ESSAYS ON THE COSTS AND BENEFITS OF COLLEGIATE ATHLETICS

by

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To my father, Kazafer Bijelic, and mother, Hasija Bijelic

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ABSTRACT

This dissertation is composed of three separate empirical analyses. Each analysis is a separate article.

Collegiate athletics are a significant aspect of many universities in the United States. The costs for running such programs are vast and the total benefits associated with athletic programs are not easily identifiable. In the following analyses, I seek to analyze the costs and benefits associated with collegiate athletics. Chapter I builds on previous work on the effect of athletic success on the university that has found estimates that suggest both basketball and football success can have a positive effect on student quantity. I utilize university data from the Integrated Postsecondary Education Data System as well as athletics data from Equity in Athletics Data Analysis to analyze how athletic success impacts university growth. I utilize a panel fixed effect model to estimate the impact of having a successful basketball or football season on forthcoming applications, undergraduate enrollment, and tuition revenue. I find that while the basketball champion has a significant impact on applications sent to the university, basketball has no significant effect on tuition revenue. However, results suggest that having a top 25 ranked football program increased tuition revenue by approximately 2% for two years following the successful season. The magnitude of this effect is estimated to be around $3 million in the subsequent academic year. The effect is found to be around 8% for the top football program, which would coincide with an increase of over $11 million in tuition revenue for the average university. When using top conference revenue figures, the magnitude rises to over $22 million. Chapter II analyzes how athletic

subsidies differ among teams that compete in football at the NCAA Division I level. The primary comparisons are made between the top 5 conferences, also known as the Power 5 conferences, and the remaining Division I conferences. University-level data from 2005 to 2015 on ticket sale revenue, rights and licensing revenue, and university subsidies are obtained from USA Today's public records requests. The key findings indicate that ticket sale revenues increase by around 1.5% for each additional football win for all Division I programs. For rights revenue, conference champions are found to generate the most significant increases in revenue, ranging from 3 to 7%, which would correspond to an increase between $500,000 and two million dollars. Regarding university subsidies, a significant decrease in university subsidies of around 37%, approximately two million dollars, is estimated for top performing teams in the Power 5 conferences. Results also suggest that non-Power 5 conferences increase university subsidies as a method for keeping up with increasing advertising revenues observed at Power 5 conferences.

Chapter III builds on findings of prior studies that have analyzed the relationship between recruiting and team performance. Prior findings indicate that high-quality recruits are associated with better on-field performance. In this paper, I determine the key factors associated with successful recruiting. I utilize panel fixed effect and negative binomial models to identify the university and athletic department indicators that bring about successful recruiting. Team performance is found to be significant in the recruiting process. However, I find that universities may signal their athletic department quality by increasing coaching salaries and by replacing underperforming coaches. These quality signals through spending on coaching staff are found to positively impact subsequent recruiting.

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CHAPTER I

ATHLETIC PROGRAMS AND UNIVERSITY GROWTH: HOW FOOTBALL AND BASKETBALL SUCCESS AFFECT STUDENT QUANTITY AND TUITION

1 Introduction

College Sports have seen tremendous growth since the start of the 21st century. The NCAA (National Collegiate Athletic Association) has seen tremendous revenue come in specifically from broadcasting agreements. In 2013, $681 million of the organization's revenue came from its marketing rights agreement with CBS and Turner Broadcasting.[1] While the growth is occurring throughout college sports, the prime focus of this paper is the top two sports, basketball and football. These sports make up more than half of all athletic revenue and expenses for the majority of universities in my sample.

In 2012, of 228 public school athletic departments at the NCAA Division I level, only 23 generated enough revenue to cover their expenses.[2] The remaining universities all required subsidies from the university to cover the cost of programs. It is common for a significant portion of this money to come out of student fees that are included in tuition. There has been growing concerns about the rapid growth of tuition rates across all

[1] Revenue figures are obtained from official financial statement released by the NCAA on March 2014.
[2] These figures come from a publication by USA Today titled, "Most NCAA Division I athletic departments take subsidies," published on May 7th, 2013.

institutions. While the steady rise in tuition seen in recent years is not completely attributed to athletic programs, it is a safe assumption that they do play a role. A look at 201 public universities from 2010 to 2014 shows that roughly 65% of these universities received more than 50% of their total financing from student fees and institutional support.[3] It is not surprising that the universities that received the least proportion of funding from students or the institution are those universities with the most successful and prestigious programs. Conversely, some of the lower ranked or newer programs had over 75% of their funding derived from university funds or student fees.

Without a closer look at the full spectrum of data for successful programs from their founding years, it is difficult to understand what level of success results in program transitioning from a burden on the university and its students to a self-sustaining and revenue generating partner. Mulholland, Tomic, and Sholander (2014) find that football success increases the institution's peer assessment score according to US News and World Report data. This finding would also suggest that successful athletic programs can lead to a perceived higher quality for a university as judged by its peers. The steady rise in athletic expenses suggest that there are more benefits to a university through athletics than can be identified in simple financial reports.

This paper closely follows the work of Pope and Pope (2009). They utilize data from 1980 to 2003 to analyze the effect of football and basketball success on the quantity and quality of students at a university. This paper focuses more on the quantity of

[3] Detailed revenue data was obtained by Huffington Post and presented through "subsidy scorecards" which can be viewed by the public at (Subsidy Scoredcards)

students and the revenue that is generated by these new students to the university. Pope and Pope find application increase estimates of 2% to 8% for the top 20 football and top 16 basketball schools. I focus on the monetary gains to the university from this increased exposure. Utilizing data from the Integrated Postsecondary Education Data System (IPEDS) for over 300 universities that compete at the Division I level in basketball or football; I find similar estimates for football success ranging from 3% to 6% for top 25 football teams. Unlike prior literature, I only find a significant effect for being the NCAA basketball champion on total applications.

When looking at the revenue generated by tuition for each public university, I find that being one of the top 25 football programs results in increased tuition revenue in the following 2 years of around 2%, or roughly $3 million. This estimate is over four times as large at around 8%, over $22 million when using top conference revenue figures, for the top football program among public universities in a given year. For private universities, I find that there is no significant positive effect for having a team ranked in the top 25. I also find no positive significant effects on tuition revenue from having any level of basketball success. These results suggest that while both sports may generate increased demand for a university, football is more impactful to increasing university revenue through tuition. Furthermore, I find that the impact of athletic success is greater for male applicants than for female applicants.

Section 2 of the paper outlines some of the key literature and more background information regarding the relationship between athletic success and the benefits to the university. Section 3 describes the data used for the purpose of this paper. Section 4 describes the empirical strategy use to identify the effects of football and basketball

success. Section 5 presents the key results from my model. Section 6 presents robustness checks. Section 7 summarizes the study.

2 Literature Review

The revenue generated from athletics is a significant portion of most universities' total revenue. Despite this fact, there is not a significant focus in prior literature on how large an impact athletic success has on the revenue generated by the increased demand for a university. One key externality that arises for successful sports programs is increased exposure to the general public. More specifically, McCormick and Tinsley (1987) examined whether increased athletic performance had an effect on the number of applications that university receives in the years after a successful season. Furthermore, these authors explored more on how this increase in applications could impact the quality of students by allowing the university to be more selective when choosing applicants to admit. McCormick and Tinsley study utilized data on 44 schools in top athletic conferences, with performance measured through winning percentages against teams within conference. To identify the quality change, they used data on average SAT scores for each school and found evidence that suggested that their intuition was correct. Lindo, et al. (2012) find that athletic success significantly reduces male academic performance compared to female students. The effect is found to occur only in fall quarters and is attributed to alcohol consumption and increased partying behavior.

Pope and Pope (2009) build on the work of McCormick and Tinsley and utilize many years of data (1983-2002) and look at over 300 schools that compete in NCAA

Division I athletics. Unlike McCormick and Tinsley, Pope and Pope do not utilize winning percentages as performance measures. Instead, they look at Associated Press's college football poll rankings as a measure of football performance and NCAA basketball tournament results as a measure of basketball performance. They find that top 20 football schools and top 16 basketball schools observe a 2% to 8% increase in applications received. This effect is two to four times larger for private schools than for public. They also find some evidence that schools, again more so private than public, raise tuition and enrollment following successful seasons. McCevoy (2005) also finds a significant effect for football success on applications, and Mixon and Trevino (2005) show that football success has positive impact on student retention.

There have been several different approaches to measuring success in prior literature. Aside from winning percentages and final ranking polls, Anderson (2017) use bookmaker spreads to estimate the probability of winning, and then utilize a propensity score design to estimate the effects of winning under these probabilities. Smith (2012) includes a variable to identify a "breakout season," which was determined to be a season where a team accomplished a result for the first time in 13-15 years. There is not an agreed upon method to measure sports success. For the purpose of this study, I will utilize Associated Press (AP) rankings as a measure of football success. AP rankings include the top 25 football teams at the conclusion of a given season. Due to the significant variation in conference recognition, a simple winning percentage would not be an ideal measure that would capture variation across all universities. Having a high winning percentage in a Power Conference is a significant and recognized accomplishment, but only 18% of sampled universities compete at this level. For this

reason, I use AP final rankings which better reflect how much media attention a team would receive for their performance. For basketball, winning percentage is even more troublesome a measure, due to the importance of the NCAA basketball tournament. A high win percentage is correlated with an appearance at the tournament, but a loss in the first round can easily diminish the return to a high win percentage season. For this reason, I utilize dummy variables for progression through the tournament. The first identifier is for teams that qualify for the tournament in a given year, and additional identifiers are included for making it to the final 16, final 8, final 4, runner-up, and champion.

Matheson, O'Connor, and Herberger (2012) examine the profitability of athletic programs at the Division I level. They find that departments in the Bowl Championship Series were highly profitable, but for departments at lower tiers, fewer than 10% of football and 15% of men's basketball programs earned positive profit. It is clear from the growth of athletic programs, that these low profit figures aren't scaring away currently competing universities from investing more and more money. Hoffer (2015) analyze the "arms race" that occurs among competing Division 1 programs. He finds that athletic departments do indeed react to the decisions of other departments. One example that is provided is of Alabama paying head coach, Nick Saban, $7 million per year as a way to increase the spending from other universities within conference. This type of competition allows the most successful teams that generate positive revenue to pressure other universities into costly decisions.

I look to advance the literature by combining the effects found in previous literature of increased enrollment, tuition, and student retention to find the size of the effect on tuition revenue for a given university. This will provide more evidence of how

significant a role successful programs play in overall university success. An additional advantage that my study has is that the timing of the data extends well into the social media era. Any effects of sports success would only be more accentuated by increased discussion across social media platforms.

3 Data

Pope and Pope (2009) break down athletic success into two components: historic athletic strength and episodic athletic strength. More simply, historic strength would best be observed in high rank universities in top conferences that regularly appear among the best teams at the conclusion of a season. For example, in college basketball, Duke would be viewed as a university with historic strength. To best analyze the effect of athletic success, I use panel data so that I can control for historic athletic strength. Episodic athletic strength, however, occurs when a team has a breakout season. This second component of athletic success is the primary focus of this analysis.

The first data set I use comes from the Equity in Athletics Data Analysis. As a result of the Equity in Athletics Disclosure Act passed in 1994, all schools that receive Title IV funding (universities that participate in federal student aid programs) and have intercollegiate athletics programs are required to submit annual reports that detail funding information for each program offered. I am able to analyze revenue and expense data from 2003-2015 for over 340 universities that have a football and/or basketball program that competes at the NCAA Division I level. While this data set provides revenue data for each sport, the public release does not break down the revenue into further components.

The universities submit detailed information, however, the only data reported for revenue is a total for each sport, rather than individual breakdowns. It would be useful to identify how reliance on student fees and university support changes as programs gain success.

Further information about each university is collected from the Integrated Postsecondary Education Data System (IPEDS). From this source I am able to obtain information on number of applicants, admissions, average professor salary, acceptance rate, cost of attendance, and tuition revenue. All of the data is linked at the university level and matched with the expense and revenue data. I also collect information about the total number of high school graduates in each state to use as one of my control variables. Following previous studies, I also obtain a measure for income in each state as an additional control variable. This final control variable is obtained through census data.

The final data required for my study is a measure of sports success. As discussed in the previous section, there are several ways that prior surveys have captured success. In this survey, I utilize the end of season AP ranking for football success and NCAA Tournament results for basketball success.[4] All teams that finished in the top 25 in football are observed for the entire sample. I also include a top 10 subcategory for AP rankings to further differentiate top performing teams. Since the football champion was chosen by voting prior to the 2014 season, the champion was determined to be the team ranked in the top position of the AP poll. This specification leads the sample to include 14 champions in my 13-year sample. This is due to the fact that Louisiana State University and the University of Southern California were tied for first place at the

[4] Both AP Rankings and NCAA Tournament results are obtained from www.sports-reference.com.

conclusion of the 2003 college football season. Of the total participants in the NCAA basketball tournament from 2002 to 2014, my sample includes all but 5 teams (99.5% of all participants.)

Table 1.1 summarizes the key variables used in this survey. The original data set contains information for 346 universities over a 13-year span that compete in Division 1 basketball and football. Due to missing data in at least one year of data for applications, the sample is reduced to 303 universities when looking at applications and admissions. When looking at the effect of athletic success on tuition revenue, the sample is only reduced to 336 universities as a result of missing data. Table 1.1 shows how public and private universities differ in some respects. Cost of tuition is nearly twice as large for private universities on average. Professor salaries are also higher for private universities. Public universities tend to have more students as is shown by higher admissions. For my sample, 77 percent of public universities have a football program compared to 50 percent of private schools.

4 Empirical Strategy

As mentioned in the previous section, athletic success can be broken down into two components: historic and recent success. Since it is difficult to capture all of the characteristics that make a university desirable, I use a fixed effects model with university and year fixed effects to capture any unobservable characteristics that a specific university may have. Additionally, several continuous variables are included that are observable for each university. The model to be estimated can be specified as follows:

$$Y_{it} = \delta_i + \lambda_t + \beta_1 P_{it} + \beta_2 P_{it-1} + \beta_3 P_{it-2} + \theta X_{it} + \varepsilon_{it}, \quad (1)$$

where Y_{it} denotes the outcome variable of interest, for each university *i* during year *t* . Initially, I look to replicate the results found in prior studies regarding the effect of athletic success on the number of applications a university receives. After that, I replace the outcome variable of applications with revenue generate by tuition. To not overweight large universities, the log values of the outcome variables are used. δ_i are university level fixed effects and λ_t represents year fixed effects. P_{it} indicates the level of athletic success. Two lags are included to measure any prolonged effects of success. X_{it} includes all control variables: average professor salary, cost of tuition, acceptance rate, number of high school graduates, and median income level. The latter two control variables are at the state level and are matched with all universities located in a given state. ε_{it}represents the error term.

It is worth noting the timing of success in relation to the outcome variables. For football, the final standings are generally observed in the month of January. This means that our measure of performance for the first year in the data comes from the 2002 season. The outcome variable in our equation for the first year in the data, for example, comes from 2003 applications. Pope and Pope (2007) note that the conclusion of the football season comes before the application deadline for the majority of universities. This allows individuals to incorporate football success as a possible criterion when sending applications. It is unclear whether universities are able, or have sufficient time, to adjust tuition rates to maximize tuition revenue in the year immediately following a successful season. The inclusion of two lags for athletic performance should allow the model to capture any delay in revenue change.

The initial model will look to replicate findings from previous work by utilizing log applications and total undergraduates as the explanatory variable. I run the model for both public and private universities together and then I include two additional models with public and private universities separately. This is done to capture any differing trends in the two types of universities. This is also done for the subsequent model where tuition revenue is the outcome variable. It is perhaps more important to look at private and public universities separately in regard to tuition revenue, since it is likely easier for private universities to adjust tuition rates and thus may have differing effects on revenue due to athletic success.

5 Results

5.1 Football Success

Table 1.2 presents the findings for equation 1 with measures of football success as the key explanatory variables. The first three columns look at the effect on football success on applications that a university receives. When looking at all universities in the sample, having a football team in the AP top 25 for a given season increases applications by 4.5% initially. This effect also is found to persist for two additional periods with an increase of around 2.5% in each subsequent year. Being the football champion in a given year has an effect of around 5.4 to 7.2% increase in applications received. The effect is statistically significant for the initial season and for the subsequent year. For public universities, the impact of having a team in the AP top 25 poll on applications are very

similar to the overall effect, however, there is no significant effect for the football champion in a given season. For private universities, there is a much less significant effect of finishing it the top 25 on applications compared to public schools. The effect is also not found to persist over time. Private schools tend to be more selective than public schools, so students may not be increasing applications to these universities as much due to higher barriers.

The result for the model looking at total undergraduate student enrollment are presented in columns 4-6 of Table 1.2. I find public universities that finish in the top 25 in football increase the number of undergraduates by roughly 1-1.5% two seasons after a successful season. This effect is not found to be significant for the initial season after finishing in the top 25. For the football champions, a similar pattern occurs where universities increase student enrollment, but with a year delay. The effect is larger in this case, with a 5.1% increase for public university football champions and an 8.9% increase for private universities. This delay in impact is likely due to costs of adjustments to accommodate a larger student body. A successful season brings about an increase in applications for time t, but universities are unable to accommodate a larger student body until time t+1.

Columns 7-9 in Table 1.2 show the impact of sports success on tuition revenue. In the initial specification that includes all universities in the sample, there are no significant results. When I limit the sample to public universities, I find that having a football team in the top 10 increases tuition revenue by 1.9% in the first year and 2.3% in the subsequent year. Public university football champions also observe an even larger increase in tuition revenue of 7.2-8%. Using the average tuition revenue for all public

universities, the magnitude of this effect would be an increase in tuition revenue of $3 million. This estimate rises to 6$ million when using power conference revenue figures. This effect is nearly four times as large for the football champion in a given year. This would equate to a rise in tuition revenue of over $11 million for a successful season, using average revenue among all universities, with a magnitude of nearly $22 million when using revenue figures from top conferences only. For private universities, I find no significant effect of finishing in the top 25 in football or for being the top ranked team. This difference between public and private universities is likely due to structural reasons. Public universities enroll more students on average and cost less on average than private universities.

5.2 Basketball Success

Table 1.3 shows the results of equation 1 with measures of basketball success as the key explanatory variables. Once again, the first three columns indicate the results for the model with log total applications as the outcome variable. Unlike Pope and Pope (2009), I do not find significant positive effects for any success indicators other than the NCAA champion. I estimate approximately an 8% increase in applications for the NCAA champion with all universities in the sample, and a 9.6% increase in applications when the sample is limited only to public universities. Unlike prior literature, I find no significant positive effect for basketball success beyond the championship winning team in relation to total applications.

In regard to undergraduate enrollment, there is evidence that teams that make it to the Round of 16 or further observe an increase. This effect is significant for all universities together, as well as when the public and private universities are separated. No evidence of increased enrollment is found for the championship winning team. In the final 3 columns, where I look at the effect of basketball success on tuition revenue, I find no significant results for the overall model or the model with public universities and private universities separated. Overall, the results indicate that while there may be some effect on total applications caused by winning the NCAA tournament, however, there is no clear positive revenue gain to the university from tuition. Any effect of simply making it to the tournament or progressing into further rounds also show no significant benefit to the university's tuition revenue.

There are some possible explanations for basketball having a lesser impact in student quantity. One explanation could be the timing of the NCAA tournament. With the tournament ending in early April most years, it may come too late in the application process to play a significant role. According to the Free Application for Federal Student Aid (FAFSA) state deadlines list, nearly half of the United States has deadlines for federal aid applications before the tournament completes. An alternative explanation could just be diminishing interest in college basketball. There has been a steady decline in attendance for college basketball.[5]

[5] The 2014-2017 official NCAA basketball attendance reports show a decline in attendance for each year.

6 Robustness and Alternate Specifications

6.1 Robustness Checks

One initial concern that may arise with the model specification used in this analysis is reverse causality. It is true that athletic success could potentially be affected by increased applications or tuition revenue. To address this concern, I include an additional model specification where I include lead variables for all of my performance measures. This lead variable would capture situations where the university is finding success in athletics as a result of increased applications, enrollment, or tuition revenue. The results for this model are presented in Table 1.4. In all specifications, lead variables are not found to be significant, and the inclusion of the lead variables does not significantly affect the results that were found in the original model results in Table 1.2.

Another alternative to my fixed effects model specification is the random effects model. Our choice of using fixed effects was primarily to control for any historic success that a university has had that may affect the impact of episodic success. If this assumption is incorrect, then the random effects model may be more useful. Under the random effects model, universities are assumed to not have any characteristic differences. The results for the random effects model with football success as the explanatory variable are shown in Table 1.5.

The results in Table 1.5 are very similar to those found in the fixed effects model. The estimated coefficients are slightly larger for the overall model and the public universities in the first 3 columns, but the same variables retain significance with respect

to the top 25 ranked teams. The football champion indicators are no longer significant, but the estimates remain consistent with earlier results. Overall this model reinforces the findings discussed in section 5. The results for basketball success are not presented as they closely align with the findings from the fixed effects model, which were mostly insignificant.

6.2 Differences Between Male and Female Applicants

To further analyze the effect of sport success, it may be useful to identify whether the effect of sports success is similar for men and women. Table 1.5 presents results for models looking at male and female applications separately. Since football is much more advertised than basketball, and the main model results were more significant for football, I only look at football success in this specification. The results show that there is a generally larger increase in male applicants than female applicants. For public schools, the results are very similar for both men and women, with males increasing applications slightly more than their female counterparts. For private schools, there is a much less significant impact on male students and no impact of football success found for female students. This could be due to the difference in costs of tuition between public and private schools or a general difference in priorities. Overall the results suggest that male applicants are more reactive to athletic success than female applicants.

7 Conclusion

College sports are large part of student life, whether they attend the games, watch them on tv, or completely ignore their existence. For some, it becomes a part of their life for years to come as they continue supporting their alma matter well into retirement. For many Division I universities, the student support is one of the key things keeping them afloat. This is not just through ticket sales, but also trough the significant student fees that make up the athletic department's revenue. Growing the student body directly affects the growth of the football program.

Using data on student applications and tuition revenue, I find that football success is the key sport driving university growth. I estimate that a successful season (measured by placement in the AP top 25) increases student applications by 4.5% in the initial year and around 2.5% for two additional years beyond that. This effect is found to be driven primarily by public universities. Public universities that finished among the AP top 25 are also estimated to increase their total number of undergraduate students by roughly 1.3%. This increase in enrollment is found to occur with delayed timing. These findings reinforce those found in prior literature. Additionally, I find that football success has a significant positive effect on public school tuition revenue. I estimate that public schools in the top 25 for football earn an additional $3 to $6 million in the subsequent school year. The top football team is estimated to see an increase of up to $22 million in the 2nd and 3rd years following a successful season.

For basketball, I find no significant positive effect on tuition revenue. This may be due to the timing of the NCAA tournament being after many application deadlines are due. It could be the case that basketball success is not as important to applicants as is football. Diminishing attendance for basketball could point to a lesser demand for basketball among college students. Further research on the cost-benefit analysis of these athletic programs that includes all external benefits would be useful. However, it is difficult to obtain detailed financial data for most universities. It would also be beneficial to find what level of success or alumni donations allows an athletic program to cease collecting money from tuition and the university. From the "subsidy scorecards" released by Huffington Post it is clear that some of the most successful programs have reached this point, with universities like Louisiana State, Ohio State, and Purdue taking no money from student fees. It would be useful to the general public, especially current and upcoming college students, to see what the path to self-sustainability for their own university's athletic program may be.

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APPENDIX A: CHAPTER I TABLES

Table 1.1: Summary Statistics for University Data

	All Universities			Public Universities			Private Universities		
Variables	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Total Applicants	13,014.98	835	92,690	13,648	1,356	92,690	11,855.19	835	54,871
	(10798.94)			(10798.94)			(10186.61)		
Total Admission	7,208.08	524	36,088	8353.62	690	31,057	5109.69	524	36,088
	(5268.01)			(5473.27)			(4113.38)		
Tuition Revenue (in millions)	155	5	1,610	159	5	1,610	177	10	1,250
	(159)			(161)			(169)		
Cost of Attendance	22,935.48	3,150	53,000	18447.92	5,307	44,365	31,185.34	3150	53000
	(6361.23)			(6365.44)			(8702.82)		
Average Professor Salary	81,183.34	44,466	165,312	78,114.86	45,705.56	133,098	86,804.11	44,465.67	165312
	(16558.60)			(13323.37)			(20066.25)		
High School Graduates (State)	107,847.30	2,725	424,110	98,433.09	5,441	424,110	123247.40	2725	424110
	(100,384.90)			(100466.20)			(103372.80)		
Median Income (State)	49,410.74	32,002	76,165	48,560.64	32,002	76,165	51,553	33,507	76,165
	(8137.26)			(8304.17)			(7934.73)		
Acceptance Rate	.63	.05	.99	.68	.13	.99	.54	.05	.98
	(.19)			(.16)			(.22)		
Schools with Football Program	.68	-	-	.77	-	-	.50	-	-
N	4,368			2,860			1,508		

Note: All values are rounded 2 decimal place. All data in the table except percentage of schools with football program comes from the Integrated Postsecondary Education Data System. Columns 2-4 summarize all universities, columns 5-7 only inclue public universities, and columns 8-10 only cover private universities.

Table 1.2: Effect of Football Success on Applications, Undergraduates, and Tuition Revenue

Variables	Log Applications			Log Undergraduates			Log Tuition Revenue		
	All	Public	Private	All	Public	Private	All	Public	Private
FootballChampion	.054*	.041	.199	.026	.023	-.033	.035	.051	.016
	(.028)	(.032)	(.280)	(.017)	(.017)	(.022)	(.049)	(.042)	(.043)
FootballChampion Lag 1	.072**	.051	.091	.053**	.051*	.089***	.061	.072*	-.004
	(.031)	(.037)	(.221)	(.023)	(.031)	(.009)	(.048)	(.041)	(.013)
FootballChampion Lag 2	.055	.037	.241	.037	.040	-.003	.080	.080*	-.002
	(.049)	(.059)	(.172)	(.036)	(.041)	(.026)	(.058)	(.043)	(.039)
Aptop10	-.02	-.023	-.049	.019**	.022**	-.004	.008	.019*	-.026
	(.019)	(.021)	(.056)	(.008)	(.009)	(.011)	(.014)	(.011)	(.028)
Aptop10 Lag 1	-.015	-.023	.031	.013	.015	.001	.015	.023**	-.031
	(.016)	(.019	(.059)	(.009)	(.010)	(.008)	(.014)	(.011)	(.023)
Aptop10 Lag 2	-.001	-.002	-.022	.009	.014	-.008	.007	.018	-.001
	(.013)	(.015)	(.059)	(.010)	(.012)	(.018)	(.017)	(.016)	(.040)
Aptop25	.045***	.042***	.047*	.007	.009	.008	.007	.008	-.005
	(.012)	(.013)	(.036)	(.006)	(.007)	(.009)	(.011)	(.010)	(.021)
Aptop25 Lag 1	.026**	.029**	.009	.009*	.014**	-.005	.002	.003	-.013
	(.011)	(.012)	(.037)	(.005)	(.007)	(.007)	(.011)	(.010)	(.024)
Aptop25 Lag 2	.024**	.025**	.030	.013**	.013**	.014	.008	.007	.001
	(.011)	(.013)	(.039)	(.006)	(.007)	(.010)	(.010)	(.010)	(.022)
N	3926	2548	1378	3926	2548	1378	4368	2860	1508

Note: Values are rounded 3 decimal places. Robust standard errors are presented in parentheses. All models contain university controls, state controls, and fixed effects. (*** = 1% level of significance, ** = 5% level of significance, and * = 10% level of significance)

Table 1.3: Effect of Basketball Success on Applications, Undergraduates, and Tuition Revenue

Variables	Log Applications			Log Undergraduates			Log Tuition Revenue		
	All	Public	Private	All	Public	Private	All	Public	Private
Champion	.077**	.096**	.004	.011	.015	.004	.012	.030	-.018
	(.034)	(.038)	(.045)	(.024)	(.028)	(.017)	(.038)	(.032)	(.019)
Champion Lag1	.008	.001	.072	-.008	-.003	-.037**	.017	.035	-.021
	(.033)	(.038)	(.048)	(.019)	(.024)	(.015)	(.027)	(.025)	(.027)
Champion Lag2	.029	.028	.044	-.013	-.006	-.060**	.005	.000	-.040
	(.042)	(.050)	(.049)	(.015)	(.018)	(.024)	(.025)	(.024)	(.025)
NCAATournament	-.003	-.011	.013	-.006	-.012	.006	-.005	-.012	.011
	(.009)	(.012)	(.014)	(.005)	(.008)	(.006)	(.007)	(.008)	(.010)
NCAATournament Lag 1	-.006	-.016	.014	-.006	-.009	-.001	-.001	-.010	.013
	(.009)	(.011)	(.017)	(.005)	(.006)	(.006)	(.007)	(.008)	(.010)
NCAATournament Lag 2	-.009	-.020	.022	.000	-.006	.010	-.004	-.010	.003
	(.009)	(.015)	(.018)	(.005)	(.007)	(.006)	(.007)	(.007)	(.013)
Round16	-.010	-.007	-.018	.017**	.014	.019*	.002	.00	-.007
	(.019)	(.018)	(.042)	(.008)	(.011)	(.011)	(.014)	(.019)	(.017)
Round16 Lag 1	-.014	-.031	-.006	.017*	.016	.019*	.005	.012	-.003
	(.020)	(.195)	(.042)	(.010)	(.014)	(.011)	(.015)	(.018)	(.016)
Round16 Lag 2	.000	-.015	.024	.004	-.006	.029**	-.003	.013	-.007
	(.019)	(.021)	(.035)	(.009)	(.012)	(.013)	(.014)	(.018)	(.019)
Final8	-.014	-.027	-.004	-.011	-.009	-.009	-.019	-.013	.004
	(.026)	(.026)	(.059)	(.015)	(.018)	(.020)	(.023)	(.025)	(.023)
Final8 Lag 1	-.001	.004	-.005	-.028	-.031	-.014	-.027	-.029	.027
	(.023)	(.022)	(.058)	(.018)	(.020)	(.016)	(.025)	(.022)	(.028)
Final8 Lag 2	-.031	-.021	-.063	-.018	-.014	-.021	.000	-.012	.039
	(.024)	(.027)	(.062)	(.011)	(.015)	(.020)	(.021)	(.021)	(.049)
Final4	.022	.038	.099	.011	.013	.014	-.026	-.033	.011
	(.029)	(.030)	(.061)	(.017)	(.021)	(.023)	(.027)	(.026)	(.027)
Final4 Lag 1	.035	.034	.026	.028**	.030*	.012	-.017	-.028	-.004
	(.032)	(.034)	(.076)	(.014)	(.018)	(.013)	(.025)	(.023)	(.031)
Final4 Lag 2	.036	.027	.089	.022**	.022	.027	-.019	-.025	-.006
	(.027)	(.028)	(.078)	(.011)	(.013)	(.019)	(.021)	(.019)	(.045)
N	3926	2548	1378	3926	2548	1378	4368	2860	1508

Note: Values are rounded 3 decimal places. Robust standard errors are presented in parentheses. All models contain university controls, state controls, and fixed effects. (*** = 1% level of significance, ** = 5% level of significance, and * = 10% level of significance)

Table 1.4: Effect of Football Success on Applications, Undergraduates, and Tuition Revenue with Leads

Variables	Log Applications			Log Undergraduates			Log Tuition Revenue		
	All	Public	Private	All	Public	Private	All	Public	Private
FootballChampion Lead 1	.012	-.004	.155	.036	.039	.091	.026	.051	-.028
	(.038)	(.036)	(.171)	(.020)	(.031)	(.117)	(.058)	(.046)	(.036)
FootballChampion	.050	.041	.209***	.028	.028	-.026	.067	.086*	-.009
	(.034)	(.045)	(.068)	(.026)	(.033)	(.111)	(.063)	(.051)	(.228)
FootballChampion Lag 1	.094***	.079*	.091***	.070***	.073**	.089	.072	.084	.009
	(.037)	(.042)	(.015)	(.027)	(.033)	(.087)	(.061)	(.059)	(.178)
FootballChampion Lag 2	.027	.006	.247***	.014	.017	.004	.060	.058*	-.006
	(.037)	(.042)	(.075)	(.026)	(.032)	(.069)	(.041)	(.035)	(.143)
APtop10 Lead 1	-.011	-.001	-.053	.016	.019	-.005	.012	.018	-.021
	(.015)	(.019)	(.031)	(.010)	(.014)	(.023)	(.014)	(.122)	(.048)
Aptop10	-.018	-.021	.002	.020**	.027*	-.016	.006	.017	-.054
	(.019)	(.022)	(.034)	(.008)	(.014)	(.024)	(.015)	(.012)	(.050)
Aptop10 Lag 1	-.016	-.018	-.009	.007	.010	.002	.009	.020*	-.020
	(.019)	(.021)	(.026)	(.009)	(.014)	(.025)	(.015)	(.013)	(.051)
Aptop10 Lag 2	.003	.003	-.023	.015	.020	-.005	.008	.017	.003
	(.015)	(.017)	(.022)	(.010)	(.014)	(.026)	(.017)	(.014)	(.054)
Aptop25 Lead 1	.032	.023	.040	-.008	-.009	.007	-.000	.008	-.000
	(.022)	(.015)	(.029)	(.009)	(.010)	(.015)	(.010)	(.009)	(.031)
Aptop25	.034***	.029**	.036*	.007	.010	.003	-.001	.004	-.006
	(.011)	(.013)	(.021)	(.006)	(.010)	(.015)	(.011)	(.012)	(.030)
Aptop25 Lag 1	.035***	.035***	.027	.012**	.015	.002	.002	.004	-.014
	(.011)	(.012)	(.023)	(.006)	(.010)	(.025)	(.011)	(.011)	(.033)
Aptop25 Lag 2	.027***	.025**	.033	.013**	.011	-.005	.013	.005	.041
	(.010)	(.011)	(.023)	(.006)	(.010)	(.026)	(.011)	(.011)	(.037)
N	3926	2548	1378	3926	2548	1378	3926	2548	1378

Note: Values are rounded 3 decimal places. Robust standard errors are in parentheses. Models contain controls and fixed effects. (*** = 1% level of significance, ** = 5% level of significance, and * = 10% level of significance)

Table 1.5: Effect of Football Success on Applications, Undergraduates, and Tuition Revenue (Random Effects)

Variables	Log Applications			Log Undergraduates			Log Tuition Revenue		
	All	Public	Private	All	Public	Private	All	Public	Private
FootballChampion	.054	.050	.171	.024	.026	-.031	.040	.053	-.012
	(.051)	(.053)	(.292)	(.028)	(.032)	(.118)	(.043)	(.038)	(.252)
FootballChampion Lag 1	.072	.052	.083	.052*	.051	.090	.064	.069*	.020
	(.050)	(.054)	(.231)	(.027)	(.032)	(.093)	(.042)	(.039)	(.199)
FootballChampion Lag 2	.060	.037	.194	.039	.040	-.001	.083**	.078**	-.004
	(.050)	(.053)	(.179)	(.027)	(.032)	(.073)	(.041)	(.039)	(.155)
Aptop10	-.021	-.024	-.043	.019*	.022*	-.004	.009	.020	-.034
	(.021)	(.022)	(.058)	(.011)	(.013)	(.023)	(.017)	(.016)	(.050)
Aptop10 Lag 1	-.016	-.025	.029	.013	.014	.001	.015	.022	-.029
	(.021)	(.022)	(.061)	(.012)	(.014)	(.025)	(.018)	(.016)	(.053)
Aptop10 Lag 2	-.004	-.003	-.025	.009	.013	-.010	.007	.017	-.012
	(.022)	(.023)	(.061)	(.012)	(.014)	(.025)	(.018)	(.017)	(.053)
Aptop25	.051***	.050***	.056	.009	.013	.010	.013	.016	.013
	(.015)	(.016)	(.038)	(.008)	(.010)	(.015)	(.013)	(.012)	(.033)
Aptop25 Lag 1	.030**	.037**	.011	.012	.017*	-.005	.006	.010	-.011
	(.015)	(.016)	(.038)	(.008)	(.010)	(.016)	(.013)	(.012)	(.033)
Aptop25 Lag 2	.031**	.033**	.038	.016*	.017*	.016	.015	.012	.015
	(.015)	(.016)	(.041)	(.008)	(.010)	(.016)	(.013)	(.012)	(.035)
N	3926	2548	1378	3926	2548	1378	4368	2860	1508

Note: Values are rounded 3 decimal places. Robust standard errors are presented in parentheses. All models contain university controls, state controls, and fixed effects. (*** = 1% level of significance, ** = 5% level of significance, and * = 10% level of significance)

Table 1.6: Effect of Football Success on Male and Female Applicants

Variables	Log Male Applications			Log Female Applications		
	All	Public	Private	All	Public	Private
FootballChampion	.056**	.043	.179	.054*	.041	.224
	(.028)	(.031)	(.290)	(.030)	(.034)	(.287)
FootballChampion Lag 1	.062*	.037	.108	.079***	.062	.078
	(.035)	(.038)	(.229)	(.029)	(.038)	(.227)
FootballChampion Lag 2	.036	.013	.239	.070	.055	.248
	(.043)	(.048)	(.178)	(.056)	(.068)	(.176)
Aptop10	-.015	-.015	-.043	-.029	-.032	-.053
	(.019)	(.022)	(.057)	(.019)	(.022)	(.057)
Aptop10 Lag 1	-.021	-.027	.023	-.010	-.020	.035
	(.016)	(.019)	(.061)	(.017)	(.020)	(.060)
Aptop10 Lag 2	-.007	-.005	-.042	.002	.001	-.008
	(.014)	(.016)	(.061)	(.014)	(.015)	(.060)
Aptop25	.051***	.044***	.060*	.041***	.039***	.037
	(.012)	(.013)	(.037)	(.012)	(.013)	(.037)
Aptop25 Lag 1	.033***	.034***	.028	.019*	.026**	-.006
	(.011)	(.012)	(.038)	(.011)	(.012)	(.038)
Aptop25 Lag 2	.028**	.026**	.046	.022*	.025**	.017
	(.012)	(.014)	(.040)	(.011)	(.012)	(.040)
N	3926	2548	1378	3926	2548	1378

Note: Values are rounded 3 decimal places. Robust standard errors are presented in parentheses. All models contain university controls, state controls, and fixed effects. (*** = 1% level of significance, ** = 5% level of significance, and * = 10% level of significance)

CHAPTER II

THE IMPACT OF PERFORMANCE AND REVENUE ON UNIVERSITY SUBSIDIES: AN ANALYSIS OF DIVISION I ATHLETICS

1 Introduction

In 2012, of 228 public school athletic departments at the NCAA (National Collegiate Athletic Association) Division I level, only 23 generated enough revenue to cover their expenses. Some of the most successful programs achieve their status on the backbone of a strong football program. There is not a clear path to becoming one of the elite programs, however.[1] In an analysis published by The Huffington Post, out of 201 public universities observed from 2010 to 2014, roughly 65% of these universities received more than 50% of their total financing from student fees and institutional support.[2] It is evident from the figures presented that self-sufficient athletic programs are not all that common.

Universities have a very important decision to make regarding funding for football programs. Football programs can be viewed either as an investment for the university or as an additional resource for students, similar to a university gym or

[1]These figures come from a publication by USA Today titled "Most NCAA Division I athletic departments take subsidies" published on May 7th, 2013.
[2]Detailed revenue data was obtained by the Huffington Post and shared with the public. The summary of the data can be accessed at [http://projects.huffingtonpost.com/projects/ncaa/subsidy-scorecards]

recreation area. If universities view football programs as investments, then it must be the case that there are significant returns to be gained in the long run. Furthermore, universities face an important decision on how to react to increased athletic success. There are two primary scenarios that may occur. Universities will either reduce subsidies as performance increases and increased revenue from other sources reduces the need for subsidies, or universities will increase subsidies as performance increases to facilitate further growth in their initial investment.

Prior work has looked to capture how various measures of athletic performance, typically in the sports of basketball and football, have affected the number of applicants and quality of students at a given university. The results of Pope and Pope (2009) suggest that suggest that successful programs receive a higher number of applications which allows them to increase enrollment and student quality by being more selective. These types of benefits can be viewed as external benefits to successful football programs. This paper looks to analyze more direct benefits of athletic success, namely revenue from ticket sales and licensing rights, as well as how the university subsidy changes as a result of performance. An important outcome is to find out how university behavior may change over time as a result of athletic performance and other changes in the market.

The key results of this analysis indicate that ticket sale revenues increase by around 1.2% for each additional football win in a prior season for all Division I programs. This effect is found to persist over time. For rights revenue, conference champions are found to generate the most significant increases in revenue, ranging from 3 to 7%, which would correspond to an increase between $500,000 and two million dollars. The key findings, however, suggest that top performing Power 5 programs

decrease university subsidies by roughly 50%, which corresponds to an estimated two million dollar decrease in university subsidies. There are no significant effects found for non-Power 5 programs in regard to subsidies, which suggests that football success does not reduce the financial burden on a university in these conferences. Results also suggest that non-Power 5 conferences have responded to rights revenue increases in Power 5 schools by increasing university subsidies. An average increase of one million dollars in advertising revenue for Power 5 conferences results in increased subsidies ranging from $300,000 to 500,000 depending on the model specifications.

Section 2 of the paper outlines the key literature and more background information on the impact of athletic success and how university subsidies change over time. Section 3 describes the data used in this analysis. Section 4 describes the empirical strategy used to identify the effects of athletic performance on revenues and subsidies. Section 5 presents the key results from the model. Section 6 presents alternate model specifications to provide a clearer understanding of the observed relationships. Section 7 concludes the study.

2 Literature Review

Prior research on the effects of athletic performance have looked at how increased football or basketball success has affected incoming student applications, student quality, and enrollment. McCormick and Tinsley (1987) utilized SAT scores and application numbers to estimate the effects of an increase in athletic performance. However, their analysis was limited due to a relatively small sample of observations. Pope and Pope

(2009) improved on prior work by utilizing panel data and looking at over 300 universities. Pope and Pope estimate that having a top 20 football program results in an increase in student applications of 2% to 8%. Similarly, they find comparable estimates for top 16 basketball programs. Furthermore, they find that due to these increased applications of varying student quality, there are signs that universities are able to be more selective which results in an increase in student quality. Mixon and Trevino (2005) find that athletic program success has a positive impact on freshman retention and graduation rates. Mulholland, Tomic, and Sholander (2012) find that football success increases the institution's peer assessment score according to US News and World Report data. This finding suggests that successful athletic programs can lead to a perceived higher quality for a university as judged by its peers. These non-monetary gains from athletic performance can be viewed as indirect benefits. The athletic department has more direct financial goals, but these additional benefits may play a key role in explaining why so many universities continue to invest into athletics.

Matheson, O'Connor, and Herberger (2012) examined the profitability of various Division I athletic programs. Athletic departments in the Bowl Championship Series were found to be highly profitable, while fewer than 10% of football and 15% of men's basketball programs earned positive profits at programs that compete in non-Division I conferences. Hoffer et al. (2015) analyzed the "arms race" of Division I programs and found that athletic departments react to the decisions made by competing departments. For example, highly profitable departments could substantially increase coaching salaries as a way to increase expenses for their competitors. This behavior highly favors the most profitable programs as they are able to force their peers into costly decisions.

Hoffer and Pincin (2016) looked at how athletic department revenue changes impact total expenditures, distribution of funding, and how it affects the subsidy paid out to athletic departments. They find that additional athletic revenue resulted in a 7.5 times larger increase in coaches' salaries than direct student-athlete expenditures. Furthermore, a $1 increase in ticket sale revenue results in an 83 cent rise in total expenditure and a 19 cent decrease in athletic subsidy. Results were found to be larger for schools in Power conferences. Hoffer and Pincin (2014) studied the impact of conference realignment on the revenue and expenses for athletic departments. They found that schools that moved into automatic-qualifying conferences experienced revenue increase of around $12.15 million and expenditure increases of $10.12 million. When moving into any Division I conference, the results were around half of the size of the automatic-qualifying conferences. Non-FBS conference moves were not found to be statistically significant. Jones (2013) finds that athletic expenditure is strongly correlated with team on-field performance for teams competing in the Football Bowl Subdivision (FBS), but not with programs that compete at the Football Championship Subdivision (FCS) or any lower divisions.

This paper adds to the literature by looking at how performance impacts athletic revenue directly. These estimates, combined with prior research on external gains from athletic performance, will give a clearer picture of the true size of the benefits associated with athletic performance. Furthermore, this paper sheds light on the investment decision that universities must make in regard to athletic programs. The results of the models in this paper show how the university subsidy to athletic performance changes over time based on athletic performance. Under certain specifications, there are suggestions that

universities treat subsidies as possible substitutes for rights and licensing revenue, which has not been noted in prior work.

3 Data

The data collected for this study come primarily from two sources. Information regarding university revenue is collected from USA Today's public records requests to each university that can be publicly accessed.[3] Revenue data is available for 230 universities. It is important to note that since the data was obtained through public records requests, there will not be any private universities in the sample. Omission of private universities may not be a significant limitation, since the focus of this paper is on university subsidies. Private universities may have significantly different revenue structures. Private universities generally charge much higher tuition rates and enroll fewer students.

The data regarding sports performance was collected from Sports Reference.[4] To measure football success, wins per season will be used to find marginal effects for small changes in performance. However, since one additional win may not have a significant effect on a team's end of season ranking, dummy variables for end of season rankings are used to differentiate teams that will receive more media attention. The Associated Press (AP) rankings are commonly cited when measuring college athletic standings. The end of

[3] USA Today makes all of their collected data available to the public. If you wish to access the data, you can do so at [http://sports.usatoday.com/ncaa/finances/||http://sports.usatoday.com/ncaa/finances/].
[4] For more information on Sports Reference data, visit their website at [https://www.sports-reference.com/cfb/||https://www.sports-reference.com/cfb/]

season AP Poll rankings present the top 25 performing college teams. The team ranked first in the poll is regarded as the best team for that season.

This paper focuses on Division I football performance since it is the sport that generates the most revenue at the Division I level. There are ten Division I football conferences as of 2018. The top 5 conferences, commonly referred to as the Power 5, are made up of the SEC, ACC, Big Ten, Big 12, and Pac 12. These conferences tend to generate much more revenue than the remaining 5 conferences: MAC, WAC, MWC, Sun Belt, and CUSA.[5] Figure 1 shows how the average ticket sale revenue, rights and licensing revenue, and university subsidy have changed over an 11-year period. While ticket sale revenue is substantially higher for Power 5 conferences, the trend over time is not much different between the two groups. For rights revenue, which includes any advertising revenue as well as any licensing fees earned, there is a clear difference in the trend between the two groups. The Power 5 conferences have generated substantially more revenue in recent years due to significant television broadcasting contracts such as the two billion-dollar, 15-year deal with ESPN signed by the Southeastern Conference (SEC) in 2008.[6] Unlike the two revenue graphs, the subsidy graph relationship is reversed. For university subsidies, the non-Power 5 athletic programs are receiving more than double the amount from their university on average as compared to the Power 5 programs. Furthermore, the trends indicate that this difference may continue to rise. This figure indicates that it may be the case that non-Power 5 programs are utilizing subsidies as a way to mitigate the difference in rights revenue between the two groups.

[5]A full list of the schools in the sample can be found in Figure 2 of the Appendix
[6] More information on the contract can be found at [http://www.espn.com/college-sports/news/story?id=3553033||http://www.espn.com/college-sports/news/story?id=3553033].

For Division I football, AP rankings will be the key measure of performance. Additionally, conference champion will be used as a measure of success to account for any additional press that is received for winning a given conference. This additional media coverage comes with the higher viewership associated with the conference championship games for each conference. The Power 5 Conferences, garner much higher fan bases due to the higher investment and recruitment associated with the teams in these conferences. Ticket sales measures will include money received from the public, as well as faculty and student for game attendance. University subsidies include money received from student fees that are incorporated in tuition costs, as well as direct and indirect funds from the university or state. More details regarding the key variables used in this analysis are provided in Table 2.1. The key variables for this paper will be measures of football performance.

Table 2.2 presents the summary statistics of the key variables used in the models of this paper. Notable distinctions between Power 5 schools and the total sample can be found in most variables. Power 5 programs have nearly double the average revenue from ticket sales and rights compared to the overall example. In regard to subsidies, Power 5 schools also differ by having half the average compared to the entire sample. Furthermore, it is clear that the Power 5 schools are more prevalent in the top measure of basketball and football performance. Table 2.3 compares subsidy levels for teams that finished the prior season in the top 25 versus those that finished unranked. If means for all Division 1 schools are compared, there is a statistically significant smaller subsidy that is noted for the ranked programs. If Power 5 schools are treated as a separate sample,

there is still evidence that higher performing teams lower their subsidies, but the difference between the groups is smaller and less significant.

4 Empirical Strategy

Athletic programs differ greatly between divisions and conferences. For this reason, the main models of this analysis will focus strictly on Division I-A football schools that compete in the Football Bowl Subdivision. Football tends to be the most expensive sport for most universities, due to large capital investments for stadiums and training facilities. Furthermore, football teams consist of many more players than the second leading sport, basketball. This typically results in more money being spent on coaching due to a need for many more position coaches in football. Since this paper is looking at university subsidies, the group of Division I programs is the most ideal sample to analyze.

The next difference that must be addressed is within the programs at the Division I level. The Power 5 conferences receive significantly more funding and generate more revenue, mainly due to significant broadcasting contracts and other commercial partnerships that they secure. For this reason, the first model that will compare the varying conferences to determine how significant the revenue and subsidy differences between the Power 5 and non-Power 5 groups are. The first model is a random effects model specified as follows:

$$Y_{it} = \delta + \lambda_t + \alpha_c + \beta_1 P_{it} + \beta_2 P_{it-1} + \varepsilon_{it}, \quad (1)$$

where Y_{it} denotes the outcome of interest for each university *i* during year *t*. In each case the log of the outcome variable is used. These three outcomes will provide an estimate of how much the conferences differ. The variable δ is the average effect between all universities and λ_t indicates year fixed effects. To identify differences between conferences, dummy variables, α_c , are included for nine conferences. The Mid-American Conference (MAC) is chosen as the omitted group due to the inclusion of a constant in this specification, so all results for conferences are to be interpreted as the difference from the omitted group. The MAC is notably not one of the Power 5 conferences, so the estimates on the Power 5 conferences should be larger than the remaining four conferences if there is indeed a difference between the two groups. P_{it} are performance measures which include the winning percentage in a football season, a dummy variable for the conference champion, and two further dummy variables for placing in the AP top 25 and AP top 10. It is important to note that the timing of the performance measures will be from the season that concludes in a given year. For example, football wins in 2004 will identify the total wins from the 2003-2004 season. Furthermore, an additional lag of each performance variable is included to capture any delayed or prolonged effects.

The next model accounts more precisely for variation between conferences over time. The model can be specified as follows:

$$Y_{it} = \delta_i + \alpha_{ct} + \beta_1 P_{it} + \beta_2 P_{it-1} + \varepsilon_{it}, \quad (2)$$

where the outcome variables, Y_{it}, will remain the same as in the first model. To further control for any differences between universities, δ_i will be included for each university *i*. Conference-year fixed effects, α_{ct}, are included to better control for annual differences

that may differ between conferences. Performance measures, P_{it}, as well as lags of these measures, are the key explanatory variables for this model. An alternative way to observe differences between Power 5 conferences and other Division 1 conferences is to include interaction terms while utilizing the entire Division 1 sample. To estimate this alternative specification, an interaction term between performance measures and Power 5 conference indicator will be added to equation 2. The coefficients on the interaction terms will capture any noticeable difference between Power 5 schools and non-Power 5 schools for any specific performance indicator.

5 Results

5.1 Conference Comparison

Table 2.4 presents the results of the random effects model of football performance on ticket revenue, rights and licensing revenue, and university subsidy amount. The primary purpose of this set of specifications is to allow comparisons between conference groups. The estimates for conference effects are all to be interpreted in comparison to the omitted group. The Power 5 conferences (ACC, SEC, Pac 12, Big 12, and Big Ten) have nearly double the estimates when looking at the log of ticket sales as an outcome. When looking at the effect on rights and licensing, there is more than double the effect for the top conferences than 3 of the 4 other Division I conferences. In regard to the subsidies, the table shows that the Power 5 conferences have a much more negative and significant effect on the size of the university subsidies.

Combining the three results together, it is fairly clear that there is indeed a noticeable difference between the Power 5 conferences and the remaining Division I programs. In regard to performance measures, the model does estimate a positive effect of over 1% for an additional football win on the ticket revenue. A 6% increase in revenue from rights and licensing is estimated as a result of being a conference champion the previous year. When looking at university subsidies, there is an estimated decrease of around 30% associated with conference champions and top 10 teams. This effect is only found to be significant with a one-year delay. The rights revenue increase for conference champions takes place immediately following a winning season, but the subsidy is delayed an additional year. This is likely because the athletic department must take time to adjust their required subsidy based on increased revenue from other sources.

5.2 Performance Impacts

Table 2.5 presents the results from the second model. The fixed effect model specification allows for a more accurate analysis of the performance effects on the outcome variables. Fixed effects for the university as well as conference by year dummies for unobservable differences between the conferences and universities are included in the model. The first three columns of results include all of the Division I programs in the same model. The estimated coefficient that is observed for football win percentage is the estimate for an increase from no wins to all wins. For easier interpretation this figure is divided by 12 as that is the typical number of games played in a given season. In this specification, after transforming the coefficient on football win

percentage to account for one additional win, a significant increase in ticket sales for an additional football win of around 1.3 to 1.5% is estimated. In regard to rights and licensing revenue, a similar increase in revenue of 1.5% is estimated for an additional win, while the conference champion receives a boost in rights and licensing revenue of 6.2% in the following year. For subsidies, there is a significant positive effect associated with being a top 25 team in a given season of around 56%. This finding may suggest that universities will financially support programs that are able to show significant signs of improvement. However, football conference champions are found to have a delayed effect of reducing the university subsidy by roughly 25%. The likely reason for this large reduction in subsidy being limited only to conference champions could be explained by the large increase in rights and licensing revenue that is received by these teams.

These two findings seem to contradict each other, but the true story may become clearer when the sample is split into Power 5 and non-Power 5 schools. For Power 5 schools, there are similar results found for football performance on ticket sale revenue. Revenue from rights and licensing is found to be more responsive to performance measures than is the case for the entire sample. Additional football wins are estimated to increase rights revenue by around 1.5%, while conference champions and teams in the AP top 25 are estimated to increase rights revenue by 3.1 and 2.4% respectively. A much larger negative effect on university subsidies, around 50%, is estimated for Power 5 schools. Top 25 teams are still found to have a significant positive effect on subsidies of around 70% when the sample is limited to just Power 5 schools. When looking at just the non-Power 5 conferences, similar effects are found on ticket sale revenue and rights revenue. However, there are no significant effects found for performance measures on

university subsidies. These subsample models provide a clearer picture of what is likely occurring for university subsidies. For the Power 5 conferences, where teams earn noticeably more revenue from television rights contracts, the conference champions in a given year are able to reduce their university subsidies substantially. Due to high levels of competition, however, teams that are in the top 25, but not conference champions may look to increase subsidies to keep up with the top performing teams. The replacement of subsidies by the increased rights revenue is a possible cause for subsidy decrease at the top performing programs. For non-Power 5 conferences, the rights and licensing revenue is significantly lower, around 23 million dollars on average. Therefore, even though findings show that non-Power 5 conference champions see significant increases of around 7% in rights revenue, this increase is just not large enough to replace the need for subsidies.

Table 2.6 presents the results of the model specification with interaction terms included for Power 5 teams at each performance level. For ticket sales revenue, the estimated effects for an additional football win are very similar to those found in Table 2.5. There is an estimate increase in ticket sale revenue of around 1.3% for each additional win. This result for Power 5 conferences is not found to be statistically different from non-Power 5 conferences. For rights and licensing revenue, there is an estimated increase of 1.6% for each additional win and an increase of 7.7% for the conference champion. Once again, there are no significant differences found between Power 5 and non-Power 5 conferences. For university subsidies, there is a notable difference found which may support the intuition that rights revenue is the key source of funding that reduces the university subsidies. An estimated reduction of university

subsidy of around 15% is found to occur only for Power 5 conference champions. The delayed timing of the subsidy decrease supports the idea that Power 5 conference champions are able to take the increased rights revenue that occurs immediately following a successful season and utilize it in reducing the university subsidy the following year. There is also an estimated increase in subsidy associated with Power 5 teams that finish in the top 25. It may be the case that a top 25 finish is not necessarily viewed as a success for some teams in these conferences.

5.3 Subsidies as Substitutes for Rights and Licensing Revenue

Finally, it is useful to capture the relationship that is shown in Figure 2 with a model. While rights and licensing revenue has been rising since 2009 for Power 5 conferences, the subsidies for non-Power 5 conferences have followed a similar growing trend in the matching period. The first impression of the trends suggest that it may be the case that non-Power 5 conferences are using higher university subsidies to keep up with the rights and licensing revenue increases. In a way, the university subsidies are acting as a substitute for rights and licensing revenue. To capture this effect, model 2 is altered so that performance indicators are replaced with the average observed rights and licensing revenue from Power 5 conferences in the prior year. The equation may be written as:

$$Y_{it} = \delta_i + \alpha_{ct} + \beta_1 ObservedRights_t * non - Power5_i + \varepsilon_{it}, \quad (3)$$

where $ObservedRights_t$ indicate the average rights and licensing revenue for Power 5 conference teams in a given year. The observed revenue is then interacted with an indicator for non-Power 5 conference programs.

Table 2.7 presents the results of three different fixed effect specifications for both log and level values for subsidies. The estimate for the coefficient of interest is highly significant in each case. An increase of one million dollars in observed rights and licensing revenue results in an estimated increase in university subsidies ranging from $300,000 to 500,000 for non-Power 5 conferences. These estimates suggest that non-Power 5 conferences are indeed increasing subsidies as a response to the large increases in rights and licensing revenue from Power 5 conferences.

6 Alternate Specifications

6.1 Level Revenue

While the natural log of all outcome variables may be preferred to mitigate the differences in scale of athletic programs, the same model could be used with level revenue figures. Table 2.8 depicts the results with level revenue figures used for all outcome variables. Revenue figures are in millions of dollars. For ticket sales, coefficients imply that a 100% increase in winning percentage results in around $789,000 of increased ticket sale revenue. To make this figure more interpretable, we can divide the coefficient by the average number of games in a football season to find that an additional win increases ticket sale revenue by roughly $65,000. This estimate is similar

to the findings in the previous models with natural logs. Power 5 programs see significantly larger ticket sale revenue increases of around $200,000 per win. Rights revenue has similar estimates for win percentage, with Power 5 programs again having larger gains for an additional win. The effect for conference champions is estimated to be a $500,000 increase in the season following a championship. This estimate is not found to be statistically different amongst the Division I programs.

An interesting finding in the university subsidy model results indicates that non-Power 5 programs respond differently to Power 5 programs for football success. A non-Power 5 team that is ranked among the top 10 football programs at the end of the year is estimated to increase the university subsidy by over $1,000,000. Power 5 programs, on the other hand, are estimated to have a negative effect of a similar magnitude for the same achievement. Once again, this could imply that universities at non-Power 5 conferences look to reinforce their investment in the athletic department if sufficient progress is observed.

6.2 Newly Ranked Versus Consistently Ranked Programs

Further analysis on the positive coefficient estimate for AP Top 25 rank on university subsidies may help explain the relationship. Initially, this positive relationship seems to be difficult to explain. My initial hypothesis is that this increase in subsidies would be coming from programs that may not view a low-end top 25 ranking as their goal. For example, a consistently ranked teams that typically finishes a campaign among the top ten may view a rank of 20 as a disappointing result. To capture this relationship,

conditional mean comparisons of the difference between revenue and subsidies from the prior year between newly ranked teams and teams that remain ranked are presented in Table 2.9. For both ticket sale revenue and rights and licensing revenue there is no significant difference found between the groups. A newly ranked program obtains similar benefits as team that was ranked the previous year. However, when looking at the university subsidies, there is a highly significant difference between the groups. Over the entire sample, teams that remain ranked increase subsidies by around eight percent, while newly ranked teams decrease subsidies by roughly three percent.

Table 2.10 presents the results of primary model with an additional interaction term identifying newly ranked programs. The results for ticket sale revenue and rights and licensing revenue are not found to differ between the groups, which is expected based on the conditional mean comparisons. For subsidies, the newly ranked team results are similar to the top performing teams found in prior specifications. Newly ranked teams reduce subsidies after an additional season has passed. Similar to the top performing teams, this delayed timing is likely due to the need to incorporate new revenues before altering the university subsidy. The teams that remain ranked appear to be driving the increased subsidies, which supports the idea that consistently ranked teams may view low rank placements as downgrades in performance.

6.3 Impact of Basketball at Division I Programs

The results presented in the previous section focus solely on football performance for Division I athletic programs. It may be the case that basketball performance has an

impact on the outcome variables. To address this concern, model 2 above was edited to incorporate basketball performance alongside football performance for Division I football schools. College basketball is heavily centered around the NCAA tournament that takes place at the very end of the season. Unlike football, where the end of season AP poll gives an accurate measure of performance for top teams, advancement in the NCAA tournament is the primary indicator for a successful season in college basketball. Therefore, dummy variables are included to capture qualification for the tournament, advancement to the round of 32, and advancement for the round of 16. No further variables are included since only a small number of programs in the sample advance to the late stages of the competition.

Results for this model specification can be found in Table 2.11. These results can best be compared to the first three columns of results in Table 2.5. For football performance, the results from Table 2.11 line up very closely to those found in Table 5. Additional football wins are once again found to significantly increase ticket revenue in ensuing seasons by around 1.2 to 1.4%. Football conference champions also retain a similar increase in rights and licensing revenue of around 5.8%. Furthermore, the effects on subsidies are also found to coincide with the findings in Table 2.4, where conference champions have a delayed reduction in subsidies and top 25 football programs increase subsidies. While advancement to the round of 16 in the NCAA basketball tournament does have an estimated positive effect on ticket revenue, the exclusion of basketball performance in the key model seems doesn't change the coefficient estimates in Table 2.5.

6.4 Examining Non-Division I Programs

To provide a more complete analysis of the effects of athletic performance on revenues and subsidies, it may be useful to look at how non-Division I athletic programs may differ from Division I programs. One key difference that must accounted for is the lesser impact of football among the non-Division I programs. For many of these lower ranked programs, basketball is the driving sport. Some of the non-Division I universities choose not to provide a football program at all. For this reason, basketball performance will once again be included in the analysis.

Results for the athletic performance model for non-Division I programs can be found in Table 2.12. After a quick glance at the football performance measures, it can be seen that football winning percentage for lower ranked programs has a slightly larger effect on ticket sales than Division I programs, around 3% for an additional win compared to 1.2% found in Table 2.5. Unlike the previous results, football conference champions are not found to have an effect on rights revenue, while additional wins do increase the revenue received. In regard to university subsidies, an additional win is estimated to increase the university subsidy by around 3%. This effect is found to persist over time. This may suggest that universities with football programs at lower ranked divisions reinforce their initial investments as they observe improvements.

When looking at the inclusion of basketball performance, there are some notable estimates found. First, there is a significant positive impact on ticket revenue of around 15% that is associated with qualifying for the NCAA basketball tournament. This is not all that surprising, since basketball attendance is typically lower than football attendance

and sellout games are highly uncommon. A smaller effect of 9.6% is found for NCAA tournament qualification on rights and licensing revenue. However, no significant effect is estimated for any basketball performance measure with respect to university subsidies.

7 Discussion of Results

There is not a clear understanding of the total benefits associated with an athletic program. Results presented in this paper have noted that there are revenue gains in ticket sales and rights and licensing as a result of increased performance. The rising subsidies for the teams at non-Power 5 programs do not seem to be supported by increased revenues from ticket sales of rights and licensing However, there are indications in prior studies that the benefits of athletic success may not all be direct revenue. If the universities with Division I football programs are acting rationally, then it must be the case that the gains from having a competitive athletic program, either in the present or for future seasons, must exceed the cost of the additional subsidies. For teams in the non-Power 5 conferences, it may be the case that the universities are investing more heavily into their programs with the hope of obtaining an invitation to a Power 5 conferences. Hoffer and Pincin (2015) note that there are gains in excess of ten million dollars in revenue for universities that enter into one of the top conferences.

Mulholland et al. (2012) discuss the role of football performance on a university's US News peer assessment score. With peer assessment scores accounting for nearly one quarter of the US News rank, increasing this score through athletic performance could be a target for some universities. Furthermore, Pope and Pope's (2009) findings of increased

applications to a university based on basketball and football performance may also highlight more of the indirect benefits of athletic performance. Increased applications allow universities to be more selective and also to increase tuition rates and total enrollment. This increase in student quality will not appear in any revenue category, but it may affect the university's ranking in later years. The complicated relationship between athletic departments and the university make it difficult to pinpoint the exact cost and benefit associated with athletics. Nevertheless, it is reasonable to assume that universities take into consideration all of these components when making decisions about athletic department funding.

8 Conclusion

Rising tuition costs continue to become a problem facing millions of students across the United States. For some universities, a portion of the rise in tuition can be attributed to the rise in subsidies paid out of athletic programs. With only around 10% of athletic programs at the Division I level earning a profit in 2012 according to USA Today, there are still a very large majority of around 200 universities that rely on funding taken from student fees or directly from the university. The trend in subsidies appears to be on the rise, particularly for universities that are not competing in the Power 5 conferences. Increasing revenue from television contracts for Power 5 contracts places additional pressure on non-Power 5 programs to borrow even more from the university to remain competitive and perhaps become a member of one of these elite conferences.

Using data on athletic revenues and university subsidies obtained by USA Today via public records requests, this paper estimated the impact that athletic performance may have on these sources of revenue. Ticket sales and rights revenue were found to increase for all Division I programs as athletic performance increased. Ticket sales were estimated to rise by roughly 1.5% for each additional football win. Rights revenue was found to rise by 3 to 7% for conference champions at all Division I programs and around 0.7% each additional football win among the Power 5 conference programs. University subsidies are estimated to decrease substantially, roughly 50%, for the conference champions at Power 5 conferences. However, no significant impact on university subsidies was found for programs that belong to non-Power 5 Division I conferences. Estimate suggest that non-Power 5 conferences raise university subsidies as a response to increasing rights and licensing revenues at the Power 5 conferences. An average increase of one million dollars in licensing revenue for Power 5 conferences results in increased subsidies ranging from $300,000 to 500,000 in the following year depending on the model specifications.

Additional models on programs that do not compete in football at the Division I level suggest that university subsidies rise as football performance improves. This may suggest that universities look to support programs that show signs of improvement at lower levels. Basketball success was estimated to increase ticket sale revenue more significantly than football success at programs that do not compete in Division I football. Tickets sale revenue was estimated to rise around 15 to 20% for teams that qualified for the NCAA basketball tournament in a prior year. For Division I programs, basketball was much less impactful on all revenue sources, which supports the decision to omit basketball from the key model.

Overall, the findings help to explain why so few programs are found to be self-sufficient. Only the most elite programs are able to generate enough revenue from other sources, particularly from rights and licensing, to be able to compete without relying on subsidies. The non-Power 5 programs continue to rely on subsidies as a way to minimize the gap in total revenue that large increases in rights revenue have created between programs in the Power 5 conference and themselves. There is no suggestion that this pattern will change in the coming future as rights and licensing revenues continue to rise.

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APPENDIX B: CHAPTER II TABLES

Table 2.1: Variable Description

Variable	Description
Ticket Sales	Sales of admissions to athletics events. Include ticket sales to the public, faculty and students, and money received for shipping and handling of tickets. Does not include amounts in excess of face value (such as for preferential seating)
Rights/Licensing	Includes revenue for athletics from radio and television broadcasts, Internet and e-commerce rights received from institution-negotiated contracts, the NCAA and conference revenue-sharing arrangements; and revenue from corporate sponsorships, licensing, sales of advertisements, trademarks and royalties. Includes the value of in-kind products and services provided as part of a corporate sponsorship (e.g., equipment, apparel, soft drinks, water and isotonic products). Also includes revenue from food, concessions and parking.
Student Fees	Fees assessed to support athletics
School Funds	Includes both direct and indirect support from the university, including state funds, tuition, tuition waivers etc., as well as federal Work Study amounts for student workers employed by athletics department. It also includes the value of university-provided support such as administrative services, facilities and grounds maintenance, security, risk management, utilities, depreciation and debt service that is not charged to the athletics department
FootballWins	Total wins by a football program in a given season
AP Top 25	Dummy variable that identifies programs that were ranked among the top 25 teams at the conclusion of a football season
AP Top 10	Dummy variable that identifies programs that were ranked among the top 10 teams at the conclusion of a football season

Note: Description of variables and data are compiled and reported by USA Today. Credit to Steve Berkowitz and Christopher Schnaars of USA TODAY; Peter Benson, Jared Bomba, Amanda Caffey, Sam Fortier, Charles (CB) Garrett, Andrew Graham, Billy Heyen, Tara Lanigan, Matt Liberman, Michael McCleary, Kent Paisley, Adam Regenstrief, Rebecca Thornburg, Jodi Upton, Kevin Van Pelt, Matthew Wieselthier of Syracuse University's S.I. Newhouse School of Public Communications.

Table 2.2: Summary Statistics

Variables	All Schools				Division 1 Schools				Power 5 Schools			
	Mean	Std. Dev	Min	Max	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
TicketSales	7.713	11.055	.052	64.645	12.574	12.267	.131	64.645	22.131	10.752	5.389	64.655
Rights/Licensing	10.099	13.263	.034	62.860	16.447	14.214	.761	62.860	27.194	28.352	8.704	62.860
Subsidies	9.637	6.377	0	48.015	9.976	7.176	0	48.015	5.007	4.437	0	36.401
Football Win Percent	.493	.233	0	1	.513	.225	0	1	.576	.205	0	1
Conference Champion	.11	.32	0	1	.11	.32	0	1	.10	.30	0	1
AP top 25	.09	.29	0	1	.21	.40	0	1	.35	.48	0	1
AP top 10	.039	.194	0	1	.083	.277	0	1	.146	.353	0	1
NCAA Tournament	.21	.40	0	1	.32	.47	0	1	.45	.50	0	1
Round 32	.10	.30	0	1	.19	.39	0	1	.31	.46	0	1
Round 16	.05	.22	0	1	.10	.31	0	1	.17	.37	0	1
N	1859				1091				577			

Note: All variables are rounded 2 decimal places. Data on ticket sales, rights revenue, and subsidies are obtained from public records requests from USA Today. All dollar values are in millions of dollars and adjusted for inflation

Table 2.3: Subsidy Comparisons Between Ranked and Unranked Teams

	Division 1			Power 5		
Year	Unranked	ApTop25	Difference	Unranked	ApTop25	Difference
2005	8.292	5.266	3.026**	5.005	4.909	0.096
2006	9.475	3.728	5.757***	6.807	3.728	3.079**
2007	9.255	6.389	2.866**	5.892	6.146	-0.254
2008	10.078	5.312	4.766***	6.367	5.057	1.310
2009	9.373	4.530	4.843***	6.134	4.136	1.998*
2010	11.180	5.421	5.758***	7.162	4.082	3.079**
2011	11.637	5.523	6.114***	7.457	4.043	3.415**
2012	12.386	5.868	6.518***	7.241	4.504	2.736*
2013	13.029	5.683	7.346***	5.635	2.910	2.725**
2014	13.059	5.109	7.949***	5.995	4.122	1.873*
2015	13.406	6.757	6.648***	4.724	5.570	-0.846
N		107			53	

Note: All variables are rounded 2 decimal places. Data on ticket sales, rights revenue, and subsidies are obtained from public records requests from USA Today. All dollar values are in millions of dollars and are adjusted for inflation.

Table 2.4: Effect of Football Performance on Revenues and Subsidies (Conference Comparison)

Variables	Division 1 Schools		
	LogTickets	LogRights	LogSubsidies
FootballWinPct	.156*** (.049)	.155*** (.046)	.015 (.342)
FootballWinPct Lag	.191*** (.048)	.088** (.045)	.298 (.331)
ConferenceChamp	.036 (.026)	.065*** (.025)	-.043 (.183)
ConferenceChamp Lag	.008 (.026)	-.001 (.024)	-.282* (.181)
APtop10	-.013 (.034)	.036 (.032)	.267 (.234)
APtop10 Lag	.017 (.034)	.029 (.032)	-.444* (.235)
APtop25	-.008 (.026)	.019 (.025)	.261 (.185)
APtop25 Lag	-.005 (.027)	-.005 (.025)	.258 (.186)
ACC	2.508*** (.176)	2.098*** (.115)	-2.117** (.990)
SEC	2.794*** (.167)	2.368*** (.106)	-3.65*** (.927)
Pac 12	2.191*** (.166)	1.986*** (.107)	-1.323 (.926)
Big 12	2.623*** (.157)	2.274*** (.099)	-2.946*** (.863)
Big Ten	2.673*** (.165)	2.365*** (.105)	-3.355*** (.916)
CUSA	1.375*** (.155)	.856*** (.097)	-.633 (.852)
MWC	1.284*** (.161)	.933*** (.102)	-.700 (.889)
American	1.694*** (.161)	1.272*** (.106)	-.694 (.905)
Sunbelt	.954*** (.158)	.342 (.099)	-.840 (.865)
N	1091	1091	1091

Note: Values are rounded 3 decimal places. Robust standard errors are presented in parentheses. The omitted conference is the Mid-American Conference (MAC). All models contain year fixed effects. (*** = 1% level of significance, ** = 5% level of significance, and * = 10% level of significance)

Table 2.5: Effect of Football Performance on Revenues and Subsidies

Variables	Division 1 Schools			Power 5 Schools			Non-Power5 Schools		
	LogTickets	LogRights	LogSubsidies	LogTickets	LogRights	LogSubsidies	LogTickets	LogRights	LogSubsidies
FootballWinPct	.158***	.167***	-.076	.132**	.167**	-.259	.146*	.169***	-.013
	(.057)	(.039)	(.330)	(.055)	(.045)	(.762)	(.088)	(.094)	(.054)
FootballWinPct Lag	.166***	.069*	.236	.169***	.033	.574	.143	.093*	-.058
	.061	(.036)	(.319)	(.051)	(.042)	(.740)	(.093)	(.050)	(.068)
ConferenceChamp	.025	.062***	.024	.010	.055***	.097	.016	.072**	-.005
	(.024)	(.019)	(.177)	(.023)	(.019)	(.344)	(.046)	(.034)	(.039)
ConferenceChamp Lag	.003	-.002	-.313*	-.014	-.012	-.556*	.007	-.017	.048
	(.022)	(.016)	(.174)	(.026)	(.014)	(.332)	(.042)	(.031)	(.043)
APtop10	-.023	.016	.015	-.009	-.013	-.025	-.004	.194*	-.031
	(.023)	(.018)	(.233)	(.023)	(.018)	(.358)	(.059)	(.102)	(.065)
APtop10 Lag	.003	-.002	-.395*	.002	.020	-.416	.106	-.096	-.099
	(.026)	(.021)	(.232)	(.025)	(.022)	(.358)	(.091)	(.081)	(.074)
APtop25	-.016	.007	.458**	-.027	.015	.576**	.102	-.037	.008
	(.022)	(.016)	(.180)	(.021)	(.015)	(.298)	(.080)	(.075)	(.055)
APtop25 Lag	-.004	.009	.448**	-.006	-.008	.449	.037	.068	-.007
	(.022)	(.018)	(.182)	(.021)	(.019)	(.301)	(.069)	(.047)	(.055)
N	1091	1091	1091	577	577	577	514	514	514

Note: Values are rounded 3 decimal places. Robust standard errors are in parentheses. All models contain conference/year fixed effects and university fixed effects. (*** = 1% level of significance, ** = 5% level of significance, and * = 10% level of significance)

Table 2.6: Effect of Football Performance on Revenues and Subsidies with Power 5 Interaction Terms

Variables	Division 1 Schools		
	LogTickets	LogRights	LogSubsidies
FootballWinPct	.171** (.084)	.180*** (.057)	.000 (.406)
FootballWinPct Lag	.146* (.084)	.052 (.050)	-.025 (.066)
ConferenceChamp	.013 (.040)	.077** (.031)	-.004 (.039)
ConferenceChamp Lag	-.009 (.037)	-.000 (.028)	.057 (.043)
APtop25	.040 (.063)	-.005 (.054)	-.003 (.053)
APtop25 Lag	.015 (.054)	.056 (.041)	-.019 (.549)
APtop10	-.026 (.061)	.091 (.064)	.004 (.064)
APtop10 Lag	.091 (.068)	-.043 (.051)	-.083 (.081)
Power5FootballWin	-.025 (.099)	-.062 (.077)	-.002 (.170)
Power5FootballWin Lag	.064 (.090)	.032 (.067)	.082 (.133)
Power5ConferenceChamp	.033 (.045)	-.045 (.037)	.096 (.087)
Power5ConferenceChamp Lag	.029 (.043)	-.018 (.033)	-.147* (.085)
Power5APtop25	-.068 (.065)	.025 (.057)	-.034 (.120)
Power5APtop25 Lag	-.033 (.057)	-.057 (.043)	.206** (.100)
Power5 APtop10	.002 (.065)	-.089 (.068)	-.082 (.112)
Power5 APtop10 Lag	-.119 (.072)	.057 (.059)	.001 (.112)
N		1091	

Note: Values are rounded 3 decimal places. All models contain conference/year and university fixed effects. (*** = 1% level of significance, ** = 5% level of significance, and * = 10% level of significance)

Table 2.7: Substitution of Subsidies for Advertising Revenue

	LogSubsidies	Subsidies	LogSubsidies	Subsidies	LogSubsidies	Subsidies
ObservedRevenue*NonPower5	.065***	329,818.9***	.038***	289,170.7***	.046***	485,286.9***
	(.017)	(26612.12)	(.014)	(43829.89)	(.015)	(126303.1)
Year Fixed Effect	X	X	X	X		
Conference Fixed Effects	X	X				
Conference by Year Fixed Effects					X	X
Individual Fixed Effects			X	X	X	X
N				995		

Note: Values are rounded 3 decimal places. Standard errors are presented in parentheses. Level coefficient estimates are in dollar figures. (*** = 1% level of significance, ** = 5% level of significance, and * = 10% level of significance)

Table 28: Effect of Football Performance on Revenues and Subsidies with Level Values

Variables	Division 1 Schools			Power 5 Schools			Non-Power5 Schools		
	Ticket Sales	Rights	Subsidies	Ticket Sales	Rights	Subsidies	Ticket Sales	Rights	Subsidies
FootballWinPct	1.369***	1.506***	-.250	2.826**	3.912***	-.485	.551**	.593**	-.099
	(.447)	(.377)	(.505)	(1.101)	(.767)	(.742)	(.226)	(.227)	(.694)
FootballWinPct Lag	1.328***	.529*	.086	2.628***	1.269	.864	.547**	.255	-.629
	(.379)	(.331)	(.587)	(.968)	(.821)	(.731)	(.239)	(.217)	(.777)
ConferenceChamp	-.028	.624***	-.020	.117	1.114***	.166	-.233	.318**	-.390
	(.228)	(.221)	(.270)	(.449)	(.347)	(.197)	(.146)	(.158)	(.443)
ConferenceChamp Lag	-.367	-.423	.025	-.496	-.575	.188	-.126	-.094	.172
	(.328)	(.267)	(.242)	(.627)	(.368)	(.287)	(.155)	(.163)	(.440)
APtop10	-.299	.418	.150	-.523	-.171	-.010	.272	1.811*	.316
	(.562)	(.432)	(.257)	(.606)	(.484)	(.289)	(.176)	(1.040)	(.886)
APtop10 Lag	.149	.309	-.054	-.014	.454	-.103	.845**	-.1.046	-1.687
	(.573)	(.525)	(.288)	(.598)	(.569)	(.264)	(.402)	(.643)	(.074)
APtop25	-.235	.450*	.053	-.688	-.033	.256	.366	.157	.008
	(.310)	(.278)	(.249)	(.433)	(.352)	(.256)	(.255)	(.421)	(.055)
APtop25 Lag	.189	.195	.273	-.068	-.061	.095	.066	.160	-.007
	(.345)	(.319)	(.328)	(.476)	(.392)	(.374)	(.264)	(.257)	(.055)
N	1091	1091	1091	577	577	577	514	514	514

Note: Values are rounded 3 decimal places. Robust standard errors are in parentheses. All models contain conference/year fixed effects and university fixed effects. (*** = 1% level of significance, ** = 5% level of significance, and * = 10% level of significance)

Table 2.9: Conditional Mean Comparison Between Teams Staying Ranked and Newly Ranked Teams

Variables	Division 1 Schools								
	Ticket Sales			Rights and Licensing			Subsidies		
Year	Remain Ranked	Newly Ranked	Difference	Remain Ranked	Newly Ranked	Difference	Remain Ranked	Newly Ranked	Difference
2006	.031	.039	.008	.069	.111	.042	.089	.177	.087
2007	.159	.170	.011	.062	.280	.218**	.416	.036	-.380*
2008	-.017	.061	.078*	.093	.093	.000	-.073	-.064	.008
2009	.204	.064	-.140**	.034	.020	-.013	-.235	-.189	.045
2010	.053	-.004	-.057	.319	.256	-.058	.290	.238	-.052
2011	.053	-.004	-.057	-.051	.088	.139**	.034	-.065	-.099
2012	.015	.087	.072*	.162	.123	-.039	.024	-.004	-.028
2013	.012	.065	.052	.042	.219	.178*	-.045	-.158	-.113
2014	.001	.028	.027	.029	.181	.152	.284	-.044	-.328*
2015	.047	.004	-.043	.214	.202	-.013	.142	-.035	-.178*
All Years	.042	.030	-.012	.098	.133	-.035	.083	-.033	-.117**

Note: Values are rounded 3 decimal places. Robust standard errors are in parentheses. All models contain conference/year fixed effects and university fixed effects. (*** = 1% level of significance, ** = 5% level of significance, and * = 10% level of significance)

Table 2.10: Effect of Football Performance on Revenues and Subsidies With Previously Unranked Comparison

Variables	Division 1 Schools			Power 5 Schools		
	Ticket Sales	Rights	Subsidies	Ticket Sales	Rights	Subsidies
FootballWinPct	.156***	.165***	.030	.132	.169	.028
	(.058)	(.039)	(.299)	(.057)	(.045)	(.699)
FootballWinPct Lag	.164***	.069*	.272	.168	.034	.588
	(.061)	(.036)	(.288)	(.052)	(.043)	(.673)
ConferenceChamp	.024	.062***	.023	.067	.052	.063
	(.024)	(.019)	(.161)	(.024)	(.020)	(.321)
ConferenceChamp Lag	.002	-.002	-.313**	-.017	-.014	-.629**
	(.022)	(.016)	(.158)	(.027)	(.014)	(.306)
APtop10	-.021	.003	-.199	-009	-.014	-.244
	(.023)	(.018)	(.217)	(.022)	(.019)	(.332)
APtop10 Lag	.004	-.002	-.484**	-.001	.017	-.470
	(.026)	(.020)	(.221)	(.024)	(.022)	(.339)
APtop25	-.029	.001	.558**	-.031	.018	.629*
	(.022)	(.023)	(.229)	(.022)	(.024)	(.349)
APtop25 Lag	.014	.017	.383*	.012	.017	.377
	(.028)	(.023)	(.222)	(.029)	(.026)	(.355)
PreviouslyUnrankedAptop25	.024	.011	-.383	.009	-.002	-.406
	(.027)	(.030)	(.264)	(.027)	(.030)	(.404)
PreviouslyUnrankedAptop25 Lag	-.017	-.007	-.403**	-.028	-.020	-.508*
	(.018)	(.018)	(.209)	(.021)	(.018)	(.312)
N	1091			577		

Note: Values are rounded 3 decimal places. Robust standard errors are in parentheses. All models contain conference/year fixed effects and university fixed effects. (*** = 1% level of significance, ** = 5% level of significance, and * = 10% level of significance)

Table 2.11: Effect of Athletic Performance on Revenues and Subsidies for Division 1 Programs

Variables	Division 1 Football Schools		
	LogTickets	LogRights	Subsidies
FootballWinPct	.159*** (.056)	.167*** (.039)	-.010 (.033)
FootballWinPct Lag	.164*** (.059)	.068* (.036)	.172 (.317)
ConferenceChamp	.022 (.024)	.065*** (.019)	.013 (.174)
ConferenceChamp Lag	.006 (.024)	-.002 (.015)	-.356** (.174)
APtop25	-.021 (.024)	.008 (.016)	.427** (.172)
APtop25 Lag	-.001 (.024)	.010 (.016)	.370** (.176)
NCAA Tournament	.019 (.029)	.018 (.019)	.128 (.154)
NCAA Tournament Lag	.008 (.018)	.011 (.019)	.108 (.155)
Round 32	.031 (.028)	.004 (.020)	-.091 (.213)
Round 32 Lag	.008 (.018)	-.033 (.022)	-.112 (.207)
Round 16	.012 (.016)	-.004 (.017)	-.058 (.222)
Round 16 Lag	.038** (.019)	.016 (.018)	.246 (.220)
N		1091	

Note: Values are rounded 3 decimal places. All models contain year fixed effects. (*** = 1% level of significance, ** = 5% level of significance, and * = 10% level of significance)

Table 2.12: Effect of Athletic Performance on Revenues and Subsidies for Non-Division 1 Football Programs

Variables	Non-Division 1 Schools		
	LogTickets	LogRights	Subsidies
FootballWinPct	.257***	.136	.083*
	(.057)	(.086)	(.045)
FootballWinPct Lag	.126*	.052	.146**
	(.073)	(.037)	(.062)
ConferenceChamp	.047	.052	-.007
	(.037)	(.038)	(.022)
ConferenceChamp Lag	.059	.005	.005
	(.040)	(.036)	(.019)
NCAA Tournament	.118**	.110***	.062*
	(.055)	(.039)	(.026)
NCAA Tournament Lag	.035	.024	.005
	(.060)	(.039)	(.041)
Round 32	.014	.061	-.098
	(.102)	(.119)	(.056)
Round 32 Lag	.008	.127*	-.028
	(.091)	(.071)	(.061)
Round 16	.093	-.062	-.007
	(.217)	(.156)	(.092)
Round 16 Lag	.029	-.116	-.011
	(.156)	(.074)	(.128)
N		793	

Note: Values are rounded 3 decimal places. All models contain year fixed effects. (*** = 1% level of significance, ** = 5% level of significance, and * = 10% level of significance)

APPENDIX C: CHAPTER II FIGURES

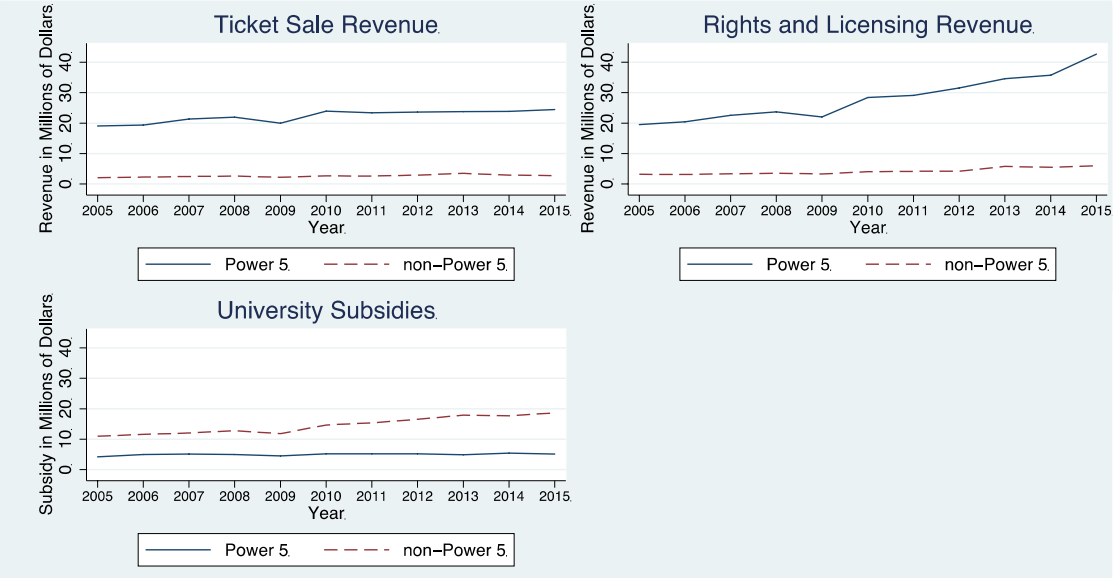

Figure 1: Comparing Revenues and Subsidies for Power 5 and non-Power 5 Conferences

Atlantic Coast Conference	Florida State University, Clemson University, University of Louisville, Boston College, North Carolina State, Syracuse University, Wake Forest University, Georgia Institute of Technology, Duke University, University of North Carolina at Chapel Hill, University of Pittsburgh, University of Miami, Virginia Polytechnic Institute and State University, University of Virginia
Big Ten	Ohio State University, Michigan State University, University of Maryland - College Park, Rutgers University, University of Michigan, Pennsylvania State University, University of Indiana, University of Wisconsin - Madison, University of Minnesota, University of Nebraska - Lincoln, University of Iowa, University of Illinois, Northwestern University, Purdue University
Big 12	Baylor University, Texas Christian University, Kansas State University, University of Oklahoma, West Virginia University, University of Texas at Austin, Oklahoma State University, Texas Tech University, University of Kansas, Iowa State University
Pac 12	University of Oregon, Stanford University, University of Washington, University of California - Berkley, Oregon State University, Washington State University, University of Arizona, University of California - Los Angeles, Arizona State University, University of Souther California, University of Utah, University of Colorado at Boulder
Southeastern Conference	University of Missouri, University of Georgia, University of Florida, University of Tennessee - Knoxville, University of South Carolina, University of Kentucky, Vanderbilt University, University of Alabama, Mississippi State University, University of Mississippi, Auburn University, Louisiana State University and Agricultural and Mechanical College, The Agricultural and Mechanical College of Texas, University of Arkansas
The American	University of Memphis, University of Cincinnati, University of Central Florida, East Carolina University, University of Houston, Temple University, University of South Florida, Tulane University, University of Tulsa, University of Connecticut, Southern Methodist University
Conference USA	Marshall University, Middle Tennessee State University, Western Kentucky University, University of Alabama at Birmingham, Old Dominion University, Florida International University, Florida Atlantic University, Louisiana Tech University, Rice University, University of Texas at El Paso, University of Texas at San Antonio, University of North Texas, University of Southern Mississippi
Mid-American Conference	Bowling Green State University, University of Ohio, University at Buffalo, University of Akron, University of Massachusetts, University of Miami - Ohio, Kent State University, Northern Illinois University, University of Toledo, Western Michigan University, Central Michigan University, Ball State University, Eastern Michigan University
Mountain West Conference	Boise State University, Colorado State University, Utah State University, University of New Mexico, University of Wyoming, California State University - Fresno, San Diego State University, University of Nevada - Reno, University of Hawaii at Manoa, San Jose State University, University of Nevada - Las Vegas
Sun Belt Conference	Georgia Southern University, University of Louisiana - Lafayette, Appalachian State University, Texas State University, Arkansas State University, University of South Alabama, University of Louisiana - Monroe, Troy University, New Mexico State University, University of Idaho, Georgia State University

Figure 2: List of Division I Schools

CHAPTER III
BRINGING IN THE RECRUITS; ANALYZING NCAA DIVISION I FOOTBALL RECRUITING

1 Introduction

In professional sports competition is the key drive for all parties involved, although some may point to the clear monetary incentives in place for players and coaches as an alternative drive. However, in collegiate athletics, the monetary incentives aren't immediately applicable to the players. In this paper, I look to add to existing literature by analyzing the key factors that contribute to the successful recruiting of high-quality college football athletes.

For college football, competition begins long before a team plays its first game. Top recruits are highly sought after by all Division I programs. Aside from the increased team performance that a recruit can offer, there is the additional benefit of landing a top recruit. It takes away talent from competitors. For collegiate athletics, these incentives have resulted in significant expenditures on recruiting. For football programs competing at the Division I level, the highest level of collegiate athletics, the average expenditures for the recruiting of male athletes is found to be over $500,000, based on college athletics data collected for the Equity in Athletics Data Analysis from 2003 to 2015.

This paper utilizes university level data alongside athletic department information to identify the factors that contribute to securing high quality football recruits. Data is

collected for universities that compete in Division I NCAA football from 2003 to 2015. Panel fixed effects models are used to examine the factors that impact the percentage of high-quality recruits at a given university and the average recruit quality. Negative binomial models are used to estimate the count of high-quality recruits at a university in a given year.

Results support findings in previous work that suggest athletic performance is a key factor in subsequent recruiting of top athletes. Higher tuition rates are found to be associated with an increase in high-quality recruits. These findings suggest that top recruits value the explicit value of the scholarships they receive. Furthermore, I find that higher coaching salaries also result in an increase in high-quality recruits. Universities that replace a coach following a losing season are estimated to have an increase in the percentage of high-quality recruits. The implication of this finding is that universities are able to signal quality through measures other than performance, such as coaching salaries and coaching changes.

A discussion of relevant literatures and background information is presented in Section 2 of the paper. Section 3 presents a summary of the data used in this analysis. Section 4 outline the empirical strategy used to identify key relationships. Section 5 presents the key results of the models used. Section 6 discusses implications based on the findings. Section 7 concludes the study.

2 Literature Review

Prior literature has addressed the positive relationship associated between athlete recruiting and team performance. Langelett, G. (2003) identified a reinforcing cycle

between team performance and recruiting. His results indicate that teams achieve success through recruiting, and as a result these same teams are then rewarded by having more success in the following recruitment cycle. This finding provides some evidence for the recurrence of teams in top performance rankings.

Bergman & Logan (2016) estimate that a 5-star recruit is worth more than $150,000 in expected revenue through increased team performance leading to wins in end-of-season bowl game earnings. Richard Borghesi (2017) examines the financial value of college athletes. He finds that if amateurism rules were removed and athletes were paid according to their revenue-generating abilities that four-star recruits would receive annual salaries of $361,000 and five-star athletes would receive $799,000.

Dronyk-Trosper & Stitzel (2017) find that athletic departments differ in their utilization of recruits. In their study, teams with lower rankings derive less benefit from high-quality recruits than better performing teams. These findings suggest that abilities alone are not enough to ensure a high-quality athlete will perform up to expectations. Differences in the quality of coaching may result in significant differences in performance for similarly ranked recruits.

A separate focus of prior research has been on the mechanisms through which universities attract new recruits. Evans & Pitts (2018) studied the cross-sport recruiting impacts of college football and basketball. In their analysis they find that football recruiting is impacted by basketball team performance, but the reverse relationship is found not have any significant impact. Huml, Pifer, Towle, & Rode (2018) found that new athletic facilities did not significantly increase football or basketball recruiting in years following the completion of new facilities. Matt Ryan Huml, N David Pifer, Caitlin

Towle & Cheryl R Rode (2018) look at the recruiting decision from the perspective of the recruits. They find that the most significant determinant in a recruit's decision is a scholarship offer. Additionally, recruits that have scheduled visits after a football season has concluded are more likely to sign with that team. They also find that low-rated recruits favor programs with more recent success while high-rated recruits favor historically successful programs.

Hoffer et al. (2015) found that athletic departments react to changes made by competing programs. An example they provide of how this competition may take place is through coaching salaries. Highly profitable departments can substantially increase coaching salaries to put pressure on competitors to do the same, which may lead to problematic expense increases. My research looks to add to prior literature by looking at more detailed salary level information for head coaches and assistant coaches. This addition will allow me to identify the impact quality signaling through spending on coaches may have on recruiting.

3 Data

I utilize university specific information for NCAA Division I football schools from 2003 to 2015. A portion of the data used in this analysis comes from the Equity in Athletics Data Analysis dataset. The Equity in Athletics Disclosure Act was passed in 1994, it required that all schools that receive Title IV funding (universities that participate in federal student aid programs) and have intercollegiate athletics programs are required to submit annual reports that detail funding information for each program offered. From

this dataset, I am able to identify the spending on coaching for each university, which I utilize as a measure of the quality of coaching a university provides. Further information about each university is collected from the Integrated Postsecondary Education Data System (IPEDS). From this source I am able to obtain information for the number of applicants to each university, total admissions, average professor salary, acceptance rate, and cost of attendance. All of the data is linked at the university level based on university identification codes.

Athletic performance data and information on coaching changes was obtained through Sports Reference.[1] Athletic performance is measures through multiple indicators. I utilize individual season wins and losses to calculate a win percentage for each season. Additionally, end of season Associate Press (AP) rankings are incorporated to capture any additional benefits from achieving a place among the top 25 teams at the end of a football season. Furthermore, basketball performance, as measured by win percentage and NCAA tournament progression, are utilized to identify any cross-sport recruiting benefits. Finally, to capture any head coach specific quality effects, head coaching salaries are collected from USA Today.[2] Unfortunately, this is not available for the full sample period. Therefore, head coach salaries are only available from 2009 to 2015. Nevertheless, this information should still allow me to capture any recruiting impacts that are specific to head coaches.

[1]AP Rankings, NCAA Tournament results, win percentages, and coach information are obtained from www.sports-reference.com.
[2]To view the complete list of collected salaries, as well as some background on the data, you can visit http://sports.usatoday.com/ncaa/salaries/.

The outcome variables for this study deal with college football recruiting. All of this data is obtained through 247Sports.[3] Total number of recruits for each season are available for teams that secure at least one recruit. Recruits are ranked based on analyst reviews of film and input from various networks into a 5-star rating system, as well as a numerical ranking system. For the purpose of this study, I collect information on the total number of recruits for each university and the distribution of the recruits based on their rating. The rankings incorporate all major media service rankings in their composite rating. Their inclusion of input from all major networks on recruit rating help minimizes error by aggregating a large sample of recruitment rankings.

Summary statistics for the variables used in this study are presented in Table 1. The average professor salary for all universities in the sample is around $86,000, while the average cost of tuition is $21,755.33. The average salary per FTE indicates the total spending on coaches' salaries divided by the full-time equivalent hours worked. The average salary is estimated to be around $449,833.80 for the universities used in this study. Average recruitment rating is calculated by finding the total number of each quality recruit divided by the total number of recruits. The lowest rated recruits are marked as 1-star, while the top recruits are 5-star. The highest average recruitment star rating for any team in a given year is 4.33. The count of high-quality recruits is a variable that identifies the total number of 4-star and 5-star recruits a university has signed in a given year. For the sample, there is an average of around 273 high quality recruits per year, with 205 as the lowest and 362 as the highest in one year. Table 3 compares the

[3]The full detailed ranking information on NCAA football and basketball recruiting rankings is available at https://247sports.com.

average recruit rating and count of high-quality recruits for teams ranked in the top 25 and those that are unranked. In all instances, the teams ranked in the top 25 have a higher average recruit rating and more high-quality recruits. Additionally, when looking at the numerical recruiting ranking, teams in the AP top 25 have an average rank of around 29, while teams outside the AP top 25 have an average rank of 72.

4 Empirical Strategy

Due to the panel nature of the data set, the primary model utilized in this study is a panel fixed effects model. Fixed effects are included for each university and for each year of the sample. University fixed effects will capture any unobserved factors that may impact recruiting. Annual fixed effects are included to account for any annual variations in the number of available recruits. The model is specified as:

$$Y_{it} = \delta + \lambda_t + \phi_i + \beta_i U_{it} + \beta_j P_{it} + \varepsilon_{it}, \quad (1)$$

where Y_{it}indicates the outcome variable for university i in time t, λ_t and ϕ_i are year and university fixed effects, U_{it} are university level covariates, and P_{it} are athletic department level covariates. University level covariates include average professor salaries, total number of applicants, the cost of tuition, and the acceptance rate for each university. Athletic department variables include football performance as measured by win percentage and AP top 25 placement, basketball performance measured by win percentage and an indicator of participation in the NCAA Tournament, and coaching salaries. Indicators for a new head coach, as well as interaction term for new coaches hired after a losing season are also included. The interaction term will help differentiate

between coaches that leave due to better opportunities or retirement from those that are released after a poor season. Average recruit quality and percentage of total recruits that are high quality are the key outcome variables used.

An alternative method of identifying factors that impact high quality recruiting is to find the count of the number of high-quality recruits. To estimate the factors that impact the number of high-quality recruits, I estimate a panel negative binomial model. The Poisson model is not applicable due to an over-dispersion problem with my outcome variable, the count of high-quality recruits. For the sample utilized in this study, the variance of the number of recruits is found to be significantly larger than the mean. As a result, the negative binomial model is more appropriate. The general form of the negative binomial equation can be written as:

$$Pr(Y = y) = \frac{\Gamma(y + \alpha^{-1})}{y!\Gamma(\alpha^{-1})}(\frac{\alpha^{-1}}{\alpha^{-1} + \lambda})^{\alpha^{-1}} \text{, (2)}$$

where,

$$\lambda = e^{x_i' B}$$

In equation 2 Γ represents the gamma function, and α is the over-dispersion parameter. Covariates in the negative binomial model are the same as those used in the initial panel fixed effects model. Cameron and Trivedi (1998) provide a more detailed explanation of the negative binomial model.

5 Results

5.1 Percentage of High-Quality Recruits

In the first model specification, I look to identify the factors that aid in the recruiting of high-quality recruits. As mentioned before, high quality recruits are identified as recruits that receive a four or five-star rating according 247sports rankings. The outcome variable is specified as a percentage of high-quality recruits out of the total number of recruits in a given year. The results of this model specification are presented in Table 3. The first column of results omits head coach salaries. I find that there are no significant university level factors that impact the percentage of high-quality recruits. Football performance, as measures by winning percentage and AP top 25 placements, are both found to increase the percentage of high-quality recruits. Finishing among the top 25 teams in a given year is estimated to increase the percentage of high-quality recruits by 3.5%. Assuming a 12-game season, an additional win is estimated to increase the percentage of high-quality recruits by roughly .5% in the subsequent season. A university's basketball win percentage is also found to positively impact high quality recruiting, with a smaller per game impact relative to football performance. This supports findings in prior literature of a cross-sport recruiting benefit.

There is an interesting result regarding coaching changes. In the model, the new coach variable identifies a coaching change from the prior season. Additionally, I include an interaction term to differentiate new coaches that are hired after a poor season to those that may leave due to retirement or for better opportunities. I find that new coaches are not found to significantly impact recruitment, however, new coaches hired after a poor season are estimated to increase the percentage of high-quality recruits by around 2.3%. Furthermore, I find that increases in average coaching salaries also increase the percentage of high-quality recruits.

The second column of coefficient estimates are for a subsample from the years 2009 to 2015 and include head coach salaries. The results, once again, indicate that university level factors do not significantly impact high quality recruits. Similar to the first model results, I find that increased football performance results in a higher percentage of high-quality recruits. The effect of a new coach hired after a bad season is still found to significantly impact the percentage of high-quality recruits. Higher coaching salaries per FTE, and head coach salaries are found to positively increase the percentage of high-quality recruits. A one million dollar increase in head coach salary is estimated to increase the percentage of high-quality recruits by around 2%.

5.2 Count of High-Quality Recruits

An alternative method to identify the factors that impact high quality recruiting is to utilize a count model. In this specification, the outcome variable is a count of the total number of four or five-star football recruits that are signed by a university in a given year. Table 4 presents the results of the panel negative binomial model. Marginal effects at mean values are presented for each coefficient. Once again, the first column of coefficient estimates is for the entire sample and exclude head coach salaries, while the second column is for the subsample which includes head coach salaries. Only one of the university level variables, cost of tuition, are found to significantly increase the number of high-quality recruits. Similar to the results in Table 3, I find that football winning percentage, new coaches, assistant coaching salaries, and head coach salaries are all found to positively impact the number of high-quality recruits that a university secures.

Unlike the prior model, finishing among the top 25 football teams is not found to significantly impact high quality recruiting.

5.3 Average Recruit Quality

To include a more general recruiting quality analysis, I estimate a third model to identify the factors that impact the average recruit quality. Table 5 presents the estimates for this model specification. As with the prior models, results are separated into two columns with the first column covering the entire sample without head coaching salaries and the second column covering a subsample with head coaching salaries included. There are some notable differences in this specification compared to the prior two models. One notable difference is that there is a significant negative effect estimated for the acceptance rate at a university. Of the athletic specific variables, I find that only football performance is statistically significant. It may be the case that there is not enough variation between universities or from season to season in the average recruit quality to identify significant impacts.

6 Discussion of Results and Limitations

The results found in this analysis reinforce prior finding that team performance is a key factor in determining future recruiting. In all model specifications, football performance was found to be statistically significant and positive with respect to the quality and count of football recruits. Additionally, I find some evidence to support the

findings of Evans & Pitts (2018) that there is a cross-sport effect for basketball performance on football recruiting. Recruits seem to place some value on the overall success of an athletic department, with a larger importance placed on football success.

This paper adds to the literature by identifying that there are additional quality signals, aside from team performance, that can benefit the recruiting of high-quality athletes. I utilize salary as a measure of quality for head coaches as well as for assistant coaches. In both cases, increases in coaching salaries are estimated to positively increase the percentage and count of high-quality recruits to a given university. One takeaway from these results is that athletic department spending on the coaching staff can signal the quality of the athletic program separately from the level of success that program is able to achieve on the field.

An additional finding of my analysis is that there may be potential gains to future recruiting that can be made by replacing coaches that have losing seasons. This result could relate to the discussion of quality signaling above. For athletic departments that have a reputation of high performance, replacing a coach that is performing poorly is a way to signal that departments' ambitions. This signal can perhaps help to alleviate any decreases in quality that may be associated with a team's poor performance. Furthermore, there is some evidence to suggest that higher tuition rates result in more high-quality athletes. This finding would imply that athletes place some value on the dollar value of the scholarship that they will receive.

One key limitation of this study is data availability. Particularly, coaching salary data is not readily available to the public and assistant coaching data is taken at an aggregate level. A further limitation is potential timing mismatch of the recruiting

commitments. It may be the case that an athlete commits to a university more than one year before he officially enrolls at the university. Some recruits are offered scholarships very early into their high school careers. I would argue that this issue would be mitigated for top athletes since they are courted by many universities leading up to their official commitment decisions and athletes are able to change commitments throughout the process.

7 Conclusion

For college athletics, recruiting is one of the largest aspects of building a successful athletic program. Competition among universities competing in NCAA football begins well before the first game is played. Securing top recruits benefits a university by increasing the performance level of a team, but it also takes away talent from competitors. Prior research has identified the revenue gains associated with recruiting top quality athletes. There is also an established recursive relationship between performance and recruiting, with successful teams obtaining top recruits and continuing their winning traditions.

In this study, I analyzed the factors that contribute to the recruiting of high-quality recruits, athletes ranked as 4-star or 5-star recruits. I utilized recruiting data, university level covariates, and athletic department related measures to identify which variables lead to a higher percentage of high-quality recruits. Results indicate that, as described in prior literature, team performance is a key factor in determining subsequent recruit quality. Alongside performance, I identify that higher coaching salaries at a university also results

in an increased number of high-quality recruits. Furthermore, estimates indicate that universities that replace coaches that have losing seasons also observe an increase in the percentage of high-quality recruits. These findings indicate that universities have multiple ways of signaling their quality. A poor season does not mean that a given team is doomed to struggle with recruiting. They can signal their department quality and ambitions through the investments that they make into their coaching staff, even if the investment involves severance payments to coaches that underperformed expectations.

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APPENDIX D: CHAPTER III TABLES

Table 3.1: Summary Statistics

Variables	*N*	Mean	Std. Dev	Min	Max
Professor Salary	1,564	85,915.72	16491.47	50,229.33	165,312
Total Applicants	1,564	17,155.24	11,055.59	1405	92690
Tuition Cost	1,564	21,755.33	9,089.27	3150	53,000
Acceptance Rate	1,564	.63	.21	0.05	.99
Average Salary per FTE	1,564	449,833.80	348,660.50	52,482	2,080,224
Head Coach Salary	756	1,683,302	1,285,551	160,000	7,160,187
Football Win Percent	1,564	.52	.23	0	1
Ap top 25	1,564	.20	.40	0	1
Basketball Win Percent	1,564	.56	.17	0	.95
NCAA Tournament	1,564	.32	.47	0	1
New Head Coach	1,564	.17	.37	0	1
New Coach/Bad Season	1,564	.09	.29	0	1
Total Recruits	1,564	21.70	5.53	1	41
Average Recruit (1-5)	1,564	2.71	.52	1	4.33
Count of High Quality(4-5)	1,564	2.66	4.44	0	24

Note: All variables are rounded 2 decimal places. All figures pertaining to money are presented in dollars. Head coach salaries only available for 2009-2015

Table 3.2: Recruiting Comparisons Between Top 25 Ranked Teams and Unranked Teams

	Average Star Rating			Count of High Quality Recruits		
Year	Unranked	ApTop25	Difference	Unranked	ApTop25	Difference
2003	2.35	3.03	-.68***	1.30	5.12	-3.82***
2004	2.42	3.14	-.72***	1.15	5.76	-4.61***
2005	2.50	3.08	-.58***	1.30	6.08	-4.78***
2006	2.56	3.23	-.67***	1.25	6.80	-5.55***
2007	2.60	3.16	-.56***	2.04	6.92	-4.88***
2008	2.71	3.25	-.54***	2.16	6.72	-4.56***
2009	2.74	3.29	-.55***	1.76	7.92	-6.16***
2010	2.53	3.12	-.59***	1.58	5.92	-4.34***
2011	2.66	3.26	-.60***	2.15	7.28	-5.13***
2012	2.65	3.23	-.58***	1.85	6.32	-4.47***
2013	2.56	3.22	-.66***	1.38	7.76	-6.38***
2014	2.64	3.37	-.73***	1.30	8.52	-7.22***
2015	2.69	3.26	-.57***	1.64	7.16	-5.52***
N				116		

Note: All variables are rounded 2 decimal places. (*** = 1% level of significance, ** = 5% level of significance, and * = 10% level of significance)

Table 3.3: Percentage of High Quality Recruits

	Percentage of High Quality Recruits	Percentage of High Quality Recruits (with coach salaries)
	University Variables	
ProfessorSalary (Ten Thousands)	.006 (.008)	.001 (.017)
TotalApplicants	.000 (.000)	-.000 (.000)
TuitionCost (Ten Thousands)	.015 (.014)	.024 (.021)
AcceptanceRate	-.041 (.039)	-.033 (.061)
	Athletics Variables	
FootballWinPercent	.050*** (.015)	.044** (.018)
APtop25	.035*** (.010)	.037*** (.013)
BasketballWinPercent	.035** (.019)	.033 (.026)
NCAATournament	-.007 (.007)	-.005 (.008)
NewHeadCoach	-.008 (.008)	-.009 (.009)
NewCoach/BadSeason	.023* (.012)	.027** (.012)
AvgSalaryPerFTE (in Millions)	.070** (.024)***	.066** (.031)
HeadCoachSalary (in Millions)	-	.019** (.008)
N	1564	756

Note: Values are rounded 3 decimal places. Robust standard errors are in parentheses. (*** = 1% level of significance, ** = 5% level of significance, and * = 10% level of significance)

Table 3.4: Count of High Quality Recruits

Variables	Count of High Quality	Count of High Quality (with coach salaries)
	University Variables	
ProfessorSalary (Ten Thousands)	.085 (.061)	.129 (.094)
TotalApplicants	-.000 (.000)	-.000 (.000)
TuitionCost (Ten Thousands)	.177* (.107)	.422*** (.159)
AcceptanceRate	-.316 (.351)	.269 (.559)
	Athletics Variables	
FootballWinPercent	.748*** (.182)	.644*** (.239)
APtop25	.029 (.066)	.013 (.082)
BasketballWinPercent	.140 (.205)	.109 (.254)
NCAATournament	-.034(.057)	.019 (.071)
NewHeadCoach	.176*** (.066)	.172* (.086)
NewCoach/BadSeason	.203* (.108)	.217* (.141)
AvgSalaryPerFTE	.421*** (.104)	.579*** (.158)
HeadCoachSalary (in Millions)	-	.114*** (.037)
N	1180	588

Note: Values are rounded 3 decimal places. (*** = 1% level of significance, ** = 5% level of significance, and * = 10% level of significance)

Table 3.5: Average Recruit Quality

Variables	Average Recruit Quality	Average Recruit Quality (with coach salaries)
	University Variables	
ProfessorSalary (Ten Thousands)	-.000 (.002)	-.003 (.003)
TotalApplicants	.000 (.000)	-.000 (.000)
TuitionCost (Ten Thousands)	-.001 (.004)	.003 (.005)
AcceptanceRate	-.015* (.008)	.001 (.012)
	Athletics Variables	
FootballWinPercent	.020*** (.004)	.019*** (.004)
APtop25	.003* (.002)	.001 (.002)
BasketballWinPercent	.003 (.004)	.002 (.005)
NCAATournament	.000 (.002)	.001 (.002)
NewHeadCoach	.001 (.002)	-.000 (.002)
NewCoach/BadSeason	.002 (.003)	.005 (.003)
AvgSalaryPerFTE (in Millions)	.005 (.004)	.006 (.005)
HeadCoachSalary (in Millions)	-	.001 (.001)
N	1564	756

Note: Values are rounded 3 decimal places. Robust standard errors are in parentheses.