferable-degree credit toward any baccalaureate program, attended the JC as a full-time student for at least three semesters or four quarters and achieved a GPA of 2.0 (Division I 2013).[6] For football players, another option is to forgo college and play semi-professional football until the player is eligible for the NFL draft. To be eligible for the NFL draft an athlete must be out of high school for at least three years. The NBA draft requires that players be only one year out of high school. There is no such requirement for players to enter the Major League Baseball (MLB) draft out of high school, but a player that decides to enroll and play at a four year college must wait until after his junior year or 21st birthday to be eligible for the MLB draft. A player that attends a Junior College (JC) is eligible for the MLB draft regardless of how many years they have completed.

Team Standards

In 2004, the NCAA introduced the Academic Progress Rate (APR). The APR was created in response to poor graduation rates. A school's APR is calculated by awarding a point to each athlete for retention and eligibility. If a student-athlete returns the next semester and is eligible to play, he earns his team two points. If he fails and drops out, the university receives zero points. A student-athlete who either fails and returns, or passes and drops out receives one point. The points are added and divided by the total number of

[6]The minimum GPA was raised to 2.5 for students who enrolled after August 1, 2012

points possible and multiplied by 1000. A score of 1000 is perfect; the NCAA determined an APR score of 925 corresponds to approximately a 60 percent graduation rate (APR 2014). In addition, the APR only applies to scholarship athletes.[7] An example is shown in Table 2.

Currently, the NCAA is on the second step of a reform that will lift the four-year average APR requirement to 930 after the 2014-2015 season. If a team fails to meet this criteria, it will be banned from postseason play. Currently, if a team scores below 925 and one of its student-athletes fails academically and leaves school it can lose up to 10 percent of its scholarships for the year. Additional penalties may be assessed if a team fails to achieve the 930 four-year average for more than one consecutive year. Previously, teams faced penalties for consecutive scores under 900, and the penalties were increased for each consecutive year the team failed to meet the APR requirements.

NCAA Recruiting Guidelines

Recruiting is closely related to and can influence the redshirt outcome for student-athletes. The school selection process allows the player to influence his redshirt outcome indirectly. When a student-athlete chooses his school he is given potentially imperfect information about his playing time from the coach and information about the school's athletic and academic characteristics that are more complete. The number of wins the team had in the previous season, how many televised games the team will have, the

[7]The average number of players on the online rosters of the 2013 AP Top Ten football teams was 109.9 (Rankings 2014). Rankings were retrieved from the NCAA page and roster players were counted at each school. Each team is only allowed 85 scholarship players. Although these teams are most likely larger than the typical Division I football team because of available resources, the APR is does not account for the academic performance of many student-athletes who are not on scholarship.

number of playoff or bowl games the team has won, how many professional players have been produced, and the quality of the athletic facilities are just a few of the margins along which coaches compete to earn recruits. Players make decisions based on all of these qualities, including expected playing time. Once the recruit chooses their school, the redshirt outcome is assumed to be made by the coach.

Once recruits have chosen their schools, this study assumes that coaches play their best players at each position, unless the estimated returns to redshirting are greater than the marginal value of the difference between the potential redshirt and the other player competing for playing time. This study assumes that redshirts are utilized for players that will get no use because of their position in the depth chart, or so little use that the heavily discounted benefit of future performance is greater than the benefit of immediate performance. The number of redshirts may be influenced by position. Positions that require more physical maturity, such as linemen, may redshirt more because their value increases substantially after putting on weight and adding strength their freshman year. Similarly, quarterbacks may redshirt more often than other positions in order to learn the offense better. Especially for these positions, the recruiting process may be less important to the redshirt decision if there is a large difference in quality between teams they would redshirt for and teams they would play immediately for.

Although one might expect that coaches would play premier players due to their skill and the lower probability of completing their education in favor of an NFL career, this is not necessarily the case. Eight out of the last ten Heisman Trophy winners redshirted at some point in their collegiate career and 49 percent of the players on teams in

the final AP Top Ten poll of 2013 redshirted at some point.[8] Of the eight Heisman winners to redshirt, six sat behind future NFL players and three left school early.[9] Based on these observations, premier players may not weigh playing as much as other factors in deciding their college and top quality coaches and programs may be able to recruit many premium players despite the competition from other programs. Recruiting regulations are shown below to provide insight into the process.

Recruiting Regulations

Recruiting in the NCAA is highly regulated. Recruiting activities and the periods during which recruiting activities are allowed are addressed in Article 13 of the 2013 NCAA Manual. The penalties for recruiting violations vary from players being declared ineligible for minor infractions to major NCAA sanctions against an athletic program for more serious violations.

The NCAA regulations surrounding recruiting are too numerous to list here and vary by sport; however, some of the more important rules related to redshirting will be highlighted. The most important agreement that is made between schools and potential players is the National Letter of Intent (NLI). NLIs are important to redshirting because they signify the end of the recruit's ability to choose a school and, indirectly, his redshirt status. NLIs ensure that recruits must attend the institution that they have signed with in the following year to receive financial aid and the school must provide financial aid to the

[8]The Heisman Trophy is awarded annually to the most outstanding collegiate football player in the nation.

[9]Robert Griffin III used a medical redshirt his junior year after playing his first two seasons at Baylor, so the coach did not make the decision.

student in the following year, unless they are not admitted for academic reasons.[10] NLIs also prohibit other coaches from further recruiting of the signed player and must be signed on or before National Signing Day, which varies by sport. Scholarships are given for one year and can be cancelled or reduced at the end of each year for almost any reason (Financial 2010).

NCAA bylaw 15.3.4.2 addresses the reduction or cancelation of first-year student aid after the National Letter of Intent is signed. Recruits may have their first-year award canceled if the individual becomes ineligible, misrepresents any information during the application process, engages in serious misconduct, or withdraws for personal reasons. Student-athletes may not have aid canceled because of athletic ability or performance, injury or any other athletic reason (Division I 2013). If a student has signed a letter of intent with the promise of playing time and finds out that they may have to redshirt, they may not exit their agreement with the school if they have signed a NLI. Broken recruiting promises may diminish the coach's reputation and make future recruiting more difficult depending on the preferences of the recruits and the information that recruits are able to obtain. If athletes sign based on other school qualities or if they have imperfect information about the coach and his past recruiting, NLI rules most likely lead to more redshirts than there would be if students were able to exit their agreements.

Individual athletic financial aid is limited to the cost of attendance of the student. There are many regulations to financial aid that can be found in Article 15 of the 2013

[10]Seth Davis, a columnist for Sports Illustrated, claims that this provides an advantage for the team, over the recruit, because teams can replace a signed recruit with another recruit and claim that the signed recruit was not admitted for academic reasons. (Davis 2007)

NCAA Manual. The number of athletic scholarships vary by sport and Division. In NCAA Division I FBS and FCS, the total number of athletic scholarships may not exceed 85. FCS schools may only give the equivalent of 63 full scholarships to be allocated between the 85 players, while all 85 players on an FBS team can receive up to full scholarships.[11] FCS teams are only allowed 25 new scholarship athletes per year, while FBS schools are allowed 30 new scholarship athletes. The total number of practicing players before the first game of the season is limited to 105. Limitations on scholarships for other sports can be found in NCAA bylaw 15.5 (Division I, 2013). These are constraints faced by college coaches when recruiting players. All penalties that have been assessed due to academic and recruiting violations are shown in Appendix A.

[11]The NCAA allows each sport a certain number of total scholarships and the total value of the scholarships that may be awarded. In NCAA FBS, 85 total players may be awarded full scholarships, total. In FCS, the equivalent of 63 full scholarships may be given in full or partial amounts to up to 85 athletes. NCAA DI men's and women's basketball teams are allowed 13 and 15 total scholarships of up to the full amount, respectively. DII basketball programs are allowed 10 for both men and women.

Table 1: NCAA Academic Eligibility Sliding Scale

Before August 1, 2016			After August 1, 2016			
Core GPA	SAT	ACT	Core GPA	Core GPA	SAT	ACT
	Verbal and Math Only	Sum	For Aid and Practice	For competition		Sum
3.550 & above	400	37	3.550 & above	4.000	400	37
3.525	410	38	3.525	3.975	410	38
3.500	420	39	3.500	3.950	420	39
3.475	430	40	3.475	3.925	430	40
3.450	440	41	3.450	3.900	440	41
3.425	450	41	3.425	3.875	450	41
3.400	460	42	3.400	3.850	460	42
3.375	470	42	3.375	3.825	470	42
3.350	480	43	3.350	3.800	480	43
3.325	490	44	3.325	3.775	490	44
3.300	500	44	3.300	3.750	500	44
3.275	510	45	3.275	3.725	510	45
3.250	520	46	3.250	3.700	520	46
3.225	530	46	3.225	3.675	530	46
3.200	540	47	3.200	3.650	540	47
3.175	550	47	3.175	3.625	550	47
3.150	560	48	3.150	3.600	560	48
3.125	570	49	3.125	3.575	570	49
3.100	580	49	3.100	3.550	580	49
3.075	590	50	3.075	3.525	590	50
3.050	600	50	3.050	3.500	600	50
3.025	610	51	3.025	3.475	610	51
3.000	620	52	3.000	3.450	620	52
2.975	630	52	2.975	3.425	630	52
2.950	640	53	2.950	3.400	640	53
2.925	650	53	2.925	3.375	650	53
2.900	660	54	2.900	3.350	660	54
2.875	670	55	2.875	3.325	670	55
2.850	680	56	2.850	3.300	680	56
2.825	690	56	2.825	3.275	690	56
2.800	700	57	2.800	3.250	700	57
2.775	710	58	2.275	3.225	710	58
2.750	720	59	2.750	3.200	710	59
2.725	730	69	2.725	3.175	720	60
2.700	730	60	2.700	3.150	730	61
2.675	740-750	61	2.675	3.125	750	61
2.650	760	62	2.650	3.100	760	62
2.625	770	63	2.625	3.075	770	63

Table 1: NCAA Academic Sliding Scale: Continued

Before August 1, 2016			After August 1, 2016			
Core GPA	SAT	ACT	Core GPA	Core GPA	SAT	ACT
	Verbal and Math Only	Sum	For Aid and Practice	for competition		Sum
2.600	780	64	2.600	3.050	780	64
2.575	790	65	2.575	3.025	790	65
2.550	800	66	2.550	3.000	800	66
2.525	810	67	2.525	2.975	810	67
2.500	820	68	2.500	2.950	820	68
2.475	830	69	2.475	2.925	830	69
2.450	840-850	70	2.450	2.900	840	70
2.425	860	70	2.425	2.875	850	70
2.400	860	71	2.400	2.850	860	71
2.375	870	72	2.375	2.825	870	72
2.350	880	73	2.350	2.800	880	73
2.325	890	74	2.325	2.775	890	74
2.300	900	75	2.300	2.750	900	75
2.275	910	76	2.275	2.725	910	76
2.250	920	77	2.250	2.700	920	77
2.225	930	78	2.225	2.675	930	78
2.200	940	79	2.200	2.650	940	79
2.175	950	80	2.175	2.625	950	80
2.150	960	80	2.150	2.600	960	81
2.125	960	81	2.125	2.575	970	82
2.100	970	82	2.100	2.550	980	83
2.075	980	83	2.075	2.525	990	84
2.050	990	84	2.050	2.500	1000	85
2.025	1000	85	2.025	2.475	1010	86
2.000	1010	86	2.00	2.450	1020	86
				2.425	1030	87
				2.400	1040	88
				2.375	1050	89
				2.350	1060	90
				2.325	1070	91
				2.300	1080	93

Notes: Student-athletes must meet the core GPA and test scores across rows. Columns 1-3 are the current requirements for athletes to play, receive aid, and participate. Columns 5-7 are the requirements that will be implemented in 2016 for competition. Column 4 represents the minimum GPA that must be achieved to be considered an academic redshirt. The implementation of the academic redshirt coincides with increased academic standards that are coming into effect in 2016.

Source: (NCAA Eligibility 2014)

Table 2: Example of Academic Progress Rate

	Fall Semester	Spring Semester	Earned/Possible
SA 1	Enrolls full time, earns eligibility, and returns for Spring	Enrolls full time, earns eligibility, and returns for Fall	4/4
	Eligible (1 point) and retained (1 point)	Eligible (1 point) and retained (1 point)	
SA 2	Enrolls full time, earns eligibility for Spring, and leaves midyear	SA does not enroll in Spring	1/2
	Eligible (1 point) but not retained		
SA 3	Enrolls full time, earns eligibility and returns for Spring	Enrolls full time, earns eligibility, but transfers for Fall	3/4
	Eligible (1 point) and retained (1 point)	Eligible (1 point) but not retained	
SA 4	Enrolls full time, is not eligible, but returns for Spring	Enrolls full time, earns eligibility and returns for Fall	3/4
	Ineligible but retained (1 point)	Eligible (1 point) and retained (1 point)	
SA 5	Enrolls full time, is not eligible, and does not return for Spring	Does not enroll	0/2
	Ineligible and not retained		
SA 6	Enrolls full time, earns eligibility, and returns for Spring	Enrolls full time and graduates	4/4
	Eligible (1 point) and Retained (1 point)	Graduated (2 points)	
SA 7	Enrolls full time, earns eligibility, and returns for Spring	Enrolls full time, Ineligible, returns for Fall	3/4
	Eligible (1 point) and retained (1 point)	Ineligible and retained (1 point)	
SA 8	Not enrolled	Enrolls full time, eligible, and returns for Fall	2/2
		Eligible (1 point) and retained (1 point)	
SA 9	Is not on aid, but plays on team, earns eligibility and returns for Spring	Enrolls full time, receives aid, earns eligibility and returns for Fall	2/2
		Eligible (1 point) and retained (1 point)	
SA 10	Exhausted eligibility in Spring, enrolled, and is on aid as fifth year SA who is completing degree	Enrolls full time and graduates	4/4
	Eligible (1 point) and retained (1 point)	Graduated (2 points)	
Totals			26/32 = .8125 APR

Notes: SA= Student Athlete NCAA uses Academic Progress Rate to determine what teams are not meeting standards. In 2012-2013, teams had to earn a minimum 900 four-year APR or a 930 average over the most recent two years to avoid penalties. In 2014-15, teams must earn a 930 four-year average APR or a 940 average over the most recent two years to avoid penalties. Beginning in 2015-16, teams must achieve a four-year APR of 930.

Source: (APR, 2014)

LITERATURE REVIEW

Although there is almost no research on the academic impacts of redshirting, there have been many economic studies that can guide us in assessing the expected impact of redshirting on academic achievement.[12] The determinants of general student retention have been examined using a variety of data and statistical techniques. Recruiting and the determinants of student's college choice have also been studied and provide a look into how recruiting could influence the redshirt decision. In addition, studies examining the consequences of sanctions imposed on NCAA teams and the effect of raising NCAA standards have been included as motivation for this study.

The most relevant literature to our study was conducted by McArdle and Hamagami (1994). McArdle and Hamagami used data from the NCAA Academic Performance Study that followed more than 3,000 student-athletes that entered Division I colleges in 1984 and 1985 and includes a redshirt variable, to regress on graduation from the initial college of admission. They present evidence that suggests that the strongest indicator of athlete graduation is total student body graduation (1994). Redshirting was included as an independent variable in a logit model with an intercept and the single variable *REDSHIRT*. The coefficient on *REDSHIRT* was positive and significant, but the regression that was used did not control for any other variables. The significant coefficient suggests that redshirting may have a positive effect on graduation; however, without

[12] A portion of an unpublished study conducted by NCAA research personnel using data from the 1994 cohort of freshman student-athletes found that redshirting has no significant effect on first-year GPA, first-year credits, first-year quality points or final GPA. We are currently in the process of obtaining additional information on this study.

addressing potential bias and including controls the results are not likely to reflect the true effect of redshirting on graduation rate. Our analysis will employ propensity score matching to account for potential bias and will include athletic, academic and institutional controls.

Maloney and McCormick (1993) also provides some guidance in assessing the impact of redshirting on academic performance. Data from Clemson University in 1988-89 was used to determine how participation in athletics influences GPA. OLS and MLE approaches are both utilized. The results using both methods are qualitatively similar and provide interesting findings that apply to this study. Larger course loads link with higher grades. This implies that when regressing on GPA, course loads are likely endogenous. A higher workload would usually mean that a student would have more work and, therefore, a harder time succeeding in his classes, but because better students also likely take more credits, this is not the case. The most relevant finding from Maloney and McCormick is the finding that football players receive worse grades than non-athletes in-season and better grades than non-athletes out-of-season. The six non-revenue producing sports had no significant difference from non-athletes in-season or out-of-season and basketball does not have a well-defined season to analyze. Maloney and McCormick suggest that this is due to higher pressure from administrators and coaches to do well. This is applicable to this study because redshirts may perform academically more like out-of-season players than in-season players. This can guide us in making predictions about the effects of redshirting and the different ways it may affect different sports.

Determinants of Retention

Debrock, Hendricks and Koenker (1996) estimate how effective schools are at graduating players using school-level data containing school characteristics and information on graduation by sport for each Division I school in the NCAA. Based on predicted values from a probit model, the best indicator of percentage of athletes graduated is the graduation rate of all other students (Debrock et. al 1996). When estimating graduation for football players, race, SAT score, playing in Division I-A, and the amount of players a school sends to the NFL also have significant coefficients. The results of the analysis indicate that student-athletes in revenue-producing sports that attend better athletic schools have a higher opportunity cost of retention because of professional opportunities and are therefore more likely to drop out. This highlights the importance of controlling for athletic variables that are most likely correlated with both redshirting and graduating.

Singell (2004) used student data from the University of Oregon (UO) and survey data from the UO dropouts to determine what factors contribute to the dropout decision. He found that important determinants of dropout rates include grade point average (GPA), inadequate financial aid, problems with advising, problems with health, and needing to work. Redshirting can theoretically impact a few of the factors that Singell discussed. GPA may be influenced by redshirting if players allocate a portion of the time that the rest of the team is traveling to studying and schoolwork. Redshirting may also improve health by allowing players to practice with the team and use the team's trainers and health and

fitness facilities without the risk of being injured during games. To determine if redshirting impacts first year GPA, our study will estimate the effect using the MSU data.

Social connectedness, college GPA, attending orientation class, having a campus job and receiving additional financial aid have been found to increase the probability of retention. Allen et al. (2008) used student-level Student Readiness Inventory data to determine factors that affect retention and found that social connectedness improves the odds of staying, rather than dropping out. This applies to redshirting in much the same way as GPA does; the student-athlete will have more time to allocate to making friends (in addition to his friends on the football team) and recreating, as opposed to traveling with the team. Using Winona State University data, Yu et al. (2012) provided further evidence that college GPA and receiving additional financial aid increase the probability of retention. Attending orientation classes and having a campus job also increased the probability of retention.

Stinebrickner and Stinebrickner (2012) used Berea Panel Study data to assess the importance of future expectations in the dropout decision. They found that students enter college too optimistic about their academic performance. They also found that the dropout decision is based on current GPA and expected future GPA. Redshirting could provide the student-athlete with additional time during their freshman year to get acclimated to college courses. This could provide realistic expectations about the remainder of their college careers without the burden of traveling during their true freshman year.

Recruiting

The Process of Recruiting

This study assumes recruiting is a two-stage process involving two economic agents, the recruit and the school (Dumond, Lynch & Platania 2007). It also assumes the schools offer scholarships to players that they are interested in and recruits choose the school that maximizes their utility from their available options. Recruiting is important to redshirting because what occurs in the recruiting process will likely play a part in determining the recruit's redshirt status. If they choose a school with a player already at their position that is less skilled then them they will redshirt. Dumond, Lynch and Platania (2007) used a probit model to estimate which players would choose which schools based on many player and school characteristics. They were able to correctly predict where 63% of the top 100 recruits of 2005 would attend college (Dumond, Lynche & Platania 2007).

The School's Choice

The characteristics that schools seek in athletes are important to predict redshirting and to estimate the true effect of redshirting. There are two studies in this section, one that highlights the importance of recruiting and another that explains the qualities that schools seek when recruiting athletes. The value of recruiting is realized through team performance. Langelett (2003) uses data collected from a variety of sources to determine that recruiting provides returns over the next five years of play. A simultaneous equations model is used to account for the bidirectional nature of recruiting. Recruits improve team

performance for five years and team performance improves recruiting power (Langelett 2003). This cycle is important to redshirting because teams that have better recruits are able to win more games and get additional high-quality recruits. These top quality recruits may redshirt behind other star athletes, as was discussed in relation to Heisman winners earlier.

Pitts and Rezek (2011) use a zero-inflated negative binomial model to measure how important different qualities are to recruiters. Measures of athletic ability are significant indicators of how many scholarship offers will be received. African-Americans receive a premium that may be explained by discrimination experienced during the recruits' upbringings. African-Americans may allocate more time to honing their athletic skills, comparatively, because in the past discrimination lowered their opportunities to succeed in other endeavors (Pitts & Rezek 2011). Players with higher academic credentials actually receive less scholarship offers, even when accounting for athletic characteristics. This seems counterintuitive; however, athletes with better academic qualities may allocate more time to studying and increasing their mental human capital (Pitts & Rezek 2011). This implies that even if redshirting is based completely on athletic performance, academic variables could still be included, as signals of time spent working on schoolwork, to improve the fit of a prediction model.

The Recruit's Choice

This study assumes the second stage of the recruiting process is the decision by the athlete about what college they would like to attend. It also assumes that the

student-athlete's objective is to maximize his utility and he does so by choosing his school based on many different characteristics. In addition to the athletic characteristics and expected playing time at each of the recruits' choices, rational-thinking recruits will consider the academic quality of potential schools. The returns to attending an academically strong school are very important. Card and Krueger (1992) use data collected from many sources, weighted least squares and fixed effects to estimate percentage returns to education, earning and years of education. Students that attended better schools received premiums in test scores and mean earnings (Card & Krueger 1992). This suggests that recruits should value the academic quality, as well as the athletic quality, of their options. This conclusion is important when assessing the role playing time has in the recruit's decision on what offer to accept.

In a 2008 study, Braddock, Lv & Dawkins used principal component factor analysis with varimax rotation to determine what factors into students' decisions. Principal component analysis (PCA) creates completely independent components that explain variation in the data, based on observed variables. PCA reduces the amount of variables to examine underlying characteristics. For example, Braddock, Lv and Dawkins' component "Academic/Career," is composed of variation from the variables Job Placement, Grad Placement, Academic Program and Job Degree Program. Braddock, Lv and Dawkins found that Academic reputation is the primary characteristic that students seek (Braddock et. al 2008). Athletes give more consideration to athletic reputation than other students, especially black males (Braddock et. al, 2008). Recruits that score higher on standardized tests are likely to give less consideration to athletic reputation (Braddock et. al 2008).

Consequences of NCAA Sanctions

Grimes and Chressanthis (2014) used data from Mississippi State University to regress academic alumni contributions on sanctions, alumni base, enrollment, state appropriations, US per capita income, winning percentage, reaching the post season, and number of televised games. Regressions were run for football, basketball, and baseball separately, and a regression using the total sample was also used. In the time period examined, Mississippi State was only penalized once. The football team received probation and a bowl ban in the 1975 and 1976 seasons. The estimated effect of the sanctions on academic alumni contributions was negative and significant in the football regression, and was negative and not statistically significant in the regression with all sports included. This indicates that sanctions negatively influence academic contributions from alumni that value football success, but the effect is reduced by success in other sports. Due to the data being collected from a single institution, this result is difficult to generalize but indicates that schools with alumni that value football may reduce their amount of giving when sanctions are imposed. Furthermore, the sanctions penalized the entire school by reducing academic alumni contributions, providing incentives to administrators to monitor the academic performance of athletes at their school.

Effects of Higher Admission Standards

The effects of the NCAA's new admission standards that were introduced in 1996 were examined by Price (2009) using a difference-in-difference approach and data from

the NCAA's Graduation Reports from the 1993-1997 seasons. The study found that there was no significant effect on average graduation rates for Division I student-athletes. Price found that freshmen student-athletes decreased due to higher test-scores required for eligibility, although total players did not. This result indicates that more transfers received athletic scholarships. This effect supports the notion that redshirting an be used as a tool. The reduction in freshman athletes should be alleviated when the new NCAA standards are implemented in 2016 due to the academic redshirt option that is being introduced that allows players to receive aid and practice without meeting standards for competition.

DATA

Two separate datasets are used in the analysis. The first was built using data from SuperPrep Magazine (Wallace 2000-2004) and contains information on top high school football recruits. The second is comprised of individual-level student-athlete data consisting of players that attended Montana State University from 2000 to 2013.[13] This dataset will allow us to examine how redshirting affects top quality athletes and athletes in three different sports at a middle-tier athletic university.[14]

SuperPrep Data

The first dataset that was constructed features top high school football recruits in the United States and will be used to estimate redshirting's effect on graduation rate for NCAA football players. It includes 1,032 of the nation's top recruits that were featured in issues of SuperPrep Magazine from the years 2000-2004 (Wallace 2000-2004). Every fifth player is recorded, and players that did not attend college are dropped from the data. SuperPrep Magazine was a recruiting magazine created by Allen Wallace that was published from 1985-2012 and ranked and assessed approximately one thousand recruits annually. Wallace is a University of Southern California graduate and lawyer who obtained his recruiting information by contacting a network of about 50 college coaches and gathering the names of players that schools were actively recruiting. After gathering

[13]Professor George Haynes, the Faculty Athletic Representative at Montana State University is on the faculty in the Department of Agricultural Economics and Economics. He provided us with access to the data that are maintained by the athletic department.

[14]Montana State University has 15 different varsity sports. Football, men's basketball, women's basketball and women's volleyball will be examined in the analysis.

information on these recruits he followed up with questionnaires and frequent phone calls to the recruits (Tybor 1996). Data that are collected from the magazines for the analysis below include name, position(s), height, weight, 40-yard dash time, high school, high school state, player's SuperPrep ranking, high school GPA, and test score.[15] SuperPrep Magazine is used because other recruiting publications and sources do not include players' academic characteristics. Both athletic and academic variables are utilized in the analysis of redshirting's influence on academic achievement. Variable definitions can be found in Table 3.

It must be noted that height, weight, 40-yard dash time, GPA and test scores are self-reported. Measurement error may be present if some high school student-athletes have inflated their desirable characteristics to increase college interest. Although the true value of misreporting information is minimal because college coaches will gather accurate information before signing high school recruits, it is likely that some recruits exaggerated their attributes. This could bias OLS coefficients on height, weight, GPA and test score towards zero, and 40-yard dash time away from zero.

Once high school information is collected for each player, other data are collected from college profile pages. The collected data from each player's collegiate career are his height and weight in his last year of college football, whether he played in community or junior college (JC), what four-year college team he played for, his major, and if he redshirted.[16] Graduation is determined from National Student Clearinghouse (NSC) data

[15]Either ACT or SAT scores are reported by SuperPrep. ACT scores are converted into SAT scores using equivalency tables (Compare 2008). In the case that both are recorded, the ACT score will be converted and the higher one will be used.

[16]If the student-athlete transferred it is noted and both schools are recorded, and characteristics of the first

or by calling registrar's offices and accessing former players' LinkedIn accounts if NSC data are unavailable. In addition to the variables listed above, playing in a National Football League game, if the player was drafted, and the draft year for players that were drafted are also recorded. This variable is not included in the analysis, but provides insight into the ability of the players in the data, and the differences in ability between redshirts and non-redshirts.

Institutional characteristics are also included in the analysis. Institutional data are collected from US News's College Rankings (Best Colleges 2013). Average GPA and test scores of incoming freshman, percent of students that graduate, conference, and enrollment are included. STATA's geocode3 command is used to measure the distance between the athletes high school and the university he attended (Bernhard 2013).[17]

There are limitations to the SuperPrep dataset. First, our sample of players is not representative of the typical Division I football players. Most of these players attended top-notch football programs in the Football Bowl Subdivision (FBS). If the athletes in this dataset allocate more of their time to practicing and playing football and less time to schoolwork, they could be less likely to redshirt and graduate than the typical NCAA athlete, which would bias estimates of the effect of redshirting upwards. If the assumption is made that coaches play their best possible players every game, these players are certainly expected to redshirt less often than less elite players. An elite athlete may opt to forgo graduation in favor of utilizing their athletic talent to play professionally earlier. The opportunity cost of staying in school is very high when playing in the NFL is an option, so

team attended are used in the analysis.

[17]Google Earth is used by geocode3 to determine driving time and distance.

the decision to leave in favor of beginning an NFL career may well be rational.[18] Elite players may also be less likely to graduate because they allocate less time to improving their cognitive human capital and more time building their physical human capital. Second, the SuperPrep data only provide information about one sport, football. To compare the effects of redshirting across other sports, data from Montana State University will be utilized.

Montana State University Data

The second dataset that is used to determine the effect of redshirting on academic performance includes all student-athletes at Montana State University (MSU) from 2000-2013 that played football, women's volleyball, men's basketball, or women's basketball. The data that are available are much more detailed than the first dataset and include semester-by-semester academic and athletic data as well as student-level characteristics. The panel data acquired from MSU allows for student-level fixed effects to be utilized to determine how redshirting affects academic achievement in the redshirt semester and subsequent semesters. It also makes comparing the effects of redshirting on academic achievement across different sports possible.[19]

Although the MSU dataset allows for analysis that is not possible with the SuperPrep data, it has a few drawbacks. First, MSU is not necessarily representative of the typical Division I institution. MSU currently has a Division I athletics program and the

[18]The minimum rookie salary in the NFL is $420,000 in 2014 (Florio 2011).

[19]Similar data from additional NCAA Division I institutions were requested, but not provided by the NCAA or by other institutions in time to be analyzed in this thesis.

football team is part of the Football Championship Subdivision (FCS). MSU is part of the Big Sky Conference and has an enrollment of 14,660 students. There are 351 universities classified as Division I in the NCAA, and 124 schools in the FCS in 2014. Montana State University's football team has been ranked in the Top 25 in Sporting News' final FCS rankings of the season six times since 2005, peaked at number one during the 2011 season, and finished the season ranked 16th in 2013. Between the 2005-2006 season and the 2013-14 season, the women's basketball team enjoyed six winning seasons and finished a .500 winning percentage once. The men's basketball team has had less success, and has finished the season with a winning record only three times between 2005-2006 and 2013-14; the volleyball team has topped .500 twice in the same amount of time. To account for this, care will be taken when generalizing results to other schools. The second and most limiting drawback of the MSU data is the number of total observations and missing values in the dataset. Out of 102 volleyball players, 803 football players, 129 men's basketball players, and 118 women's basketball players, there are only 29 volleyball players, 233 football players, 35 men's basketball players, and 34 women's basketball players that have no missing values and can be used in a simple OLS regression with the full set of variables and 45 volleyball players, 334 football players, 73 men's basketball players, and 53 women's basketball players that have full data to be used for fixed effects. The missing values vary by variable, so to account for this shortcoming, variables will be added to the regression successively and the results of each regression will be examined to determine if the results are influenced by the incompleteness of the data. These data will provide a different perspective on how redshirting affects Division I

athletes in a variety of sports and will provide an opportunity for redshirting's effect on players of both genders to be examined.

Semester-level variables such as academic year, GPA, cumulative GPA up to the latest observed semester, if the student was full-time, hours earned, what term it was, how much financial aid was received, whether or not the student was full time, if a hardship waiver was received, if the student was medically unable to play, and if the student redshirted, or exhausted his eligibility are included in the MSU analysis. It also includes student level data, including high school test scores, high school GPA, and what sport the athlete played. The semester-level and student-level characteristics will allow different specifications of the empirical model to account for student-level variation and provide a broad analysis of the effects of redshirting. Variable definitions can be found in Table 4.

Table 3: SuperPrep Variable Definitions

Outcome Variable:	
Graduate	=1 if Graduated from college in six years, =0 otherwise
Independent Variables:	
Junior College	=1 if attended junior college, =0 otherwise
Retake	=1 if retook SAT/ACT, =0 otherwise
Ineligible	=1 if Ineligible for NCAA DI play coming out of high school
SuperPrep Rank	high school regional SuperPrep rank
Height	height in high school
Weight	weight in high school
40-Yard Dash	40-yard dash time in high school
GPA	high school GPA
Test Score	SAT score or converted ACT score
Distance	distance from high school to college
Time	driving time from high school to college
US News Ranking	college's US News ranking
Enrollment	college's Enrollment
Out-of-State Tuition	college's out-of-state tuition
In-State Tuition	college's in-state tuition
Accepted	college's acceptance rate
Graduation Rate	college's graduation rate
NFL	=1 if played in the NFL , =0 otherwise
Position is a categorical variable	
=Quarterback if played at quarterback	
=Special Teams if played on special teams	
=Back if played at running back or linebacker	
=End if played at defensive end or tight end	
=Lineman if played on the offensive or defensive lineman	
=Receivers/Defensive Backs if played either wide receiver or defensive back	
High School Region is a categorial variable	
=Large if high school was in California, Texas or Florida	
=South if high school was in the South	
=East if high school was in the East	
=West/Midwest if high school was in the West or Midwest	
High School Class is a categorical variable	
=2000 if member of the high school class of 2000	
=2001 if member of the high school class of 2001	
=2002 if member of the high school class of 2002	
=2003 if member of the high school class of 2003	
=2004 if member of the high school class of 2004	

Table 3: SuperPrep Variable Definitions: Continued

Conference is a categorical variable
=ACC if college is member of the ACC
=Big 12 if college is member of the Big 12
=Big Ten if college is member of the Big 10
=Pac-12 if college is member of the Pac 12
=SEC if college is member of the SEC
=Other if college is member of any other conference

Table 4: Montana State University Variable Definitions

Outcome Variables:	
GPA	semester GPA
Hours Earned	hours earned in semester
Cumulative GPA	cumulative GPA at the end of student-athlete's last semester
Total Hours Earned	hours earned in college career
Independent Variables:	
Redshirt	=1 if redshirted, =0 otherwise
Redshirt_{t-1}	=1 if redshirted in previous year, =0 otherwise
Redshirt_{t-2}	=1 if redshirted two years prior, =0 otherwise
Redshirt_{t-3}	=1 if redshirted three years prior, =0 otherwise
Redshirt_{t-4}	=1 if redshirted four years prior, =0 otherwise
Remedial Hours	remedial hours earned
Total Financial Aid	financial aid received
Recruited	=1 if recruited, =0 otherwise
HS GPA	high school GPA
Test Score	SAT or converted ACT score
Semester	
=Fall if Fall semester	
=Spring if Spring semester	
=Summer if Summer semester	
Class	
=Freshman if freshman year	
=Sophomore if sophomore year	
=Junior if junior year	
=Senior if senior year	
=Fifth Year if fifth or higher year senior	
Medically Unable	=1 if medically unable to play, =0 otherwise
Eligibility Exhausted	=1 if used all eligibility during career, =0 otherwise
Hardship	=1 if used hardship waiver, =0 otherwise
Football	=1 if played football, =0 otherwise
Volleyball	=1 if played Volleyball, =0 otherwise
Basketball	=1 if played Basketball, =0 otherwise

THEORETICAL MODEL

The theoretical model representing redshirting and academic performance consists of two economic outcomes, the redshirt outcome and the decision to perform well academically.[20]

In this study, we make the assumption that when deciding whether to redshirt a player, the coach plays his best player at each position unless the expected value of the difference between wins when playing the recruit and wins when playing the replacement in the recruit's true freshman year is less than the discounted expected value of the difference between wins when playing the recruit and wins when playing the replacement in the recruit's final season. In other words, the coach will redshirt the recruit during his freshman season if he is low enough on the depth chart to not see game time or if the following is true

$$E(W_t(Recruit_t)) - E(W_t(Backup_t)) < \frac{E(W_{t+4}(Recruit_{t+4}) - E(W_{t+4}(Backup_{t+4}))}{(1+r)^4}, \quad (1)$$

where W_t is the wins of the team in year t and *Recruit* is the player whose redshirt status is being determined at $t = 0$. $Backup_t$ is not necessarily the same player as $Backup_{t+4}$. *Backup* represents the player that is next in line to see game time if the recruit does not play. The discount rate of future wins is represented by r and is determined by many things. For example, if the coach is in the final year of his contract he may have a very high discount rate because future wins are not valuable to him if he leaves, and wins in the

[20]In our study the academic decision is represented by graduating, earning credit hours, and maintaining a high GPA.

current year increase his opportunities to receive a large contract when his current contract is over. To simplify the redshirt decision, it can be represented as

$$Redshirt_{ijk} = f(Athletic_i, Academic_i, Character_i, Team_j, Coach_j, Institutional_k, \varepsilon_{ijk}), \quad (2)$$

where $Redshirt_{ink}$ takes on a value of one if recruit *i* on team *j* at school *k* is redshirted and zero otherwise, $Athletic_i$ is a vector of the recruit's athletic characteristics, $Academic_i$ is a vector of the recruit's academic characteristics, $Character_i$ is a vector of the recruit's unobservable characteristics like work ethic, motivation, and interests, $Team_j$ is a vector of team characteristics, $Coach_j$ is a vector of the coach's characteristics, $Institutional_k$ is a vector of the school's institutional characteristics, and ε_{ijk} is an error term.

$Athletic_i$ and $Character_i$ are included because they influence the recruit's spot on the depth chart, as well as the expected wins of the team when *Recruit* in equation (1) receives playing time. $Academic_i$ contributes to the school decision of the recruit, as does $Institutional_k$, which indirectly factors into the redshirt outcome. The decision of what school to attend by recruit *i* is assumed to be made considering many different qualities of the institutions to which they have been accepted, including the academic and social attributes of the school, the distance from the home of the recruit to the prospective school, and expected playing time.

$Team_j$ is included because the spot of the recruit on the depth chart, the expected wins of the team with the recruit playing, and the expected wins of the team with the potential backup playing are partially determined by team characteristics. The better the team, or an increase in the number of quality players at the recruit's position, will increase

the probability of redshirting. $Coach_j$ is included because he decides whether the player redshirts once the player chooses his school and influences the discount rate of future wins. For example, if a coach is in the last year of his contract, he may not value future wins as much as a coach in the first year of a long-term contract.

The second economic outcome to be considered when examining how redshirting affects academic outcomes is the decision to do well academically. The decision to perform well academically can be expressed as

$$AcademicOutcome_{ijk} = g(Athletic_i, Academic_i, Character_i, Team_j, Coach_j, Institutional_k, Redshirt_i, \eta_{ijk}) \quad (3)$$

where $AcademicOutcome_{ijk}$ is an academic outcome representing GPA, $Hours\ Earned$, and $Graduation$ in our study, η_{ijk} is an error term and the other variables are defined as above. In an experimental study, $Redshirt_i$ would be randomly assigned. Because redshirting is determined based on many of the same qualities as academic performance, however, nonrandom selection into the redshirt group is an issue. It is unlikely that there are observable variables that are correlated with $Redshirt_i$, but not η_{ijk}; in other words, redshirting is assigned in a way that is systematically related to η_{ijk}. The implication of this is that there is not a legitimate instrumental variable that can be used to reduce selection bias. To approximate replication of an experimental study, the academic outcomes of recruits that are similar in their expectation to redshirt, but different in their realized redshirt status will be compared. For example, if recruit 1 and recruit 2 have

similar expectations of redshirting, expressed as

$$E(Redshirt_1) = E(Redshirt_2) = f(Athletic_i, Academic_i, Character_i, Team_j, Coach_j, Institutional_k), \quad (4)$$

but realize different redshirt outcomes due to exogenous variation in the redshirt outcome, their academic outcomes can be compared to replicate random assignment. Players that are higher than the recruit on the depth chart in equation (1) being injured or failing to meet expectations once play begins is an example of exogenous variation in the redshirt decision. If a starter is injured or plays poorly, the recruit, that expected to redshirt, may be required to enter the games. This leaves us with the following theoretical model to simulate a random design when examining the relationship between redshirting and academic achievement

$$Y_{ijk} = h(E(Redshirt_{ijk}), \varepsilon_{ijk}, \eta_{ijk}), \quad (5)$$

where players with similar expectations of redshirting, but different redshirt outcomes, are compared to determine the effect of ε_{ijk}, which is unrelated to η_{ijk}, on Y_{ijk}.

EMPIRICAL MODEL

The effects of redshirting on multiple academic outcomes will be estimated in this study. When using data on top football prospects from SuperPrep magazine, ordinary least squares (OLS) and propensity score matching (PSM) will be used to determine the effect of redshirting on graduation. OLS will be used with the Montana State data to determine the effect of redshirting on GPA and hours earned in the redshirt semester and subsequent semesters, cumulative GPA and total hours earned. Student fixed-effects will be used to determine the effect of redshirting on GPA and hours earned in the redshirt semester and subsequent semesters. The separate datasets and estimation procedures will provide a broad analysis examining how redshirting affects academic performance, and whether redshirting may have different effects on athletes involved in different sports.

SuperPrep Empirical Methods

To provide an accurate estimate of the effect of redshirting on graduation using SuperPrep data, two different empirical strategies will be used. First, a simple OLS regression with heteroskedasticity-robust standard errors will be employed.[21] The basic econometric specification takes the following form:

$$Graduation_{ij} = \beta_0 + \beta_1 Redshirt_i + \mathbf{X_1}\delta + \mathbf{X_2}\theta + \varepsilon_{\mathbf{ij}}. \tag{6}$$

$Graduation_i$ is a dummy variable that is assigned a value of one if player i graduated at college j. $Redshirt_i$ is a dummy variable that assigned a value of one if player

[21] A Breusch-Pagan/Cook-Weisberg test for heteroskedasticity produces a p-value of .0001 for the null hypothesis of constant variance.

i redshirted during his career. $\mathbf{X_1}$ is a vector of individual level characteristics containing the variables $Weight_i$, $Height_i$, $40YardDash_i$, $TestScore_i$, GPA_i, $Ineligible_i$, $\mathbf{Position_i}$, $\mathbf{HighSchoolRegion_i}$, and an interaction term $\mathbf{HighSchoolRegion_i}$*$SuperPrepRank_i$.[22] $Ineligible_i$ is assigned a value of one if player *i* was ineligible for NCAA play coming out of high school. $Weight_i$, $Height_i$, $40YardDash_i$, $TestScore_i$, and GPA_i are continuous variables representing student *i*'s weight, height, 40-yard dash time, test score, and GPA in high school. $\mathbf{Position_i}$ is a vector of dummy variables that represent the player's position as follows: *Quarterback* if player *i* plays quarterback, *SpecialTeams* if he is a kicker, punter, or his main position is on special teams, *Back* if he plays running back or linebacker, *End* if he plays tight end or defensive end, *Line* if he plays on the offensive or defensive line, *Receiver/DefensiveBack* if he plays receiver, safety or cornerback. $\mathbf{HighSchoolRegion_i}$ is a vector of dummy variables that represent the player's high school's region as follows: *Large* if player *i* attended high school in California, Texas, or Florida, *South* if he attended school in the South, *East* if he attended high school in the East, and *West/Midwest* if he attended high school in the West or Midwest. $\mathbf{HighSchoolRegion_i}$*$SuperPrepRank_i$ is the interaction between player *i*'s high school region and SuperPrep rank. The interaction is included because rankings have very different values depending on where the player is ranked. For example, a player ranked tenth in California is likely very different than a player ranked tenth in Minnesota.

$\mathbf{X_2}$ is a vector of institution level characteristics containing $Distance_{ij}$, $Enrollment_j$, $OutOfStateTuition_j$, $InStateTuition_j$, $GraduationRate_j$, $Accepted_j$,

[22] Bolder variable names represent vectors.

$USNewsRanking_j$, and $Conference_j$. $Distance_{ij}$ is the distance between student i's high school and first four year college. $Enrollment_j$, $OutOfStateTuition_j$, $InStateTuition_j$, $GraduationRate_j$, $Accepted_j$, and $USNewsRanking_j$ are characteristics of the first four year college the player attended, giving the school's enrollment, out of state tuition, in state tuition, graduation rate, acceptance rate and ranking from U.S. News's annual Best Colleges report (Best Colleges 2013). Finally, $\mathbf{Conference_j}$ is a vector of dummy variables that represent the conference of school j. The conferences represented are the ACC, $Big12$, $BigTen$, $Pac12$, SEC, and $Other$. $Other$ includes teams from the American Conference, CUSA, Mountain West, other small conferences in Division I, independent schools, and non-Division I schools.

Many of the variables in this OLS regression will be collinear, and Table 5 displays the pairwise correlations of the variables in the dataset. High collinearity will not bias the coefficients on the variables in question but will result in large standard errors, making it difficult to estimate coefficients precisely. Because we are interested in the effect of redshirting, we are willing to include collinear coefficients to reduce omitted variable bias. There are a few different sets of variables that exhibit high collinearity. The first set can be characterized as high school physical attributes. Height, weight, and 40-yard dash time have Pearson correlation coefficients above 0.60 and are significant at the 0.01 level. Although these variables also have statistically significant correlation coefficients with redshirting, none of the three exceed 0.20. The second set of variables that display high collinearity with each other are the student's test score and GPA. These variables represent the student-athletes' academic skill. Although the pairwise correlation coefficients

between these two variables and redshirting are significant at the 0.01 level, the coefficients are relatively low. Test score and redshirting have a correlation coefficient of 0.13 and GPA and redshirting have a correlation coefficient of 0.10. The final set of variables that exhibit high collinearity are college quality characteristics. *InStateTuition*, *OutOfStateTuition*, *USATodayRank*, *GradRate*, and *Accepted* have significant pairwise correlations that range between 0.50 and 0.85. None of the pairwise correlation coefficients with the *Redshirt* variable are significant at the 0.01 level or have a p-value greater than 0.10, indicating that none of our observed controls are likely to have collinearity problems with our *Redshirt* variable that would result in large standard errors on the *Redshirt* estimate. In fact, none of the pairwise Pearson correlation coefficients exceed 0.20. Collinearity should not impede our ability to estimate the *Redshirt* coefficient precisely.

Although multicollinearity with other independent variables should not be problematic, omitted variables could present an issue to the analysis. To get unbiased estimates of the academic impacts of redshirting, it is important to control for student-athlete characteristics that could influence both redshirting and graduating. For example, student-athletes from areas with better socioeconomic conditions may have access to more resources to improve both academic and athletic performance. A school district with more funding could have more AP classes, better tutors and teachers, and better athletic facilities. If better athletic facilities improve athletic performance, this would reduce the chance of redshirting, increase the chance of graduating, and introduce downward bias on the *Redshirt* coefficient. Alternatively, students in areas with worse

socioeconomic conditions may have a lower opportunity cost of allocating time to athletic endeavors if their school district does not offer many resources to facilitate continuing their education in college. As long as the student-athlete remains eligible to play in the NCAA, spending more time practicing and lifting weights may improve the student-athlete's probability of attending a top-tier university more than studying, on the margin. In these cases, players would have lower probabilities of redshirting and graduating, presenting upwards bias on the estimates of the *Redshirt* coefficient. Our empirical strategy will account for this potential bias.

As discussed previously in the Theoretical Model chapter, the probability of redshirting may be correlated with unobserved factors that are also correlated with academic achievement. A commonly used tool to reduce this bias is an instrumental variable approach. Unfortunately, there are no observable variables that fulfill both of the requirements for an appropriate instrument. The first requirement states that the instrumental variable must be correlated with the treatment variable. The second requirement stipulates that the instrument must be uncorrelated with the outcome of interest. In the context of this study, the instrument must be correlated with $Redshirt_i$ and uncorrelated with academic achievement, or η_{ijk} in equation (3). $Position_i$, $Height_i$, $Weight_i$, and $SuperPrepRank_i$ were all considered and satisfy the first requirement for an instrument, but all of these variables could potentially affect academic achievement and, therefore, be related to η_{ijk}.[23] To account for the potential endogeneity bias without the

[23]For example, football players that are more intelligent may be more likely to play quarterback because the quarterbacks needs to make in game decisions that often include reading defenses and calling plays. Higher ranked players may allocate more time to football and have less of a chance of succeeding academically due to time allocation. Height has also been positively linked to cognitive ability (Case & Paxson 2008).

use of an instrumental variable, propensity score matching (PSM) estimators will be utilized (Rosenbaum & Rubin 1983).

PSM consists of matching treated (i.e. student-athletes that redshirt) and untreated student-athletes (i.e. student-athletes that did not redshirt) with similar propensities to redshirt. The outcomes of the matched student-athletes are then compared and the average treatment effect on the treated (ATT) is estimated by averaging differences in the outcomes of the treated and untreated.

Propensity scores are estimated using a probit model, regressing on *Redshirt*. Redshirts and nonredshirts with similar estimated propensities to redshirt are then matched using one of many matching algorithms. After matching, the ATT is calculated as the mean difference between propensity score matched treated and untreated samples. There are no functional form restrictions imposed when using PSM (Zhao 2005). PSM estimates of ATT are valid under the assumptions of unconfoundedness and common support (Guo & Fraser 2010). The unconfoundedness assumption states that conditional on observed characteristics, the outcome is independent of treatment and is expressed as

$$(Y_i = 0, Y_i = 1) \perp T_i \mid p(\mathbf{X_i}).$$

In our specification, Y_i is $Graduation_i$, T_i is $Redshirt_i$, and $p(\mathbf{X_i})$ is the propensity to redshirt based on a vector of observable characteristics. The unconfoundedness assumption relies on redshirting being random conditional on the estimated propensity score. The pre-treatment observable characteristics must be sufficient to estimate propensity scores that make selection into the redshirt group random and unrelated to

academic achievement. In this study, the unconfoundedness assumption is likely not satisfied. Although the set of covariates include many athletic and academic characteristics, as well as college characteristics, endogeneity bias may likely remain. Estimates of the ATT obtained by PSM in this study will indicate if selection bias is present and the direction of the bias, but PSM is not a magic bullet. Because of unobserved characteristics that are not accounted for by our covariates and are related to both redshirting and graduation, it is unlikely that the estimates provided by our PSM analysis are accurate estimates of the causal effect of redshirting on graduation.

The redshirt outcome is determined by a combination of athletics, academics, position, and school choice. Various academic and athletic characteristics of each student-athlete before redshirt status was decided, as well as school characteristics that contribute to the redshirt decision and academic achievement are included to provide the best estimate of the propensity to redshirt. The *Pseudo* R^2 of the treatment model is 0.153. Although the low R^2 may be partially due to omitted variables, not all of these omitted variables will bias the estimates of redshirting on academic performance. There are unobserved sources of variation in the redshirt outcome that are unrelated to academic performance like the performance, eligibility, and health of the players at the top of the depth chart. These unobserved variables do not present an issue to our analysis because they are unrelated to academic performance.

Some other factors that may cause variation in redshirting that is not picked up by our covariates, and may be systematically related to academic performance, include the number of years remaining in the coach's contract and the number of returning players at

the student-athlete's position. These would influence redshirt status if coaches do not value the academic performance and future athletic performance of their students as much in the later years of their contract or if the number of returning players at the same position as the student-athlete affects redshirt status and school choice. Some of the variation in work ethic, time allocation, and other unobserved variables that affect both redshirting and academic performance will be picked up by the set of independent variables that are included in the treatment model, but these variables may not account for all of the variation in redshirting from these characteristics. Although PSM reduces the amount of selection bias in estimates of redshirting's impact on graduation, there is likely still some bias present due to these factors.

The common support assumption can be expressed as

$$0 < Pr(T_i = 1|p(\mathbf{X_i})) < \mathbf{1}.$$

The common support assumption states that each redshirted student-athlete can be compared to a non-redshirt with a similar estimated propensity score. In other words, there must be sufficient overlap between the estimated propensity scores of the treated and untreated groups. Comparing the treated and untreated samples after propensity scores have been estimated supports the validity of this assumption. The minimum estimated propensity scores in the treated and untreated groups are 0.186 and 0.051 respectively, and the maximum values of the treated and untreated samples are 1.000 and 0.964. There are 34 treated observations with estimated propensity scores greater than the maximum untreated observation's estimated propensity score. Figure 1 shows the distribution of

estimated propensity scores by treatment. To ensure that the common support assumption is satisfied, ATTs will be estimated using a sample that omits treated observations with estimated propensity scores greater than the maximum untreated observation's estimated propensity score. This will be referred to as implementing common support. Figure 2 shows the distribution of estimated propensity scores and highlights treated observations with estimated propensity scores greater than the maximum untreated observation's estimated propensity score. A caliper matching algorithm will also be used, which will only match untreated observations that have estimated propensity scores within k units of the closest treated observation's propensity score. Figure 3 shows the distribution of estimated propensity scores with treated units outside of a 0.01 caliper highlighted. Applying the 0.01 caliper omits 33 treated observations.

To estimate the propensity to redshirt, the following probit model will be used

$$Redshirt_i = \beta_0 + \beta_1 \mathbf{X_3} + \beta_2 \mathbf{X_4} + \varepsilon \mathbf{ij} \tag{7}$$

$\mathbf{X_3}$ is a vector of student characteristics that includes the variables $JuniorCollege_i$, $Retake_i$, $Ineligible_i$, $Height_i$, $40YardDash_i$, $SuperPrepRank_i$, $HSGPA_i$, $\mathbf{Position_i}$, $\mathbf{HSRegion_i}$, $HSGradYear_i$, and the interaction terms $\mathbf{Position_i} * SuperPrepRank_i$, $\mathbf{Position_i} * Height_i$, $\mathbf{Position_i} * Weight_i$, $\mathbf{Position_i} * 40YardDash_i$. $\mathbf{X_4}$ is a vector of school characteristics containing the variables $GraduationRate_j$, $USATodayRank_j$, $USATodayRank_j^2$, $Enrollment_j$, $OutOfStateTuition_j$, $InStateTuition_j$, $OutofStateTuition_j * InStateTuition_j$, $Accepted_j$, and $\mathbf{Conference_j}$. The variables specified in Equation (6) are chosen to minimize omitted variable bias and achieve the best fit

possible. The Balancing Property Hypothesis is used to determine the functional form.

The Balancing Property Hypothesis requires that the distributions of the observable and unobservable characteristics are not statistically different across treated and untreated groups, conditional on estimated propensity score. This ensures that the redshirts and nonredshirts that are compared are as similar as possible. To test the Balancing Property Hypothesis, we first divide the sample into k equally spaced groups across the estimated propensity scores and check whether the average estimated propensity score of the treated and untreated groups differ (Dehejia & Wahba, 1999, 2002; Becker & Ichino, 2002; Mocan & Tekin, 2006; Anderson, 2013). If there are significant differences in the mean estimated propensity scores in a group between the treated and untreated units, the group is divided in half and tested again, until the average estimated propensity scores are not statistically different across samples for any group. After the groups are created, each variable specified in the propensity score model is tested across groups for statistical difference. If this test fails, interaction terms are added and the Balancing Property Hypothesis is retested; this process is repeated until the Balancing Property Hypothesis is satisfied (Dehejia & Wahba, 1999, 2002; Becker & Ichino, 2002; Mocan & Tekin, 2006; Anderson, 2013).[24]

Similar to the OLS regression, the coefficients in equation (6) will most likely have large standard errors due to collinearity. This is relatively unimportant. As much

[24] After testing, seven groups were created. The values of the 57 covariates are balanced across redshirts and nonredshirts in each group, except for the following exceptions. There are five total significant differences that are significant at the 0.05 level, six at the 0.10 level, but none at the 0.01 level. $Big12_j$ is not balanced in blocks 3 and 6, $OutOfStateTuition_j$ is not balanced in block 6, $Height_i$ is not balanced in block 7 and SEC_j is not balanced in block 7.

predictive accuracy as possible is necessary to fulfill the unconfoundedness assumption, so the tradeoff between collinearity and omitted variable bias is made appropriately. The interaction terms $\mathbf{Position_i}*SuperPrepRank_i$, $\mathbf{Position_i}*Height_i$, $\mathbf{Position_i}*Weight_i$, and $\mathbf{Position_i}*40YardDash_i$ are included, as well as the squared term $USATodayRank_j^2$ and $InStateTuition_j*OutoOfStateTuition_j$. $Height_i$, $Weight_i$, $40YardDash_i$, and $SuperPrepRank_i$ are likely to have different effects on redshirt status dependent on $\mathbf{Position_i}$. Position influences SuperPrep rank because players are valued differently by recruiters, so $\mathbf{Position_i}*SuperPrepRank_i$ is included.[25] $USATodayRank_j^2$ and $InStateTuition_j*OutoOfStateTuition_j$ are included as controls to improve covariate balance. This specification produces the best covariate balance between the treated and untreated samples when testing the Balancing Property Hypothesis and has a *Pseudo* $R^2 = 0.153$.

After each player's propensity to redshirt is estimated, we use four commonly-used matching methods: nearest neighbor, *k*-nearest-neighbor, kernel density, and radius matching. When employing nearest neighbor matching, each redshirted athlete is matched with the non-redshirt that has the closest estimated propensity score. This reduces bias while using all of the treated observations available because treated units are only matched with the untreated observation with the closest estimated propensity score, but standard errors using this method will be high because each treated unit is matched to one untreated unit. This matching algorithm could also provide poor matches if there are treated units that are matched with untreated units that have estimated propensity scores

[25]For example, defensive back that is ranked 20th may be less likely than a quarterback that is ranked 20th due to the perceived values of both positions.

that are relatively different. To reduce bias caused by poor matches, common support will be implemented. Common support is discussed below.

Each matching algorithm uses a different sample for a few reasons. Radius matching may exclude untreated units that do not have a match within the radius. This prevents ”bad” matches, or matches that have propensity scores that are relatively far away from each other. The tradeoff for preventing these matches is losing observations that provide additional information. Samples also differ because when using each different algorithm, untreated units are weighted differently. Treated units are matched to all untreated units that fulfill the criteria so many untreated units are matched more than one time. For example, when common support is not applied the untreated observation with the highest propensity score was matched to all of the treated observations that had greater propensity scores, which means that the untreated observation with the highest propensity score was weighted very heavily.

Tables 6 and 7 show the balance of the post-estimation samples without and with common support. Balance should be maintained as well as possible to maintain the randomness of the treatment selection. In terms of post-matching balance, k-Nearest Neighbor matching with $k = 5$ provided the best balance, followed, in order, by Radius (0.02), Radius (0.01), k-Nearest Neighbor (3), Kernel, and Nearest Neighbor matching. Differences are displayed and the significance is denoted by *,**, or *** for significant differences between the redshirt and nonredshirt samples at the 0.10, 0.05 and 0.01, respectively. Better balance in the post-match sample indicates that the treatment is assigned more randomly. In other words, an experimental design is more accurately

simulated with a more balanced post-treatment sample.

Nearest neighbor matching produced a difference in mean estimated propensity scores of the treated and untreated groups of 0.001 and 0.000 without and with common support, respectively. The mean standardized percentage biases of the covariates between the treated and untreated groups are 8.489 percent and 6.988 without and with common support, respectively. [26] The standardized percentage bias of each matching algorithm without common support is shown in Table 6, and Table 7 contains standardized percentage bias of each matching algorithm with common support. Column 5 of each shows the balance of the covariates after implementing the nearest neighbor matching algorithm. Although nearest neighbor matching provides the smallest difference in mean estimated propensity scores between samples while using all treated observation, the samples are relatively biased in terms of covariate balance and will provide relatively large standard errors.

The k-nearest neighbor matching algorithm matches each redshirt with the k closest non-redshirts. As k is increased, the difference between mean estimated propensity scores in the treated and untreated samples increases, mean standardized percent bias between covariates decreases, and standard errors decrease. In this analysis, k-nearest neighbor matching with and without common support was implemented with $k = 3$ and $k = 5$. The differences between mean estimated propensity score in the treated and untreated groups when $k = 3$ are 0.002 and 0.000 without and with common support,

[26] Standardized percentage bias is calculated as the percent difference of the sample means in the treated and untreated samples as a percentage of the square root of the average of the sample variances and should be kept as low as possible (Rosenbaum & Rubin 1985).

respectively. When $k = 5$, these differences become 0.002 and 0.000. The mean standardized percentage bias when $k = 3$ is 5.234 and decreases to 4.374 when common support is utilized. These are reduced to 4.686 and 3.689 when k is increased to five. Although k-nearest neighbor matching provides higher differences in mean estimated propensity score in the treated and untreated samples, the balance of covariates is improved and standard errors are decreased. Columns 6 and 7 of Tables 6 and 7 display standardized percentage biases of k-nearest neighbor matched samples. Although covariate balance is improved and standard errors will be smaller when compared with the nearest neighbor algorithm, estimated propensity scores are not as similar in the treated and untreated samples. In this study, k-nearest neighbor matching is an improvement upon nearest neighbor matching because the bias introduced from adding additional matches to the difference in estimated propensity scores between the untreated and treated samples is relatively small and the improvement in covariate bias is substantial.

The kernel density matching algorithm matches each redshirt with a weighted average of all non-redshirts based on estimated propensity scores. Each non-redshirt's value is weighted by the inverse difference between the redshirt's and his estimated propensity score. This matching algorithm produces low standard errors, relatively low standardized percentage biases, and relatively high differences in mean estimated propensity scores between treated and untreated samples. Without common support, the difference in the mean estimated propensity scores between the treated and untreated samples is 0.004. When common support is applied, this is reduced to 0.003. The mean standardized percentage biases are 4.56 and 4.26 when using full and common support

samples, respectively. Column 1 of Tables 6 and 7 show the standardized percentage bias after implementing kernel density matching. Although this matching algorithm provides a matched sample with relatively strong covariate balance, it also provides the sample with the least similar estimated propensity scores between redshirts and nonredshirts. Because of this, it likely produces a biased estimate of the ATT and the estimates are not as reliable as estimates produced by the algorithms presented above.

The caliper matching algorithm matches each redshirt with all non-redshirts whose estimated propensity scores fall within a certain range. In this analysis, calipers of 0.02 and 0.01 are applied. Using the caliper matching algorithm ensures that there will be no matches that fall outside the caliper. This prevents bad matches but may omit treated observations that do not have a close match. The tradeoff between bias and standard error is dependent on the size of the caliper. Larger calipers will omit fewer observations, will produce smaller standard errors and lower mean standardized percentage biases, but will provide larger differences of mean estimated propensity scores between the treated and untreated samples. Without common support, 33 and 13 observations are omitted when calipers of 0.01 and 0.02 are utilized, respectively. These observations had relatively poor matches when using other matching algorithms. When common support is applied, 45 and 34 observations are omitted when using the 0.01 and 0.02 calipers, respectively. This implies that there are 12 treated observations that are not within the 0.01 caliper, but do not exceed the maximum estimated propensity score of the untreated observations. There are no treated observations that have estimated propensity scores that do not fall within a 0.02 caliper of an untreated observation and have estimated propensity scores that are less

than the maximum untreated observation's estimated propensity score. The difference in mean estimated propensity scores without common support for calipers of 0.01 and 0.02 are 0.000 and 0.001, respectively, and 0.000 and 0.000 with common support. Mean standardized percentage biases for 0.01 caliper matching, with and without support, are 4.397 and 4.667. When the caliper is increased to 0.02, these decrease to 3.972 and 4.630. The covariate balance of caliper matched samples are shown in columns 2 and 3 of Tables 6 and 7. In this analysis, caliper matching omits treated observations that were matched poorly using the previously mentioned matching algorithms and is likely to produce the most unbiased, efficient estimates of ATT.

When implementing each of these matching algorithms, replacement is allowed. This means that untreated units may be matched more than once with treated units. Regressions can be run on the matched sample, however, there are no appropriate post-redshirt variables in the data that are not used in the matching process (Dehejia & Wahba 1999). Although PSM can reduce the amount of bias on the $Redshirt_i$ coefficient by comparing the outcomes of redshirts and nonredshirts with the same probability of redshirting, there are still drawbacks to the technique. The unconfoundedness assumption states that unobserved determinants of academic success must be unrelated to redshirting, conditional on the estimated propensity score, for our PSM estimates to be unbiased estimates of the causal effect of redshirting on graduation. If this condition is satisfied, the estimated propensity score captures all of the differences between redshirts and non-redshirts that affect academic achievement and the effect of redshirting can be estimated by examining mean differences in academic outcomes between redshirts and

matched nonredshirts. As discussed previously, this condition is not likely met and endogeneity is still likely to be an issue in the ATT estimates.

MSU Empirical Model

The Montana State University (MSU) panel data provide some unique opportunities for our analysis. Each student-athlete is followed throughout their time at MSU, which allows us to examine several different outcomes, and employ three different empirical strategies. First, OLS will be used to determine how redshirting influences credit hours earned and GPA in the redshirt year, and subsequent years. Separate regressions, by sport, will be used, as well as a regression including interaction terms to determine if the impacts of redshirting on academic performance are statistically different depending on sport. Second, a student fixed-effects approach will be used to determine redshirting's effect on GPA and hours earned in the redshirt year. Finally, total hours earned and cumulative GPA will be examined after collapsing the data into student-level observations.[27]

In the MSU portion of our analysis, we are able to address several issues that we cannot address in the SuperPrep analysis. First, panel data allows us to analyze the influence of redshirting on academic performance in the year the redshirt is taken and the years following the redshirt year. It is important to analyze redshirting's effect on individual semester performance in the redshirt year and the following years to understand how redshirting impacts academic performance. Second, the MSU data contribute two

[27]Graduation data were not obtainable due to time constraints.

additional outcomes to examine, credit hours earned and GPA. Graduating is the most important outcome for NCAA student-athletes, but GPA and hours earned are indicators of academic performance that can be measured through time and provide additional information about the student-athletes' academic experience in college. Third, the influence of redshirting can be compared across different sports. It is likely that redshirting has different effects on athletes dependent on their sport. Volleyball and football are played in the fall and men's and women's basketball are played in the winter. The student-athletes that play in the fall play all of their games in the fall semester and the athletes that participate in athletics during the winter split their games between semesters. This could either burden the fall athletes more because they are not able to spread out their athletic workload between semesters, or may allow the fall athletes to take their easier classes in the spring semester and their more difficult classes in the spring. If redshirting is an effective way to reduce student-athletes' work loads, it could help fall athletes immensely in the fall semester and help improve winter athletes' year-round academic performance. In addition, football has fewer games than the other sports that are included in the analysis, so redshirting may have less of an effect on football players' academic performance. The MSU analysis will provide information about the differences between sports.

There are also limitations to the MSU analysis. The biggest shortcoming is the incompleteness of the data. Although the empirical strategy shown below will account for this, it is still problematic for the analysis. If all relevant variables are included, there are 29 volleyball players, 233 football players, 35 men's basketball players, and 34 women's

basketball players in the data. The MSU data also only include semesters completed at MSU. This means that transfers will have significantly less hours earned in their college careers. There is no way to distinguish between students that transferred and dropouts so these students will be treated the same and their information will be included, even if the student completed his education at another school.

To begin, the basic econometric specification takes the form

$$\begin{aligned} AcademicOutcome_{it} = &\beta_0 + \beta_1 Redshirt_{it} + \beta_2 Redshirt_{it-1} + \beta_3 Redshirt_{it-2} + \\ &\beta_4 Redshirt_{it-3} + \beta_5 Redshirt_{it-4} + \beta_6 TestScore_i + \\ &\beta_7 HSGPA_i + \beta_8 TotalFinancialAid_{it} + \beta_9 White_i + \\ &\beta_{10} Black_i + \boldsymbol{TermCode_{it}}\delta + \mathbf{ClassYear_{it}}\gamma + \varepsilon_{\mathbf{it}}. \end{aligned} \tag{8}$$

$AcademicOutcome_i$ is a continuous outcome variable that represents either GPA_{it} or $HoursEarned_{it}$. The $Redshirt_{it}$ variable takes on a value of one if the student-athlete redshirted in the observed year, and zero otherwise. $Redshirt_{it-1}$, $Redshirt_{it-2}$, $Redshirt_{it-3}$ and $Redshirt_{it-4}$ are also included to estimate lagged effects of redshirting on academic performance. $TestScore_i$ and $HSGPA_i$ are the SAT score (or converted ACT score) of the student and the student-athlete's high school GPA. $TotalFinancialAid_{it}$ is the amount of financial aid received in the observed semester. $MedicallyUnable_{it}$ and $EligibilityExhausted_{it}$ are dummy variables that are assigned a value of one if the student is medically unable to play or their eligibility is exhausted in the current semester. $White_i$ and $Black_i$ are dummy variables that represent the race of the student-athlete. Students that reported other races are recorded as $Other_i$, which is omitted. $\mathbf{TermCode_{it}}$ is a vector

of dummy variables that includes $Fall_{it}$, $Spring_{it}$, or $Summer_{it}$ that assigned a value of one if the semester is in the Fall, Spring, or Summer, respectively, and zero otherwise. $\mathbf{ClassYear_{it}}$ is a vector of dummy variables that contains $Freshman_{it}$, $Sophomore_{it}$, $Junior_{it}$, $Senior_{it}$, and $FifthYear_{it}$. After running separate regressions for each sport, the terms $Volleyball_i * \mathbf{X_{it}}$, $MensBasketball_i * \mathbf{X_{it}}$, and $WomensBasketball_i * \mathbf{X_{it}}$ will be added to the model. $Volleyball_i * \mathbf{X_{it}}$ is an interaction term that interacts playing volleyball with $\mathbf{X_{it}}$, which is a vector containing all of the previously mentioned independent variables. $MensBasketball_i * \mathbf{X_{it}}$ and $WomensBasketball_i * \mathbf{X_{it}}$ are similar interaction terms that interact playing men's or women's basketball with $\mathbf{X_i}$. These will be used to compare coefficients across sports. Robust standard errors are also used to adjust for heteroskedasticity.

As discussed above, there are many missing values in the data. Observations must be dropped to include some of the variables that would be appropriate to include. To examine if these missing observations are biasing coefficients, regressions will first be run with only the $Redshirt_{it}$ variable on the right hand side. After this initial regression, $TotalFinancialAid_{it}$ and $\mathbf{TermCode_{it}}$ are added and the regression is run again. $TotalFinancialAid_{it}$ and $\mathbf{TermCode_{it}}$ are included first because financial aid is likely to improve academic performance by lowering the stress levels of student-athletes and the term is likely to influence student performance. Term may impact student performance differently depending on the student-athlete's sport. In the fall, during their season, volleyball and football players may perform worse academically due to the amount of time they are spending practicing and competing in their sport. Basketball players

participate during a portion of both semesters, so the difference between their academic performance in the fall and spring semesters may not be as different. During the summer semester, there are two different ways academic performance could be influence. First, the student-athlete could perform better due to the reduction in credit hours. Second, the athlete could perform worse due to the increased opportunities for recreation with friends. A regression including the previous variables and $\mathbf{ClassYear_{it}}$ is run next. Class year is included after the $TotalFinancialAid_{it}$ and $\mathbf{TermCode_{it}}$ variables because although it is likely a factor in determining academic success, it also presents a collinearity issue with our redshirt variables. Most redshirts are taken during the freshman year, so as class year progresses from $Freshman_{it}$ to $FifthYear_{it}$, in many cases redshirt status progresses from $Redshirt_{it}$ to $Redshirt_{it-4}$. Next, $HSGPA_i$ and $TestScore_i$ are added to the model. These are included after the variables mentioned above because of the number of missing observations. These variables are also very likely to impact athletic performance because they indicate the academic preparedness of the student-athletes upon entering college. Finally, the variables $White_i$ and $Black_i$ are included to complete the model. Coefficient values are examined to determine if the missing observations bias the results.

A correlation matrix containing variables in the MSU analysis is presented in Table 8. Although collinearity does not bias the coefficients, it does produce large standard errors that make it difficult to obtain precise coefficient estimates. In our model, it appears that collinearity will present a problem to the $Redshirt_{it}$ estimate. All of the class year variables and $Summer_{it}$ have Pearson correlation coefficients with $Redshirt_{it}$ that are significantly different from zero. The magnitude of most of these Pearson

correlations are under 0.15, however, the absolute value of the Pearson correlations between $Redshirt_{it}$ and $Freshman_{it}$ exceeds 0.5 and could be problematic. This is intuitive. Most players that redshirt do so in their freshman year. Although no bias will be present due to collinearity, the collinearity of $Redshirt_{it}$ and $Freshman_{it}$ may weaken the precision of the $Redshirt_{it}$ estimate.

Omitted variable bias could also be present for many of the same reasons that were discussed in the SuperPrep empirical methodology section. There may be unobserved heterogeneity due to student-athlete characteristics that were not controlled for that affect both the redshirt decision, and our outcome variables. Unfortunately, the relatively small number of observations in the data make propensity score matching a poor option to account for this bias. The panel data allow us to use student fixed-effects to control for unobserved student-level characteristics and examine how redshirting affects academic performance in the redshirt year. The student fixed-effects model will be used to determine redshirting's effect on hours earned and GPA in the redshirt year. Separate student fixed-effects regressions will be run for each sport. This method also presents another benefit. The most frequently missing variables are $HSGPA_i$ and $TestScore_i$. The variation that is due to these two variables is accounted for in the student fixed-effects, which allows us to include more observations than in the previous specification.

Finally, the data are collapsed into student-level observations and the outcomes $TotalHoursEarned_i$ and $CumulativeGPA_i$ are studied, representing the total credit hours earned and cumulative GPA earned at Montana State University. The number of students with complete data are very limited. $HSGPA_i$, $CumulativeGPA_i$ and $TestScore_i$ are

missing for many students, which leaves us with 31 volleyball players, 193 football players, 30 men's basketball players, and 27 women's basketball players when the dependent variable being studied is $CumulativeGPA_i$ and 44 volleyball players, 333 football players, 40 men's basketball players, and 37 women's basketball players when the dependent variable being studied is $TotalHoursEarned_i$.

Figure 1: Propensity Score Distribution by Redshirt Status, No Common Support

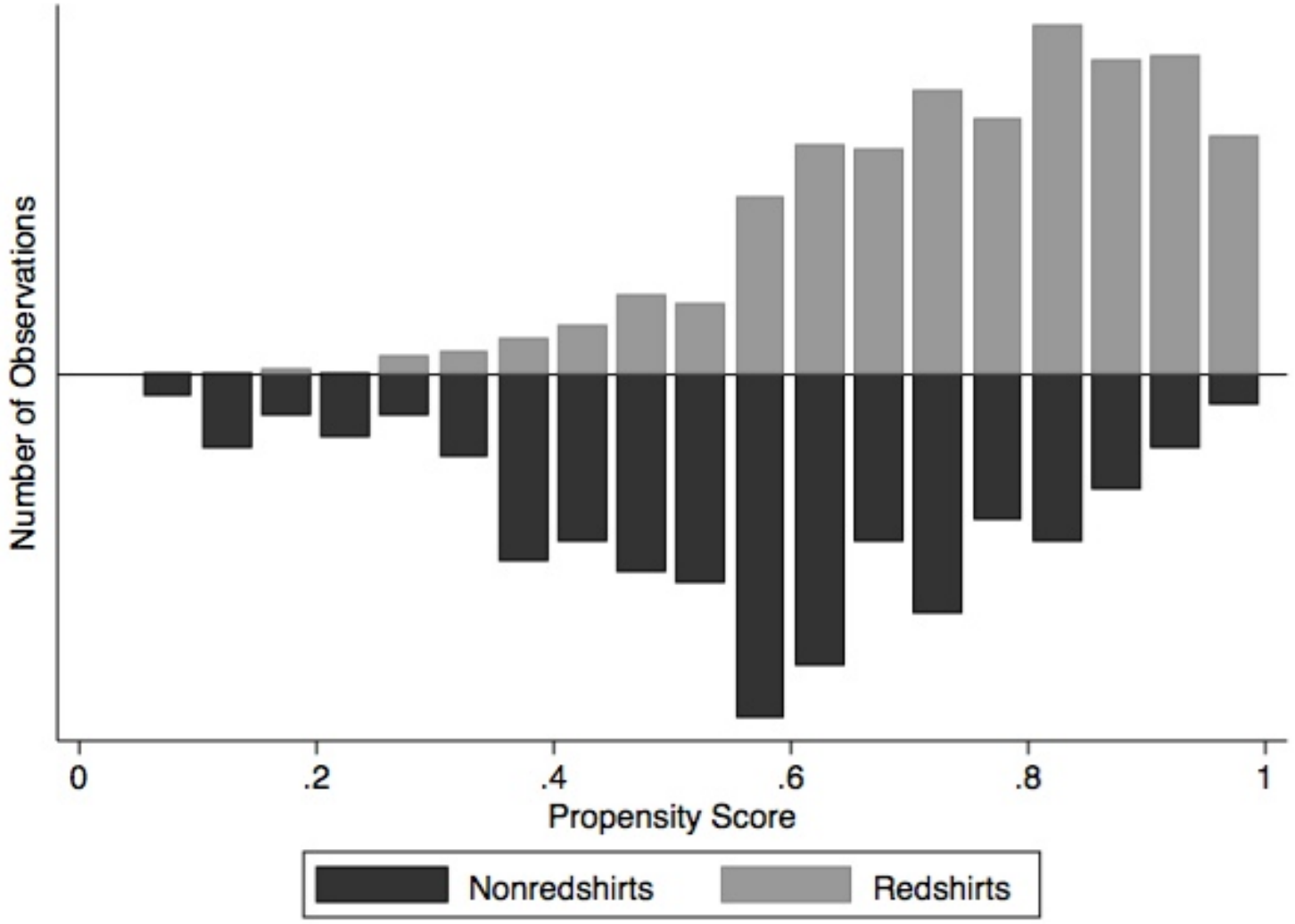

Figure 2: Propensity Score Distribution by Redshirt Status, Common Support

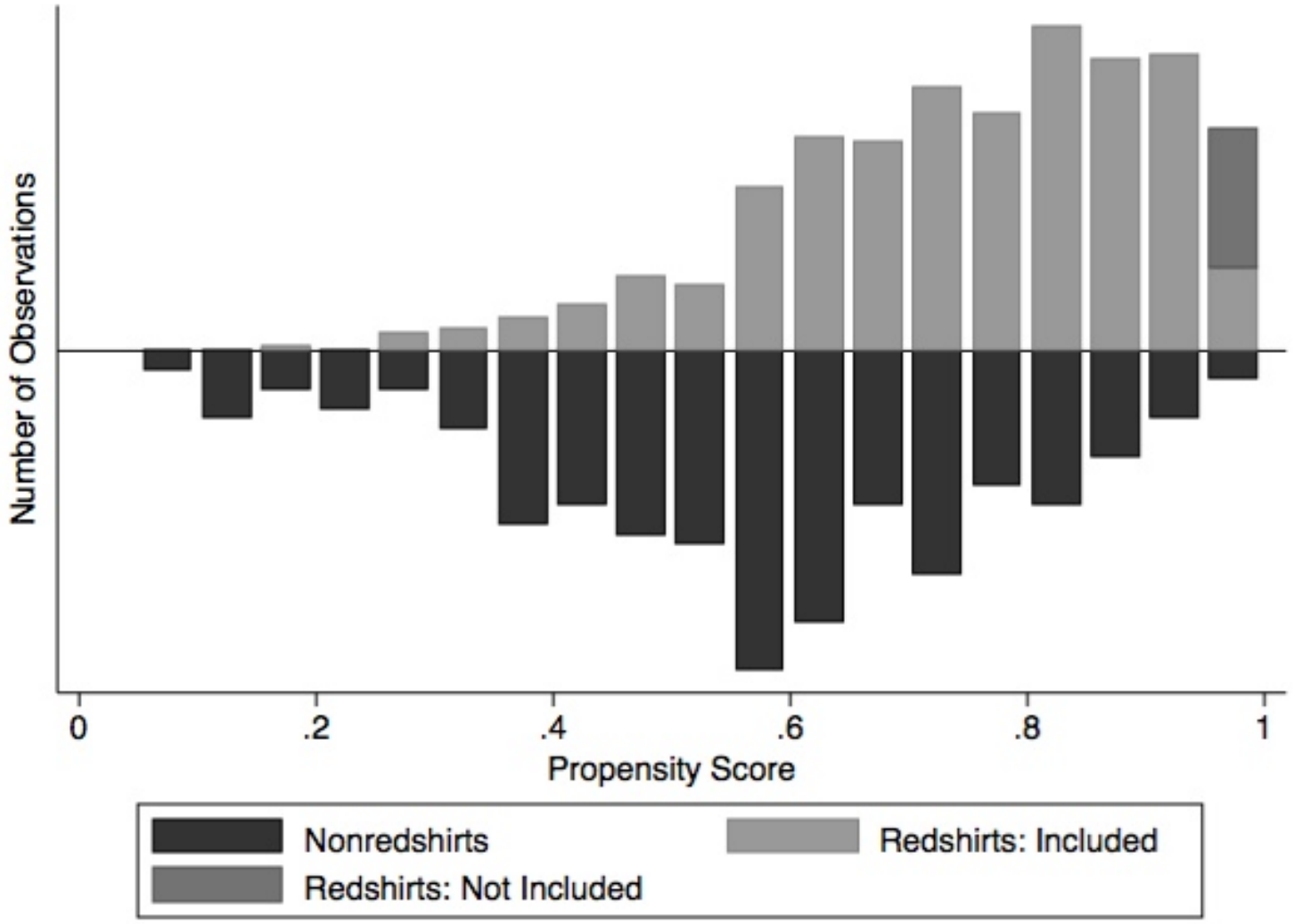

Figure 3: Propensity Score Distribution by Redshirt Status, Caliper (0.01)

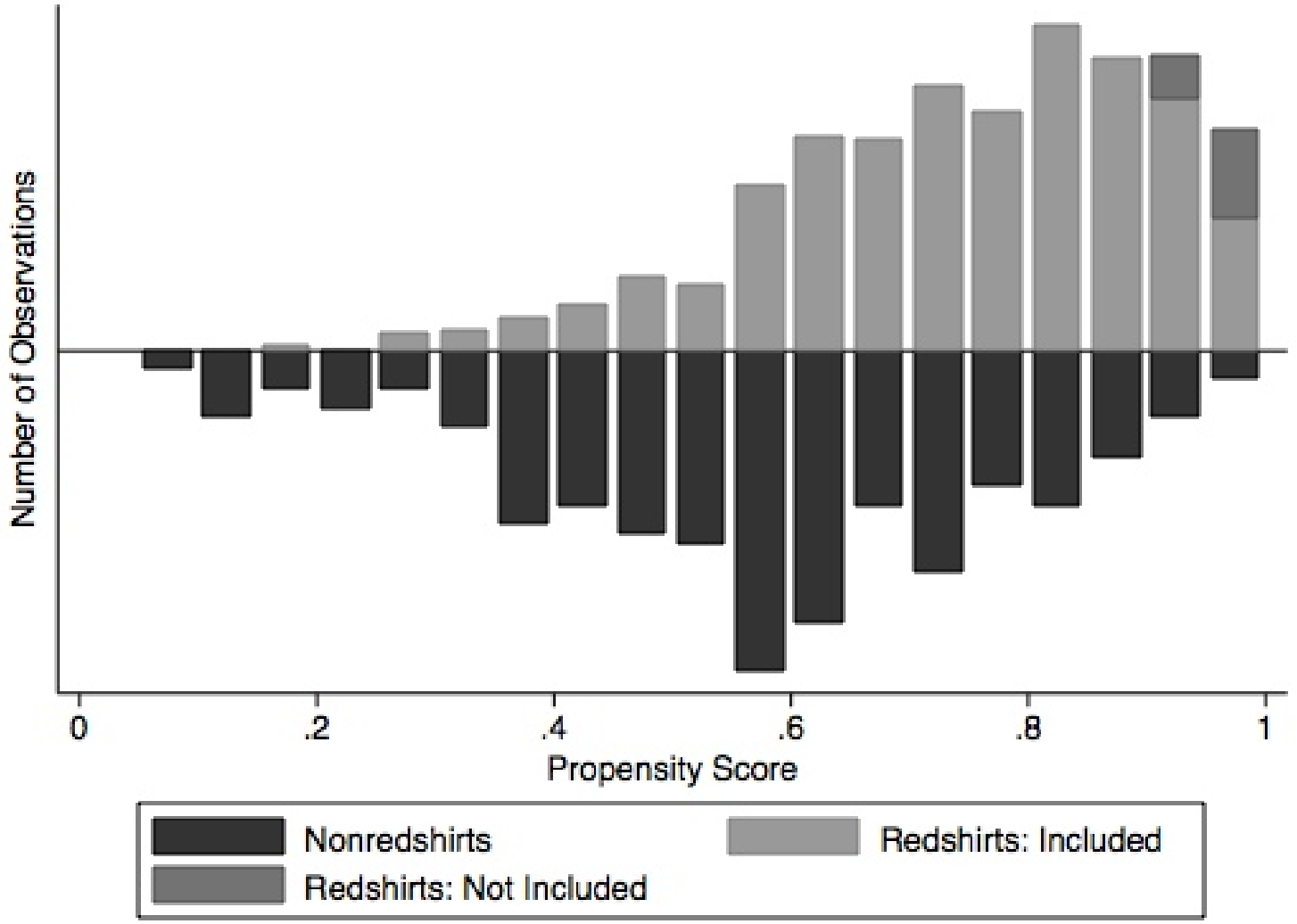

Table 5: SuperPrep Pairwise Correlations

	SuperPrep Rank	Height	Weight	40-Yard Dash	Test Score	GPA	Retake
SuperPrep Rank	1.000						
Height	-0.050	1.000					
Weight	-0.035	0.661***	1.000				
40-Yard Dash	0.078**	0.621***	0.854***	1.000			
Test Score	0.014	0.257***	0.159***	0.222***	1.000		
GPA	-0.014	0.165***	0.092***	0.160***	0.508***	1.000	
Retake	0.042	-0.113***	-0.079**	-0.090***	-0.431***	-0.2561***	1.000
Ineligible	-0.048	-0.018	0.029	0.020	-0.068**	-0.128***	0.001
Junior College	0.014	-0.072**	-0.054*	-0.042	-0.098***	-0.1508***	0.062**
Distance	0.098***	-0.021	-0.009	0.006	0.145***	0.060	0.033
Redshirt	0.140***	0.165***	0.164***	0.186***	0.126***	0.098***	-0.063**
IS Tuition	-0.001	0.031	0.013	0.018	0.144***	0.085**	-0.086***
OOS Tuition	-0.050	0.081***	0.040	0.027	0.210***	0.120***	-0.140***
USA Today Rank	0.026	-0.105***	-0.047	-0.027	-0.258***	-0.131***	0.110***
Grad Rate	-0.105***	0.105***	0.065**	0.050	0.261***	0.130***	-0.136***
Accepted	0.043	-0.101***	-0.090***	-0.074**	-0.259***	-0.170***	0.129***
East	-0.156***	0.037	0.063**	0.051*	0.070**	-0.047	-0.022
Large	0.1002***	0.015	0.013	0.023	0.044	0.065**	-0.038
South	-0.1719***	0.010	-0.004	-0.041	-0.116***	-0.039	-0.005
West/Midwest	0.182***	-0.048	-0.051*	-0.018	0.019	0.013	0.0512
QB	-0.048	0.024	-0.183***	-0.051	0.080**	0.109***	0.003
ST	-0.025	-0.088***	-0.123***	-0.123***	-0.029	0.012	0.023
Back	-0.011	-0.293***	-0.160***	-0.271***	-0.093***	-0.061*	0.000
End	-0.044	0.351***	0.159***	0.094***	0.101***	0.049	-0.035
Lineman	0.026	0.459***	0.790***	0.780***	0.144***	0.084**	-0.063**
Receiver/DB	0.061*	-0.410***	-0.566***	-0.479***	-0.170***	-0.135***	0.075**
ACC	-0.185***	0.048	0.008	-0.000	0.041	-0.063*	-0.016
Big Ten	0.114***	0.052	0.006	-0.015	0.068**	0.036	-0.073**
Big 12	0.058*	-0.049	-0.026	-0.026	-0.084**	-0.016	0.069**
Pac-12	0.0825***	-0.002	-0.026	0.012	0.149***	0.076**	-0.030
SEC	-0.196***	-0.010	0.036	-0.020	-0.165***	-0.044	0.016
Other	0.171***	-0.051*	-0.004	0.046	-0.028	0.014	0.044
2000	-0.030	0.032	-0.005	0.026	-0.042	0.024	0.118***
2001	-0.028	-0.051	-0.081***	-0.069**	0.019	-0.026	-0.044
2002	0.058*	-0.023	0.004	0.018	-0.015	-0.063*	0.018
2003	0.039	0.024	0.035	0.020	0.005	0.031	0.039
2004	-0.037	0.028	0.057*	0.017	0.029	0.039	-0.111***
Graduate	0.078**	0.079**	0.111***	0.134***	0.211***	0.218***	-0.123***

	Ineligible	Junior College	Distance	Redshirt	IS Tuition	OOS Tuition	US News Rank
Ineligible	1.000						

Table 5: SuperPrep Correlations: Continued

	SuperPrep Rank	Height	Weight	40-Yard Dash	Test Score	GPA	Retake
	Ineligible	Junior College	Distance	Redshirt	IS Tuition	OOS Tuition	US News Rank
Junior College	0.444***	1.000					
Distance	-0.023	0.024	1.000				
Redshirt	-0.117***	-0.131***	0.002	1.000			
IS Tuition	-0.001	-0.049	0.118***	0.079**	1.000		
OOS Tuition	-0.051	-0.100***	0.154***	0.062**	0.830***	1.000	
USA Today Rank	-0.024	0.047	-0.132***	-0.053*	-0.517***	-0.655***	1.000
Grad Rate	-0.046	-0.104***	0.128***	0.059*	0.661***	0.792***	-0.812***
Accepted	0.030	0.071**	-0.179***	-0.023	-0.631***	-0.659***	0.755***
East	0.035	-0.007	-0.091***	-0.025	0.125***	0.103***	-0.155***
Large	-0.029	0.004	0.097***	-0.015	0.166***	0.218***	-0.248***
South	0.005	0.005	-0.138***	-0.039	-0.030	-0.042	0.101***
West/Midwest	-0.004	-0.003	0.108***	0.066**	-0.194***	-0.216***	0.229***
QB	-0.030	0.031	-0.037	0.070**	-0.046	-0.040	0.016
ST	0.034	0.015	-0.032	-0.020	-0.032	-0.022	-0.001
Back	0.021	0.018	-0.003	-0.093***	0.025	0.020	0.006
End	-0.035	-0.0650**	0.007	0.055	0.053	0.067**	-0.067*
Lineman	0.0316	-0.030	0.008	0.138***	-0.001	0.007	0.000
Receiver/DB	-0.019	0.037	0.026	-0.121***	-0.024	-0.045	0.0383
ACC	0.027	0.012	-0.068**	0.016	0.269***	0.266***	-0.278***
Big Ten	-0.008	-0.073**	-0.072**	0.043	-0.069**	0.026	-0.200***
Big 12	-0.006	0.021	0.009	-0.034	-0.087***	-0.131***	0.214***
Pac-12	-0.021	-0.010	0.237***	0.058*	0.013	0.185***	-0.051
SEC	-0.041	0.000	-0.147***	-0.049	-0.243***	-0.223***	0.284***
Other	0.049	0.043	0.043	-0.038	0.082***	-0.176***	0.107***
2000	-0.072**	-0.028	0.040	-0.021	-0.041	-0.055*	0.044
2001	-0.066**	-0.012	-0.017	-0.028	-0.054*	-0.045	0.083***
2002	-0.067**	0.017	-0.001	0.018	0.020	0.019	-0.044
2003	0.132***	-0.008	-0.012	0.032	0.093***	0.090***	-0.061*
2004	0.077**	0.0304	-0.004	0.002	-0.014	-0.006	-0.031
Graduate	-0.097***	-0.074**	-0.002	0.221***	0.085***	0.102***	-0.080**
	Grad Rate	Accepted	Graduate				
Grad Rate	1.000						
Accepted	-0.791***	1.000					
East	0.287***	-0.069**	0.080***				
Large	0.216***	-0.432***	-0.032				
South	-0.137***	0.007	0.022				
West/Midwest	-0.260***	0.400***	-0.050				
QB	-0.036	0.057*	0.007				
ST	-0.020	0.034	-0.024				
Back	-0.006	0.008	-0.047				

Table 5: SuperPrep Correlations: Continued

	Grad Rate	Accepted	Graduate
End	0.064*	-0.060	0.023
Lineman	0.037	-0.055	0.102***
Receiver/DB	-0.050*	0.043	-0.0650**
ACC	0.380***	-0.263***	0.064**
Big Ten	0.086***	0.037	0.064**
Big 12	-0.172***	0.216***	0.021
Pac-12	0.050	-0.081***	0.013
SEC	-0.186***	0.170***	-0.059*
Other	-0.232***	-0.001	0.039
2000	-0.057*	0.019	-0.003
2001	-0.067**	0.073**	0.026
2002	0.016	-0.007	-0.017
2003	0.090***	-0.062**	-0.008
2004	0.024	-0.031	-0.002
Graduate	0.115***	-0.080**	1.000

Notes: 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively. Represent pairwise Pearson correlations.

Table 6: Standardized Percent Bias, No Common Support

	Kernel	Radius (.02)	Radius (.01)	NN	*k*-NN (3)	*k*-NN (5)
JC	4.4	4.6	3.8	6.4*	4.7	3.2
Retook Test	-3.6	-2.1	-3.4	4.7	0.5	-3.3
Ineligible	1.6	0.8	1.3	3.9	3.3	1
Height	4.5	2.3	4.4	5.5	1.4	1.1
Weight	-1.2	-1.7	0.1	-2.6	-5.2	-5.7
40-Yard Dash	2	0.4	2.6	-3.3	-2.2	-0.8
SuperPrep Rank	6.1	4.1	-1.7	-0.1	2.8	6.2
Special Teams	1.6	1.5	1.4	6.7	0.3	0
Running Back/Linebacker	-2.1	-3.1	-6.6	-2.6	-8.2	-5.4
Defensive End/Tight End	6.9	7.8	6.3	5.7	10.1*	10.5*
Offensive/Defensive Line	-1.2	-2.2	1.7	-5	-3.1	-5
Wide Receiver/Defensive Back	-3.4	-2.8	-2.7	-10.5*	-2.1	0
QB*SuperPrep Rank	13.7**	10.1*	7.6	21.8***	18.3***	15**
ST*SuperPrep Rank	4.7	5	4.9	12.7***	6.7	5.4
RB/LB*SuperPrep Rank	-2.5	-2.9	-5.6	-2.5	-6.7	-4.8
TE/DE*SuperPrep Rank	4.6	6.2	0.1	-9.2	7.2	9.3
OL/DL*SuperPrep Rank	4.8	1.6	3.1	5.4	-2	-0.1
WR/DB*SuperPrep Rank	-3.8	-2.7	-4.4	-9.3	-2.5	-0.8
QB*Height	0.7	1.7	3.9	17.6***	8.3	2.5
ST*Height	1.7	1.6	1.4	6.8	0.4	0.1
RB/LB*Height	-2	-3.1	-6.7	-2.5	-8.2	-5.4
TE/DB*Height	7	7.9	6.3	5.8	10.2*	10.6*
OL/DL*Height	-1.2	-2.3	1.7	-5.2	-3.4	-5.1
WR/DB*Height	-3.4	-2.8	-2.7	-10.4*	-2.1	-0.1
QB*Weight	0.1	1.3	3.6	17.3***	7.7	1.4
ST*Weight	1.7	1.6	1.4	6.9	0.4	0
RB/LB*Weight	-2.2	-3.2	-6.8	-2.1	-8.6	-5.6
TE/DE*Weight	6.7	7.7	5.9	4.6	9.8*	10.5*
OL/DL*Weight	-1.7	-2.6	1.1	-5.4	-4.2	-5.8
WR/DB*Weight	-3.4	-2.8	-2.5	-10.2*	-2	0
QB*40-Yard Dash	1.1	2.1	4.1	17.8***	8.6	3
ST*40-Yard Dash	1.5	1.8	1.6	6.9	0.5	0.1
RB/LB*40-Yard Dash	-2.1	-3.1	-6.6	-2.4	-8.2	-5.4
TE/DE*40-Yard Dash	7.1	7.9	6.3	5.6	10.2*	10.7*
OL/DL*40-Yard Dash	-1.4	-2.5	1.4	-5.7	-3.7	-5.3
WR/DB*40-Yard Dash	-3.5	-2.9	-2.8	-10.6*	-2.2	-0.1
Graduation Rate	13**	10.6*	8.5	14.7***	5.3	9.4
High School GPA	2.6	2.5	5.6	7.7	9.2	6.3
Big 12	-7.3	-5.6	-5.8	-9.3	-1.7	-4.5
Big Ten	6.5	5.2	4.7	2.7	7.4	5.7

Table 6: Standardized Percent Bias, No Common Support: Continued

	Kernel	Radius (.02)	Radius (.01)	NN	k-NN (3)	k-NN (5)
Other	3	4.3	4.8	5.4	4.5	4.6
Pac-12	-4.8	-5.4	-5.3	-3.5	-4.3	-6.9
SEC	-6.5	-8.7	-9.3	-17.9***	-9.7*	-8.6
US News Ranking	-13.7**	-11.1*	-8.8	-13.8**	-8.5	-9.6*
US News Rank^2	-10.9**	-8.1	-5.5	-8.8*	-6.9	-7.4
Enrollment	-5.2	-6.6	-7.6	8**	0.9	-2.6
Out-Of-State Tuition	10.9*	9.5*	7.2	11.9**	2.6	6.6
In-State Tuition	9.4	10*	9.3	12.9**	5.4	7.5
IS Tuition*OOS Tuition	9.5	10.2*	9.4	12.6**	5.1	7.2
Acceptance Rate	-12.1**	-12.9**	-13.1**	-22.5***	-8.3	-10.3
CA/FL/TX	-3.2	-2.5	-2	2.9	4.7	-2.4
South	3	2.9	1	9.8*	-8.2	0.5
West/MW	-4.9	-6	-6.5	-16.6***	-2.7	-3.5
2001	1.2	2.9	5.3	8.2	-1.7	-0.8
2002	-5.8	-12.1*	-13.9**	-23.4***	-10.1*	-8.9
2003	-1	-0.6	1.4	0	4.6	-0.1
2004	4.4	5.5	2.6	3.7	0.8	4.8

Notes: Standardized percent bias is the percent difference of the sample means as a percentage of the square root of the average of the sample variances in the treated and non-treated groups (Rosenbaum & Rubin 1985). 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively.

Table 7: Percent Standard Bias, Common Support

	Kernel	Radius (.02)	Radius (.01)	NN	*k*-NN (3)	*k*-NN (5)
JC	3.9	4.1	3.9	6.1*	4.3	2.7
Retook Test	-5.5	-3.8	-4	3.3	-1.1	-5.2
Ineligible	1.7	0.8	1.4	4.2	3.5	1
Height	8.9	6.3	6.6	12.4	8.1	5
Weight	3.3	0.6	0.5	0.5	0.9	-1.4
40-Yard Dash	6	3.7	4.2	2.9	4.8	3.1
SuperPrep Rank	0.8	0.5	-4.7	-8.4	-0.5	0.7
Special Teams	0.6	1.6	1.4	6.1	-0.7	-1
Running Back/Linebacker	-2	-3.2	-6.8	-2.8	-8.7	-5.7
Tight End/Defensive End	4.3	5.6	4.4	2.5	7.2	7.6
Offensive/Defensive Line	3.5	1.6	4	2.7	4.7	-0.4
Wide Receiver/Defensive Back	-3.6	-2.9	-2.7	-11.1*	-2.2	0
QB*SuperPrep Rank	3	5.9	7	11.4**	7.8	4.4
ST*SuperPrep Rank	3.3	5.2	5	11.7**	5.4	4
RB/LB*SuperPrep Rank	-2.4	-3	-5.7	-2.7	-7.1	-5.1
TE/DE*SuperPrep Rank	1.1	2.4	-3.1	-14.5*	2.9	5
OL/DL*SuperPrep Rank	5.1	1.1	1.4	2.7	2.3	0.5
WR/DB*SuperPrep Rank	-4.1	-2.8	-4.5	-9.9	-2.6	-0.9
QB*Height	-1.8	-0.7	3.3	11.9**	2.1	0.6
ST*Height	0.7	1.7	1.5	6.1	-0.7	-1
RB/LB*Height	-1.9	-3.2	-6.8	-2.7	-8.7	-5.7
TE/DE*Height	4.3	5.7	4.4	2.6	7.3	7.7
OL/DL*Height	3.7	1.8	4.1	3	4.9	-0.2
WR/DB*Height	-3.6	-2.9	-2.7	-11.1*	-2.3	-0.1
QB*Weight	-1.8	-1.2	3	11.7**	1.4	0.2
ST*Weight	0.6	1.6	1.5	6.1	-0.8	-1.2
RB/LB*Weight	-2.1	-3.4	-6.9	-2.2	-9.1	-5.9
TE/DE*Weight	4.1	5.5	4	1.3	6.8	7.7
OL/DL*Weight	3.2	1.1	3.1	1.5	3.9	-0.9
WR/DB*Weight	-3.6	-2.9	-2.6	-10.8*	-2.1	0
QB*40-Yard Dash	-1.6	-0.4	3.5	12.1**	2.4	0.9
ST*40-Yard Dash	0.8	1.8	1.7	6.5	-0.3	-0.7
RB/LB*40-Yard Dash	-2	-3.2	-6.7	-2.6	-8.6	-5.7
TE/DE*40-Yard Dash	4.3	5.6	4.3	2.2	7.1	7.7
OL/DL*40-Yard Dash	3.5	1.5	3.7	2.2	4.5	-0.4
WR/DB*40-Yard Dash	-3.7	-3	-2.9	-11.2*	-2.4	-0.1
Graduation Rate	10.5*	8.8	6.7	12	5.9	6.4
High School GPA	4.6	6	8.9	16.1***	11.5*	8
Big 12	-9.5	-5.8	-5.9	-11.7*	-3.7	-6.7
Big Ten	4.7	2.7	2.3	-1.9	3	4.5

Table 7: Percent Standard Bias, Common Support: Continued

	Kernel	Radius (.02)	Radius (.01)	NN	*k*-NN (3)	*k*-NN (5)
Other	2.5	3.5	4.5	4.7	3.8	3.9
Pac-12	-3.8	-5.7	-6.5	-8.2	-4	-5.7
SEC	-3.5	-3.9	-4.4	-4.4	-5.7	-6.5
US News Ranking	-10.9*	-8.6	-6.3	-10*	-7.9	-6.4
US News Rank^2	-8.3	-6.2	-3.9	-6.4	-6.1	-4.3
Enrollment	-6	-5.7	-6.5	-11.1*	-0.4	-3.6
Out-Of-State Tuition	10.2*	8.4	5.8	7.9	4.2	5.6
In-State Tuition	8	8.4	7.5	8.7	6.2	6
IS Tuition*OOS Tuition	8.7	8.8	7.7	8.7	6.6	6.3
Acceptance Rate	-10.3*	-9.4	-9.4	-16***	-8.1	-8.5
CA/FL/TX	-6.1	-4.8	-3.4	0	1.9	-5.6
South	4.4	3.5	1.1	8.8	-5.7	1.6
West/MW	-2.3	-3	-4.4	-11.9**	-1.2	-0.4
2001	4.6	3.9	5.4	7.1	1	2.9
2002	-4.2	-8.2	-9.4	-11.7*	-7.8	-8.6
2003	-5	-4.1	-1.8	-6.4	-1.5	-3.4
2004	4.6	4.7	1	0.9	2.8	5

Notes: Standardized percent bias is the percent difference of the sample means as a percentage of the square root of the average of the sample variances in the treated and non-treated groups (Rosenbaum & Rubin 1985). 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively.

Table 8: MSU Correlations

	GPA	HE	Redshirt	Participate	HS GPA	Test Score
GPA	1.000					
HE	0.046**	1.000				
Redshirt	0.031	0.073***	1.000			
Participate	-0.019	0.032	-0.567***	1.000		
HS GPA	0.436***	0.064***	0.030	-0.006	1.000	
Test Score	0.368***	0.040	0.003	-0.035	0.455***	1.000
Freshman	0.046**	0.086***	0.537***	-0.394***	-0.032	0.017
Sophomore	-0.055**	-0.014	-0.137***	0.141***	-0.045*	-0.054**
Junior	-0.031	-0.007	-0.143***	0.169***	-0.022	-0.002
Senior	0.028	-0.011	-0.125***	0.133***	0.079***	0.044
Fifth-Year	0.026	-0.063***	-0.109***	-0.118***	0.041	0.001
Fall	0.015	0.288***	0.004	0.045**	0.035	0.015
Spring	0.012	0.337***	0.033*	-0.001	0.024	0.021
Summer	-0.037*	-0.834***	-0.050**	-0.060***	-0.079***	-0.047*

Notes: GPA=Semester GPA, HE=Hours Earned, HS GPA=High School GPA. 0.10, 0.05, and 0.01 significance levels for difference from zero denoted by *,**, and ***, respectively. Represent pairwise Pearson correlations.

RESULTS

SuperPrep Results

To begin our analysis, we analyze the SuperPrep data. Table 9 reports means and standard deviations for the SuperPrep data by redshirt status. The Full Sample columns provide information about the sample as a whole. The Redshirts and Non-Redshirts columns provide means and standard deviations of each variable in their respective samples. In the Non-Redshirt column, * denotes a statistical difference between the redshirts and non-redshirts at the 0.10 level. Significance at the 0.05 and 0.01 levels are denoted by ** and ***, respectively. There are some notable differences between the redshirts and non-redshirts. First, redshirts tend to be ranked lower. This is intuitive because redshirts are most likely less talented than the players that are above them on the depth chart. Second, redshirts weigh more, are taller, and are slower. These differences may be due to position. Compared with non-redshirts, a higher percentage of redshirts play offensive or defensive line. The redshirt sample also has a higher percentage of quarterbacks, while the non-redshirt sample has a higher percentage of running backs and linebackers, and wide receivers and defensive backs. Third, non-redshirts enter college with lower test scores and high school GPAs. This may be due to time allocation. Better players may be allocating more time to football and less time to academics before college begins. Finally, a higher percentage of redshirts graduate. The mean difference between the graduation rates of redshirts and non-redshirts is 18 percentage points.

SuperPrep OLS

Before we begin our analysis of the influence of redshirting on academic achievement, we will do a short examination of the determinants of redshirting using the SuperPrep data. Six different specifications of an OLS model with *Redshirt* as the left-hand side variable are conducted to determine what factors most influence redshirting. The results are presented in Table 10. The variables that are estimated to have a statistically significant influence on redshirting support the notion that the redshirt decision is based mainly on athletic skill and team quality.

The only positive and statistically significant indicator of redshirting is *SuperPrep Rank*. The statistical significance of *SuperPrep Rank* makes intuitive sense. Players who are ranked lower are more likely to redshirt because they are less skilled and less likely to be game-ready. The variables *Running Back/Linebacker*, *Wide Receiver/Defensive Back*, *Other* (this variable indicates the player attended a conference other than the ACC, Big 12, Big Ten, Pac-12, or SEC), and *Out-Of-State Tuition* are negative and statistically significant. The omitted position is *Quarterback*, so players that play *Running Back/Linebacker* or *Wide Receiver/Defensive Back* are less likely to redshirt, compared to quarterbacks. Position appears to be important in determining which players redshirt, and this could be due to the number of players at each position, or the characteristics that make a player at each position more valuable. For example, there could be less knowledge of the playbook required to play running back, linebacker, defensive back, or wide receiver compared to quarterbacks. The negative and significant coefficient on *Other* is also

intuitive because schools in a conference that is not named above are less likely to have high-quality football programs, so their recruits do not have as talented competition for a starting spot.

To begin the analysis of the influence of redshirting on graduation, the estimates produced using OLS with robust standard errors are presented in Table 11.[28] Five different specifications are used. First, *Redshirt* and academic factors are controlled for. Specification (1), includes *Redshirt*, *HS GPA*, *Test Score*, and a constant. Specification (2) also includes dummies for the high school regions *Large*, *South*, and *West/Midwest* to examine if athletic and high school characteristics influence graduation.[29] In addition, specification (3) includes the college's US News School Ranking, and specification (4) adds a series of dummy variables for conference. The conference dummies are *Big 12*, *Big Ten*, *Pac-12*, *SEC*, and *Other*, with *ACC* omitted. Other school characteristics, *Enrollment*, *Out-of-State Tuition*, *In-State Tuition*, *Acceptance Rate*, and *Graduation Rate* are also included in specification (5). Some determinants of graduation that are positive and significant at the 0.05 level are *Test Score*, *HS GPA*, and *SuperPrep Rank*.[30] The coefficient of interest, *Redshirt*, is positive and statistically significant at the 0.01 level and indicates that redshirting corresponds to an approximately 15.5 percentage point increase in the probability of graduation.

Redshirting has a relatively large and statistically significant estimated effect on

[28] A Breusch-Pagan test for heteroskedasticity returned a p-value of 0.000 for the null hypotheses of constant variance.

[29] *Large* includes California, Texas and Florida. *East* is omitted. *West/Midwest* includes all of the states in the midwest or western United States (besides California), *South* includes states in the southern United States (besides Texas and Florida), and *East* includes all of the states in the eastern United States.

[30] Indicates that lower ranked students from large states are more likely to graduate.

graduation. Other factors that have relatively large significant effects are *Test Score* and *HS GPA*. For every 100 point increase in SAT score, student-athletes are 3.4 percentage points more likely to graduate. The scores in our sample ranged from 500 to 1500, with a mean of 956.8 and a standard deviation of 147.8.[31] The estimated effect of an additional high school GPA point is an 11.9 percentage point increase in probability of graduating. In our sample the maximum GPA is 4.00, the minimum GPA is 2.00, and the mean GPA is 3.065. Although the coefficient on *SuperPrep Rank* is positive and significant, the magnitude of the effect is relatively small. Being ranked ten spots lower in SuperPrep magazine corresponds to a one percentage point increase in the probability of graduation. This could reflect the increased opportunity cost of staying in school for more gifted football players, or differences in time allocation between top athletes and less elite players.

As indicated in Table 5, collinearity is present in some of the independent variables. The statistically insignificant coefficients in Table 11 on enrollment, out-of-state tuition, in-state tuition, acceptance rate, and graduation rate indicate collinearity could be present, as we would expect a few, if not all of these factors, to influence the student's academic achievement. Only *Graduation Rate* is significant at the 0.10 level, and the coefficient indicates that a one percentage point increase in the overall graduation rate of the college the student-athlete attends corresponds to a 0.3 percentage point increase in probability of graduation. The estimated coefficients on the college traits could have high standard errors due to collinearity, making it more difficult to obtain precise estimates. In the context of this analysis, the coefficients on the college characteristics are not the focus

[31]The SAT up until 2005 was on a scale from 400-1600. All of the student-athletes in our sample took this test before 2005. In 2005, the scores were changed and are now on a scale from 600 to 2400.

of interest. To obtain an unbiased estimate of the effect of redshirting on graduation, omitted variable bias must be avoided. None of the Pearson correlation coefficients between the *Redshirt* variable and other variables exceed 0.15, and the standard error on the *Redshirt* estimate is relatively small when compared to the estimated coefficient.

Although the estimated effect of redshirting appears to be statistically significant and relatively large, endogeneity due to selection into the redshirt group could be influencing the *Redshirt* coefficient. Redshirts and non-redshirts could be systematically different in ways that affect academic achievement, as discussed in the theoretical methodology chapter. To account for this bias, we will now continue to the propensity score matching portion of our analysis.

SuperPrep Propensity Score Matching

The first step in conducting the propensity score matching portion of our analysis is to estimate a treatment model that balances each covariate within the blocks that were discussed in the empirical model chapter. The results of the probit model used to estimate propensity scores are shown in Table 12. The explanatory variables are chosen to minimize differences in between treated and untreated groups and likely have a high amount of collinearity. This is not a concern because the purpose of the treatment model is to estimate the propensity to redshirt as accurately as possible. Collinearity does not bias coefficients, and omitted variable bias could be problematic if the omitted variables provide additional explanatory power to the model. Propensity score matching does not impose any functional form restrictions, so interaction and squared terms, along with the

term *In-State Tuition*Out-of-State Tuition*, were added until balance was achieved. Although collinearity produces large standard errors, factors that remain significant at the 0.05 level include *Junior College (JC)*, *Ineligible*, *SuperPrep Rank*, *Other*, *In-State Tuition*, *In-State Tuition*Out-Of-State Tuition*, *West/MW*, *2002*, and *2003*.

Many of these results are intuitive, and a few were discussed earlier when examining OLS results with *Redshirt* as the dependent variable. Attending a JC and ineligibility are highly correlated, and reduce the chance of redshirting because the player has had time to develop while attending the JC, and ineligible players are most likely to attend a JC. Higher ranked players (i.e. those with lower SuperPrep rankings) have a lower chance of redshirting because they are more talented, and are more likely to be an upgrade from other players at their position. Playing in a conference other than the ACC, Big 12, Big Ten, Pac 12 or SEC means that the player is most likely at an inferior school and is less likely to redshirt.[32] In-state tuition has a positive and significant coefficient. It is included as a proxy for school quality because most top-quality football players do not pay for their education out of pocket, but the coefficient is difficult to interpret because of the inclusion of the *In-State Tuition*Out-Of-State Tuition* variable, which is included for balance. Propensity score matching does not impose any functional form restrictions, and *In-State Tuition*Out-Of-State Tuition* is included, along with *In-State Tuition* and *Out-Of-State Tuition* as a measure of balance between the two. The higher the value, the more balanced *In-State Tuition* and *Out-Of-State Tuition* are, given the values of *In-State*

[32]There are a few notable schools that compete independently and are included in the *Other* conference variable. Notre Dame, Brigham Young University, Army, and Navy are the four independent FBS schools. *ACC* is omitted in the regressions.

Tuition and *Out-Of-State Tuition*. Attending high school in the West or Midwest has a positive and significant effect on redshirting. There are many players from these regions and players often go to schools that are closer to home, so the positive and significant coefficient may indicate that the players have to compete harder for a spot on their college teams. Two of the year dummies, 2002 and 2003, are significant as well. These two years may have been weak classes that redshirted more often due to strong classes preceding them in the years before their arrival. The R^2 of the treatment model is 0.153. This indicates that the variables that we include explain a relatively small amount of the variation in redshirting.

After propensity scores are estimated, a variety of matching algorithms are implemented to estimate the average treatment effect on the treated (ATT). The results are presented in Table 13, and are ordered by the balance of the post-matched sample with common support. The balance of each sample with and without common support are shown in Tables 7 and 6, respectively. The estimated impacts of redshirting reported in Table 13 vary, but not greatly, with the matching algorithm used. Without common support, all but two algorithms produce statistically significant coefficients that estimate an impact of redshirting on graduation of between ten and twelve percentage points. Kernel matching, caliper matching with a radius of 0.02 and 0.01, and k-nearest neighbor matching with five neighbors estimate the ATT of redshirting on graduation to be positive and significant at the 0.05 level with coefficients of 0.118, 0.116, 0.105, and 0.100, respectively. Nearest neighbor and k-nearest neighbor matching with three neighbors provide statistically insignificant coefficients of 0.066 and 0.084.

Common support was also implemented and the results are shown to the right of the estimates without common support. Common support omits treated observations that fall above the maximum propensity score value of the untreated group to ensure that treated observations are not matched poorly. The number of omissions are shown to the right of these results. After adding the common support option, k-Nearest Neighbor matching with $k = 3$ produces a significant coefficient, indicating that the algorithm is not finding close matches for all treated units that have propensity scores over the maximum untreated propensity score before common support is implemented; the t-value produced by nearest neighbor matching increased from 1.07 to 1.41. After implementing common support, the significant estimated ATTs range from increases in probability of graduation between 9.8 percentage points and 12.4 percentage points and all of the estimated impacts are slightly larger with common support. The common support estimates may be more accurate estimates of the impact of redshirting on graduation due to the omission of treated observations that were matched poorly.

MSU OLS Results

To gain another perspective on how redshirting affects academic achievement, we will now discuss the Montana State University data analysis. First, simple OLS regressions with robust standard errors and lagged effects using semester-level data will be run for each of the four sports in the dataset to determine if redshirting influences *GPA* or *Hours Earned* in the redshirt year, or the following years. Second, OLS regressions with student-level fixed effects will be run as a robustness check and to account for unobserved

student-level traits. Third, three separate OLS regressions with robust standard errors, lagged effects and sport interactions will be run to examine if effects are statistically different between sports. Finally, OLS regressions will be run using student-level data to determine how redshirting influences *Total Hours Earned* and *Cumulative GPA*.

Montana State University data summary statistics can be found in Table 14. Two sets of summary statistics are provided for each sport. The first column under each sport represents the sample of athletes that are used in an OLS regression including all of the relevant variables. The second column under each sport represents the sample of athletes that are used in a student fixed-effects regression including all of the relevant variables. The differences in sample size are due to missing *HS GPA* and *Test Score* values. The summary statistics presented in Table 14 display some interesting differences between sports. First, the female athletes academically outperformed the male athletes. The mean semester GPA in the volleyball and women's basketball samples are notably higher than the mean semester GPAs of football and men's basketball players. The mean test scores and high school GPAs are also higher for volleyball and women's basketball players. When compared to volleyball and women's basketball players, a higher percentage of semesters in the men's basketball and football samples were redshirt semesters. These summary statistics represent semesters in the sample. When collapsed into student level observations, football, volleyball, men's basketball, and women's basketball players that are included in the OLS sample with all of the relevant variables redshirted 56 percent, 31 percent, 54 percent, and 32 percent of the time, respectively.

Football

To begin the analysis, semester-level MSU football player data are examined to determine if redshirting influences academic performance either in the redshirt year or in subsequent years. Table 15 displays OLS results with lagged redshirt variables, regressing on the dependent variable *GPA*. In columns (4), that contain all of the relevant variables without student fixed-effects, the estimated coefficient on *Redshirt* is negative and significant at the 0.01 level and $Redshirt_{t-3}$ is positive and significant at the 0.05 level. The estimated lagged benefits in the third and fourth year after redshirting make intuitive sense. Redshirts may be able to plan for a five year career and spread out their more difficult classes. The negative and significant coefficient on *Redshirt* could also be reflective of this effect if redshirts take more difficult classes in their freshman year, when they do not have to spend as much time traveling for and worrying about playing in games, to relieve some pressure in their later years. It is unclear why redshirting does not have any significant effect on GPA in the first and second years after redshirting. After implementing specification (4), an F-test for the sum of the redshirt and lagged redshirt coefficients is conducted to test if the net estimated effect of redshirting on GPA, over the players' college career, is significantly different from zero. The test yields a p-value of 0.245, indicating that there is no statistically significant difference between the sum of the redshirt and lagged redshirt variables and zero.

In addition to the OLS estimates, columns (5) through (7) contain student fixed-effects estimates. Because there are still many unobserved student characteristics

that can both effect redshirting, *GPA*, and *Hours Earned*, a student fixed-effect analysis was conducted to check for robustness of the OLS estimates. Ultimately, the student fixed-effects analysis yields results that are not consistent with the OLS results. The statistically significant estimates *Redshirt* and $Redshirt_{t-3}$ in specification (4) are not statistically significant in specification (7). These estimates indicate that there could be endogeneity issues in the analysis. For example, the amount of time players spend playing basketball could be influencing their selection into the redshirt group, which could be negatively correlated with both redshirting and academic performance. This would lead to the influence of redshirting on academic performance being overstated in the OLS regressions. The presence of selection bias is problematic for this analysis. Additional data and further research on this topic are necessary to draw any conclusions about the potential mechanism through which redshirting influences semester-level *GPA* and *Hours Earned* across sports that can be generalized.

The remaining negative and significant coefficients in column (4) are *Sophomore* and *Medically Unable*. This implies that sophomore year is more difficult than freshman year, and players earn lower GPAs when they are medically unable to play. The relationship between health and academic performance have been studied and reenforce the negative and statistically significant estimate of *Medically Unable* on *Graduation* (Singell 2004). There are also three positive and statistically significant coefficients in addition to the lagged redshirt variables, *Test Score*, *HS GPA*, and *White*. *Test Score* and *HS GPA* are indicators of academic aptitude and are expected to be positive and significant indicators of college GPA. The white players in the sample received higher GPAs than

players in the sample that did not identify as white or black.[33]

Although the OLS estimates in Table 15 suggest that redshirting may be negatively correlated with GPA in the redshirt year and positively correlated with GPA in later years, *Hours Earned* do not appear to be influenced by the redshirt year. There are no significant estimates that suggest that redshirting influences hours earned in the redshirt year, or subsequent years in any of the sports included in this analysis. These estimates are presented and discussed in Appendix B.

Men's Basketball

The next step in our analysis is to examine MSU Men's Basketball players. OLS and student fixed-effects estimates that are produced using the basketball sample with the dependent variable *GPA* are shown in Table 16. $Redshirt_{t-1}$ and $Redshirt_{t-2}$ are positive and significant at the 0.05 level. The only other significant coefficient is *Test Score*, which is positive. There were no players in the sample that attended school four years after redshirting. The sample size is very small due to missing missing observations. It contains 177 semesters from 33 different students after the *Test Score* and *HS GPA* variables are added. Before these variables are added, the sample size is considerably larger. Omitting *Test Score*, *HS GPA*, *Medically Unable*, and *Eligibility Exhausted* increases the number of semesters in the sample to 339 from 69 students.

In specification (2), which contains the redshirt lags, *Financial Aid*, term code

[33]Other races include *American Indian/Alaskan Native*, *Asian*, *Hispanic/Latino*, *Non-Resident Alien*, *Unknown*, *Native Hawaiian/Pacific Islander*, or *Two or More Races*. These races account for 23.73 percent of the football sample.

dummies, and class year dummies, *Redshirt*, $Redshirt_{t-1}$, and $Redshirt_{t-2}$ are positive and statistically significant. If specification (2) is run on the sample from specification (4), the coefficients are smaller in magnitude, but retain their statistical significance, however, *Redshirt* and $Redshirt_{t-2}$ are not statistically significant in specification (4). This implies that there may be omitted variable bias in the estimates produced by specification (2). Estimates from specification (4) indicate that basketball players may receive statistically significant benefits from redshirting in the year following their redshirt year. Basketball players play in many more games than football players, so a positive relationship between redshirting and *GPA* is more likely than in the football sample.[34]

The positive and statistically significant estimates on $Redshirt_{t-1}$ can be explained similarly to the football lagged effects. Student-athletes are able to spread out their credits more if they redshirt. The estimated coefficient on $Redshirt_{t-1}$ is not statistically significant after student fixed-effects are included in the model in specifications (5) through (7). This indicates that there may be unobserved student-level characteristics, such as work ethic, that are positively correlated with both redshirting and GPA and are biasing the estimates produced by OLS in specification (4). $Redshirt_{t-4}$ is negative and significant in specification (2). After student fixed-effects are included, the estimated impact of $Redshirt_{t-4}$ on GPA remains statistically significant. It is unclear why this estimate would be negative, but there are only three students in the basketball sample that attended school in their fourth year after redshirting so the estimate may not be generalizable due to the small sample size. Due to the small sample size in the basketball

[34]In 2014, the MSU football team played in 12 regular season games and the MSU basketball team is scheduled to play in 32 games.

sample, these results should be interpreted as providing enough evidence to encourage future research on the academic impacts of redshirting on basketball players, rather than strong evidence that redshirting impacts *GPA* positively. A post-estimation F-test, conducted after implementing specification (4), for the difference between zero and the sum of the redshirt and lagged redshirt coefficients yields a p-value of 0.373. This p-value indicates that there is no significant total effect of redshirting on GPA experienced throughout MSU basketball players' careers.

Volleyball

Results from regressions estimating the influence of various factors on *GPA* using the MSU volleyball student-athlete dataset are presented in Table 17. Again, sample size is an issue. In specification (4), $Redshirt_{t-2}$ is the only redshirt variable to have a statistically significant influence on *GPA*, and there are 198 semester-level observations from 29 individuals. This estimate is statistically significant at the 0.10 level when student fixed-effects are included in specification (7). If the variables *Test Score*, *HS GPA*, *Medically Unable*, and *Eligibility Exhausted* are omitted, as in specification (2), the sample size increases to 276 semester-level observations from 36 individuals and the estimated effect of $Redshirt_{t-3}$ is also positive and statistically significant. When model (2) is run using the sample from model (4), $Redshirt_{t-3}$ is not significant. This indicates that the observations that do not include values for the *Test Score* and *HS GPA* variables may be systematically different than the observations that include those values. This may be biasing the OLS estimate of $Redshirt_{t-3}$ towards zero in specifications (3) and (4).

After including student fixed-effects and all other relevant variables in specification (7), $Redshirt_{t-3}$ is not statistically significant. This estimate accounts for differences in *Test Score* and *HS GPA*, while maintaining the sample from specification (2). The student fixed-effects results in specification (7) may suggest that there is omitted variable bias in the statistically significant estimated coefficient on $Redshirt_{t-3}$ from specification (2), and that $Redshirt_{t-3}$ does not actually have a statistically significant estimated effect on GPA. After implementing specification (4), a post-estimation F-test yields a p-value of 0.691 for the null hypothesis that the sum of *Redshirt* and the lagged redshirt values is equal to zero. This implies that redshirting does not have a statistically significant effect on cumulative GPA. Because of the small sample size, these estimates cannot be widely generalized, but indicate that the influence of redshirting on GPA and GPA in the years after redshirting of volleyball players may warrant further investigation.

Spring, *Senior*, and *Test Score* are also positive and significant. Volleyball season takes place in the Fall, so the positive coefficient on *Spring* is intuitive. *Senior*, and *Test Score* were discussed earlier and indicate seniors earn better GPAs when compared to freshman and students that enter college with better high school GPAs earn higher GPAs in college.

Women's Basketball

Finally, MSU women's basketball players are examined. The results of regression models with GPA are shown in Table 18. Unlike the other sports that have been included in this study, OLS estimates of the impact of redshirting on GPA suggest that redshirting

has no influence on *GPA* in the redshirt year, or subsequent years for women basketball players. This could in part be due to women's basketball players having less room for improvement. Women's basketball players have higher mean GPAs than athletes in other sports. Mean GPAs by sport are shown in Table 18. When student fixed-effects and all of the available relevant variables are included in specification (7), *Redshirt* and $Redshirt_{t-3}$ are statistically significant at the 0.05 level. Omitted variable bias from unobserved student-level characteristics may be biasing the estimates in specification (4) towards zero. This could occur if there is an unobserved trait, like work ethic, that is negatively correlated with redshirting and positively correlated with academic performance. *Summer*, *White*, and *Financial Aid* have statistically significant and negative influences on GPA for women's basketball players. An F-test is used to test if the sum of *Redshirt* and the lagged redshirt variables is significantly different from zero, and returns a value of 0.373. There appears to be no total impact of redshirting on cumulative GPA in the redshirt year and the years following the redshirt year.

Comparison Across Sports

To compare the factors that influence *GPA* across sports, an OLS model with robust standard errors was performed with volleyball and football interaction terms for each variable. The results are presented in Tables 19-21. Table 19 compares football with men's basketball, volleyball, and women's basketball. Table 20 compares men's basketball with volleyball and women's basketball, and Table 21 compares volleyball and

women's basketball.[35]

There is one statistically significant difference between football and volleyball. In the second year after redshirting, volleyball players are more positively influenced by their redshirt year. The reason is unclear, and not robust across all specifications. Specification (3) does not provide a statistically significant estimate of $Volleyball*Redshirt_{t-2}$, but when specification (3) is run using the sample from specification (5), the estimate is statistically significant. This indicates that observations with missing *Test Score* and *HS GPA* values may be causing bias in the estimate specification (5) estimate. Men's basketball players and women's basketball players have significantly larger estimated effects of redshirting than football players in their redshirt year. This may support the idea that basketball players receive more benefit than football players because of the number of games that they play in a season, or because of the timing of their season. Basketball season overlaps both the Fall and Spring semesters, meaning that a relaxation in the amount of time they spend traveling with the team could provide benefits in both the Fall and Spring semester of their redshirt year and difficult classes can be spread out more, which may help them in later years as well. Men's basketball players also have a statistically significant, negative estimated difference in their fourth year after redshirting when specification (3) is used, however, this estimate is based on only three basketball players that attended MSU four years after redshirting. When the variables *Test Score* and *HS GPA* are included, there are no longer any basketball players in the sample that attended school four years after

[35]These tables only include the coefficient estimates for the *Redshirt* and lagged redshirt variables and the interactions between each sport and these variables. The full results, including all of the included variables and interactions, can be found in Appendix C. Appendix D also contains the full estimates produced when these regressions are run with the dependent variable *TotalHoursEarned*.

redshirting. Differences in the impacts of redshirting on academic performance between sports are important to understand to utilize redshirting to improve academic performance of NCAA student athletes. Although these results indicate that there may be differences in the influence of redshirting on GPA between sports, more research in this area is needed. The data that are used in this portion of the analysis are limiting. The results should not be generalized, but can be used as foundation for future research on the effects of redshirting on academic performance in the redshirt year and following years.

There are no other significant differences between any of the redshirt variables across any of the other sports. These results are shown in Tables 20 and 21. There are also no significant differences between sports in any of the specifications using *Hours Earned* as a dependent variable. These results are shown in Appendix D.

Montana State Student-Level OLS

The final step in our empirical analysis is a student-level OLS analysis of the impacts of redshirting on *Cumulative GPA* and *Total Hours Earned*. The student-level model faces the same challenges as the fixed effects model. There are 193 football players, 30 men's basketball players, 31 volleyball players, and 27 women's basketball players in their respective samples in our analysis of the determinants of *Cumulative GPA* and 333 football players, 40 men's basketball players, 44 volleyball players and 37 women's basketball players in our analysis of *Hours Earned*. The differences in sample size are due to missing *Cumulative GPA* observations.[36] The *Cumulative GPA* and *Hours*

[36] Additional *Cumulative GPA* information may be available for future research, but obtaining those data is not possible in the time frame available for this thesis.

Earned results are presented in Tables 22 and 23, respectively. No significant effect of redshirting was found on *Cumulative GPA* in any of the samples. There is evidence that volleyball and football players both received a positive, significant benefit of redshirting to their total credit hours earned during their collegiate careers. This would be intuitive, as redshirts use five years to exhaust their athletic eligibility, so there is extra time to attend school longer and earn additional credits. There are issues with the analysis. There may be selection bias present, and sample sizes are small. These issues make this portion of the analysis difficult to generalize. A more comprehensive study on the effects of redshirting on *Cumulative GPA* and *Hours Earned* would be required to draw strong conclusions about the impacts of redshirting on *Cumulative GPA* and *Hours Earned*.

Table 9: SuperPrep Data Descriptive Statistics

	Full Sample		Redshirts		Non-Redshirts	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
SuperPrep Rank	38.416	36.046	41.801	37.419	30.396***	31.197
Height	74.370	2.564	74.656	2.515	73.694***	2.558
Weight	223.687	39.629	228.152	39.938	213.110***	36.858
40-Yard Dash Time	4.697	0.263	4.733	0.271	4.611***	0.218
Retake	0.107	0.309	0.096	0.295	0.133	0.341
Ineligible	0.021	0.143	0.008	0.091	0.051***	0.220
Junior College	0.057	0.232	0.031	0.175	0.118***	0.323
Graduate	0.746	0.435	0.800	0.401	0.620***	0.486
NFL	0.242	0.428	0.196	0.398	0.349***	0.478
Distance to College	718064.5	810791.6	713824.5	758048.3	728128.3	925604.7
Test Score	954.365	141.666	964.511	141.604	928.341***	138.777
HS GPA	3.056	0.455	3.083	0.452	2.992***	0.456
College Characteristics						
US News Ranking	74.902	44.584	73.806	44.133	77.498	45.617
Enrollment	23313.67	10292.31	22974.62	10262.62	24116.75	10338.11
Out-of-State Tuition	29424.610	8841.182	29663.350	8849.815	28859.150	8812.214
In-State Tuition	16169.390	13289.260	16724.450	13602.620	14854.660*	12442.930
Accepted	56.389	20.905	56.216	21.097	56.800	20.476
Graduation Rate	52.898	19.280	53.414	19.267	51.675	19.295
Position						
Quarterback	0.085	0.279	0.098	0.297	0.055**	0.228
Special Teams	0.029	0.168	0.026	0.161	0.035	0.185
Running Back/Linebacker	0.255	0.436	0.225	0.418	0.325***	0.469
Tight End/Defensive End	0.150	0.357	0.161	0.367	0.125	0.332
Offensive/Defensive Line	0.232	0.422	0.275	0.447	0.129***	0.336
Wide Receiver/Defensive Back	0.249	0.433	0.215	0.411	0.329***	0.471
Conference						
ACC	0.214	0.411	0.219	0.414	0.204	0.404
Big 12	0.085	0.279	0.079	0.271	0.098	0.298
Big Ten	0.166	0.373	0.177	0.382	0.141	0.349
Other	0.157	0.364	0.149	0.356	0.176	0.382
Pac-12	0.189	0.391	0.202	0.402	0.157	0.364
SEC	0.189	0.391	0.174	0.379	0.224	0.417
High School Region						
East	0.141	0.348	0.132	0.339	0.161	0.368
Large	0.200	0.400	0.2	0.401	0.200	0.401
South	0.251	0.434	0.237	0.425	0.286	0.453
West/Midwest	0.407	0.492	0.430	0.496	0.353**	0.479

Table 9: SuperPrep Data Descriptive Statistics: Continued

	Full Sample		Redshirts		Non-Redshirts	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Year						
2000	0.161	0.367	0.152	0.360	0.180	0.385
2001	0.268	0.443	0.260	0.439	0.286	0.453
2002	0.190	0.392	0.197	0.398	0.173	0.379
2003	0.185	0.389	0.194	0.396	0.165	0.372
2004	0.197	0.398	0.197	0.398	0.196	0.398
Number of Observations	N=859		N=604		N=255	

Notes: 0.10, 0.05, and 0.01 significance levels for difference between redshirts and non-redshirts denoted by *,**, and ***, respectively. Summary statistics are calculated for the sample used in the propensity score matching treatment model shown in Table 12.

Table 10: SuperPrep OLS Results, Redshirt

	(1)	(2)	(3)	(4)	(5)	(6)
Height	0.018**	0.011	0.006	0.004	0.004	0.005
	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)
Weight	0.000	0.001	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
40-Yard Dash Time	0.170*	0.079	0.074	0.070	0.095	0.098
		(0.108)	(0.112)	(0.112)	(0.115)	(0.112)
SuperPrep Rank	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
High School Region						
Large	-0.013	-0.009	0.010	0.033	0.039	0.107
	(0.050)	(0.050)	(0.054)	(0.060)	(0.062)	(0.070)
South	0.004	0.002	0.019	0.049	0.035	0.050
	(0.048)	(0.048)	(0.053)	(0.058)	(0.058)	(0.066)
West/MW	0.049	0.054	0.076	0.109*	0.117*	0.107*
	(0.046)	(0.046)	(0.050)	(0.059)	(0.061)	(0.062)
Position						
Special Teams		-0.141	-0.105	-0.096	-0.114	-0.098
		(0.093)	(0.099)	(0.099)	(0.100)	(0.105)
Running Back/Linebacker		-0.179***	-0.177***	-0.177***	-0.171***	-0.174***
		(0.057)	(0.06)	(0.061)	(0.062)	(0.064)
Tight End/Defensive End		-0.111*	-0.111*	-0.105	-0.114*	-0.131*
		(0.064)	(0.067)	(0.067)	(0.068)	(0.070)
Offensive/Defensive Line		-0.114	-0.080	-0.071	-0.102	-0.128
		(0.079)	(0.08)	(0.081)	(0.082)	(0.085)
Wide Receiver/Defensive Back		-0.177***	-0.162***	-0.161**	-0.169***	-0.159**
		(0.057)	(0.062)	(0.062)	(0.063)	(0.066)
HS GPA			0.009	0.016	0.014	0.016
			(0.039)	(0.039)	(0.04)	(0.040)
Test Score			0.020*	0.015	0.015	0.012
			(0.012)	(0.012)	(0.013)	(0.014)
Conference						
Big 12				-0.123*	-0.122	-0.123
				(0.071)	(0.075)	(0.076)
Big Ten				-0.063	-0.076	0.020
				(0.062)	(0.064)	(0.073)
Other				-0.134**	-0.146**	-0.152**
				(0.057)	(0.060)	(0.064)

Table 10: SuperPrep OLS Results, Redshirt: Continued

	(1)	(2)	(3)	(4)	(5)	(6)
Pac-12				-0.030	-0.041	0.039
				(0.058)	(0.059)	(0.066)
SEC				-0.088*	-0.092	-0.054
				(0.053)	(0.057)	(0.060)
US News Rank					0.000	0.000
					(0.000)	(0.001)
Enrollment						-0.005*
						(0.002)
Out-Of-State Tuition						-0.009**
						(0.004)
In-State Tuition						0.005*
						(0.003)
Acceptance Rate						0.003*
						(0.002)
Graduation Rate						0.003
						(0.002)
Constant	-1.552***	-0.587	-0.408	-0.223	-0.379	-0.546
	(0.549)	(0.672)	(0.708)	(0.71)	(0.730)	(0.797)
	N=1027	N=1027	N=865	N=864	N=828	N=796
	R^2=0.060	R^2=0.070	R^2=0.080	R^2=0.090	R^2=0.097	R^2=0.108

Notes: 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively. Standard errors are shown in parentheses. Omitted High School Region, Position, and Conference are East, Quarterback, and ACC, respectively. Tuitions are measured in thousands of dollars. Enrollment is measured in thousands of students.

Table 11: SuperPrep OLS Results, Graduate

	(1)	(2)	(3)	(4)	(5)
Redshirt	0.164***	0.159***	0.152***	0.156***	0.155***
	(0.034)	(0.034)	(0.035)	(0.035)	(0.036)
HS GPA	0.128***	0.140***	0.132***	0.129***	0.119***
	(0.034)	(0.034)	(0.035)	(0.035)	(0.036)
Test Score	0.034***	0.035***	0.029**	0.032***	0.034***
	(0.011)	(0.011)	(0.012)	(0.011)	(0.012)
Height		-0.011	-0.013*	-0.013*	-0.010
		(0.007)	(0.007)	(0.007)	(0.007)
Weight		0.001*	0.001**	0.001*	0.001*
		(0.000)	(0.000)	(0.000)	(0.000)
SuperPrep Rank		0.001**	0.001**	0.001*	0.001**
		(0.000)	(0.000)	(0.000)	(0.000)
High School Region					
Large		-0.130***	-0.124***	-0.080	-0.035
		(0.047)	(0.047)	(0.054)	(0.065)
South		-0.013	-0.007	0.017	0.049
		(0.043)	(0.044)	(0.048)	(0.058)
West/MW		-0.137***	-0.117***	-0.073	-0.065
		(0.042)	(0.044)	(0.049)	(0.053)
US News Rank			0.000	0.000	0.000
			(0.000)	(0.000)	(0.001)
Conference					
Big 12				0.041	0.046
				(0.063)	(0.066)
Big Ten				-0.023	0.005
				(0.055)	(0.067)
Other				0.035	0.085
				(0.050)	(0.052)
Pac-12				-0.096*	-0.099
				(0.054)	(0.062)
SEC				-0.052	-0.065
				(0.051)	(0.054)
Enrollment					-0.002
					(0.002)
Out-Of-State Tuition					0.006
					(0.004)
In-State Tuition					-0.004*
					(0.002)

Table 11: SuperPrep OLS Results, Graduate: Continued

	(1)	(2)	(3)	(4)	(5)
Acceptance Rate					0.002
					(0.002)
Graduation Rate					0.003*
					(0.002)
Constant	-0.078	0.564	0.817*	0.761	0.122
	(0.106)	(0.473)	(0.487)	(0.486)	(0.546)
	N=868	N=868	N=831	N=831	N=798
	R^2=0.088	R^2=0.113	R^2=0.103	R^2=0.114	R^2=0.122

Notes: 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively. Standard errors are shown in parentheses. Omitted High School Region, Position, and Conference are East, Quarterback, and ACC, respectively. Tuitions are measured in thousands of dollars. Enrollment is measured in thousands of students.

Table 12: SuperPrep PSM Treatment Results

	Coef.	Std. Err.	z	$P > \|z\|$	95% Conf. Interval	
JC	-0.778***	0.230	-3.38	0.001	-1.229	-0.327
Retook Test	-0.058	0.166	-0.35	0.726	-0.383	0.267
Ineligible	-1.001***	0.378	-2.64	0.008	-1.742	-0.259
Height	0.083	0.155	0.54	0.590	-0.220	0.387
Weight	0.010	0.023	0.43	0.669	-0.035	0.055
40-Yard Dash	-0.491	2.507	-0.20	0.845	-5.404	4.423
SuperPrep Rank	0.017**	0.009	1.99	0.046	0.000	0.034
Special Teams	2.418	16.083	0.15	0.880	-29.105	33.940
Running Back/Linebacker	9.508	10.978	0.87	0.386	-12.010	31.025
Tight End/Defensive End	8.095	13.814	0.59	0.558	-18.981	35.170
Offensive Line/Defensive Line	14.958	11.043	1.35	0.176	-6.686	36.602
Wide Receiver/Defensive Back	12.751	11.511	1.11	0.268	-9.809	35.312
ST*SuperPrep Rank	-0.005	0.019	-0.26	0.792	-0.043	0.033
RB/LB*SuperPrep Rank	-0.011	0.009	-1.18	0.239	-0.028	0.007
TE/DE*SuperPrep Rank	-0.014	0.010	-1.43	0.153	-0.033	0.005
OL/DL*SuperPrep Rank	-0.010	0.009	-1.12	0.264	-0.029	0.008
WR/DB*SuperPrep Rank	-0.013	0.009	-1.43	0.153	-0.031	0.005
ST*Height	0.113	0.220	0.51	0.607	-0.318	0.544
RB/LB*Height	0.030	0.167	0.18	0.859	-0.298	0.358
TE/DB*Height	-0.190	0.187	-1.01	0.310	-0.556	0.177
OL/DL*Height	-0.032	0.167	-0.19	0.847	-0.359	0.295
WR/DB*Height	-0.191	0.165	-1.16	0.247	-0.514	0.133
QB*Weight	-0.002	0.028	-0.05	0.958	-0.057	0.054
RB/LB*Weight	-0.011	0.024	-0.45	0.652	-0.058	0.036
TE/DE*Weight	-0.020	0.025	-0.78	0.433	-0.069	0.030
OL/DL*Weight	-0.014	0.024	-0.58	0.564	-0.060	0.033
WR/DB*Weight	0.009	0.025	0.37	0.712	-0.040	0.058
QB*40-Yard Dash	2.463	3.057	0.81	0.420	-3.528	8.455
RB/LB*40-Yard Dash	0.276	2.712	0.10	0.919	-5.041	5.592
TE/DE*40-Yard Dash	4.594	2.909	1.58	0.114	-1.108	10.295
OL/DL*40-Yard Dash	0.393	2.602	0.15	0.880	-4.706	5.492
WR/DB*40-Yard Dash	2.292	2.860	0.80	0.423	-3.313	7.897
Graduation Rate	0.009	0.007	1.23	0.219	-0.005	0.023
High School GPA	0.049	0.118	0.42	0.678	-0.182	0.279
Big 12	-0.233	0.230	-1.01	0.313	-0.684	0.219
Big Ten	-0.097	0.238	-0.41	0.684	-0.563	0.369
Other	-0.509**	0.207	-2.46	0.014	-0.914	-0.104
Pac-12	0.024	0.215	0.11	0.912	-0.398	0.446
SEC	-0.158	0.188	-0.84	0.402	-0.526	0.211
US News Rank	0.004	0.007	0.52	0.606	-0.010	0.017

Table 12: SuperPrep PSM Treatment Results: Continued

Redshirt	Coef.	Std. Err.	z	$P > \|z\|$	95% Conf.	Interval
US News Rank^2	-0.002	0.003	-0.73	0.468	-0.008	0.004
Enrollment	-0.013*	.008	-1.74	0.081	-0.028	.002
Out-Of-State Tuition	-0.017	0.015	-1.14	0.253	-0.045	0.012
In-State Tuition	0.098**	0.042	2.35	0.019	0.016	0.180
IS Tuition*OOS Tuition	-0.002**	.001	-1.98	0.048	-.004	.000
Acceptance Rate	0.006	0.006	0.97	0.332	-0.006	0.018
CA/FL/TX	0.348	0.226	1.54	0.124	-0.096	0.791
South	0.204	0.209	0.98	0.329	-0.206	0.615
West/MW	0.479**	0.204	2.34	0.019	0.079	0.880
2001	0.245	0.157	1.57	0.117	-0.061	0.552
2002	0.371**	0.169	2.19	0.028	0.039	0.703
2003	0.407**	0.175	2.32	0.020	0.064	0.751
2004	0.231	0.169	1.36	0.173	-0.101	0.562
Constant	-17.621*	9.848	-1.79	0.074	-36.922	1.680
					N=859	R^2=0.153

Notes: 0.10, 0.05, and 0.01 significance levels denoted by *,**, and ***, respectively. Enrollment is measured in thousands of students, in-state and out-of-state tuition is measured in thousands of dollars, in-state times out-of-state tuition is measured in hundreds of thousands of dollars, and SuperPrep Rank squared is measured in hundreds of spots.

Table 13: Estimated PSM ATT by Matching Algorithm

	No Common Support		Common Support	
	ATT	Omitted	ATT	Omitted
k-Nearest Neighbor (5)	0.100**	0	0.103**	34
	(0.050)		(0.047)	
Radius (.02)	0.116**	0	0.124***	34
	(0.047)		(0.045)	
Radius (.01)	0.105**	33	0.111**	45
	(0.048)		(0.047)	
k-Nearest Neighbor (3)	0.084	0	0.098**	34
	(0.053)		(0.049)	
Kernel	0.118**	0	0.124***	34
	(0.048)		(0.045)	
Nearest Neighbor	0.066	0	0.079	34
	(0.062)		(0.056)	

Notes: ATT=Average Treatment Effect on the Treated. 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively. Standard errors are shown in parentheses. When common support is implemented, treated observations are omitted that have propensities to be treated greater than the maximum propensity score for untreated units. When radius matching is applied, treated units that do not have an untreated unit with a propensity score within the radius are omitted.

Table 14: Montana State Summary Statistics

	Football		Volleyball		Men's Basketball		Women's Basketball	
	OLS	FE	OLS	FE	OLS	FE	OLS	FE
GPA	2.687	2.617	3.151	3.079	2.872	2.599	3.308	3.294
	(0.843)	(0.872)	(0.748)	(0.81)	(0.727)	(0.834)	(0.851)	(0.813)
Hours Earned	11.407	11.112	11.843	12.261	11.198	10.634	11.298	11.542
	(4.04)	(4.093)	(4.322)	(4.021)	(4.519)	(4.493)	(4.617)	(4.538)
Financial Aid	16262.04	16689.26	23123.44	21477.36	20913.89	21215.85	20966.67	19637.47
	(9689)	(9268.883)	(6523.904)	(6863.541)	(7512.261)	(7579.174)	(6724.382)	(6899.202)
Hardship	0.005	0.010	0.000	0.000	0.000	0.006	0.009	0.006
	(0.073)	(0.101)	(0.000)	(0.000)	(0.000)	(0.077)	(0.092)	(0.077)
Medically Unable	0.028	0.030	0.005	0.004	0.023	0.012	0.038	0.027
	(0.164)	(0.171)	(0.071)	(0.06)	(0.149)	(0.108)	(0.192)	(0.162)
Redshirt	0.235	0.218	0.096	0.091	0.277	0.159	0.123	0.125
	(0.424)	(0.413)	(0.295)	(0.288)	(0.449)	(0.366)	(0.33)	(0.331)
Eligibility Exhausted	0.014	0.030	0.035	0.047	0.000	0.029	0.017	0.051
	(0.117)	(0.170)	(0.185)	(0.212)	(0.000)	(0.169)	(0.130)	(0.219)
HS GPA	3.170		3.460		3.275		3.612	
	(0.518)		(0.368)		(0.562)		(0.478)	
Test Score	986.181		1014.697		1008.192		1034.383	
	(144.889)		(135.705)		(151.609)		(149.769)	
Redshirt_{t-1}	0.191	0.174	0.106	0.098	0.113	0.059	0.077	0.071
	(0.393)	(0.38)	(0.309)	(0.298)	(0.317)	(0.236)	(0.267)	(0.258)
Redshirt_{t-2}	0.143	0.123	0.081	0.065	0.073	0.038	0.043	0.042
	(0.35)	(0.329)	(0.273)	(0.247)	(0.262)	(0.192)	(0.202)	(0.2)
Redshirt_{t-3}	0.100	0.089	0.076	0.069	0.062	0.041	0.017	0.012
	(0.300)	(0.285)	(0.265)	(0.254)	(0.242)	(0.199)	(0.13)	(0.109)
Redshirt_{t-4}	0.051	0.044	0.051	0.043	0.000	0.009	0.000	0.000
	(0.219)	(0.205)	(0.22)	(0.204)	(0.000)	(0.094)	(0.000)	(0.000)
Freshman	0.242	0.206	0.258	0.221	0.379	0.245	0.340	0.271
	(0.428)	(0.404)	(0.438)	(0.416)	(0.486)	(0.431)	(0.475)	(0.445)
Sophomore	0.258	0.233	0.253	0.243	0.226	0.186	0.289	0.235
	(0.438)	(0.423)	(0.436)	(0.43)	(0.419)	(0.39)	(0.454)	(0.425)
Junior	0.235	0.246	0.237	0.228	0.209	0.313	0.226	0.256
	(0.424)	(0.431)	(0.427)	(0.42)	(0.408)	(0.464)	(0.419)	(0.437)
Senior	0.193	0.246	0.157	0.228	0.164	0.218	0.128	0.208
	(0.395)	(0.431)	(0.364)	(0.42)	(0.371)	(0.414)	(0.334)	(0.407)
Fall	0.072	0.07	0.096	0.457	0.023	0.422	0.017	0.432
	(0.259)	(0.255)	(0.295)	(0.499)	(0.149)	(0.495)	(0.13)	(0.496)
Spring	0.461	0.464	0.434	0.409	0.412	0.383	0.413	0.396
	(0.499)	(0.499)	(0.497)	(0.493)	(0.494)	(0.487)	(0.493)	(0.49)

Table 14: Montana State Summary Statistics, Continued

	Football		Volleyball		Men's Basketball		Women's Basketball	
Summer	0.416	0.411	0.399	0.134	0.401	0.195	0.396	0.173
	(0.493)	(0.492)	(0.491)	(0.341)	(0.492)	(0.397)	(0.49)	(0.378)
White	0.123	0.125	0.167	0.725	0.186	0.454	0.191	0.685
	(0.328)	(0.331)	(0.374)	(0.448)	(0.391)	(0.499)	(0.394)	(0.465)
Black	0.667	0.615	0.828	0.000	0.565	0.348	0.664	0.104
	(0.471)	(0.487)	(0.378)	(0.000)	(0.497)	(0.477)	(0.473)	(0.306)
Other Race	0.229	0.262	0.000	0.275	2.872	0.198	0.149	0.211
	(0.420)	(0.440)	(0.000)	(0.448)	(0.440)	(0.399)	(0.357)	(0.409)
	N=1304	N=1755	N=198	N=276	N=177	N=339	N=235	N=336
	I=233	I=283	I=29	I=39	I=35	I=63	I=34	I=49

Notes: OLS=Sample used in OLS regression including all relevant variables. FE=Sample used in Student Fixed-Effects regression including all relevant variables. N=Number of semester-level observations. I=Number of individuals in sample. Standard deviations are shown in parentheses. Each sport's OLS and Student Fixed-Effect HS GPA and Test Score mean values and standard deviations are equivalent.

Table 15: MSU Football OLS Results, GPA

	OLS				Student Fixed-Effects		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Redshirt	-0.060	-0.134*	-0.237***	-0.246***	0.000	-0.020	-0.015
	(0.050)	(0.071)	(0.072)	(0.072)	(0.105)	(0.113)	(0.115)
$Redshirt_{t-1}$	0.046	0.099	0.035	0.019	-0.129	-0.054	-0.05
	(0.053)	(0.067)	(0.077)	(0.078)	(0.101)	(0.117)	(0.121)
$Redshirt_{t-2}$	0.176***	0.163	-0.035	-0.060	-0.184*	-0.163	-0.158
	(0.064)	(0.081)	(0.084)	(0.083)	(0.107)	(0.123)	(0.128)
$Redshirt_{t-3}$	0.408***	0.474***	0.206**	0.213**	0.005	0.152	0.159
	(0.064)	(0.077)	(0.085)	(0.082)	(0.110)	(0.131)	(0.134)
$Redshirt_{t-4}$	0.390***	0.574***	0.421*	0.408*	0.028	0.297	0.315
	(0.115)	(0.203)	(0.218)	(0.217)	(0.133)	(0.217)	(0.212)
Financial Aid	-0.012***	-0.014***	-0.003	0.003	0.010	0.004	0.005
	(0.002)	(0.002)	(0.002)	(0.003)	(0.006)	(0.007)	(0.007)
Spring	0.012	0.016	-0.006	-0.008	-0.030	-0.025	-0.025
	(0.038)	(0.041)	(0.040)	(0.039)	(0.025)	(0.028)	(0.028)
Summer	-0.083	-0.068	-0.109	-0.109	0.062	0.049	0.049
	(0.074)	(0.082)	(0.097)	(0.097)	(0.079)	(0.087)	(0.087)
Sophomore		-0.210**	-0.257***	-0.265***		-0.117	-0.117
		(0.086)	(0.088)	(0.088)		(0.087)	(0.087)
Junior		-0.124	-0.099	-0.105		-0.056	-0.056
		(0.084)	(0.089)	(0.088)		(0.091)	(0.092)
Senior		-0.182**	-0.098	-0.140		-0.168	-0.170
		(0.085)	(0.090)	(0.090)		(0.105)	(0.106)
Fifth Year		-0.320*	-0.268	-0.294		-0.311*	-0.322
		(0.183)	(0.200)	(0.200)		(0.185)	(0.180)
Medically Unable			-0.277**	-0.259**			-0.036
			(0.124)	(0.124)			(0.142)
Eligibility Exhausted			-0.449*	-0.407*			0.029
			(0.241)	(0.236)			(0.146)
Test Score			0.001***	0.001***			
			(0.000)	(0.000)			
HS GPA			0.603***	0.550***			
			(0.048)	(0.050)			
White				0.222***			
				(0.076)			
Black				-0.032			
				(0.077)			

Table 15: MSU Football OLS Results, GPA: Continued

	OLS				Student Fixed-Effects		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	2.766***	2.916***	0.419**	0.413**	2.501***	2.659***	2.654
	(0.054)	(0.083)	(0.192)	(0.200)	(0.101)	(0.107)	(0.108)
	N=2057	N=1755	N=1304	N=1304	N=2057	N=1755	N=1755
					G=387	G=334	G=334
	R^2=0.049	R^2=0.063	R^2=0.231	R^2=0.242	R^2=0.019	R^2=0.000	R^2=0.001

Notes: 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively. Standard errors are shown in parentheses. Financial Aid is measured in thousands of dollars.

Table 16: MSU Basketball OLS Results, GPA

	OLS				Student Fixed-Effects		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Redshirt	0.251**	0.355***	0.162	0.148	-0.034	-0.031	-0.047
	(0.112)	(0.122)	(0.109)	(0.115)	(0.188)	(0.185)	(0.191)
$Redshirt_{t-1}$	0.617***	0.682***	0.303**	0.271***	0.117	0.058	0.066
	(0.127)	(0.139)	(0.131)	(0.131)	(0.219)	(0.223)	(0.229)
$Redshirt_{t-2}$	0.714***	0.813***	0.259**	0.219*	0.254	0.071	0.101
	(0.104)	(0.120)	(0.120)	(0.123)	(0.184)	(0.228)	(0.243)
$Redshirt_{t-3}$	0.462	0.378	-0.060	-0.094	0.312	0.029	0.114
	(0.282)	(0.298)	(0.522)	(0.524)	(0.336)	(0.276)	(0.336)
$Redshirt_{t-4}$	-1.076	-1.562**	No Obs.	No Obs.	-0.461	-1.311***	-1.130**
	(0.708)	(0.749)			(0.337)	(0.433)	(0.542)
Financial Aid	-0.025***	-0.018***	-0.002	0.000	-0.008	0	0.001
	(0.006)	(0.006)	(0.009)	(0.009)	(0.012)	(0.014)	(0.014)
Spring	-0.086	-0.091	0.007	0.004	-0.124*	-0.127*	-0.125*
	(0.084)	(0.089)	(0.090)	(0.090)	(0.063)	(0.07)	(0.07)
Summer	0.017	0.010	0.098	0.083	0.004	-0.045	-0.042
	(0.130)	(0.131)	(0.170)	(0.173)	(0.13)	(0.143)	(0.145)
Sophomore		0.032	0.011	0.010		-0.025	-0.032
		(0.138)	(0.138)	(0.138)		(0.144)	(0.147)
Junior		-0.013	0.192	0.186		0.201*	0.171
		(0.121)	(0.122)	(0.122)		(0.12)	(0.134)
Senior		-0.036	0.206	0.197		0.038	-0.018
		(0.141)	(0.164)	(0.166)		(0.153)	(0.183)
Fifth Year		0.622**	1.109**	1.076*		0.600***	0.448
		(0.272)	(0.545)	(0.559)		(0.185)	(0.293)
Medically Unable			0.102	0.075			0.17
			(0.205)	(0.202)			(0.192)
Eligibility Exhausted				No Obs.			0.184
							(0.217)
Test Score			0.002***	0.002***			
			(0.000)	(0.000)			
HS GPA			0.209**	0.226*			
			(0.104)	(0.117)			
White				-0.038			
				(0.118)			
Black				-0.148			
				(0.167)			

Table 16: MSU Basketball OLS Results, GPA: Continued

	OLS				Student Fixed-Effects		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	3.088***	2.864***	0.281	0.384	2.834***	2.570***	2.568***
	(0.139)	(0.163)	(0.433)	(0.425)	(0.257)	(0.277)	(0.287)
	N=367	N=339	N=177	N=177	N=367	N=339	N=339
					G=77	G=73	G=73
	R^2=0.141	R^2=0.161	R^2=0.324	R^2=0.328	R^2=0.091	R^2=0.024	R^2=0.027

Notes: 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively. Standard errors are shown in parentheses. Financial Aid is measured in thousands of dollars.

Table 17: MSU Volleyball OLS Results, GPA

	OLS				Student Fixed-Effects		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Redshirt	0.019	0.038	-0.057	-0.138	0.269**	0.208	0.215
	(0.142)	(0.196)	(0.230)	(0.224)	(0.104)	(0.159)	(0.155)
$Redshirt_{t-1}$	0.006	0.068	0.087	0.029	0.237*	0.185	0.182
	(0.127)	(0.122)	(0.132)	(0.125)	(0.139)	(0.216)	(0.214)
$Redshirt_{t-2}$	0.416***	0.404***	0.366***	0.240**	0.528***	0.469*	0.457*
	(0.118)	(0.126)	(0.108)	(0.104)	(0.137)	(0.247)	(0.250)
$Redshirt_{t-3}$	0.318***	0.368**	0.159	-0.013	0.426**	0.378	0.336
	(0.113)	(0.174)	(0.154)	(0.120)	(0.195)	(0.314)	(0.343)
$Redshirt_{t-4}$	0.305	0.491	-0.008	-0.375	0.348	0.104	-0.008
	(0.302)	(0.477)	(0.417)	(0.421)	(0.265)	(0.350)	(0.499)
Financial Aid	-0.006	-0.003	-0.008	-0.014**	0.013	0.002	0
	(0.005)	(.007)	(0.006)	(0.006)	(0.018)	(0.019)	(0.016)
Spring	0.101	0.072	0.152*	0.150*	0.093	0.051	0.05
	(0.086)	(0.095)	(0.081)	(0.078)	(0.064)	(0.073)	(0.073)
Summer	-0.138	-0.110	-0.021	-0.027	-0.141	-0.121	-0.123
	(0.200)	(0.207)	(0.191)	(0.184)	(0.170)	(0.176)	(0.175)
Sophomore		-0.131	-0.033	-0.006		-0.023	-0.016
		(0.141)	(0.149)	(0.145)		(0.140)	(0.139)
Junior		0.054	0.137	0.154		0.077	0.09
		(0.145)	(0.149)	(0.146)		(0.166)	(0.169)
Senior		-0.063	0.302**	0.308**		-0.071	-0.035
		(0.200)	(0.152)	(0.145)		(0.244)	(0.247)
Fifth Year		-0.209	0.284	0.485*		0.208	0.324
		(0.394)	(0.257)	(0.250)		(0.241)	(0.382)
Medically Unable			-3.146***	-3.386***			Omitted
			(0.268)	(0.260)			
Eligibility Exhausted			0.199	0.154			-0.159
			(0.221)	(0.232)			(0.424)
Test Score			0.002***	0.002***			
			(0.000)	(0.000)			
HS GPA			0.377***	0.205			
			(0.137)	(0.127)			
White				-0.508***			
				(0.093)			
Black				No Obs.			

Table 17: MSU Volleyball OLS Results, GPA: Continued

	OLS				Student Fixed-Effects		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	3.144***	3.086***	-0.070	1.229**	2.680***	2.928***	2.961***
	(0.145)	(0.172)	(0.535)	(0.514)	(0.356)	(0.355)	(0.303)
	N=318	N=276	N=198	N=198	N=318	N=276	N=276
					G=53	G=45	G=45
	R^2=0.035	R^2=0.042	R^2=0.343	R^2=0.391	R^2=0.016	R^2=0.027	R^2=0.024

Table 18: MSU Women's Basketball OLS Results, GPA

	OLS				Student Fixed-Effects		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Redshirt$	0.041	-0.011	0.230	0.197	0.127	0.154	0.284**
	(0.100)	(0.112)	(0.155)	(0.151)	(0.107)	(0.109)	(0.121)
$Redshirt_{t-1}$	-0.119	-0.144	-0.202	-0.195	-0.231*	-0.116	0.016
	(0.155)	(0.157)	(0.203)	(0.202)	(0.131)	(0.146)	(0.142)
$Redshirt_{t-2}$	-0.090	-0.070	-0.577	-0.551	-0.379*	-0.241	-0.05
	(0.328)	(0.323)	(0.415)	(0.412)	(0.210)	(0.176)	(0.187)
$Redshirt_{t-3}$	0.256**	0.190	-0.173	-0.036	0.222*	0.348*	0.600***
	(0.112)	(0.135)	(0.250)	(0.247)	(0.128)	(0.187)	(0.175)
$Redshirt_{t-4}$	No Obs.	No Obs.	No Obs.	No Obs.	No Obs.	No Obs.	No Obs.
Financial Aid	-0.016***	-0.019***	-0.015**	-0.015*	0.008	0.033	0.023
	(0.005)	(0.006)	(0.006)	(0.008)	(0.026)	(0.025)	(0.024)
Spring	-0.07	-0.024	0.033	0.036	-0.078	-0.048	-0.048
	(0.077)	(0.079)	(0.081)	(0.080)	(0.061)	(0.066)	(0.066)
Summer	-0.324*	-0.354**	-0.399**	-0.406**	-0.448***	-0.418***	-0.420***
	(0.179)	(0.177)	(0.203)	(0.201)	(0.153)	(0.156)	(0.157)
Sophomore		0.025	0.007	-0.005		-0.116	-0.113
		(0.119)	(0.123)	(0.120)		(0.084)	(0.082)
Junior		-0.186	-0.041	-0.063		-0.259**	-0.244*
		(0.130)	(0.165)	(0.166)		(0.122)	(0.123)
Senior		-0.039	0.291	0.255**		-0.108	-0.089
		(0.118)	(0.110)	(0.108)		(0.102)	(0.087)
Fifth Year		0.253*	0.191	0.110		0.068	0.227
		(0.137)	(0.268)	(0.243)		(0.202)	(0.360)
Medically Unable			-0.172	-0.278			-0.395***
			(0.375)	(0.374)			(0.104)
Eligibility Exhausted			No Obs.	No Obs.			-0.179
							(0.304)
Test Score			0.001***	0.002***			
			(0.000)	(0.000)			
HS GPA			0.323**	0.422***			
			(0.156)	(0.155)			
White				-0.446***			
				(0.159)			
Black				-0.329*			
				(0.190)			

Table 18: MSU Women's Basketball OLS Results, GPA: Continued

	OLS				Student Fixed-Effects		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	3.648***	3.796***	0.970	0.613	3.215***	2.854***	3.006***
	(0.106)	(0.124)	(0.620)	(0.606)	(0.497)	(0.456)	(0.453)
	N=371	N=336	N=235	N=235	N=371	N=336	N=336
					G=63	G=53	G=53
	R^2=0.043	R^2=0.075	R^2=0.259	R^2=0.288	R^2=0.100	R^2=0.000	R^2=0.007

Table 19: MSU Football vs. Other Sports, GPA

	(1)	(2)	(3)	(4)	(5)
Redshirt	0.011	-0.06	-0.134*	-0.237***	-0.246***
	(0.042)	(0.050)	(0.071)	(0.073)	(0.073)
Volleyball**Redshirt*	0.024	0.078	0.172	0.18	0.108
	(0.141)	(0.150)	(0.205)	(0.235)	(0.230)
Basketball**Redshirt*	0.257**	0.310**	0.488***	0.399***	0.394***
	(0.118)	(0.122)	(0.140)	(0.129)	(0.133)
Women's Basketball**Redshirt*	0.013	0.100	0.123	0.467***	0.442***
	(0.103)	(0.112)	(0.131)	(0.169)	(0.165)
$Redshirt_{t-1}$	0.059	0.046	0.099	0.035	0.019
	(0.047)	(0.053)	(0.068)	(0.078)	(0.079)
Volleyball*$Redshirt_{t-1}$	-0.040	-0.040	-0.031	0.052	0.01
	(0.127)	(0.136)	(0.138)	(0.150)	(0.145)
Men's Basketball*$Redshirt_{t-1}$	0.439***	0.571***	0.583***	0.269*	0.252*
	(0.147)	(0.137)	(0.153)	(0.149)	(0.150)
Women's Basketball*$Redshirt_{t-1}$	-0.194	-0.165	-0.243	-0.237	-0.214
	(0.148)	(0.163)	(0.170)	(0.214)	(0.213)
$Redshirt_{t-2}$	0.199***	0.176***	0.163**	-0.035	-0.06
	(0.059)	(0.064)	(0.081)	(0.085)	(0.084)
Volleyball*$Redshirt_{t-2}$	0.144*	0.240*	0.241	0.401***	0.300**
	(0.122)	(0.134)	(0.148)	(0.135)	(0.132)
Men's Basketball*$Redshirt_{t-2}$	0.350**	0.538***	0.649***	0.294**	0.279*
	(0.160)	(0.122)	(0.144)	(0.145)	(0.146)
Women's Basketball*$Redshirt_{t-2}$	-0.301	-0.266	-0.233	-0.541	-0.491
	(0.360)	(0.332)	(0.330)	(0.417)	(0.413)
$Redshirt_{t-3}$	0.402***	0.408***	0.474***	0.206**	0.213**
	(0.062)	(0.064)	(0.077)	(0.086)	(0.083)
Volleyball*$Redshirt_{t-3}$	-0.100	-0.09	-0.106	-0.047	-0.225
	(0.121)	(0.129)	(0.188)	(0.173)	(0.143)
Men's Basketball*$Redshirt_{t-3}$	0.074	0.054	-0.097	-0.266	-0.307
	(0.269)	(0.287)	(0.305)	(0.515)	(0.514)
Women's Basketball*$Redshirt_{t-3}$	-0.144	-0.152	-0.284*	-0.379	-0.245
	(0.174)	(0.128)	(0.154)	(0.260)	(0.256)
$Redshirt_{t-4}$	0.427***	0.390***	0.574***	0.421*	0.408*
	(0.113)	(0.116)	(0.204)	(0.220)	(0.219)
Volleyball*$Redshirt_{t-4}$	-0.136	-0.086	-0.084	-0.43	-0.783*
	(0.332)	(0.321)	(0.512)	(0.461)	(0.464)
Men's Basketball*$Redshirt_{t-4}$	-1.29*	-1.466**	-2.136***	No Obs.	No Obs.
	(0.694)	(0.713)	(0.769)		

Table 19: MSU Football vs. Other Sports, GPA: Continued

	(1)	(2)	(3)	(4)	(5)
Women's Basketball*$Redshirt_{t-4}$	No Obs.	No Obs.	No Obs.	No Obs.	No Obs.
	N=3524	N=3113	N=2706	N=1914	N=1914
	R^2=0.091	R^2=0.125	R^2=0.147	R^2=0.305	R^2=0.319

Notes: 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively. Standard errors are shown in parentheses. Interactions indicate difference from the football sample (i.e. *Redshirt* is the estimated effect for football, and $Redshirt * Men'sBasketball$ is the difference between the estimated effect of redshirting between men's basketball players and football players). This table only provides the estimated coefficients on the variables of interest. The full results from these models, with the complete variable set, are presented in Appendix C.

Table 20: MSU Men's Basketball vs. Volleyball and Women's Basketball, GPA

	(1)	(2)	(3)	(4)	(5)
Redshirt	0.268**	0.251**	0.355***	0.162	0.148
	(0.111)	(0.112)	(0.123)	(0.109)	(0.114)
Volleyball*$Redshirt$	-0.233	-0.232	-0.317	-0.219	-0.286
	(0.175)	(0.181)	(0.23)	(0.254)	(0.251)
Women's Basketball*$Redshirt$	-0.243*	-0.21	-0.366**	0.068	0.049
	(0.146)	(0.150)	(0.166)	(0.190)	(0.190)
$Redshirt_{t-1}$	0.498***	0.617***	0.682***	0.303**	0.271**
	(0.14)	(0.127)	(0.139)	(0.13)	(0.131)
Volleyball*$Redshirt_{t-1}$	-0.479***	-0.611***	-0.614***	-0.216	-0.242
	(0.184)	(0.18)	(0.185)	(0.185)	(0.181)
Women's Basketball*$Redshirt_{t-1}$	-0.633***	-0.736***	-0.827***	-0.506**	-0.466*
	(0.199)	(0.201)	(0.210)	(0.242)	(0.242)
$Redshirt_{t-2}$	0.550***	0.714***	0.813***	0.259**	0.219*
	(0.149)	(0.104)	(0.12)	(0.12)	(0.122)
Volleyball*$Redshirt_{t-2}$	-0.207	-0.298*	-0.409**	0.107	0.02
	(0.183)	(0.158)	(0.174)	(0.161)	(0.161)
Women's Basketball*$Redshirt_{t-2}$	-0.651*	-0.804**	-0.883**	-0.836*	-0.77*
	(0.387)	(0.344)	(0.345)	(0.434)	(0.433)
$Redshirt_{t-3}$	0.476*	0.462	0.378	-0.06	-0.094
	(0.263)	(0.282)	(0.298)	(0.52)	(0.52)
Volleyball*$Redshirt_{t-3}$	-0.174	-0.144	-0.01	0.219	0.081
	(0.283)	(0.304)	(0.345)	(0.542)	(0.534)
Women's Basketball*$Redshirt_{t-3}$	-0.218	-0.206	-0.188	-0.113	0.061
	(0.310)	(0.303)	(0.328)	(0.578)	(0.577)
$Redshirt_{t-4}$	-0.862	-1.076	-1.562**	-0.008	-0.375
	(0.687)	(0.708)	(0.75)	(0.415)	(0.419)
Volleyball*$Redshirt_{t-4}$	1.153	1.38*	2.052**	No Obs.	No Obs.
	(0.755)	(0.769)	(0.888)		
Women's Basketball*$Redshirt_{t-4}$	No Obs.	No Obs.	No Obs.	No Obs.	No Obs.
	N=1111	N=1056	N=951	N=610	N=610
	R^2=0.124	R^2=0.165	R^2=0.204	R^2=0.335	R^2=0.381

Notes: 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively. Standard errors are shown in parentheses. No football players are included in the sample. Interactions indicate the difference from the men's basketball sample (i.e. *Redshirt* is the estimated effect for men's basketball players, and $Redshirt * Volleyball$ is the difference between the estimated effect of redshirting between volleyball players and men's basketball players). This table only provides the estimated coefficients on the variables of interest. The full results from these models, with the complete variable set, are presented in Appendix C.

Table 21: MSU Volleyball vs. Women's Basketball, GPA

	(1)	(2)	(3)	(4)	(5)
Redshirt	0.035	0.019	0.038	-0.057	-0.138
	(0.135)	(0.142)	(0.195)	(0.229)	(0.223)
Women's Basketball*red	-0.011	0.022	-0.049	0.287	0.334
	(0.165)	(0.174)	(0.225)	(0.277)	(0.27)
$Redshirt_{t-1}$	0.019	0.006	0.068	0.087	0.029
	(0.119)	(0.127)	(0.121)	(0.131)	(0.125)
Women's Basketball*$Redshirt_{t-1}$	-0.154	-0.125	-0.213	-0.289	-0.224
	(0.184)	(0.2)	(0.199)	(0.242)	(0.238)
$Redshirt_{t-2}$	0.343***	0.416***	0.404***	0.366***	0.24**
	(0.107)	(0.118)	(0.126)	(0.107)	(0.104)
Women's Basketball*$Redshirt_{t-2}$	-0.444	-0.506	-0.474	-0.942**	-0.79*
	(0.372)	(0.349)	(0.347)	(0.43)	(0.427)
$Redshirt_{t-3}$	0.302***	0.318***	0.368**	0.159	-0.013
	(0.104)	(0.112)	(0.173)	(0.153)	(0.12)
Women's Basketball*$Redshirt_{t-3}$	-0.044	-0.061	-0.178	-0.332	-0.02
	(0.194)	(0.159)	(0.22)	(0.294)	(0.276)
$Redshirt_{t-4}$	0.291	0.305	0.491	-0.008	-0.375
	(0.313)	(0.301)	(0.475)	(0.414)	(0.418)
Women's Basketball*$Redshirt_{t-4}$	No Obs.	No Obs.	No Obs.	No Obs.	No Obs.
	N=715	N=689	N=612	N=433	N=433
	R^2=0.020	R^2=0.049	R^2=0.077	R^2=0.299	R^2=0.335

Notes: 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively. Standard errors are shown in parentheses. Financial Aid is measured in thousands of dollars. Test Scores are measured in hundreds of points. No football or men's basketball players are included in the sample. Interactions indicate difference from the volleyball sample (i.e. *Redshirt* is estimated effect for volleyball players, and $Redshirt * Women'sBasketball$ is the difference between the estimated effect of redshirting between volleyball players and women's basketball players). This table only provides the estimated coefficients on the variables of interest. The full results from these models, with the complete variable set, are presented in Appendix C.

Table 22: MSU Student-Level OLS, GPA

	Football	Men's Basketball	Volleyball	Women's Basketball
Redshirt	-0.125	-0.169	-0.700	-0.225*
	(0.090)	(0.332)	(0.449)	(0.129)
Recruited	-0.044	-0.009	0.750	1.431***
	(0.115)	(0.237)	(0.506)	(0.283)
Medically Unable	-0.071	-0.268	No Obs.	0.184
	(0.177)	(0.285)		(0.396)
Financial Aid	0.002***	0.001	-0.004***	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)
Test Score	0.045	0.284**	0.235*	0.077*
	(0.030)	(0.102)	(0.128)	(0.041)
HS GPA	0.570***	0.047	-0.129	0.156
	(0.090)	(0.271)	(0.426)	(0.151)
Black	-0.101	-0.312	No Obs.	-0.102
	(0.167)	(0.392)		(0.212)
White	0.282	0.198	1.077	0.195
	(0.173)	(0.221)	(0.787)	(0.250)
Constant	0.198	-0.170	0.073	0.283
	(0.383)	(0.819)	(1.869)	(0.603)
	N=193	N=30	N=31	N=27
	R^2=0.326	R^2=0.588	R^2=0.531	R^2=0.785

Notes: 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively. Standard errors are shown in parentheses. Financial Aid is measured in thousands of dollars. Test Score is measured in hundreds of points.

Table 23: MSU Student-Level OLS, Hours Earned

	Football	Men's Basketball	Volleyball	Women's Basketball
Redshirt	8.577**	1.067	14.520**	5.679
	(3.526)	(6.248)	(6.600)	(8.522)
Recruited	-5.608	0.879	-9.918	3.288
	(4.064)	(13.028)	(6.716)	(16.672)
Medically Unable	19.131**	-3.797	46.468***	-12.437
	(7.965)	(9.436)	(5.008)	(20.883)
Financial Aid	0.383***	0.359***	0.373***	0.365***
	(0.02)	(0.024)	(0.027)	(0.038)
Test Score	0.017	0.044*	0.01	-0.017
	(0.012)	(0.026)	(0.023)	(0.028)
HS GPA	11.933***	9.728	12.068*	21.21*
	(3.48)	(6.436)	(6.316)	(10.63)
Black	-5.221	-22.466**	No Obs.	-20.614*
	(5.003)	(9.274)		(11.596)
White	22.013***	-15.160	10.390	4.999
	(6.037)	(10.644)	(6.866)	(10.746)
Constant	-41.563***	-42.778	-38.245	-37.026
	(13.207)	(28.436)	(32.922)	(35.129)
	N=333	N=40	N=44	N=37
	R^2=0.536	R^2=0.870	R^2=0.879	R^2=0.767

Notes: 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively. Standard errors are shown in parentheses. Financial Aid is measured in thousands of dollars. Test Score is measured in hundreds of points.

CONCLUSION

The potential impact of redshirting on academic performance is a subject that has largely been ignored by researchers. Based on evidence presented in this thesis, redshirting can potentially be used as a device for improving college graduation rates in top high school football recruits. We find a positive and statistically significant impact of redshirting on graduation after accounting for potential selection bias. The influence of redshirting on semester-level academic performance in the redshirt year and subsequent years is also examined, but due to a variety of data limitations no strong conclusions can be drawn from that analysis. OLS results do indicate, however, that further research in this area is warranted.

To the author's knowledge, only two studies have been conducted that consider the relationship between redshirting and academic performance (McArdle & Hamagami 1994; NCAA Research, personal communication, September 17, 2014). The research examining this topic that has been conducted yields estimates that are likely inaccurate due to omitted variable bias. In addition, these studies do not acknowledge that the redshirt decision is likely determined endogenously with academic success. Two separate datasets are used in this study to determine if redshirting impacts academic performance. First, individual-athlete level data from issues of SuperPrep magazine from 2000-2004 are used to estimate the influence of redshirting on college graduation for elite high school football players. OLS results provide positive and statistically significant estimates of the effect of redshirting on graduation. These estimates do not account for the possibility that

the redshirt decision is determined in a way that is systematically related to academic success. After accounting for this endogeneity using propensity score matching, the estimates of the impact of redshirting on graduation remain positive and statistically significant, although they are somewhat smaller in magnitude.

Second, semester-level panel data from Montana State University (MSU) from 1995-2014 are used to determine how redshirting affects academic performance in the redshirt year and subsequent years. These data are relatively incomplete and limit the conclusions that can be drawn from the analysis. OLS results indicate that there may be a positive influence of redshirting on GPA in the years following redshirting for volleyball, football, and men's basketball players, although these results are not consistent when checked for robustness using student-fixed effects. This indicates that there may be bias present in the OLS estimates due to individual-level omitted variables that influence both redshirting and academic achievement. More research is required in order to fully understand how redshirting influences semester-level academic performance.

Although this study provides strong evidence that redshirting improves the probability of graduation for top quality college football players, it does have limitations. First, propensity score matching allows us to identify the direction of selection bias and provides more accurate estimates of the true effect of redshirting on graduation, but that does not necessarily mean that the endogeneity bias is fully accounted for. Our propensity score matching estimates of the impact of redshirting on graduation are smaller in magnitude than our OLS estimates, indicating that the effect of redshirting is overstated in our OLS regressions due to selection bias. However, there could still be bias present in the

PSM estimates due to unobserved characteristics that are related to both redshirting and graduation and not captured by the included covariates. This study supports that selection bias, highlighted by the differences between OLS and PSM estimates, should be considered when assessing the impact of redshirting in the future. Second, the data used in the MSU portion of the analysis is relatively incomplete. The small sample sizes do not allow for generalizations of the findings, but arguably provide evidence that a relationship between redshirting and GPA in later years may exist, although student fixed-effects results contradict these findings. Future research could focus on obtaining similar data from more schools to expand the analysis and strengthen the conclusions that might be drawn from the results.

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APPENDICES

APPENDIX A

NCAA FBS SANCTIONS

Table 24: NCAA FBS Sanctions

		Probation		Bowl Ban	
School	Violations	Years	Seasons	Years	Seasons
Alabama	1989-1990,1993	1995-1996	2	1995	1
Alabama	1995-2000	2002-2006	5	2002-2003	2
Alabama	2005-2007	2009-2011	3	-	0
Arizona	1952-1956	1961	1	-	0
Arizona	1976-1980	1983-1984	2	1983-1984	2
Arizona St.	1949-1952	1953 (Sep)-1955	2	1953	1
Arizona St.	1958	1959 (Oct)-1961	2	1959	1
Arizona St.	1975-1979	1980 (Dec)-1982	2	1981	1
Arizona St.	2002-2004	2005 (Nov)-2007	2	-	0
Arkansas		1964 (Dec)-1965	1	-	0
Arkansas	1994,1997-1999	2003-2005	3	-	0
Arkansas St.	2005-2006	2011-2012	2	-	0
Auburn	1955	1956-1958	3	1956-1957	2
Auburn	1957	1958-1960	3	1958-1960	3
Auburn	1974-1979	1979-1981 (Nov)	3	1979-1980	2
Auburn	1986-1992	1993 (Nov)-1995	2	1993-1994	2
Ball St.	2004-2005	2007 (Oct)-2009	2	-	0
Baylor	2007-2011	2012-2014	3	-	0
Baylor	2004	2005-2009	5	-	0
Boise St.	2005-2009	2011 (Sep)-2014	3	-	0
Buffalo	1969-1970	1970	1	-	0
California	1952-1955	1956 (Nov)-1957	1	-	0
California	1970-1971	1973-1974	2	1973-1974	2
California	1997-2001	2001-2005	5	2002	1
Central Florida	2007-2009	2010-2011	2	-	0
Central Florida	2009-2011	2012-2016	5	2013	1
Cincinnati	2009-2010	2011 (Sep)-2013	2	-	0
Cincinnati	1951-1953	1955	1	1955	1
Cincinnati	1974-1977	1978 (Dec)-1980	2	-	0
Cincinnati	1984-1987	1988 (Nov)-1991	3	1988	1
Clemson	19,851,987	1990	1	-	0
Clemson	1977-1982	1982 (Nov)-1984	2	1982-1983	2
Colorado	1972	1973	1	-	0
Colorado	1959-1961	1962-1963	2	1962-1963	2
Colorado	1971-1979	1980 (Dec)-1982	2	1981	1
Colorado	1996-1999	2002 (Oct)-2004	2	-	0
Colorado	2000-2005	2007-2008	2	-	0
East Carolina	1980-1984	1986 (Sep)-1987	1	-	0
Florida	1953-1956	1956-1957	2	1956-1957	2

Table 24: NCAA FBS Sanctions: Continued

		Probation		Bowl Ban	
School	Violations	Years	Seasons	Years	Seasons
Florida	1979-1983	1985-1986	2	1984-1985	2
Florida	1986-1988	1990 (Sep)-1992	2	1990	1
Florida Intl	2002-2004	2005-2007	3	-	0
Florida Intl	20,042,007	2008-2011	4	-	0
Florida St.	1972-1973	1974	1	-	0
Florida St.	1992-1994	1996	1	-	0
Florida St.	2006-2007	2009-2012	4	-	0
Fresno St.	1980-1982	1983	1	-	0
Georgia	1982	1985	1	-	0
Georgia	1981-1982	1982 (Sep)-1983	1	-	0
Georgia	1993-1995	1997-1998	2	-	0
Georgia Tech	1998-2004	2005 (Nov)-2007	2	-	0
Georgia Tech	2009-2010	2011-2014	4	-	0
Hawaii	1974-1975	1977-1978	2	-	0
Houston	1977	1977 (Sep)-1978	1	-	0
Houston	1962-1965	1966-1968	3	1966-1968	3
Houston	1978-1987	1988 (Dec)-1991	3	1989-1990	2
Illinois	1962-1966	1967-1968	2	1967-1968	2
Illinois	1971-1973	1974-1975	2	-	0
Illinois	1980-1982	1984-1985	2	1984	1
Illinois	1984-1985	1988-1989	2	-	0
Illinois	2003	2005 (Oct)-2006	1		0
Indiana	1956-1957	1957 (Oct)-1958	1	-	0
Indiana	1958-1959	1960-1963	4	1960-1963	4
Iowa St.	1983-1985	1986 (Dec)-1988	2	-	0
Kansas	1968-1971	1972	1	1972	1
Kansas	19,571,959	1960 (Oct)-1962	2	1960	1
Kansas	1979-1982	1983 (Nov)-1985	2	1984	1
Kansas	2003	2006 (Oct)-2009	3	-	0
Kansas St.	1947-1952	1954	1	-	0
Kansas St.	1997-1998	1999	1	-	0
Kansas St.	1968-1970	1970 (Oct)-1973 (Jan)	3	1970-1972	3
Kansas St.	1975-1978	1978-1980	3	1978-1979	2
Kentucky	1962-1963	1964	1	1964	1
Kentucky	1974-1975	1976 (Dec)-1978	2	1977	1
Kentucky	1999-2000	2002-2004	3	2002	1
Louisiana St.	2009	2011	1	-	0
Louisiana St.	1981-1984	1986 (Sep)-1987	1	-	0
Louisiana-Lafayette	1966-1967	1968-1969	2	-	0
Louisiana-Lafayette	2002-2005	2007-2008	2	-	0

Table 24: NCAA FBS Sanctions: Continued

		Probation		Bowl Ban	
School	Violations	Years	Seasons	Years	Seasons
Marshall	1968-1969	1969 (Oct)-1970	1	1969	1
Marshall (WV)	1996-2000	2001 (Dec)-2005	4	-	0
Maryland	2002-2003	2003	1	-	0
Massachusetts	1966-1968	1970	1	-	0
Memphis	1975-1978	1979-1980	2	1979	1
Memphis	1983-1985	1986-1987	2	-	0
Memphis	1988	1989-1991	3	1989	1
Miami (FL)	1950-1954	1954 (Oct)-1957 (Jan)	3	1954-1956	3
Miami (FL)	1977-1980	1981 (Nov)-1983	2	1981	1
Miami (FL)	1985-1994	1995 (Nov)-1998	3	1995	1
Michigan	2008-2009	2010 (Nov)-2013	3	-	0
Michigan St.	1957-1959	1964 (Nov)-1967	3	-	0
Michigan St.	1967,1972-1975	1976-1978	3	1976-1978	3
Michigan St.	1991-1995	1995 (Dec)-1999	4	-	0
Minnesota	1985-1986	1988-1989	2	-	0
Minnesota	1982-1988	1991-1992	2	1991	1
Mississippi	1957	1959 (Oct)-1960	1	-	0
Mississippi	1982-1984	1986 (Dec)-1988	2	1987	1
Mississippi	1991-1994	1994 (Sep)-1998	4	1995-1996	2
Mississippi St.	1991-1993	1996	1	-	0
Mississippi St.	1974	1975 (Sep)-1977	2	1975-1976	2
Mississippi St.	1998-2002	2004-2007	4	2004	1
Navy	1964	1964 (Nov)-1965	1	-	0
Nebraska	19,831,986	1986 (Oct)-1987	1	-	0
Nebraska	2007-2010	2012-2013	2	-	0
New Mexico	2004-2005	2008-2010	3	-	0
New Mexico St.	1959-1960	1962-1964	3	1962-1963	2
North Carolina	2008-2010	2012-2014	3	2012	1
North Carolina St.	1952-1953	1954	1	-	0
North Carolina St.	1981-1982	1983	1	-	0
Notre Dame	1995-1999	1999 (Dec)-2001	2	-	0
Ohio St.	1951-1955	1956	1	1956	1
Ohio St.	2004	2006-2008	3	-	0
Ohio St.	2008-2010	2011 (Dec)-2014	3	2012	1
Oklahoma	1952,1954-1955	1960	1	1960	1
Oklahoma	1953	1955-1956	2	-	0
Oklahoma	1972	1973-1974	2	1973-1974	2
Oklahoma	1983-1986	1988 (Dec)-1991	3	1989-1990	2
Oklahoma	2005-2006	2008-2009	2	-	0
Oklahoma St.	1972-1978	1978-1981	4	1978-1979	2

Table 24: NCAA FBS Sanctions: Continued

		Probation		Bowl Ban	
School	Violations	Years	Seasons	Years	Seasons
Oklahoma St.	1982-1987	1989-1992	4	1989-1991	3
Oregon	1977-1979	1981 (Dec)-1983	2	1982	1
Oregon	2003	2004-2005	2	-	0
Oregon St.	19,771,979	1981	1	1980	1
Penn St.	1998-2011	2012-2016	5	2012-2015	4
Pittsburgh	1986-1989	1993 (Nov)-1995	2	-	0
Rutgers	1967	1967 (Dec)-1968 (May)	0	-	0
Rutgers	1998-2000	2003-2004	2	-	0
San Diego St.	1998-2002	2004-2004	2	-	0
South Carolina	1965-1966	1967-1968	2	1967-1968	2
South Carolina	2001-2002	2005-2007	3	-	0
South Carolina	2009-2010	2012-2014	3	-	0
Southern California	1952-1956	1956 (Nov)-1958	2	1956	1
Southern California	1957-1958	1959-1960	2	1959	1
Southern California	1971-1979	1982-1984	3	1982-1983	2
Southern California	1983-1985	1985 (Dec)-1987	2	-	0
Southern California	1996-1998	2001-2002	2	-	0
Southern California	2004-2005	2010-2013	4	2010-2011	2
Southern Methodist	1957	1958	1	-	0
Southern Methodist	1963	1964-1965	2	1964-1965	2
Southern Methodist	1970-1975	1974-1976	3	1974-1975	2
Southern Methodist	1978-1980	1981-1982	2	1981	1
Southern Methodist	1981-1984	1985-1987	3	1985-1986	2
Southern Methodist	1984-1986	1987-1990	4	1987-1988	2
Southern Methodist	1995-1998	2000 (Dec)-2002	2	-	0
Southern Mississippi	1983-1985	1985	1	-	0
Southern Mississippi	1979-1982	1982 (Oct)-1984	2	1982-1983	2
Syracuse	1986-1990	1992 (Oct)-1994	2	-	0
Tennessee	1976-1985	1986 (Oct)-1987	1	-	0
Tennessee	1989-1990	1991 (Sep)-1993	2	-	0
Tennessee	2009-2010	2013-2014	2	-	0
Texas	1963	1964	1	-	0
Texas	1980-1985	1987	1	-	0
Texas	19,781,982	1982 (Sep)-1983	1	-	0
Texas A& M	1990-1992	1994-1998	5	1994	1
Texas A&M	1955	1956	1	1956	1
Texas A&M	1964-1965	1966	1	1966	1
Texas A&M	1983-1987	1988 (Sep)-1990	2	1988	1
Texas Christian	1981-1985	1986-1988	3	1986	1
Texas St.	1997-2001,2003	2005-2007	3	-	0

Table 24: NCAA FBS Sanctions: Continued

		Probation		Bowl Ban	
School	Violations	Years	Seasons	Years	Seasons
Texas Tech	1982-1984	1987	1	-	0
Texas Tech	1991-1997	1998-2001	4	1997	1
Texas Tech	2007-2010	2011-2012	2	-	0
Texas-ElPaso	1992-1996	1997-2001	5	-	0
Tulsa		1960	1	-	0
Tulsa	1969-1970	1970 (Oct)-1973 (Jan)	3	1970-1972	3
UCLA	1952-1956	1956-1958	3	1956-1958	3
UCLA	1970-1971	1971 (Oct)-1972	1	-	0
UCLA	1977	1981 (Dec)-1983	2	1980	1
Utah	1984-1985	1987	1	-	0
Utah	2000-2002	2003-2005	3	-	0
Utah St.	1967-1968	1968 (Oct)-1970	2	1968-1969	2
Virginia	1987-1990	1993-1994	2	-	0
Virginia Tech	1979-1982	1983	1	-	0
Virginia Tech	1983-1986	1987 (Nov)-1989	2	-	0
Washington	1951-1956	1956-1957	2	1956-1957	2
Washington	1980-1992	1994-1995	2	-	0
Washington	2000-2003	2005-2006	2	-	0
West Virginia	2005-2009	2011-2012	2	-	0
Wisconsin	1979-1980	1982	1	-	0
Wisconsin	19,811,983	1983 (Nov)-1984	1	-	0
Wisconsin	1996	1999-2000	2	-	0
Wisconsin	1998-2000	2001 (Oct)-2006	5	-	0
Wyoming	1957	1959 (Oct)-1960	1	1959	1

Notes: Table includes all probation and bowl bans handed out by the NCAA to Football Bowl Subdivision. Column 2 displays when the violations took place, columns 3 and 4 show what years and how many seasons the penalized team was on probation, and columns 5 and 6 show what seasons a bowl ban was implemented, if any. The violations vary between academic, recruiting, and ethical infractions. Source: (College Football 2012)

APPENDIX B

MSU OLS RESULTS - DEPENDENT VARIABLE, HOURS EARNED

This appendix contains OLS and student fixed-effects results for the dependent variable *Hours Earned* that were produced using the MSU data. There are no significant effects of redshirting, or lagged redshirt variables, on *Hours Earned* for any of the sports included in this study. This may be due to the limited flexibility that student-athletes have in constructing their schedules. Student-Athletes have many time commitments that the general student body does not. They often have to practice, compete, watch film, and study playbooks, in addition to other team activities. This makes options for scheduling limited. To assist student-athletes, many schools have advisors specifically for student-athletes to assist them in remaining eligible and making progress towards their degrees.[37] These advisors may have specific academic plans for each sport and major that student-athletes can utilize to graduate on time. The utilization of these programs by student-athletes may limit the impact of redshirting on hours earned during each semester. One possibility that is not addressed in the data is the possibility that student-athletes may be able to take more difficult classes during their redshirt year. This could be a focus of future research.

Although redshirting does not have a statistically significant impact on hours earned, there are factors that influence hours earned. MSU football results are presented in Table 25. In the football sample, *Summer*, *Senior*, and *Fifth Year* are the three negative and significant coefficient estimates. In the summer, students take fewer classes than in the fall or spring semesters. Compared to their freshman year, the players in the sample were expected to take 0.743 less credits in their senior year and 1.829 less credits in their fifth year. *Spring*, *HS GPA*, and *Test Score* have positive and significant effects on *Hours*

[37]Montana State University has a Student-Athlete Advisory Committee that provides academic assistance to student-athletes.

Earned.

We may expect volleyball players to have similar results because both football and volleyball are fall sports. Volleyball OLS results with the dependent variable *Hours Earned* are shown in Table 27. In the volleyball sample, *Senior*, *Fifth Year*, and *HS GPA* are not statistically significant. *Spring* is significant at the 0.10 level in specification (4), and is statistically significant at the 0.05 level, once student fixed-effects are implemented, in specification (7). *Summer* is statistically significant at the 0.01 level, and *Test Score* is significant at the 0.05 level.

Men's basketball results are shown in Table 26. Only the *Summer* and *HS GPA* variables are statistically significant in specification (4), although *Fifth Year* and *Medically Unable* are statistically significant at the 0.05 level in specification (7). Men's basketball players at MSU take more classes when they are medically unable to play. This is intuitive because they likely have more time to devote to schoolwork than they would if they were participating in practice and competition. Table 28 presents results for MSU women's basketball players. *Summer* and *Senior* are negative and statistically significant in all specifications that they are included in. When student fixed-effects are implemented, *Junior* and *Eligibility Exhausted* are also negative and statistically significant. These estimates indicate that women's basketball players at MSU take less credits in the summer, and in their finals years of school.

Table 25: MSU Football OLS Results, Hours Earned

	OLS			Student Fixed-Effects			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Redshirt	0.199	0.032	-0.222	-0.222	0.298	0.453	0.470
	(0.180)	(0.240)	(0.260)	(0.259)	(0.424)	(0.447)	(0.453)
$Redshirt_{t-1}$	0.443**	0.279	-0.074	-0.103	-0.111	0.104	0.122
	(0.198)	(0.252)	(0.296)	(0.302)	(0.413)	(0.469)	(0.477)
$Redshirt_{t-2}$	0.138	-0.126	-0.654**	-0.729	-0.886**	-0.848*	-0.825*
	(0.222)	(0.280)	(0.306)	(0.307)	(0.398)	(0.477)	(0.488)
$Redshirt_{t-3}$	-0.049	0.499	-0.252	-0.234	-1.132**	-0.244	-0.219
	(0.258)	(0.326)	(0.381)	(0.375)	(0.465)	(0.567)	(0.583)
$Redshirt_{t-4}$	-1.912***	-0.392	-1.036	-1.072	-2.986***	-1.256	-1.205
	(0.433)	(0.737)	(0.962)	(0.953)	(0.499)	(0.884)	(0.910)
Financial Aid	-0.025***	-0.029***	-0.008	0.009	0.037	0.023	0.023***
	(0.008)	(0.009)	(0.010)	(0.011)	(0.023)	(0.028)	(0.028)
Spring	0.651***	0.589***	0.524***	0.517***	0.516***	0.476***	0.476***
	(0.155)	(0.169)	(0.174)	(0.173)	(0.139)	(0.154)	(0.154)
Summer	-7.151***	-7.285***	-7.765***	-7.765***	-6.800***	-7.043***	-7.042***
	(0.198)	(0.205)	(0.233)	(0.236)	(0.253)	(0.250)	(0.249)
Sophomore		-0.171	-0.097	-0.120		-0.055	-0.058
		(0.306)	(0.326)	(0.326)		(0.296)	(0.297)
Junior		0.042	0.243	0.240		0.144	0.143
		(0.297)	(0.325)	(0.322)		(0.367)	(0.367)
Senior		-0.882***	-0.635*	-0.743**		-0.778*	-0.779*
		(0.318)	(0.367)	(0.364)		(0.422)	(0.424)
Fifth Year		-1.885***	-1.764**	-1.829**		-1.674**	-1.696**
		(0.651)	(0.873)	(0.862)		(0.759)	(0.783)
Test Score			0.002***	0.002***			
			(0.001)	(0.001)			
HS GPA			1.233***	1.073***			
			(0.182)	(0.191)			
Medically Unable			0.244	0.322			-0.166
			(0.620)	(0.620)			(0.665)
Eligibility Exhausted			0.381	0.516			0.058
			(0.991)	(0.951)			(0.876)
White				0.438			
				(0.338)			

Table 25: MSU Football OLS Results, Hours Earned: Continued

	OLS			Student Fixed-Effects			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Black				-0.424			
				(0.327)			
Constant	12.140***	12.565***	6.898***	7.139***	11.419***	11.761***	11.748***
	(0.198)	(0.293)	(0.813)	(0.867)	(0.399)	(0.459)	(0.452)
	N=2057	N=1755	N=1304	N=1304	N=2057	N=1755	N=1755
					G=387	G=334	G=334
	R^2=0.380	R^2=0.395	R^2=0.493	R^2=0.498	R^2=0.341	R^2=0.371	R^2=0.371

Notes: 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively. Standard errors are shown in parentheses. Financial Aid is measured in thousands of dollars.

Table 26: MSU Men's Basketball OLS, Hours Earned

	OLS			Student Fixed-Effects			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Redshirt	0.094	0.262	0.176	0.331	0.309	0.612	0.375
	(0.508)	(0.556)	(0.567)	(0.578)	(1.085)	(1.066)	(1.108)
$Redshirt_{t-1}$	0.275	0.302	-0.117	-0.027	-0.133	0.608	0.569
	(0.502)	(0.550)	(0.626)	(0.656)	(0.938)	(0.954)	(0.979)
$Redshirt_{t-2}$	1.191	1.163	0.214	0.190	0.42	1.057	1.208
	(0.954)	(0.972)	(1.071)	(1.134)	(1.208)	(1.397)	(1.431)
$Redshirt_{t-3}$	-0.545	-0.027	-0.896	-1.046	-1.666**	-0.073	0.488
	(1.134)	(1.132)	(1.646)	(1.647)	(0.818)	(1.171)	(1.241)
$Redshirt_{t-4}$	-5.98**	-4.454		No Obs.	-8.013***	-4.98**	-3.83*
	(2.650)	(2.922)			(0.828)	(1.943)	(2.01)
Financial Aid	-0.042*	-0.039	0.050	0.056	0.025	0.051	0.05
	(0.024)	(0.027)	(0.044)	(0.049)	(0.088)	(0.097)	(0.104)
Spring	-0.427	-0.588	-0.155	-0.155	-0.495	-0.683*	-0.674*
	(0.402)	(0.435)	(0.536)	(0.536)	(0.376)	(0.403)	(0.405)
Summer	-7.747***	-7.773***	-8.836***	-8.832***	-7.863***	-8.004***	-7.98***
	(0.360)	(0.384)	(0.487)	(0.499)	(0.426)	(0.495)	(0.503)
Sophomore		0.036	-0.230	-0.325		-0.987	-1.015
		(0.610)	(0.648)	(0.637)		(0.699)	(0.714)
Junior		0.275	0.225	0.233		-0.374	-0.598
		(0.483)	(0.594)	(0.593)		(0.638)	(0.623)
Senior		0.008	0.21	0.276		-1.121	-1.567*
		(0.639)	(0.999)	(0.990)		(0.854)	(0.907)
Fifth Year		-1.348	-2.149	-2.084		-2.575*	-3.609**
		(1.381)	(3.306)	(3.318)		(1.314)	(1.433)
Test Score			0.000	0.000			
			(0.002)	(0.002)			
HS GPA			1.182***	1.434***			
			(0.443)	(0.464)			
Medically Unable			-0.027	0.025			2.183***
			(1.513)	(1.549)			(0.800)
Eligibility Exhausted				No Obs.			1.165
							(0.966)
White				-0.945			
				(0.699)			

Table 26: MSU Men's Basketball OLS, Hours Earned: Continued

	OLS			Student Fixed-Effects			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Black				-0.635			
				(0.924)			
Constant	13.248***	13.089***	7.608***	7.982***	11.945***	11.899***	12.066***
	(0.562)	(0.681)	(2.456)	(2.368)	(1.846)	(1.903)	(2.050)
	N=367	N=339	N=177	N=177	N=367	N=339	N=339
					G=77	G=73	G=73
	R^2=0.483	R^2=0.471	R^2=0.589	R^2=0.594	R^2=0.464	R^2=0.444	R^2=0.445

Notes: 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively. Standard errors are shown in parentheses. Financial Aid is measured in thousands of dollars.

Table 27: MSU Volleyball OLS, Hours Earned

	OLS			Student Fixed-Effects			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Redshirt	-0.038	0.305	0.633	0.620	-1.152	-0.858	-0.793
	(0.556)	(0.639)	(0.689)	(0.686)	(1.818)	(1.406)	(1.337)
$Redshirt_{t-1}$	0.261	0.27	0.622	0.613	-1.156	-1.305	-1.338
	(0.493)	(0.483)	(0.524)	(0.528)	(1.711)	(1.446)	(1.384)
$Redshirt_{t-2}$	-0.128	-0.183	-0.39	-0.410	-1.675	-1.95	-2.065
	(0.753)	(0.768)	(0.820)	(0.812)	(2.102)	(2.018)	(1.963)
$Redshirt_{t-3}$	-0.514	-0.295	0.186	0.158	-2.099	-2.08	-2.501
	(0.600)	(0.662)	(0.908)	(0.905)	(2.166)	(2.061)	(1.934)
$Redshirt_{t-4}$	-2.069*	-0.96	0.156	0.097	-3.903	-3.152	-4.253*
	(1.062)	(1.659)	(2.151)	(2.043)	(2.630)	(2.500)	(2.516)
Financial Aid	-0.045**	-0.044**	-0.032	-0.033	-0.003	0.004	-0.014
	(0.018)	(0.021)	(0.027)	(0.027)	(0.035)	(0.051)	(0.047)
Spring	0.467	0.574*	0.715*	0.714*	0.445*	0.624**	0.614**
	(0.308)	(0.330)	(0.411)	(0.412)	(0.256)	(0.297)	(0.295)
Summer	-8.621***	-8.664***	-8.776***	-8.777***	-8.492***	-8.441***	-8.458***
	(0.457)	(0.499)	(0.587)	(0.590)	(0.499)	(0.508)	(0.504)
Sophomore		-0.130	0.204	0.208		0.252	0.325
		(0.413)	(0.471)	(0.473)		(0.425)	(0.425)
Junior		0.071	0.225	0.227		0.499	0.625
		(0.526)	(0.606)	(0.609)		(0.528)	(0.536)
Senior		-0.076	-0.603	-0.602		0.368	0.726
		(0.552)	(0.788)	(0.788)		(0.504)	(0.527)
Fifth Year		-1.172	-1.742	-1.710		-0.507	0.632
		(1.385)	(1.813)	(1.802)		(0.837)	(1.063)
Test Score			0.003**	0.003**			
			(0.001)	(0.001)			
HS GPA			-0.027	-0.054			
			(0.512)	(0.572)			
Medically Unable			2.491	2.453			Omitted
			(1.852)	(1.839)			
Eligibility Exhausted			-0.269	-0.276			-1.560
			(1.423)	(1.420)			(0.826)
White				-0.081			
				(0.590)			

Table 27: MSU Volleyball OLS, Hours Earned: Continued

	OLS			Student Fixed-Effects			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Black				No Obs.			
Constant	14.280***	14.282***	11.269***	11.478***	13.873***	13.456***	13.780***
	(0.437)	(0.528)	(2.065)	(2.750)	(0.818)	(1.074)	(0.955)
	N=318	N=276	N=198	N=198	N=318	N=276	N=276
					G=53	G=45	G=45
	R^2=0.599	R^2=0.617	R^2=0.657	R^2=0.657	R^2=0.564	R^2=0.572	R^2=0.575

Notes: 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively. Standard errors are shown in parentheses. Financial Aid is measured in thousands of dollars.

Table 28: MSU Women's Basketball OLS, Hours Earned

	OLS			Student Fixed-Effects			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Redshirt	0.659	0.523	0.730	0.651	0.175	0.798	1.193
	(0.432)	(0.454)	(0.587)	(0.588)	(0.980)	(0.944)	(0.834)
$Redshirt_{t-1}$	0.395	0.278	0.449	0.465	-0.154	0.923	1.056
	(0.487)	(0.542)	(0.641)	(0.635)	(0.888)	(0.875)	(0.973)
$Redshirt_{t-2}$	-1.713**	-1.496**	-0.981	-0.935	-2.575**	-0.478	-0.817
	(0.728)	(0.752)	(0.816)	(0.873)	(1.035)	(1.167)	(1.077)
$Redshirt_{t-3}$	-1.398***	-0.546	-0.640	-0.484	-2.396***	1.689	0.119
	(0.405)	(0.557)	(1.121)	(1.131)	(0.835)	(1.338)	(1.546)
$Redshirt_{t-4}$	No Obs.	No Obs.	No Obs.	No Obs.	No Obs.	No Obs.	No Obs.
Financial Aid	0.001	-0.004	0.000	-0.011	0.12	0.242*	0.100
	(0.021)	(0.022)	(0.024)	(0.030)	(0.159)	(0.121)	(0.105)
Spring	-0.680**	-0.686*	-0.514	-0.510	-0.668**	-0.669*	-0.674*
	(0.328)	(0.353)	(0.394)	(0.393)	(0.310)	(0.358)	(0.360)
Summer	-9.867***	-10.097***	-10.182***	-10.193***	-9.882***	-10.381***	-10.393***
	(0.292)	(0.327)	(0.393)	(0.393)	(0.289)	(0.335)	(0.339)
Sophomore		-0.120	-0.171	-0.183		-0.474	-0.392
		(0.400)	(0.446)	(0.444)		(0.334)	(0.311)
Junior		-0.048	-0.683	-0.722		-1.007**	-1.073**
		(0.383)	(0.468)	(0.471)		(0.479)	(0.465)
Senior		-1.198**	-2.303***	-2.333***		-3.256***	-2.698***
		(0.486)	(0.677)	(0.691)		(0.744)	(0.721)
Fifth Year		-0.616	-0.839	-0.910		-1.603	1.687
		(0.721)	(1.282)	(1.359)		(1.328)	(1.839)
Test Score			0.000	0.000			
			(0.001)	(0.001)			
HS GPA			1.041	1.080*			
			(0.647)	(0.633)			
Medically Unable			2.309**	2.296*			2.452
			(1.167)	(1.191)			(1.477)
Eligibility Exhausted			No Obs.	No Obs.			-3.552***
							(1.202)
White				-0.606			
				(0.613)			

Table 28: MSU Women's Basketball OLS, Hours Earned: Continued

	OLS			Student Fixed-Effects			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Black				-0.039			
				(0.700)			
Constant	13.464***	13.930***	10.465***	10.071***	11.304***	9.781***	12.431***
	(0.419)	(0.473)	(2.470)	(2.459)	(3.062)	(2.299)	(1.964)
	N=371	N=336	N=235	N=235	N=371	N=336	N=336
					G=63	G=53	G=53
	R^2=0.630	R^2=0.654	R^2=0.711	R^2=0.713	R^2=0.594	R^2=0.520	R^2=0.606

Notes: 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively. Standard errors are shown in parentheses. Financial Aid is measured in thousands of dollars.

APPENDIX C

MSU OLS ALL VARIABLES AND INTERACTIONS, GPA

The results of interest, the differences in impact of redshirting on GPA between sports, presented in the following tables, Table 29-31, are discussed on pages 91-93. Tables 19-21, in the text, present the redshirt variables and interactions, but the rest of the estimated coefficients were excluded for brevity. The complete tables are presented here to display the full set of variables used in each regression and differences in other variables. Table 29 shows the differences between MSU football players and MSU student-athletes that play volleyball, men's basketball, and women's basketball. Differences between men's basketball, and women's basketball and volleyball are shown in Table 30. Table 31 displays the results of regressions run with interaction terms comparing volleyball and women's basketball.

Table 29: MSU Football vs. Other Sports, GPA

	(1)	(2)	(3)	(4)	(5)
Redshirt	0.011	-0.06	-0.134*	-0.237***	-0.246***
	(0.042)	(0.050)	(0.071)	(0.073)	(0.073)
Volleyball**Redshirt*	0.024	0.078	0.172	0.18	0.108
	(0.141)	(0.150)	(0.205)	(0.235)	(0.230)
Basketball**Redshirt*	0.257**	0.310**	0.488***	0.399***	0.394***
	(0.118)	(0.122)	(0.140)	(0.129)	(0.133)
Women's Basketball**Redshirt*	0.013	0.100	0.123	0.467***	0.442***
	(0.103)	(0.112)	(0.131)	(0.169)	(0.165)
$Redshirt_{t-1}$	0.059	0.046	0.099	0.035	0.019
	(0.047)	(0.053)	(0.068)	(0.078)	(0.079)
Volleyball*$Redshirt_{t-1}$	-0.040	-0.040	-0.031	0.052	0.01
	(0.127)	(0.136)	(0.138)	(0.150)	(0.145)
Men's Basketball*$Redshirt_{t-1}$	0.439***	0.571***	0.583***	0.269*	0.252*
	(0.147)	(0.137)	(0.153)	(0.149)	(0.150)
Women's Basketball*$Redshirt_{t-1}$	-0.194	-0.165	-0.243	-0.237	-0.214
	(0.148)	(0.163)	(0.170)	(0.214)	(0.213)
$Redshirt_{t-2}$	0.199***	0.176***	0.163**	-0.035	-0.06
	(0.059)	(0.064)	(0.081)	(0.085)	(0.084)
Volleyball*$Redshirt_{t-2}$	0.144*	0.240*	0.241	0.401***	0.300**
	(0.122)	(0.134)	(0.148)	(0.135)	(0.132)
Men's Basketball*$Redshirt_{t-2}$	0.350**	0.538***	0.649***	0.294**	0.279*
	(0.160)	(0.122)	(0.144)	(0.145)	(0.146)
Women's Basketball*$Redshirt_{t-2}$	-0.301	-0.266	-0.233	-0.541	-0.491
	(0.360)	(0.332)	(0.330)	(0.417)	(0.413)
$Redshirt_{t-3}$	0.402***	0.408***	0.474***	0.206**	0.213**
	(0.062)	(0.064)	(0.077)	(0.086)	(0.083)
Volleyball*$Redshirt_{t-3}$	-0.100	-0.09	-0.106	-0.047	-0.225
	(0.121)	(0.129)	(0.188)	(0.173)	(0.143)
Men's Basketball*$Redshirt_{t-3}$	0.074	0.054	-0.097	-0.266	-0.307
	(0.269)	(0.287)	(0.305)	(0.515)	(0.514)
Women's Basketball*$Redshirt_{t-3}$	-0.144	-0.152	-0.284*	-0.379	-0.245
	(0.174)	(0.128)	(0.154)	(0.260)	(0.256)
$Redshirt_{t-4}$	0.427***	0.390***	0.574***	0.421*	0.408*
	(0.113)	(0.116)	(0.204)	(0.220)	(0.219)
Volleyball*$Redshirt_{t-4}$	-0.136	-0.086	-0.084	-0.43	-0.783*
	(0.332)	(0.321)	(0.512)	(0.461)	(0.464)
Men's Basketball*$Redshirt_{t-4}$	-1.29*	-1.466**	-2.136***	Omitted	Omitted
	(0.694)	(0.713)	(0.769)		
Women's Basketball*$Redshirt_{t-4}$	No Obs.	No Obs.	No Obs.	No Obs.	No Obs.

Table 29: MSU Football vs. Other Sports, GPA: Continued

	(1)	(2)	(3)	(4)	(5)
Financial Aid		-0.012***	-0.014***	-0.003	0.003
		(0.002)	(0.002)	(0.002)	(0.003)
Volleyball*Financial Aid		0.006	0.011	-0.005	-0.017***
		(0.006)	(0.007)	(0.007)	(0.006)
Men's Basketball*Financial Aid		-0.013**	-0.004	0.001	-0.003
		(0.006)	(0.006)	(0.009)	(0.010)
Women's Basketball*Financial Aid		-0.004	-0.006	-0.012*	-0.018**
		(0.006)	(0.006)	(0.007)	(0.009)
Spring		0.012	0.016	-0.006	-0.008
		(0.038)	(0.041)	(0.040)	(0.040)
Summer		-0.083	-0.068	-0.109	-0.109
		(0.074)	(0.082)	(0.098)	(0.098)
Volleyball*Spring		0.089	0.057	0.158*	0.158*
		(0.093)	(0.103)	(0.088)	(0.086)
Volleyball*Summer		-0.055	-0.042	0.088	0.082
		(0.212)	(0.220)	(0.210)	(0.204)
Men's Basketball*Spring		-0.098	-0.107	0.013	0.012
		(0.092)	(0.097)	(0.096)	(0.096)
Men's Basketball*Summer		0.100	0.078	0.207	0.192
		(0.149)	(0.153)	(0.192)	(0.194)
Women's Basketball*Spring		-0.082	-0.04	0.039	0.045
		(0.085)	(0.089)	(0.089)	(0.088)
Women's Basketball*Summer		-0.241	-0.286	-0.29	-0.297
		(0.193)	(0.194)	(0.222)	(0.220)
Sophomore			-0.210**	-0.257***	-0.265***
			(0.087)	(0.089)	(0.089)
Junior			-0.124	-0.099	-0.105
			(0.084)	(0.090)	(0.089)
Senior			-0.182**	-0.098	-0.14
			(0.085)	(0.091)	(0.091)
Fifth Year			-0.320*	-0.268	-0.294
			(0.184)	(0.202)	(0.202)
Volleyball*Sophomore			0.079	0.224	0.259
			(0.164)	(0.170)	(0.166)
Volleyball*Junior			0.178	0.236	0.259
			(0.166)	(0.170)	(0.168)
Volleyball*Senior			0.12	0.400**	0.449***
			(0.215)	(0.174)	(0.168)
Volleyball*Fifth Year			0.111	0.552*	0.779**
			(0.430)	(0.321)	(0.316)

Table 29: MSU Football vs. Other Sports, GPA: Continued

	(1)	(2)	(3)	(4)	(5)
Men's Basketball*Sophomore			0.241	0.268*	0.275*
			(0.162)	(0.161)	(0.161)
Men's Basketball*Junior			0.111	0.291*	0.291**
			(0.146)	(0.149)	(0.148)
Men's Basketball*Senior			0.146	0.304*	0.337*
			(0.164)	(0.184)	(0.185)
Men's Basketball*Fifth Year			0.943***	1.377**	1.370**
			(0.326)	(0.567)	(0.578)
Women's Basketball*Sophomore			0.235	0.264*	0.260*
			(0.147)	(0.150)	(0.147)
Women's Basketball*Junior			-0.062	0.058	0.041
			(0.154)	(0.186)	(0.185)
Women's Basketball*Senior			0.144	0.388***	0.395***
			(0.145)	(0.141)	(0.139)
Women's Basketball*Fifth Year			0.574**	0.908**	0.811**
			(0.229)	(0.395)	(0.373)
Test Score				0.058***	0.054***
				(0.017)	(0.016)
Volleyball*Test Score				0.130***	0.012***
				(0.033)	(0.032)
Men's Basketball*Test Score				0.113***	0.105**
				(0.043)	(0.046)
Women's Basketball*Test Score				0.090***	0.123***
				(0.033)	(0.039)
HS GPA				0.603***	0.550***
				(0.048)	(0.051)
Volleyball*HS GPA				-0.225	-0.344***
				(0.142)	(0.133)
Men's Basketball*HS GPA				-0.394***	-0.324***
				(0.113)	(0.124)
Women's Basketball*HS GPA				-0.280*	-0.128
				(0.161)	(0.160)
Medically Unable				-0.277**	-0.259**
				(0.125)	(0.126)
Volleyball*Medically Unable				-2.869***	-3.127***
				(0.289)	(0.282)
Men's Basketball*Medically Unable				0.378	0.334
				(0.235)	(0.233)
Women's Basketball*Medically Unable				0.105	-0.019
				(0.39)	(0.388)

Table 29: MSU Football vs. Other Sports, GPA: Continued

	(1)	(2)	(3)	(4)	(5)
Eligibility Exhausted				-0.449*	-0.407*
				(0.244)	(0.239)
Volleyball*Eligibility Exhausted				0.648**	0.561*
				(0.325)	(0.328)
Men's Basketball*Eligibility Exhausted					No Obs.
Women's Basketball*Eligibility Exhausted					No Obs.
Black					-0.032
					(0.077)
Men's Basketball*Black					-0.116
					(0.179)
Volleyball*Black					No Obs.
Women's Basketball*Black					-0.298
					(0.202)
White					0.222***
					(0.077)
Men's Basketball*White					-0.260*
					(0.138)
Volleyball*White					-0.730***
					(0.119)
Women's Basketball*White					-0.668***
					(0.174)
Volleyball	0.483***	0.378**	0.17	-0.489	0.816
	0.063)	(0.154)	(0.189)	(0.555)	(0.539)
Men's Basketball	-0.018	0.323**	-0.052	-0.139	-0.029
	0.054)	(0.148)	(0.182)	(0.464)	(0.459)
Women's Basketball	0.702***	0.883***	0.880***	0.551	0.2
	0.055)	(0.118)	(0.149)	(0.641)	(0.629)
Constant	2.547***	2.766***	2.916***	0.419**	0.413**
	0.026)	(0.054)	(0.083)	(0.195)	(0.203)
	N=3524	N=3113	N=2706	N=1914	N=1914
	R^2=0.091	R^2=0.125	R^2=0.147	R^2=0.305	R^2=0.319

Notes: 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively. Standard errors are shown in parentheses. Financial Aid is measured in thousands of dollars. Test Scores are measured in hundreds of SAT points. Interactions indicate difference from the football sample (i.e. $Redshirt$ is the estimated effect for football, and $Redshirt * Men'sBasketball$ is the difference between the estimated effect of redshirting between men's basketball players and football players).

Table 30: MSU Men's Basketball vs. Volleyball and Women's Basketball, GPA

	(1)	(2)	(3)	(4)	(5)
Redshirt	0.268**	0.251**	0.355***	0.162	0.148
	(0.111)	(0.112)	(0.123)	(0.109)	(0.114)
Volleyball*$Redshirt$	-0.233	-0.232	-0.317	-0.219	-0.286
	(0.175)	(0.181)	(0.23)	(0.254)	(0.251)
Women's Basketball*$Redshirt$	-0.243*	-0.21	-0.366**	0.068	0.049
	(0.146)	(0.15)	(0.166)	(0.19)	(0.19)
$Redshirt_{t-1}$	0.498***	0.617***	0.682***	0.303**	0.271**
	(0.14)	(0.127)	(0.139)	(0.13)	(0.131)
Volleyball*$Redshirt_{t-1}$	-0.479***	-0.611***	-0.614***	-0.216	-0.242
	(0.184)	(0.18)	(0.185)	(0.185)	(0.181)
Women's Basketball*$Redshirt_{t-1}$	-0.633***	-0.736***	-0.827***	-0.506**	-0.466*
	(0.199)	(0.201)	(0.21)	(0.242)	(0.242)
$Redshirt_{t-2}$	0.550***	0.714***	0.813***	0.259**	0.219*
	(0.149)	(0.104)	(0.12)	(0.12)	(0.122)
Volleyball*$Redshirt_{t-2}$	-0.207	-0.298*	-0.409**	0.107	0.02
	(0.183)	(0.158)	(0.174)	(0.161)	(0.161)
Women's Basketball*$Redshirt_{t-2}$	-0.651*	-0.804**	-0.883**	-0.836*	-0.77*
	(0.387)	(0.344)	(0.345)	(0.434)	(0.433)
$Redshirt_{t-3}$	0.476*	0.462	0.378	-0.06	-0.094
	(0.263)	(0.282)	(0.298)	(0.52)	(0.52)
Volleyball*$Redshirt_{t-3}$	-0.174	-0.144	-0.01	0.219	0.081
	(0.283)	(0.304)	(0.345)	(0.542)	(0.534)
Women's Basketball*$Redshirt_{t-3}$	-0.218	-0.206	-0.188	-0.113	0.061
	(0.31)	(0.303)	(0.328)	(0.578)	(0.577)
$Redshirt_{t-4}$	-0.862	-1.076	-1.562**	-0.008	-0.375
	(0.687)	(0.708)	(0.75)	(0.415)	(0.419)
Volleyball*$Redshirt_{t-4}$	1.153	1.38*	2.052**	No Obs.	No Obs.
	(0.755)	(0.769)	(0.888)		
Women's Basketball*$Redshirt_{t-4}$	No Obs.	No Obs.	No Obs.	No Obs.	No Obs.
Financial Aid		-0.025***	-0.018***	-0.002	0.000
		(0.006)	(0.006)	(0.009)	(0.009)
Volleyball*Financial Aid		0.019**	0.015*	-0.007	-0.014
		(0.008)	(0.009)	(0.011)	(0.011)
Women's Basketball*Financial Aid		0.009	-0.001	-0.013	-0.015
		(0.008)	(0.008)	(0.011)	(0.013)
Spring		-0.086	-0.091	0.007	0.004
		(0.084)	(0.089)	(0.089)	(0.09)
Summer		0.017	0.01	0.098	0.083
		(0.13)	(0.131)	(0.169)	(0.171)

Table 30: MSU Men's B-Ball vs. Volleyball and Women's B-Ball, GPA: Continued

	(1)	(2)	(3)	(4)	(5)
Volleyball*Spring		0.187	0.164	0.145	0.146
		(0.12)	(0.130)	(0.12)	(0.119)
Volleyball*Summer		-0.155	-0.12	-0.119	-0.11
		(0.238)	(0.244)	(0.255)	(0.251)
Women's Basketball*Spring		0.016	0.067	0.026	0.032
		(0.114)	(0.119)	(0.121)	(0.121)
Women's Basketball*Summer		-0.341	-0.364*	-0.497*	-0.489*
		(0.221)	(0.221)	(0.265)	(0.265)
Sophomore			0.032	0.011	0.01
			(0.138)	(0.137)	(0.138)
Junior			-0.013	0.192	0.186
			(0.121)	(0.122)	(0.121)
Senior			-0.036	0.206	0.197
			(0.141)	(0.164)	(0.165)
Fifth Year			0.622**	1.109**	1.076*
			(0.272)	(0.543)	(0.556)
Volleyball*Sophomore			-0.162	-0.044	-0.016
			(0.197)	(0.202)	(0.199)
Volleyball*Junior			0.067	-0.055	-0.032
			(0.188)	(0.192)	(0.19)
Volleyball*Senior			-0.026	0.096	0.112
			(0.244)	(0.223)	(0.22)
Volleyball*Fifth Year			-0.831*	-0.825	-0.591
			(0.478)	(0.6)	(0.609)
Women's Basketball*Sophomore			-0.006	-0.004	-0.016
			(0.183)	(0.185)	(0.183)
Women's Basketball*Junior			-0.173	-0.233	-0.25
			(0.178)	(0.206)	(0.206)
Women's Basketball*Senior			-0.002	0.085	0.058
			(0.185)	(0.198)	(0.197)
Women's Basketball*Fifth Year			-0.369	-1.117*	-1.12*
			(0.305)	(0.645)	(0.650)
Test Score				0.171***	0.159***
				(0.041)	(0.044)
Volleyball*Test Score				0.018	0.017
				(0.050)	(0.052)
Women's Basketball*Test Score				-0.023	0.024
				(0.050)	(0.057)
HS GPA				0.209**	0.226*
				(0.104)	(0.116)

Table 30: MSU Men's B-Ball vs. Volleyball and Women's B-Ball, GPA: Continued

	(1)	(2)	(3)	(4)	(5)
Volleyball*HS GPA				0.169	-0.02
				(0.171)	(0.172)
Women's Basketball*HS GPA				0.114	0.196
				(0.189)	(0.195)
Medically Unable				0.102	0.075
				(0.204)	(0.201)
Volleyball*Medically Unable				-3.247***	-3.461***
				(0.336)	(0.328)
Women's Basketball*Medically Unable				-0.274	-0.352
				(0.429)	(0.427)
Eligibility Exhausted				0.199	0.154
				(0.22)	(0.231)
Volleyball*Eligibility Exhausted				No Obs.	No Obs.
Women's Basketball*Eligibility Exhausted				Omitted	Omitted
Black					-0.148
					(0.166)
Volleyball*Black					No Obs
Women's Basketball*Black					-0.181
					(0.253)
White					-0.508***
					(0.093)
Volleyball*White					0.47***
					(0.15)
Women's Basketball*White					0.062
					(0.185)
Volleyball	0.501***	0.056	0.222	-0.350	0.844
	(0.075)	(0.201)	(0.237)	(0.685)	(0.664)
Women's Basketball	0.720***	0.560***	0.932***	0.689	0.229
	(0.068)	(0.174)	(0.206)	(0.759)	(0.743)
Constant	2.529***	3.088***	2.864***	0.281	0.384
	(0.047)	(0.139)	(0.164)	(0.431)	(0.423)
	N=1111	N=1056	N=951	N=610	N=610
	R^2=0.124	R^2=0.165	R^2=0.204	R^2=0.335	R^2=0.381

Notes: 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively. Standard errors are shown in parentheses. Financial Aid is measured in thousands of dollars. Test Score is measured in hundreds of SAT points. No football players are included in the sample. Interactions indicate the difference from the men's basketball sample (i.e. *Redshirt* is the estimated effect for men's basketball players, and $Redshirt * Volleyball$ is the difference between the estimated effect of redshirting between volleyball players and men's basketball players).

Table 31: MSU Volleyball vs. Women's Basketball, GPA

	(1)	(2)	(3)	(4)	(5)
Redshirt	0.035	0.019	0.038	-0.057	-0.138
	(0.135)	(0.142)	(0.195)	(0.229)	(0.223)
Women's Basketball*red	-0.011	0.022	-0.049	0.287	0.334
	(0.165)	(0.174)	(0.225)	(0.277)	(0.27)
$Redshirt_{t-1}$	0.019	0.006	0.068	0.087	0.029
	(0.119)	(0.127)	(0.121)	(0.131)	(0.125)
Women's Basketball*$Redshirt_{t-1}$	-0.154	-0.125	-0.213	-0.289	-0.224
	(0.184)	(0.2)	(0.199)	(0.242)	(0.238)
$Redshirt_{t-2}$	0.343***	0.416***	0.404***	0.366***	0.24**
	(0.107)	(0.118)	(0.126)	(0.107)	(0.104)
Women's Basketball*$Redshirt_{t-2}$	-0.444	-0.506	-0.474	-0.942**	-0.79*
	(0.372)	(0.349)	(0.347)	(0.43)	(0.427)
$Redshirt_{t-3}$	0.302***	0.318***	0.368**	0.159	-0.013
	(0.104)	(0.112)	(0.173)	(0.153)	(0.12)
Women's Basketball*$Redshirt_{t-3}$	-0.044	-0.061	-0.178	-0.332	-0.02
	(0.194)	(0.159)	(0.22)	(0.294)	(0.276)
$Redshirt_{t-4}$	0.291	0.305	0.491	-0.008	-0.375
	(0.313)	(0.301)	(0.475)	(0.414)	(0.418)
Women's Basketball*$Redshirt_{t-4}$	No Obs.	No Obs.	No Obs.	No Obs.	No Obs.
Financial Aid		-0.006	-0.003	-0.008	-0.014**
		(0.005)	(0.007)	(0.006)	(0.006)
Women's Basketball*Financial Aid		-0.01	-0.017*	-0.006	-0.001
		(0.008)	(0.009)	(0.009)	(0.01)
Spring		0.101	0.072	0.152*	0.15*
		(0.086)	(0.095)	(0.08)	(0.078)
Summer		-0.138	-0.11	-0.021	-0.027
		(0.2)	(0.206)	(0.19)	(0.183)
Women's Basketball*Spring		-0.171	-0.096	-0.119	-0.113
		(0.115)	(0.124)	(0.114)	(0.112)
Women's Basketball*Summer		-0.186	-0.244	-0.378	-0.379
		(0.268)	(0.272)	(0.279)	(0.272)
Sophomore			-0.131	-0.033	-0.006
			(0.14)	(0.148)	(0.144)
Junior			0.054	0.137	0.154
			(0.145)	(0.148)	(0.146)
Senior			-0.063	0.302**	0.308**
			(0.2)	(0.151)	(0.145)
Fifth Year			-0.209	0.284	0.485*
			(0.393)	(0.255)	(0.249)

Table 31: MSU Volleyball vs. Women's Basketball, GPA: Continued

	(1)	(2)	(3)	(4)	(5)
Women's Basketball*Sophomore			0.156	0.04	0
			(0.184)	(0.192)	(0.188)
Women's Basketball*Junior			-0.24	-0.178	-0.217
			(0.195)	(0.222)	(0.221)
Women's Basketball*Senior			0.024	-0.011	-0.054
			(0.232)	(0.187)	(0.18)
Women's Basketball*Fifth Year			0.462	-0.292	-0.529
			(0.416)	(0.359)	(0.342)
Test Score				0.188***	0.176***
				(0.023)	(0.028)
Women's Basketball*Test Score				-0.041	0.007
				(0.041)	(0.046)
HS GPA				0.377***	0.205
				(0.136)	(0.126)
Women's Basketball*HS GPA				-0.054	0.217
				(0.208)	(0.2)
Medically Unable				-3.146***	-3.386***
				(0.266)	(0.259)
Women's Basketball*Medically Unable				2.974***	3.108***
				(0.462)	(0.456)
Eligibility Exhausted				0.199	0.154
				(0.22)	(0.231)
Women's Basketball*Eligibility Exhausted				Omitted	Omitted
Black					-0.329*
					(0.191)
Women's Basketball*Black					No Obs.
White					-0.508***
					(0.092)
Women's Basketball*White					0.062
					(0.184)

Table 31: MSU Volleyball vs. Women's Basketball, GPA: Continued

	(1)	(2)	(3)	(4)	(5)
Women's Basketball	0.219***	0.504***	0.710***	1.040	-0.616
	(0.075)	(0.18)	(0.212)	(0.819)	(0.795)
Constant	3.030***	3.144***	3.086***	-0.070	1.229**
	(0.058)	(0.145)	(0.172)	(0.531)	(0.511)
	N=715	N=689	N=612	N=433	N=433
	R^2=0.020	R^2=0.049	R^2=0.077	R^2=0.299	R^2=0.335

Notes: 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively. Standard errors are shown in parentheses. Financial Aid is measured in thousands of dollars. Test Scores are measured in hundreds of points. No football or men's basketball players are included in the sample. Interactions indicate difference from the volleyball sample (i.e. *Redshirt* is estimated effect for volleyball players, and $Redshirt * Women'sBasketball$ is the difference between the estimated effect of redshirting between volleyball players and women's basketball players).

APPENDIX D

MSU OLS ALL VARIABLES AND INTERACTIONS, HOURS EARNED

This appendix presents results of OLS regressions comparing redshirting's impact on hours earned across sports. There are no significant differences in any of the variables of interest (i.e. the redshirt variables) between any of the sports. Football and the other sports included in this study, men's basketball, volleyball, and women's basketball, are compared in Table 32. Men's basketball is compared to volleyball and women's basketball in Table 33, and volleyball and women's basketball are compared in Table 34.

Table 32: MSU Football vs. Other Sports, HE

	(1)	(2)	(3)	(4)	(5)
Redshirt	0.532***	0.199	0.032	-0.222	-0.222
	(0.195)	(0.181)	(0.242)	(0.263)	(0.262)
Volleyball**Redshirt*	0.398	-0.236	0.273	0.855	0.842
	(0.685)	(0.581)	(0.675)	(0.72)	(0.716)
Basketball**Redshirt*	0.041	-0.105	0.23	0.398	0.552
	(0.661)	(0.536)	(0.601)	(0.611)	(0.618)
Women's Basketball**Redshirt*	0.123	0.46	0.491	0.951	0.873
	(0.72)	(0.466)	(0.511)	(0.635)	(0.633)
$Redshirt_{t-1}$	0.284	0.443**	0.279	-0.074	-0.103
	(0.234)	(0.198)	(0.254)	(0.299)	(0.306)
Volleyball*$Redshirt_{t-1}$	-0.161	-0.182	-0.009	0.696	0.715
	(0.825)	(0.528)	(0.539)	(0.591)	(0.597)
Men's Basketball*$Redshirt_{t-1}$	-0.815	-0.168	0.022	-0.044	0.076
	(0.95)	(0.536)	(0.601)	(0.679)	(0.705)
Women's Basketball*$Redshirt_{t-1}$	-0.067	-0.048	-0.001	0.523	0.567
	(0.98)	(0.523)	(0.594)	(0.698)	(0.694)
$Redshirt_{t-2}$	-0.15	0.138	-0.126	-0.654**	-0.729**
	(0.287)	(0.222)	(0.282)	(0.309)	(0.31)
Volleyball*$Redshirt_{t-2}$	-0.263	-0.267	-0.057	0.264	0.319
	(0.992)	(0.779)	(0.808)	(0.855)	(0.847)
Men's Basketball*$Redshirt_{t-2}$	1.551	1.053	1.289	0.868	0.919
	(1.131)	(0.973)	(1.003)	(1.087)	(1.142)
Women's Basketball*$Redshirt_{t-2}$	-1.470	-1.852**	-1.370*	-0.327	-0.206
	(1.142)	(0.758)	(0.797)	(0.86)	(0.911)
$Redshirt_{t-3}$	-0.257	-0.049	0.499	-0.252	-0.234
	(0.319)	(0.259)	(0.328)	(0.385)	(0.38)
Volleyball*$Redshirt_{t-3}$	-0.63	-0.466	-0.794	0.438	0.393
	(1.146)	(0.649)	(0.731)	(0.963)	(0.958)
Men's Basketball*$Redshirt_{t-3}$	0.023	-0.496	-0.526	-0.644	-0.812
	(1.417)	(1.155)	(1.168)	(1.648)	(1.64)
Women's Basketball*$Redshirt_{t-3}$	0.316	-1.349***	-1.045	-0.388	-0.249
	(0.464)	(0.479)	(0.642)	(1.168)	(1.173)
$Redshirt_{t-4}$	-1.032**	-1.912***	-0.392	-1.036	-1.072
	(0.438)	(0.434)	(0.742)	(0.973)	(0.964)
Volleyball*$Redshirt_{t-4}$	-1.464	-0.157	-0.568	1.192	1.17
	(1.278)	(1.139)	(1.795)	(2.307)	(2.206)
Men's Basketball*$Redshirt_{t-4}$	-5.691**	-4.068	-4.062	Omitted	Omitted
	(2.226)	(2.668)	(2.987)		
Women's Basketball*$Redshirt_{t-4}$		No Obs.	No Obs.	No Obs.	No Obs.

Table 32: MSU Football vs. Other Sports, HE: Continued

	(1)	(2)	(3)	(4)	(5)
Financial Aid		-0.025***	-0.029***	-0.008	0.009
		(0.008)	(0.009)	(0.01)	(0.012)
Volleyball*Financial Aid		-0.02	-0.016	-0.024	-0.042
		(0.020)	(0.022)	(0.028)	(0.029)
Men's Basketball*Financial Aid		-0.017	-0.01	0.058	0.046
		(0.026)	(0.029)	(0.044)	(0.049)
Women's Basketball*Financial Aid		0.027	0.024	0.008	-0.02
		(0.022)	(0.023)	(0.026)	(0.032)
Spring		0.651***	0.589***	0.524***	0.517***
		(0.156)	(0.17)	(0.176)	(0.175)
Summer		-7.151***	-7.285***	-7.765***	-7.765***
		(0.199)	(0.207)	(0.236)	(0.239)
Volleyball*Spring		-0.184	-0.015	0.19	0.197
		(0.343)	(0.367)	(0.437)	(0.437)
Volleyball*Summer		-1.470***	-1.378***	-1.011	-1.012
		(0.494)	(0.534)	(0.618)	(0.621)
Men's Basketball*Spring		-1.078**	-1.177**	-0.679	-0.672
		(0.428)	(0.463)	(0.551)	(0.548)
Men's Basketball*Summer		-0.596	-0.488	-1.071**	-1.067**
		(0.409)	(0.433)	(0.53)	(0.539)
Women's Basketball*Spring		-1.331***	-1.275***	-1.038**	-1.026**
		(0.361)	(0.389)	(0.426)	(0.424)
Women's Basketball*Summer		-2.716***	-2.812***	-2.417***	-2.428***
		(0.352)	(0.384)	(0.453)	(0.454)
Sophomore			-0.171	-0.097	-0.12
			(0.308)	(0.33)	(0.33)
Junior			0.042	0.243	0.24
			(0.299)	(0.328)	(0.326)
Senior			-0.882***	-0.635*	-0.743**
			(0.320)	(0.371)	(0.368)
Fifth Year			-1.885***	-1.764**	-1.829**
			(0.655)	(0.882)	(0.872)
Volleyball*Sophomore			0.041	0.3	0.328
			(0.510)	(0.564)	(0.566)
Volleyball*Junior			0.029	-0.018	-0.013
			(0.598)	(0.675)	(0.676)
Volleyball*Senior			0.806	0.032	0.141
			(0.631)	(0.851)	(0.849)
Volleyball*Fifth Year			0.713	0.022	0.119
			(1.514)	(1.971)	(1.956)

Table 32: MSU Football vs. Other Sports, HE: Continued

	(1)	(2)	(3)	(4)	(5)
Men's Basketball*Sophomore			0.207	-0.134	-0.204
			0.678)	(0.711)	(0.7)
Men's Basketball*Junior			0.232	-0.018	-0.007
			(0.564)	(0.664)	(0.66)
Men's Basketball*Senior			0.890	0.845	1.019
			(0.709)	(1.04)	(1.028)
Men's Basketball*Fifth Year			0.537	-0.385	-0.255
			(1.516)	(3.336)	(3.331)
Women's Basketball*Sophomore			0.051	-0.075	-0.063
			(0.502)	(0.549)	(0.547)
Women's Basketball*Junior			-0.091	-0.926	-0.962*
			(0.483)	(0.566)	(0.566)
Women's Basketball*Senior			-0.316	-1.668**	-1.590**
			(0.578)	(0.763)	(0.772)
Women's Basketball*Fifth Year			1.269	0.543	0.403
			(0.969)	(1.654)	(1.7)
Test Score				0.194***	0.177***
				(0.069)	(0.069)
Volleyball*Test Score				0.065	0.080
				(0.133)	(0.136)
Men's Basketball*Test Score				-0.153	-0.201
				(0.192)	(0.191)
Women's Basketball*Test Score				-0.234*	-0.130
				(0.142)	(0.157)
HS GPA				1.233***	1.073***
				(0.184)	(0.193)
Volleyball*HS GPA				-1.260**	-1.127*
				(0.53)	(0.589)
Men's Basketball*HS GPA				-0.051	0.361
				(0.468)	(0.489)
Women's Basketball*HS GPA				-0.191	0.007
				(0.663)	(0.651)
Medically Unable				0.244	0.322
				(0.626)	(0.628)
Volleyball*Medically Unable				2.248	2.131
				(1.907)	(1.894)
Men's Basketball*Medically Unable				-0.271	-0.296
				(1.600)	(1.627)
Women's Basketball*Medically Unable				2.066	1.974
				(1.308)	(1.327)

Table 32: MSU Football vs. Other Sports, HE: Continued

	(1)	(2)	(3)	(4)	(5)
Eligibility Exhausted				0.381	0.516
				(1.002)	(0.962)
Volleyball*Eligibility Exhausted				-0.65	-0.792
				(1.708)	(1.682)
Men's Basketball*Eligibility Exhausted					No Obs
Women's Basketball*Eligibility Exhausted					No Obs.
Black					-0.424
					(0.330)
Men's Basketball*Black					-0.211
					(0.954)
Volleyball*Black					No Obs.
Women's Basketball*Black					0.385
					(0.763)
White					0.438
					(0.342)
Men's Basketball*White					-1.383*
					(0.759)
Volleyball*White					-0.52
					(0.668)
Women's Basketball*White					-1.044
					(0.692)
Volleyball	1.239***	2.140***	1.717***	4.371**	4.338
	(0.284)	(0.476)	(0.598)	(2.169)	(2.813)
Men's Basketball	-0.45	1.109*	0.524	0.710	0.843
	(0.284)	(0.593)	(0.736)	(2.527)	(2.456)
Women's Basketball	0.517*	1.324***	1.365**	3.567	2.932
	(0.285)	(0.461)	(0.554)	(2.566)	(2.568)
Constant	11.173***	12.140***	12.565***	6.898***	7.139***
	(0.122)	(0.198)	(0.294)	(0.821)	(0.877)
	N=3524	N=3113	N=2706	N=1914	N=1914
	R^2=0.020	R^2=0.453	R^2=0.470	R^2=0.554	R^2=0.558

Notes: HE=Hours Earned. 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively. Standard errors are shown in parentheses. Financial Aid is measured in thousands of dollars. Test Score is measured in hundreds of SAT points. Interactions indicate difference from the football sample (i.e. $Redshirt$ is the estimated effect for football, and $Redshirt * Men'sBasketball$ is the difference between the estimated effect of redshirting between men's basketball players and football players).

Table 33: MSU Men's Basketball vs. Volleyball and Women's Basketball, HE

	(1)	(2)	(3)	(4)	(5)
Redshirt	0.573	0.094	0.262	0.176	0.331
	(0.635)	(0.508)	(0.557)	(0.565)	(0.575)
Volleyball*$Redshirt$	0.357	-0.131	0.043	0.457	0.289
	(0.916)	(0.753)	(0.846)	(0.889)	(0.893)
Women's Basketball*$Redshirt$	0.082	0.565	0.261	0.554	0.321
	(0.942)	(0.667)	(0.719)	(0.818)	(0.825)
$Redshirt_{t-1}$	-0.531	0.275	0.302	-0.117	-0.027
	(0.925)	(0.502)	(0.551)	(0.623)	(0.652)
Volleyball*$Redshirt_{t-1}$	0.654	-0.014	-0.031	0.739	0.639
	(1.22)	(0.703)	(0.731)	(0.812)	(0.838)
Women's Basketball*$Redshirt_{t-1}$	0.748	0.119	-0.024	0.567	0.491
	(1.33)	(0.7)	(0.773)	(0.897)	(0.913)
$Redshirt_{t-2}$	1.401	1.191	1.163	0.214	0.19
	(1.099)	(0.954)	(0.973)	(1.066)	(1.128)
Volleyball*$Redshirt_{t-2}$	-1.814	-1.319	-1.346	-0.604	-0.6
	(1.455)	(1.215)	(1.238)	(1.343)	(1.388)
Women's Basketball*$Redshirt_{t-2}$	-3.021*	-2.905**	-2.659**	-1.195	-1.125
	(1.562)	(1.201)	(1.23)	(1.346)	(1.43)
$Redshirt_{t-3}$	-0.234	-0.545	-0.027	-0.896	-1.046
	(1.386)	(1.134)	(1.133)	(1.639)	(1.637)
Volleyball*$Redshirt_{t-3}$	-0.652	0.031	-0.269	1.082	1.205
	(1.773)	(1.282)	(1.311)	(1.872)	(1.869)
Women's Basketball*$Redshirt_{t-3}$	0.293	-0.853	-0.52	0.256	0.563
	(1.427)	(1.204)	(1.263)	(1.99)	(1.995)
$Redshirt_{t-4}$	-6.724***	-5.98**	-4.454	0.156	0.097
	(2.192)	(2.65)	(2.925)	(2.14)	(2.036)
Volleyball*$Redshirt_{t-4}$	4.227*	3.911	3.494	No Obs.	No Obs.
	(2.502)	(2.854)	(3.359)		
Women's Basketball*$Redshirt_{t-4}$	No Obs.	No Obs.	No Obs.	No Obs.	No Obs.
Financial Aid		-0.042*	-0.039	0.05	0.056
		(0.024)	(0.027)	(0.044)	(0.049)
Volleyball*Financial Aid		-0.003	-0.005	-0.082	-0.089
		(0.03)	(0.034)	(0.052)	(0.056)
Women's Basketball*Financial Aid		0.043	0.035	-0.05	-0.066
		(0.032)	(0.035)	(0.051)	(0.057)
Spring		-0.427	-0.588	-0.155	-0.155
		(0.402)	(0.436)	(0.534)	(0.533)
Summer		-7.747***	-7.773***	-8.836***	-8.832***
		(0.36)	(0.385)	(0.485)	(0.496)

Table 33: MSU Men's B-Ball vs. Volleyball and Women's B-Ball, HE: Continued

	(1)	(2)	(3)	(4)	(5)
Volleyball*Spring		0.895*	1.162**	0.869	0.869
		(0.506)	(0.546)	(0.673)	(0.673)
Volleyball*Summer		-0.874	-0.89	0.06	0.055
		(0.581)	(0.629)	(0.76)	(0.769)
Women's Basketball*Spring		-0.253	-0.098	-0.359	-0.355
		(0.519)	(0.561)	(0.665)	(0.664)
Women's Basketball*Summer		-2.12***	-2.324***	-1.346**	-1.362**
		(0.464)	(0.505)	(0.626)	(0.634)
Sophomore			0.036	-0.23	-0.325
			(0.611)	(0.645)	(0.633)
Junior			0.275	0.225	0.233
			(0.483)	(0.591)	(0.589)
Senior			0.008	0.21	0.276
			(0.639)	(0.995)	(0.985)
Fifth Year			-1.348	-2.149	-2.084
			(1.382)	(3.293)	(3.298)
Volleyball*Sophomore			-0.166	0.434	0.533
			(0.736)	(0.797)	(0.789)
Volleyball*Junior			-0.203	0	-0.006
			(0.713)	(0.845)	(0.846)
Volleyball*Senior			-0.084	-0.813	-0.878
			(0.843)	(1.266)	(1.259)
Volleyball*Fifth Year			0.175	0.407	0.374
			(1.953)	(3.754)	(3.756)
Women's Basketball*Sophomore			-0.156	0.059	0.141
			(0.73)	(0.786)	(0.775)
Women's Basketball*Junior			-0.323	-0.908	-0.955
			(0.617)	(0.756)	(0.757)
Women's Basketball*Senior			-1.206	-2.513**	-2.609**
			(0.804)	(1.206)	(1.206)
Women's Basketball*Fifth Year			0.731	1.579	1.45
			(1.56)	(3.81)	(3.841)
Test Score				0.042	-0.024
				(0.183)	(0.183)
Volleyball*Test Score				0.217	0.281
				(0.217)	(0.220)
Women's Basketball*Test Score				-0.082	0.071
				(0.223)	(0.233)
HS GPA				1.182***	1.434***
				(0.441)	(0.461)

Table 33: MSU Men's B-Ball vs. Volleyball and Women's B-Ball, HE: Continued

	(1)	(2)	(3)	(4)	(5)
Volleyball*HS GPA				-1.208*	-1.488**
				(0.673)	(0.733)
Women's Basketball*HS GPA				-0.14	-0.354
				(0.787)	(0.787)
Medically Unable				-0.027	0.025
				(1.507)	(1.54)
Volleyball*Medically Unable				2.518	2.427
				(2.381)	(2.394)
Women's Basketball*Medically Unable				2.336	2.27
				(1.911)	(1.952)
Eligibility Exhausted				-0.269	-0.276
				(1.416)	(1.416)
Volleyball*Eligibility Exhausted				No Obs.	No Obs.
Women's Basketball*Eligibility Exhausted				Omitted	Omitted
Black					-0.635
					(0.919)
Volleyball*Black					No Obs.
Women's Basketball*Black					0.596
					(1.158)
White					-0.081
					(0.588)
Volleyball*White					-0.864
					(0.91)
Women's Basketball*White					-0.524
					(0.853)
Volleyball	1.689***	1.032	1.193	3.661	3.496
	(0.364)	(0.712)	(0.861)	(3.194)	(3.614)
Women's Basketball	0.967***	0.216	0.841	2.857	2.089
	(0.365)	(0.702)	(0.83)	(3.488)	(3.417)
Constant	10.724***	13.248***	13.089***	7.608***	7.982***
	(0.257)	(0.562)	(0.682)	(2.446)	(2.354)
	N=1111	N=1056	N=951	N=610	N=610
	R^2=0.040	R^2=0.577	R^2=0.586	R^2=0.660	R^2=0.663

Notes: HE=Hours Earned. 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively. Standard errors are shown in parentheses. Financial Aid is measured in thousands of dollars. Test Score is measured in hundreds of SAT points. No football players are included in the sample. Interactions indicate the difference from the men's basketball sample (i.e. $Redshirt$ is the estimated effect for men's basketball players, and $Redshirt * Volleyball$ is the difference between the estimated effect of redshirting between volleyball players and men's basketball players).

Table 34: MSU Volleyball vs. Women's Basketball, HE

	(1)	(2)	(3)	(4)	(5)
Redshirt	0.93	-0.038	0.305	0.633	0.62
	(0.66)	(0.555)	(0.637)	(0.685)	(0.682)
Women's Basketball*red	-0.275	0.696	0.218	0.097	0.031
	(0.959)	(0.704)	(0.783)	(0.904)	(0.902)
$Redshirt_{t-1}$	0.123	0.261	0.27	0.622	0.613
	(0.795)	(0.492)	(0.481)	(0.52)	(0.525)
Women's Basketball*$Redshirt_{t-1}$	0.094	0.134	0.008	-0.173	-0.148
	(1.244)	(0.693)	(0.726)	(0.828)	(0.826)
$Redshirt_{t-2}$	-0.413	-0.128	-0.183	-0.39	-0.41
	(0.953)	(0.752)	(0.766)	(0.815)	(0.807)
Women's Basketball*$Redshirt_{t-2}$	-1.206	-1.585	-1.313	-0.591	-0.525
	(1.463)	(1.048)	(1.075)	(1.156)	(1.192)
$Redshirt_{t-3}$	-0.887	-0.514	-0.295	0.186	0.158
	(1.105)	(0.599)	(0.66)	(0.902)	(0.9)
Women's Basketball*$Redshirt_{t-3}$	0.946	-0.884	-0.251	-0.826	-0.642
	(1.156)	(0.723)	(0.865)	(1.443)	(1.449)
$Redshirt_{t-4}$	-2.496**	-2.069*	-0.96	0.156	0.097
	(1.206)	(1.06)	(1.653)	(2.137)	(2.031)
Women's Basketball*$Redshirt_{t-4}$	No Obs.	No Obs.	No Obs.	No Obs.	No Obs.
Financial Aid		-0.045**	-0.044**	-0.032	-0.033
		(0.018)	(0.02)	(0.027)	(0.027)
Women's Basketball*Financial Aid		0.046*	0.04	0.032	0.022
		(0.027)	(0.03)	(0.037)	(0.041)
Spring		0.467	0.574*	0.715*	0.714*
		(0.307)	(0.328)	(0.408)	(0.41)
Summer		-8.621***	-8.664***	-8.776***	-8.777***
		(0.456)	(0.498)	(0.584)	(0.586)
Women's Basketball*Spring		-1.148**	-1.259***	-1.229**	-1.224**
		(0.45)	(0.483)	(0.569)	(0.569)
Women's Basketball*Summer		-1.246**	-1.433**	-1.406**	-1.416**
		(0.542)	(0.596)	(0.705)	(0.707)
Sophomore			-0.13	0.204	0.208
			(0.412)	(0.468)	(0.471)
Junior			0.071	0.225	0.227
			(0.524)	(0.602)	(0.606)
Senior			-0.076	-0.603	-0.602
			(0.55)	(0.782)	(0.783)
Fifth Year			-1.172	-1.742	-1.71
			(1.38)	(1.801)	(1.792)

Table 34: MSU Volleyball vs. Women's Basketball, HE: Continued

	(1)	(2)	(3)	(4)	(5)
Women's Basketball*Sophomore			0.01	-0.375	-0.391
			(0.574)	(0.648)	(0.648)
Women's Basketball*Junior			-0.12	-0.908	-0.949
			(0.65)	(0.765)	(0.769)
Women's Basketball*Senior			-1.122	-1.7	-1.731*
			(0.735)	(1.037)	(1.047)
Women's Basketball*Fifth Year			0.556	1.172	1.076
			(1.558)	(2.263)	(2.316)
Test Score				0.003**	0.003**
				(0.001)	(0.001)
Women's Basketball*Test Score				-0.003*	-0.002
				(0.002)	(0.002)
HS GPA				-0.027	-0.054
				(0.508)	(0.569)
Women's Basketball*HS GPA				1.068	1.134
				(0.826)	(0.854)
Medically Unable				2.491	2.453
				(1.84)	(1.829)
Women's Basketball*Medically Unable				-0.182	-0.157
				(2.182)	(2.185)
Eligibility Exhausted				-0.269	-0.276
				(1.414)	(1.412)
Women's Basketball*Eligibility Exhausted				Omitted	Omitted
Black					-0.039
					(0.703)
Women's Basketball*Black					No Obs.
White					-0.081
					(0.587)
Women's Basketball*White					-0.524
					(0.851)

Table 34: MSU Volleyball vs. Women's Basketball, HE: Continued

	(1)	(2)	(3)	(4)	(5)
Women's Basketball	-0.722**	-0.816	-0.352	-0.804	-1.406
	(0.365)	(0.605)	(0.709)	(3.221)	(3.686)
Constant	12.413***	14.28***	14.282***	11.269***	11.478***
	(0.257)	(0.436)	(0.527)	(2.051)	(2.735)
	N=715	N=689	N=612	N=433	N=433
	R^2=0.020	R^2=0.619	R^2=0.642	R^2=0.689	R^2=0.690

Notes: HE=Hours Earned. 0.10, 0.05, and 0.01 significance levels for difference from zero are denoted by *,**, and ***, respectively. Standard errors are shown in parentheses. Financial Aid is measured in thousands of dollars. No football or men's basketball players are included in the sample. Interactions indicate difference from the volleyball sample (i.e. *Redshirt* is estimated effect for volleyball players, and $Redshirt * Women's Basketball$ is the difference between the estimated effect of redshirting between volleyball players and women's basketball players).