FBS CONFERENCE SIZE AND ITS EFFECT ON PROFITABILITY IN COLLEGE FOOTBALL

by

Christopher A. Moore

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Approved by:

_____
Dr. Craig A. Depken II.

_____
Dr. Ted Amato

_____
Dr. Artie Zillante

ABSTRACT

CHRISTOPHER A. MOORE. FBS conference size and its effect on profitability in college football (Under the direction of DR. CRAIG A. DEPKEN II)

Previous studies have explored the dynamic between member schools and the conferences to which they belong, particularly regarding optimal alignment and profit maximization. Conference members have to decide whether switching is worthwhile, and as a conference they seek to determine the optimal structure. This paper seeks to explore the relationship between the number of teams in a conference and additionally to control for the geographical makeup of the conference. This can be built upon to help determine if there is a shift in the dynamics underlying conference alignment and to help determine optimal conference size and structure.

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LIST OF ABBREVIATIONS

AAC	American Athletic Conference
ACC	Atlantic Coast Conference
B1G	Big Ten Conference
BWC	Big West Conference
BYU	Brigham Young University
CBR	competitive balance ratio
C-USA	Conference USA
DHHI	Depken's proposed modification to the HHI
HHI	Herfindahl-Hirschman Index
ISD	idealized standard deviation
MAC	Mid-American Conference
MGF	mobility gain function
MW	Mountain West Conference
NCAA	Nation Collegiate Athletic Association
PAC-12	Pacific-12 Conference
RSD	ratio of standard deviations
SEC	Southeastern Conference
SWC	Southwest Conference
UOH	uncertainty of outcome hypothesis
WAC	Western Athletic Conference

INTRODUCTION

It has been widely acknowledged that the National Collegiate Athletic Association operates as a cartel, enforcing rules to promote amateurism, enhancing competitive balance, and sanctioning athletic contests within the confines of collegiate athletics.[1] The presence of the NCAA makes conference behavior a particularly fertile ground for examining profit maximizing dynamics under the regime of a cartel. The rules imposed by the NCAA have wide reaching effects, from governing how players are recruited to how revenues are distributed. This, in turn, impacts the specific decisions schools make, such as the specific athletes to recruit or the conference that best suits their athletic and academic goals. This also gives conferences extraordinary power as most schools lack the drawing power to maintain athletic programs without the conference support.[2]

Realignment emerges as an interesting issue in college football due to the significant increase in consolidation and creation of super conferences. As seen in Table 1, significant movement occurred between conferences from 2004 through 2014.

[1] The NCAA is one of four separate governing bodies in college sport. The others being the NAIA, the NJCAA and the NCCAA.

[2] Historically, Notre Dame was an independent in football. In 1995 they joined the Big East in all sports but football. In 2013 they joined the ACC, again with football remaining independent.

Table 1: Conference changes since 2004

Year	Team	Prior Conference	New Conference	Conference Size
2004	Connecticut	Independent	Big East	7
2004	Miami (FL)	Big East	ACC	11
2004	Troy	Independent	Sun Belt	9
2004	Virginia Tech	Big East	ACC	11
2004	Florida Atlantic	FCS	Independent	1
2005	Boston College	Big East	ACC	12
2005	South Florida	Conference USA	Big East	8
2005	Louisville	Conference USA	Big East	8
2005	Cincinnati	Conference USA	Big East	8
2005	Temple	Big East	Independent	1
2005	FIU	FCS	Sun Belt	8
2005	Florida Atlantic	Independent	Sun Belt	8
2005	New Mexico State	Sun Belt	WAC	10
2005	Idaho	Sun Belt	WAC	10
2005	Utah State	Sun Belt	WAC	10
2005	Tulsa	WAC	Conference USA	12
2005	SMU	WAC	Conference USA	12
2005	Rice	WAC	Conference USA	12
2005	UTEP	WAC	Conference USA	12
2005	UCF	MAC	Conference USA	12
2005	Marshall	MAC	Conference USA	12
2005	TCU	Conference USA	MWC	9
2007	Temple	Independent	MAC	13
2008	WKU	FCS	Independent	1
2009	WKU	Independent	Sun Belt	9
2011	Colorado	Big 12	Pac 10	12
2011	Utah	MWC	Pac 10	12
2011	Nebraska	Big 12	Big 10	12
2011	BYU	MWC	Independent	1
2011	Boise State	WAC	MWC	8
2012	Texas A&M	Big 12	SEC	14
2012	Missouri	Big 12	SEC	14
2012	West Virginia	Big East	Big 12	10
2013	Syracuse	Big East	ACC	14
2013	Pitt	Big East	ACC	14
2013	UCF	Conference USA	AAC	11
2014	Louisville	Big East	ACC	14
2014	Rutgers	Big East	Big Ten	12
2014	Maryland	ACC	Big Ten	12
2014	WKU	Sun Belt	Conference USA	13

It is worth noting that we examine NCAA football primarily because it is the major revenue center for college athletics and plays a disproportionally large role in conference alignment decisions. Previous academic research pointed toward a profit maximizing size of approximately twelve teams (Depken 2005), but recently several of the largest conferences surpassed that threshold[1]. Notably the Southeastern Conference (SEC) and Atlantic Coast Conference (ACC) now consist of fourteen and fifteen members respectively. The same trend continues among the other conferences, with the average number of teams per conference in Division I FBS[2] now being 12.4 members per conference. The question that arises is whether conference dynamics shifted, and whether there is a new optimal conference size. If there is a new optimal size, the goal here is to examine one possible reason for the shift, geographic size, while controlling for other impacts highlighted by previous research.

[1] There are currently four conferences with more than 12 teams: the ACC, Conference USA, the MAC and the SEC.

[2] The NCAA Division I FBS is the more competitive subdivision of the NCAA Division I, which consists of the largest and most competitive schools in the NCAA.

THE MEDIA HYPOTHESIS

Increasingly lucrative television contracts with the potential to generate significant revenue streams provide one possible explanation for conference realignment. Based on the NCAA's 2014-2015 financial statement, media and marketing rights also generate the lion's share of revenue for the NCAA itself, making up seventy-six percent of revenue for the fiscal year. This is something conferences have taken note of: the largest conferences are now packaging their own sports networks, and signing contracts that guarantee significant annual revenue for each member. This might indicate a shift away from proximity-based conferences to ones that span a much larger geographical footprint.

The intuition behind increasing the geographical footprint would be to extend the number of media markets represented by the conference with hopes of increasing the potential viewership of conference events. Perhaps one of the best examples of this is Atlantic Coast Conference (ACC), which expanded to encompass a much larger portion of the eastern coast of the United States when compared to its four-state origin. The ACC now includes member schools in ten different states, ranging from Florida to Massachusetts and as far west as Kentucky and Indiana. If viewership is a driving factor for conference realignment, the trend toward super conferences will likely continue and the revenue benefit should be evident in the geographic size indicator.

Another indication that television contracts may be playing a role is the recent movement of the FBS independents towards joining conferences. Notre Dame has become a full member of the ACC in all sports but football, though they retain the right to

join as a football member at a later date. Notre Dame opted not to join as a football member, likely in part because they still have a lucrative television rights contract with NBC to broadcast their games through 2025. Navy, a long time independent, joined the American Athletic Conference as a football only member at the start of the 2015 season. This may point to the importance of a conference for teams who alone cannot draw much of an audience and lends credence to the overall importance of football in college athletics. Brigham Young University and Army are the remaining two, both having their own reasons to remain independent. Brigham Young funds and operates its own independent television station which airs BYU sporting events amongst other programming.

Another factor to be explored is the impact of adding teams to a conference which had very little previous interaction. Historically rivalries are considered the biggest games of the season for each team, particularly those that are not regularly in competition for conference or national championships. The recent realignment ended several of these rivalry games and placed new teams in competition that have not historically been in contention with each other. This lends itself to exploring whether these super conferences are doing themselves a disservice by disrupting these natural geographic rivalries. The same dynamic can be generalized beyond rivalries, as conferences become larger and more spread out, it may dilute the draw of each game. Is a long time ACC fan interested in games between Louisville and Syracuse? Or does the lack of familiarity with new member schools reduce interest and, correspondingly, reduce the profitability of adding a school like Syracuse to the conference? We aim to examine this impact, using geographical proximity as a proxy for familiarity.

One remaining factor for consideration is the presence of the bowl system. All things remaining equal, a larger conference may benefit from having more teams that are bowl eligible. The bowl system is a lucrative part of the college football landscape and the impact of more teams in bowls games is rarely trivial for any given conference. Though the introduction of the college championship series seems to be a tentative step away from the bowl system, the bowl system still provides a non-trivial economic boost for conferences. Based on the 2014-2015 revenue distribution circulated by the College Football Playoff Administration, each conference will receive $300,000 per bowl eligible school, and $4 million for each team that plays in a non-playoff bowl. All else equal the bowl system could provide additional incentive to expand the size of conference while maintaining the overall competitiveness.

COMPETITIVE BALANCE

There are other factors that impact profits that must be accounted for; chief among them being competitiveness. The trend appears to be consolidating the most competitive teams, which has been demonstrated by the dominance of the so-called five big conferences. Two of the most competitive conferences, the aforementioned ACC and SEC, are also the largest. A common line of inquiry is whether moving from a less competitive conference to a more competitive one is advantageous for the school making the move and the conference it joins as seen in Eckard (2015). Such a move is also expected to impact the original conference, the assumption being that the dominant team acts as a significant draw for games against other members of the conference.

A vast body of work on competitive balance and its impact on profitability in various sports is well documented. As discussed below, it appears that competitive balance positively effects league profitability, and is expected to similarly impact the profitability of individual conferences. This impact is expected to show up in two places, ticket sales and overall revenue generated from media contracts. A more competitive sports league is a higher quality product and should ultimately lead to an increase in profit generation through increased attendance and the increased pricing power conferred by a higher quality product.

LITERATURE REVIEW

The literature concerning competitive balance is divided clearly along two lines: the effect of competitive balance on the fans and how competitive balance has changed over time. Both lines of research provide insight for our investigation, though it falls directly into the effect on fans and accordingly how that drives revenue and profitability for member schools and ultimately the conferences to which they belong. The Uncertainty of Outcome Hypothesis (UOH) addresses the impact of competitive balance on fan interest. The UOH, attributed to Simon Rottenberg (1956), posits that fans derive higher utility from sporting events with less certain outcomes. This, in turn, makes the games more compelling, driving attendance and ultimately profit.

The UOH can be divided into two potential impacts: the absolute quality of the games and the relative quality of the competition. This maps neatly to most sports, where a star player can be a great draw, or a particularly even match between opposing teams fills the stands. Ultimately the UOH posits that if spectators knew the outcome of the game, they would be less likely to pay to watch the game itself. This seems to bear itself out, as the vast majority of sporting events are televised live, with only a few being re-broadcasted. Perhaps even more telling is the fact that the games that tend to be re-broadcasted are ones that feature outsized performances either by a team or a particular player.

While there is competition amongst schools for recruits, colleges rarely have the same control over adding standout players to their teams as in professional sports. This is in part driven by the amateurism rules imposed by the NCAA. Without the ability to pay

market wages for talent, colleges must compete indirectly, often by pouring money into facilities and coaches. Another potential point of differentiation can be conference alignment, which leads to the UOH as a potential catalyst for realignment. Recruiting is not the only consideration for conference alignment, and likely plays a secondary role to the other portion of the UOH which is concerned with the relative quality of the competition.

Teams voluntarily organize themselves into conferences to provide a more compelling series of games, in this case, along lines of team strength. Empirically there is evidence of this, as illustrated by Eckard (2015) who examines the UOH in the context of college football. In particular Eckard examines the relative strength of teams who leave conferences for others, based on the premise that they should be stronger than the conference they are leaving and competitive with the conference they are joining. He finds clear evidence that the conference switchers took more than their fair share of wins prior to switching and found improved balance after a majority of the realignments. It seems there is evidence that competitive balance plays a part in some realignments, though competitive balance may not explain all realignment. This was also evident in Eckard, where two realignments within the sample showed no positive impact on competitive balance.

While there is evidence that competitive balance does have an impact, it is not the sole driver of revenue or realignment. One plausible reason for this is that fans are simply not as sensitive to competitive balance in college sports as hypothesized. Though this has not been explored empirically in college football, there is some evidence for professional leagues, including the European professional football leagues. Pawloski

(2013) finds that while competitive balance matters, there are breakpoints where striving to improve balance is not a productive allocation of resources. This confirms previous research based on revealed preferences that indicated an S-shaped curve for the relationship between competitive balance and revenues. Using surveys of fans for the German Bundesliga, Pawloski was able to demonstrate that while 70 percent of fans did care about competitiveness, the teams in question were nowhere near a relevant breakpoint. This indicates competitiveness would be necessary to see a benefit from increasing competitiveness. Similar conditions may exist within FBS football, leading to the possibility that balance is not the only motivator for realignment.

Based on previous work, it appears there are clear dynamics that dictate both the profitability and ideal competitive balance for sports leagues, and college football in particular. While it seems the literature largely agrees that competitive balance is a key to maximizing the profit generated by a sports league, there is debate over the ideal competitive balance measure. As such, it is necessary to examine the landscape of available measures.

Competitive balance measures can be roughly categorized into three groups: measures of concentration, measures of dominance, and measures that function as a combination of the two. Measures of concentration can be as simple as the range of wins among teams, or more complex like the Herfindahl-Hirschman Index and Lorenz Curve methods. Measures of dominance include descriptive stats, correlation coefficients, reoccurrence measures, and HHI measured over multiple seasons. Note that scope has an impact on which category the HHI belongs, according to this classification. Commonly

used measures that combine both are the Competitive Balance Ratio (CBR), Mobility gain function (MGF), and Markov models.

Each class of measures has its merit and depending on the task at hand one may outperform the other. There is also evidence that different measures within a particular class are better suited for certain investigations and that some are more sensitive to season length and other variables. The ratio of standard deviations (RSD) method compares the actual standard deviation of wins to an idealized standard deviation of wins. Unity indicates perfect competitive balance. The standard deviation measure is typically calculated as the number of wins achieved by a team divided by the maximum possible wins for the team. RSD then weights the standard deviation method by an idealized standard deviation (ISD) which is characterized by several assumptions, the first of which is that teams are of equal strengths. It also depends on two other assumptions: there are only two potential outcomes, a win or loss, and that each outcome is equally likely to occur. There are multiple measures of ISD including ones that make the necessary adjustment to include the potential of a tie, which did happen occasionally in college football prior to a rule change in 1996. Interestingly, Trandel and Maxcy (2011) point out that ISD is sensitive to home field advantage, something that typically was not accounted for in previous ISD formulations. This makes intuitive sense as most collegiate sports make an effort to hold playoff and championship games at neutral sites. Given its flexibility and various adaptions the RSD method is considered a stalwart in examining competitive balance.

However, the RSD family of methods is not without its drawbacks, chief among them being their sensitivity to the number of teams in the league. According to Owen

(2010): “RSD has properties that limit its usefulness in comparisons of competitive balance involving different numbers of teams and/or games.” Owen concludes that while RSD can be used to make comparisons across leagues and over time, it only provides a partial view of competitive balance. The upper bound of RSD has been shown to change dramatically in response to a change in number of teams or games played, making direct comparison in a shifting landscape unreliable. For the purposes of this paper, this precludes the RSD method and its derivatives from being the ideal measure of competitive balance.

For a different view of inequality, the Lorenz curve and Gini coefficient allow for a graphical representation. When applied to competitive balance the Lorenz curve shows the overall distribution of wins or performance points within the league. Perfect equity of winning is a 45-degree line and the curve representing the actual distribution is below it. The Gini index is the ratio of the actual distribution area over the idealized distribution. This gives competitive balance an inverse relationship to the Gini index which ranges from 0 to 1. While the Gini coefficient seems to lend itself immediately to competitive balance, it has two serious limitations outlined by Utt and Fort (2002). First, the ideal distribution typically used fails to account for the fact that winning in a league is zero sum and bounded by games a team participates in. That is to say, that the most unequal distribution of winning percentages cannot be that one team ends up with all the wins available. Simply put, the dominant team can only win the games in which it participates. The second, more pressing concern for this research, is that the Gini coefficient does not account for league expansion and unbalanced schedules, both of

which are featured prominently in the data used. Both of these issues are computational in nature, but preclude the use of the Lorenz curve and Gini coefficients in our analysis.

Though not as widely used as the RSD class of methods, HHI has become a mainstay among competitive balance measures. It is a measure of concentration, constructed from the quadratic summation of all firm market shares within a given industry. For a given industry, competitive balance, H, is given by the following:

$$H = \sum_{i=1}^{N} s_i^2$$

where N is the number of firms in the industry and s represents the market share for firm i. When applied to competitive balance, the market share of interest is share of wins within league or conference play. HHI can range from $\frac{10,000}{N}$ where there is perfect competitive balance, to 10,000, which indicates a single dominate team in the league. Alternate formulations range from $\frac{1}{N}$ to 1, depending on how win share is calculated. HHI is particularly well suited for measuring win concentration within a sports conference because there is complete information regarding win share.

While HHI provides a clear indication of concentration of wins, it is not without its own issues. As pointed out in Depken (1999) HHI always decreases as the number of firms in a given market increases. This would prove to be particularly problematic in our investigation since it is clear that firms are entering and leaving their respective markets. Depken's proposed solution is to modify HHI by the ideal competitive level of a conference, given by $\frac{1}{N}$ where N is the number of teams in the conference. This new statistic is denoted dHHI where dHHI = HHI - $\frac{1}{N}$ though it too is not without issues.

As pointed out by Owen, Ryan and Weatherston (2008), though the dHHI statistic controls for variation in the lower bound of HHI, it neglects the impact of changes in conference size on the upper bound. This is particularly the case when the market share used to calculate HHI is number of wins over total number of wins in the conference. It is clear that under this construction the upper bound cannot be 10,000, because no single team can win all the games in a conference by virtue of not being able to participate in every conference game. This may not be a major problem in the following analysis, but it is worth drawing attention to the boundary issues.

Given the most frequently used options within the competitive balance measures concentration domain, it seems each has its own set of drawbacks. It seems that the most stable of the previously reviewed measures is the HHI approach, as such the HHI statistic was included for testing.

DATA

The revenue data were obtained primarily from the U.S. Department of Education's Office of Post-Secondary Education. The decision was made to only examine the Division I FBS schools because they are the most profitable and the data set was the most complete. The location of the stadiums of FBS schools are easily obtained which was helpful in constructing the conference average travel distance statistic. While data were gathered for the FBS Independents, they were not included for the conference analysis as they do not belong to a conference.

Due to the varying modes of travel available, the distance is calculated using the great-circle method. This is viewed as a more economical way of creating the distance between schools statistic without determining likely mode of travel, shortest paths, and other such concerns. The distance statistic is the arithmetic mean of travel distance for each school in kilometers if they traveled to every other school in the conference. In the event that the longitude and latitude of a stadium was unavailable, the center of the main campus was used as a proxy. As an example, the distance metric for the ACC is the distance a member school would travel, as the crow flies, to reach every other stadium in the conference. This statistic is designed to help capture any effect on revenue driven by significant changes in geographical footprint for the conference. While distance does vary with the number of teams, there is not a direct linear relationship. A school that is located near other schools in the conference will likely reduce the distance statistic, while one that is further afield should increase the statistic. Figure 1 below offers an alternate view of conference footprints. Each conference footprint is represented by a polygon

created by connecting the fewest number of schools such that all other schools in the conference are within the boundaries created.

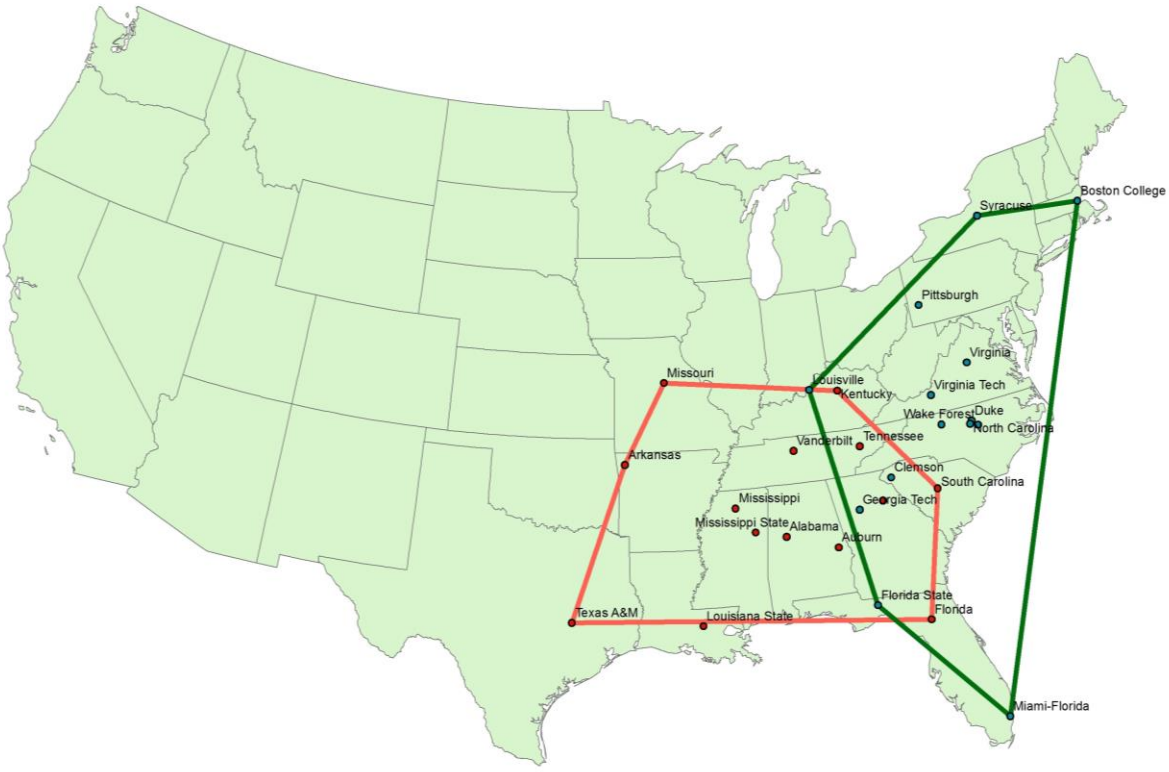

Figure 1: Conference footprints (ACC and SEC)

The win-loss records for each team were compiled from various sources, including the NCAA's official website as well as a few college football databases with verified game results. Attendance was also sourced from the NCCA's official database, though ultimately it remained unused. The competitive measure used for each conference was the Herfindahl-Hirschman Index. As discussed earlier, while there are various ways to measure competitive balance, the HHI approach works well for season to

season and conference to conference comparisons, which are the primary focus of this investigation.

The resulting data set is an unbalanced panel of 214 observations, representing 14 conferences from 1996 to 2015.[1] This allows for the control of conference specific effects, including those that may be unobservable or difficult to measure. The data span almost two decades and are unbalanced primarily due to the ebb and flow of conferences. Three conferences dissolved during the data set and the Big East reformed itself as the American Athletic Conference (AAC).[2] The AAC is not only the spiritual successor to the Big East, having been formed with previous members of the Big East, it is also the legal successor and retains the charter of the original Big East Conference. As such, the AAC data in the data set is included with Big East, despite the name change.

[1] See APPENDIX A for descriptive statistics on each conference included in the sample.
[2] Both the SWC and Big 8 Conferences folded after the first year of the data set (1996). The BWC disbanded later (2001).

ANALYSIS

First, we examine the optimal size of a conference using the method outlined in Depken's *Realignment and Profitability in Division IA Football*. The paper relies on the working assumption that the NCAA acts as a cartel and accordingly allows member conferences to participate in profit maximizing by setting marginal revenues equal to marginal costs. Based on the previous paper, it appears that during the 1993 to 2003 time frame the optimal size was approximately 12 teams. However, the landscape has changed since that analysis and warrants updated analysis before examining potential drivers.

Recall the simple model of joint profit maximization at the conference level proposed by Depken. It depends on two equations: Total revenue (TR) and total cost (TC). Total revenue is the aggregation of annual revenues for a given member school related to football and includes all sources of income. Total cost is similar, as it is the aggregate of reported football related expenses for the member school in question. Total profit at the conference level is then given by the difference between aggregated total revenues and total costs for the conference or $\sum \Pi_{ijt} = \sum TR_{ijt} - \sum TC_{ijt}$ where i indicates a member school, j indicates conference and t indicating school year. To maximize profit, the conference would then set marginal benefit equal to the marginal cost of an additional team. As pointed out by Depken, for this to hold the conference must decide on the number of teams, if individual members within the conference were allowed to choose the number of teams it is less likely that joint profits would be maximized. Again, following the path set by Depken, the updated data set was used to

estimate a series of regression models including the following regressors: the number of teams in the conference (TEAMS), the number of teams squared (TEAMS-SQ), average travel distance measured in kilometers (AVERAGEDIST), and the competitive balance measure (HHI). As discussed previously, prior work has shown a positive relationship between attendance and competitive balance, accordingly revenue is expected to have a positive relationship with HHI and costs are expected to have a negative relationship with HHI.

In this paper HHI is constructed using the following points system: 2 points for a win, 1 for a tie, and zero points for a loss. The point value of each team is then calculated based on their conference record in a given season. The conference HHI is then calculated as the sum of squared points over total possible points. The second statistics, dHHI is constructed as described earlier.

Table 2: Descriptive statistics of full sample

Variable	Obs	Mean	Std. Dev.	Min	Max
Year	214	2005.565	5.68772	1996	2015
Teams	214	10.49065	2.061816	6	16
HHI	214	1,287.467	289.4696	755.0296	2,355.556
dHHI	214	296.927	113.4618	60.7639	972.2222
Total Revenue (in 1,000s USD)	214	175,215.6	171,778.4	6597	899,550.9
Total Expense (in 1,000s USD)	214	102,594.2	75,915.5	12,860	404,589.5
Distance (km)	214	7,873.551	4,020.253	2,166.44	24,281.1

Table 2 shows the descriptive statistics of the sample. The maximum number of teams in a conference for the sample is 16. Interestingly, this occurred early in the sample and the conference in question, the WAC, has declined dramatically. Another

interesting point is the range of conference geographic sizes in the sample, with the minimum of 2,166 km and a maximum of 24,281 km. The mean is approximately 7,873 km, which indicates a skew right distribution. It is also worth noting that distance shows a general positive trend with time, showing an increase toward the end of the sample. As one would expect, a significant decrease in distance also appears to precede the complete decline of a conference.

Both total revenues and total expenses show a high level of variability. This is driven in part by dramatically increasing revenues for the so called Power 5 conferences and a general upward trend in conference revenues and expenses over time. The maximum value of HHI in the sample is 2,355.5 confirming that conferences are not perfectly balanced, but far from being completely one-sided.

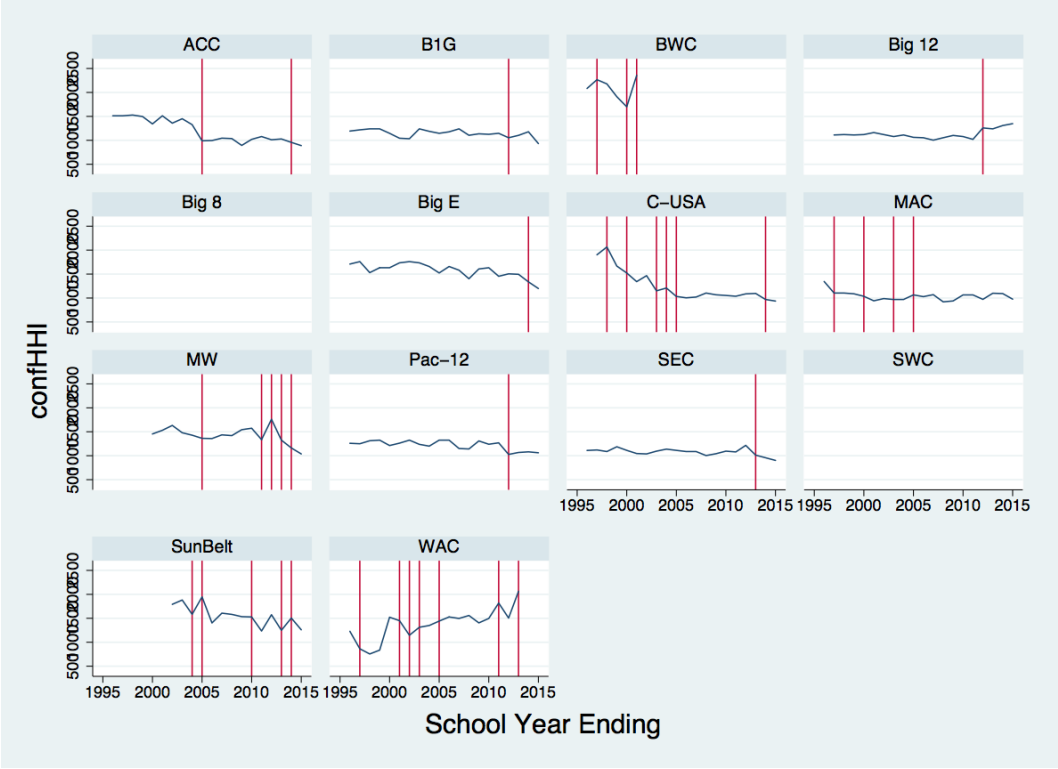

Figure 2: Conference HHI

Figure 2 shows conference HHI over time, while the vertical bars denote expansions and contractions. As expected, dHHI stays fairly stable during periods that lack alignment changes. This is best illustrated by the Big 12 and Pac-12, both of which exhibit relatively stable dHHI until a shift in composition occurs.

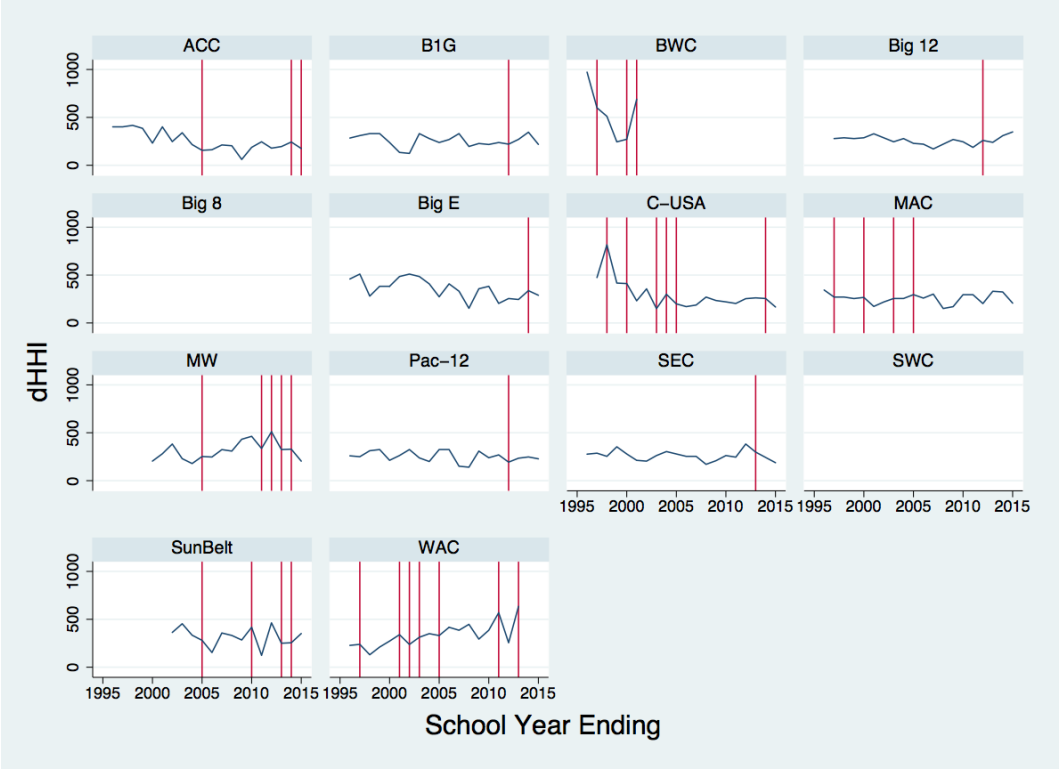

Figure 3: Conference dHHI

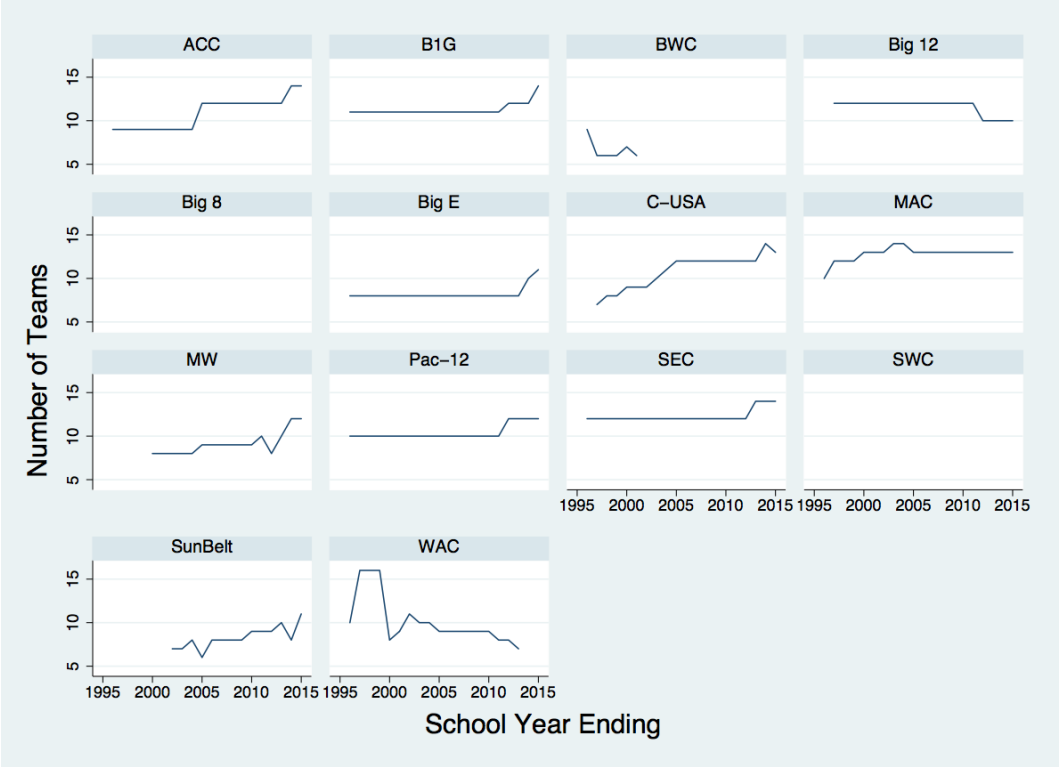

Figure 4: Number of teams per conference

There are 14 conferences in the sample, several of which no longer exist. As expected, the more profitable conferences are the ones that survived. The AAC conference had its first season ending in 2014, while the SWC and Big 8 conferences both dissolved at the beginning of the sample. Note, the AAC data is included with the Big East as it is the legal successor of the original Big East. Of the current conferences, seven exhibit upward trends in number of teams with the remaining either staying flat or showing a downward trajectory toward the end of the sample. This is, in part, driven by the expansion of the larger conferences, as just twenty teams have been added to the FBS during the sample. [1] As such they had to be drawn from other conferences.

[1] During the sample the following teams joined the FBS: Appalachian State, Boise State, Buffalo, UCF, Charlotte, Connecticut, Florida Atlantic, FIU, Georgia Southern, Georgia State, Idaho, Marshall,

First the original equations from Depken's paper were estimated using total revenue and total expenditures at the conference level. Each regression is estimated in the following form:

$$\mathrm{Dep}_{it} = \beta_0 + \beta_1 TEAMS_{it} + \beta_2 TEAMS_{it}^2 + \beta_3 CONFHHI + \epsilon_{it},$$

where Dep_{it} represents revenues or expenditures at the conference level. As a starting point, a subset of the data through 2003 was used to replicate Depken's initial results as seen in Table 3. The outcome is similar, even in light of a smaller data set. It points to twelve as the optimal number of teams, confirming the original results. The confidence interval does not rule out the possibility of 12 being the optimized team number. As expected it is not a whole number, but given that a partial team is impossible, we round up to the nearest whole number.

Table 3: Replication results

	Model 3	**Model 4**
Dependent Variable	TOTALREV	TOTALEXP
TEAMS	107,746.3	31,681.87
(t-statistic)	(4.25)	(3.53)
TEAMS-SQ	-4,630.468	-1,399.587
(t-statistic)	(-5.16)	(-4.32)
CONFHHI	-23.05002	-20.29522
(t-statistic)	(-0.43)	(-1.08)
CONSTANT	-463,161	-86,570.52
(t-statistic)	(-2.04)	(-1.08)
Optimal Number of Teams	~12	
Confidence Interval	[10.25402, 13.01497]	

Massachusetts, Middle Tennessee, Old Dominion, South Alabama, South Florida, Texas Tech, UTSA, Troy, and Western Kentucky.

Next the curves were estimated using the entire dataset. The Feasible Generalized Least Squares method was used to produce these quadratic fits, correcting for heteroskedasticity within panels. The regressions were also estimated adjusting for panel-specific autocorrelation which, as expected, reduced the significance of most variables. Interestingly, it seems that HHI is not statistically significant in either regression at the 10 percent significance level. This could point to a shift in the importance of competitive balance, namely that competitive balance is not as important as other revenue drivers. It may also point to the fact that competitive balance is in a range where fans are insensitive to change.

Table 4: Regression results (in nominal dollars)

	Model 5	**Model 6**		**Model 7**	**Model 8**
Dependent Variable	TOTALREV	TOTALEXP		TOTALREV	TOTALEXP
TEAMS	87.2773	48.26581	TEAMS	111.7866	52.78842
(t-statistic)	(2.45)	(3.10)	(t-statistic)	(4.00)	(4.50)
TEAMS-SQ	-3.350362	-1.791243	TEAMS-SQ	-4.131332	-1.929338
(t-statistic)	(-2.20)	(-2.69)	(t-statistic)	(-3.07)	(-3.38)
CONFHHI	-.0904735	-.0205684	dHHI	-0.1262241	-0.0363
(t-statistic)	(-1.60)	(-0.82)	(t-statistic)	(-2.31)	(-1.47)
CONSTANT	-262.8762	-187.188	CONSTANT	-509.6356	-234.4208
(t-statistic)	(-0.99)	(-1.61)	(t-statistic)	(-3.49)	(-3.86)

Plotting Models 5 and 6 simultaneously gives the figure below (Figure 5) which points to an optimized conference profit at 13 teams. Taken in isolation this would point to a shift in the dynamics of conference size. Based on previous research the optimal number of teams was twelve when rounded to the next whole number.

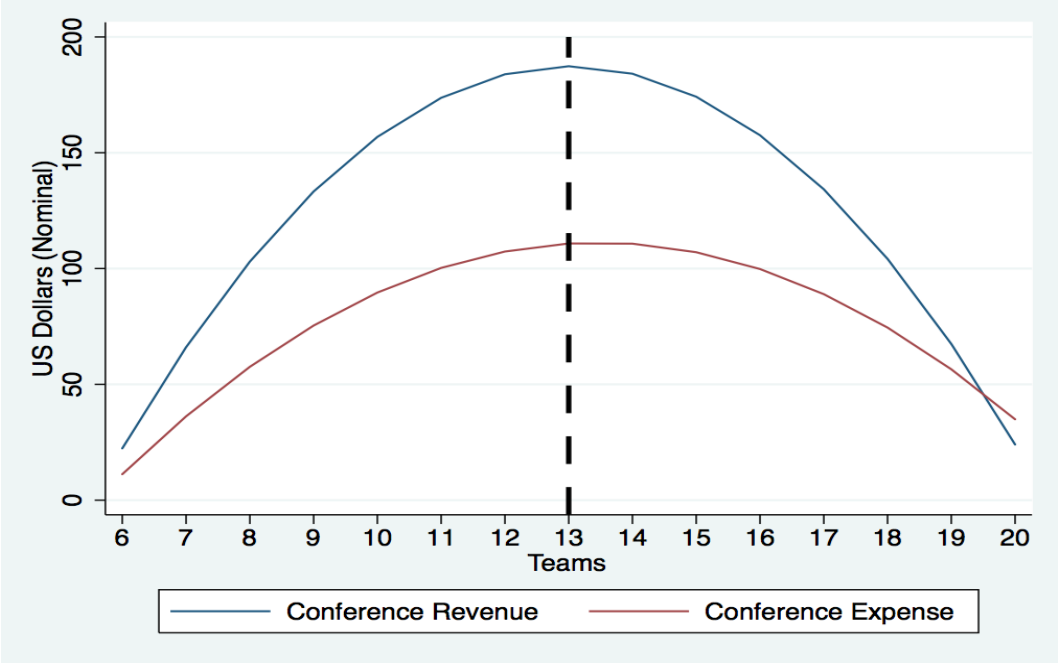

Figure 5: Revenue and expenses

An alternate model was subsequently constructed (Table 5) by adding the distance variable (AVERAGEDIST). At the 1 percent level of significance, AVERAGEDIST is statistically significant for both total conference revenue and total conference expense. This implies that the size of the conference does have an impact on revenues and expenses.

Table 5: Alternate regression results (in nominal dollars)

	Model 9	Model 10		Model 11	Model 12
Dependent Variable	TOTALREV	TOTALEXP		TOTALREV	TOTALEXP
TEAMS	103.0946	50.6831	TEAMS	107.7461	50.01015
(t-statistic)	(3.93)	(3.81)	(t-statistic)	(5.47)	(5.09)
TEAMS-SQ	-3.582606	-1.703101	TEAMS-SQ	-3.72636	-1.674361
(t-statistic)	(-3.45)	(-3.08)	(t-statistic)	(-4.12)	(-3.53)
CONFHHI	-.023883	-0.0037869	dHHI	-0.0504219	-0.0166792
(t-statistic)	(-0.49)	(-0.16)	(t-statistic)	(-1.04)	(-4.29)
DISTANCE (km)	-0.008678	-0.0032068	DISTANCE (km)	-0.0085764	-0.0031531
(t-statistic)	(-7.40)	(-4.39)	(t-statistic)	(-7.19)	(-4.29)
CONSTANT	-418.4968	-216.2821	CONSTANT	-467.0939	-212.8536
(t-statistic)	(-1.98)	(-2.09)	(t-statistic)	(-4.29)	(-4.08)

Based on the regressions in Table 5, it is clear that AVERAGEDIST is statistically significant for both regressions. Interestingly the sign on the coefficient shows a negative relationship with each dependent variable. This would suggest two conflicting relationships. In the total revenue regression this seems to provide empirical evidence that adding far flung schools to the conference lessens the total revenue of the conference. This points to the familiarity hypothesis having some empirical support. On the other hand, the relationship implied between total conference expenses and AVERAGEDIST seems counterintuitive. The negative correlation implies that a conference which is more spread out incurs lower total expenses. Since travel expenses are included in total expenses this points to some unseen relationship or efficiency. Holding all other variables constant and controlling for average distance, the optimal number of teams appears to be 14, which offers empirical evidence that conference dynamics have shifted toward a larger number of teams being optimal.

The next step is to explore the dynamics between average distance of the conference and profitability. To this end an additional term was added, AVERAGEDIST_SQ, which is the average distance statistic squared. This allows for an estimator of the optimal geographic size of a conference. In addition to the AVERAGEDIST_SQ statistic, regressions including conference effects, year effects, and both conference and year effects were also estimated.

For both conference and year effects, F-tests were conducted to determine whether each was jointly equal to zero. The outcome for both tests allows the rejection of the null hypothesis that they are jointly equal to zero with an F value of 17.90 for the year effects and 26.58 for conference effects. This confirms that both are statistically significant, but as addressed earlier including both soaks up too much of the variation in the data set.

The table below shows four models with varying specifications: with no conference or year effects, with conference effects but no year effects, with year effects but no conference effects and lastly a model with both conference and year effects. Note to simplify these equations, the dependent variable, total profit, is constructed as the difference of conference total revenue and conference total expenditures.

Table 6: Alternate model results (contains full sample)

	Model 13	Model 14	Model 15	Model 16
	No effects	Conference effects included	Year effects included	Conference and Year effects included
Dependent Variable	Total Profit	Total Profit	Total Profit	Total Profit
Teams	35,720.04	-85,375.68	43,995.41	-60,395.17
(t-statistic)	(1.19)	(-3.54)	(1.45)	(-2.85)
TEAM-SQ	-644.8645	4,127.291	-1,156.759	2,877.971
(t-statistic)	(-0.42)	(3.81)	(-0.75)	(3.06)
dHHI	-19.02884	-20.86799	-0.572488	23.33256
(t-statistic)	(-0.46)	(-0.85)	(-0.01)	(0.72)
DISTANCE (km)	13.8057	23.92016	4.378711	-6.155859
(t-statistic)	(2.12)	(4.50)	(0.65)	(-1.30)
DISTANCE-SQ	-0.0008477	-0.0009188	-0.0004643	0.0001592
(t-statistic)	(-3.05)	(-4.70)	(-1.66)	(0.89)
CONSTANT	-265,328.6	287,671.8	-281,047.9	216,929.7
(t-statistic)	(-2.12)	(2.71)	(-2.04)	(1.93)
Optimal Number of Teams	27.69577	10.34282	19.01667	10.49267
	[-56.05789, 111.4494]	[9.261, 11.424]	[-5.23, 43.27]	[9.02625, 11.95908]
Optimal Geographic Size	8,143.195	13,017.45	4,715.153	19,338.61
	[5559.99, 10726.4]	[10386.07, 15648.83]	[-4178.133, 13608.44]	[-9247.624, 47924.84]

It is clear that there is some interaction between both number of teams and geographic size. In model 13, which does not account for year or conference effects, the number of teams is not statistically significant while distance is. The optimal number of teams is not

reliable, while the optimal geographic size appears to be slightly higher than sample average of 7,873. In the model containing conference effects, both sets of variables are statistically significant and point to an interesting result. Controlling for distance the optimal number of teams is 11 and the optimal geographic size is 13,017. This suggests that the optimal conference has less teams than the current average of 12.4 and 1.65 times larger geographically. Models 15 and 16 exhibit similar trends, though neither is as well specified as model 13.

It appears that there may be evidence that geographic size does impact the optimal make up of conferences, even when controlling for competitive balance and the number of teams. Importantly the estimated ideal size is significantly larger than the average conference size found in the sample.

CONCLUSION

There are several findings to note, foremost being the replication of Depken's previous study. We were able to confirm twelve as an optimal number of teams for the period in question. Additionally, extending the data series and reproducing Depken's specification indicates an upward shift in the optimal number of teams in a conference. This result suggests that the optimal number of teams in now thirteen and that conference dynamics may have shifted. Our investigation of the impact of geographical footprint on conference profits also yielded interesting results. When accounting for geographical size, the optimal number of teams declines to eleven but the optimal size is roughly 65 percent larger than the sample mean.

As pointed out earlier, there is evidence that geographical footprint has a negative relationship with conference revenue. Interestingly it seems that the relationship between conference profits and competitive balance is not statistically significant in this sample. This could point to a change in the dynamics of conference realignment, or alternatively, that a shift in competitive balance measure has a significant impact. This warrants further study and perhaps indicates the need to test several potential competitive balance measures. If competitive balance does not have a significant impact on revenues, this could offer some evidence that the media hypothesis has some merit.

There are several potential areas for further research, not least of which being the aforementioned further exploration of competitive balance measures. Several constructions of the HHI measure are present in the literature, and each may offer some nuance to the outcome. Additionally there may be other measures of geographical

dispersion worth exploring. Another potential area of exploration is to control for the size of the media market directly affiliated with the schools added to a given conference.

Lastly, given that there is evidence that the number of teams in a conference has impact, examining the impact of being able to shift to a divisional format is worth further investigation.

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APPENDIX A: CONFERENCE STATISTICS

The following tables show the statistics of each conference included in the sample. Of the fourteen conferences included, several have disbanded or reorganized, so the following tables may be informative. All revenue and expense totals are in thousands of US dollars.

Table 7: ACC and B1G

Atlantic Coast Conference (ACC)					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Year	20	2005.5	5.627314	1996	2015
Teams	20	10.85	1.814416	9	14
HHI	20	1199.418	241.668	889.5045	1527.778
dHHI	20	252.989	102.0223	60.7639	416.6667
Total Revenue	20	207,762.6	135,151.4	54,943	538,167.2
Total Expense	20	137,705.1	85,667.81	32,535	307,535.3
Distance (km)	20	5,722.723	2,116.197	3,529.458	9,272.998

Big Ten Conference (B1G)					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Year	20	2005.5	5.91608	1996	2015
Teams	20	11.3	.7326951	11	14
HHI	20	1144.479	81.98728	932.5947	1,239.669
dHHI	20	256.4916	63.52664	123.9669	345.3422
Total Revenue	20	343,780	162,751	118,281	660,740
Total Expense	20	159,113.1	84,302.91	36,899	344,047.7
Distance (km)	20	5,363	934.0229	4,989.069	8,868.262

Table 8: BWC and Big-12

Big West Conference (BWC)					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Year	6	1998.5	1.870829	1996	2001
Teams	6	6.666667	1.21106	6	9
HHI	6	2,082.407	242.1717	1,700	2,355.556
dHHI	6	548.0159	272.953	244.4444	972.2222
Total Revenue	6	12,781.14	1,942.682	10,454	14,935.19
Total Expense	6	15,123.38	1,964.013	12,860	17,493.32
Distance (km)	6	7,836.308	2,653.732	6,120.635	12,866.14
Big 12 Conference (Big-12)					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Year	19	2006	5.627314	1997	2015
Teams	19	11.57895	.8377078	10	12
HHI	19	1,129.911	94.48497	1,003.748	1,348.148
dHHI	19	261.4903	44.9954	170.4151	348.1482
Total Revenue	19	291,836.4	124,547.7	104,324	476,297.2
Total Expense	19	141,785.6	58,136.97	54,466	233,344.6
Distance (km)	19	7,5211.104	457.445	5,765.268	7,686.221

Table 9: Big 8 and Big East

Big 8 Conference (Big 8)					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Year	1	1996	-	1996	1996
Teams	1	8	-	8	8
HHI	1	1,692.042	-	1,692.042	1,692.042
dHHI	1	442.0425	-	442.0425	442.0425
Total Revenue	1	55,549	-	55,549	55,549
Total Expense	1	33,949	-	33,949	33,949
Distance (km)	1	3,680.323	-	3,680.323	3,680.323
Big East Conference (BIG EAST)					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Year	20	2005.5	5.91608	1996	2015
Teams	20	8.25	0.7863975	8	11
HHI	20	1,577.469	148.8041	1,198.347	1,760.204
dHHI	20	357.0145	103.4901	153.0613	510.2041
Total Revenue	20	115,879.8	35,567.75	44,788	165,324.4
Total Expense	20	93,683.61	35,929.84	24,244	151,252.2
Distance (km)	20	6,090.182	1,893.819	5,366.868	12,190.28

Table 10: C-USA, MAC and MW

Conference USA (C-USA)					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Year	19	2006	5.627314	1997	2015
Teams	19	10.84211	1.951158	7	14
HHI	19	1,249.177	327.8245	969.5291	2,066.116
dHHI	19	293.6767	155.6653	150	816.1157
Total Revenue	19	76,458.51	33,878.49	24,157	125,361.3
Total Expense	19	75,184.63	31,824.92	27,041	121,565.2
Distance (km)	19	10,082.13	2,475.297	5,182.386	14,449.29
Mid-American Conference (MAC)					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Year	20	2005.5	5.91608	1996	2015
Teams	20	12.8	.8335088	10	14
HHI	20	1,041.909	93.86714	920	1,343.75
dHHI	20	257.0193	54.82717	150.7692	343.75
Total Revenue	20	46,854.18	31,125.78	6,597	94,658.06
Total Expense	20	56,113.19	25,264.78	14,518	94,205.35
Distance (km)	20	4,480.772	1,010.713	2,289.323	6,423.982
Mountain West Conference (MW)					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Year	16	2007.5	4.760952	2000	2015
Teams	16	9.125	1.310216	8	12
HHI	16	1,427.442	173.7076	1,037.068	1,760.204
dHHI	16	312.8583	96.41205	178.5714	510.2041
Total Revenue	16	70,310.94	29,335.13	34,237.94	120,312.8
Total Expense	16	63,182.85	23,956.03	32,282.26	103,166.6
Distance (km)	16	7,989.001	4,105.804	4,899.038	16,547.23

Table 11: PAC-12, SEC and SunBelt

Pacific-12 Conference (PAC-12)					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Year	20	2005.5	5.91608	1996	2015
Teams	20	10.4	.8207827	10	12
HHI	20	1,218.986	98.53228	1,026.786	1,325
dHHI	20	252.3193	56.32245	140.7407	325
Total Revenue	20	234,866.8	118,821.8	95,450	505,981.4
Total Expense	20	138,107.1	65,057.78	47,842	265,393.4
Distance (km)	20	9,174.06	1,015.404	8,670.213	11,153.45
Southeastern Conference (SEC)					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Year	20	2005.5	5.91608	1996	2015
Teams	20	12.3	.7326951	12	14
HHI	20	1,076.229	72.47725	901.8159	1,216
dHHI	20	260.7524	51.77771	170.4151	382.6667
Total Revenue	20	443,889.1	220,052.4	150,757	899,550.9
Total Expense	20	181,825	106,633.5	47,585	404,589.5
Distance (km)	20	6,675.958	888.7899	6,312.046	8,738.13
Sun Belt Conference (SunBelt)					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Year	14	2008.5	3.89444	2002	2015
Teams	14	8.285714	1.266647	6	11
HHI	14	1,548.723	220.1322	1,234.568	1,947.07
dHHI	14	315.4202	100.1217	123.4568	462.963
Total Revenue	14	37,282.24	19,343.41	13,584.2	70,326.77
Total Expense	14	38,336.82	16,490.66	17,391.1	70,080.08
Distance (km)	14	7,148.809	2,250.546	3,075.342	12,679.2

Table 12: WAC and SWC

Western Athletic Conference (WAC)					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Year	18	2004.5	5.338539	1996	2013
Teams	18	10.16667	2.833622	7	16
HHI	18	1,376.553	327.524	755.0296	2,063.492
dHHI	18	335.4178	126.0256	130.0296	634.9205
Total Revenue	18	45,277.14	11,290.15	22,581.26	62,494.34
Total Expense	18	44,916.14	8,866.967	25,188	59,849.62
Distance (km)	18	17,764.42	3,926.369	9,208.896	24,281.1
Southwest Conference (SWC)					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Year	1	1996	-	1996	1996
Teams	1	8	-	8	8
HHI	1	1,659.808	-	1,659.808	1,659.808
dHHI	1	409.808	-	409.808	409.808
Total Revenue	1	43,730	-	43,730	43,730
Total Expense	1	20,964	-	20,964	20,964
Distance (km)	1	2,166.444	-	2,166.444	2,166.444

APPENDIX B: CONFERENCE FOOTPRINTS

The following graphics help illustrate the size of individual conferences. The geometric figures represent a rough approximation of the size of conferences themselves. Each figure is created by using the schools located at the edge of each conference, such that the figure created contains all other members of the conference. This differs from the distance metric used in the research conducted earlier, but is meant to give the reader a basis for the size discrepancy between conferences. Additionally it helps illustrate the regional nature of the conferences as well as the overlap between competing conferences.

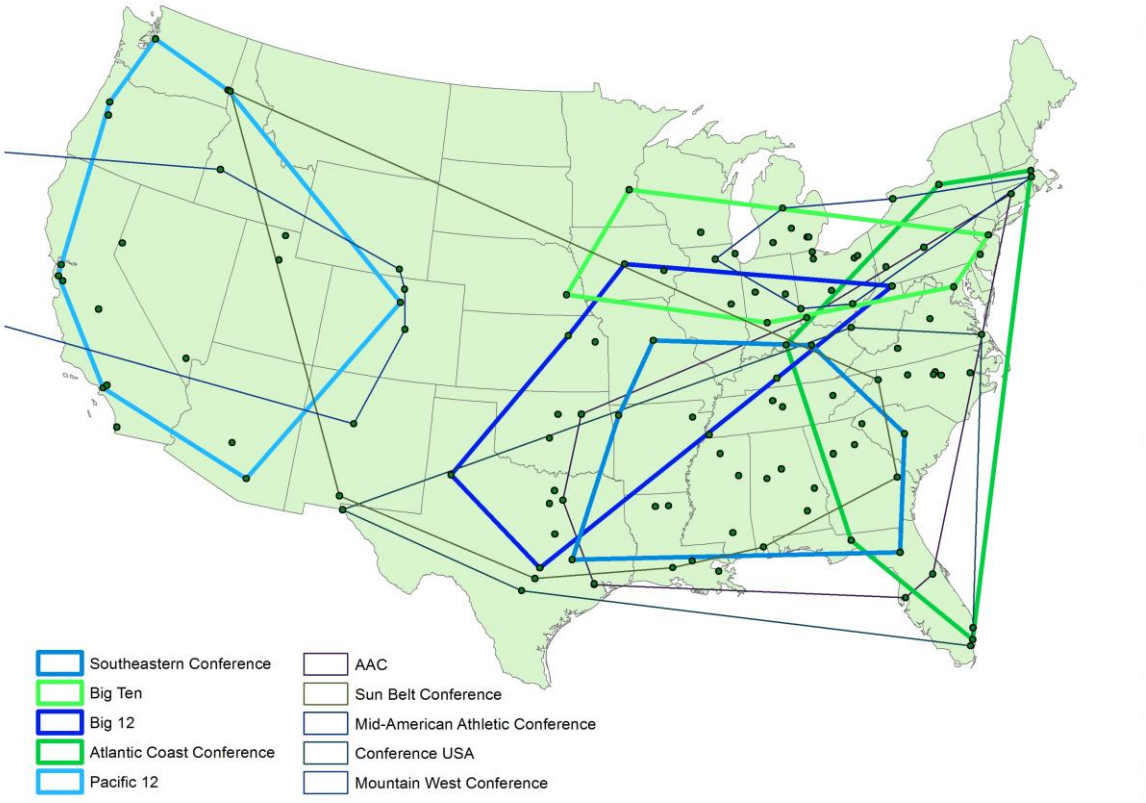

Figure 6: All FBS conference footprints

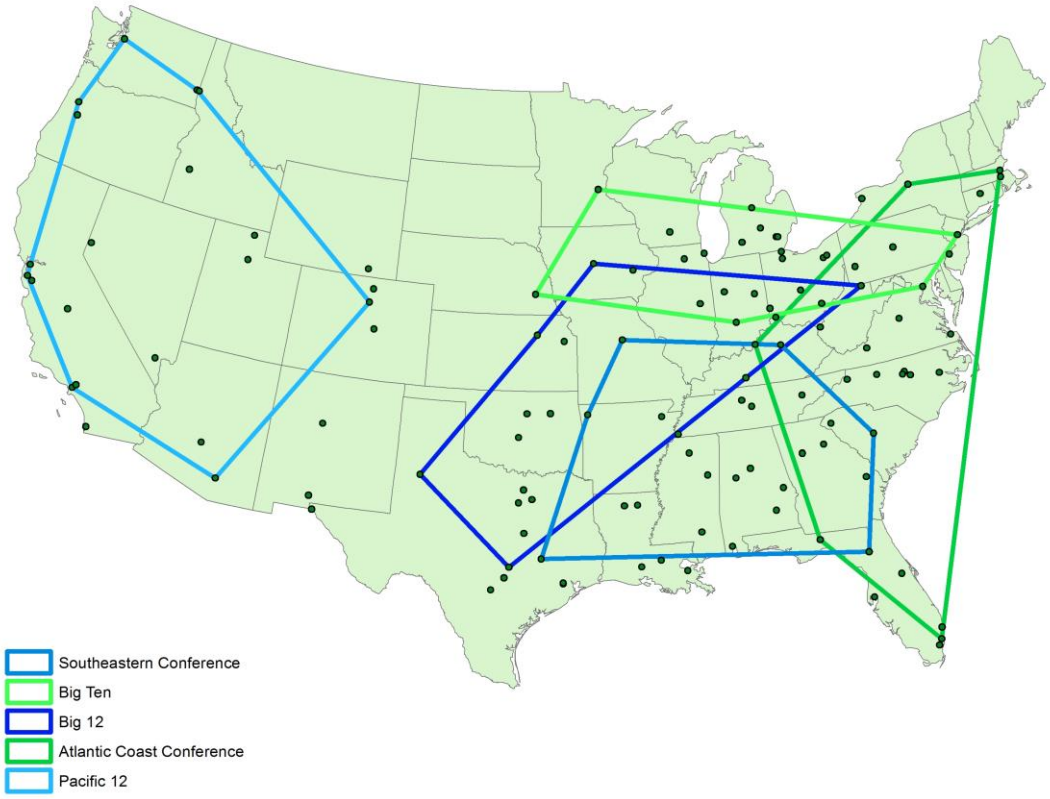

Figure 7: Power 5 conference footprints

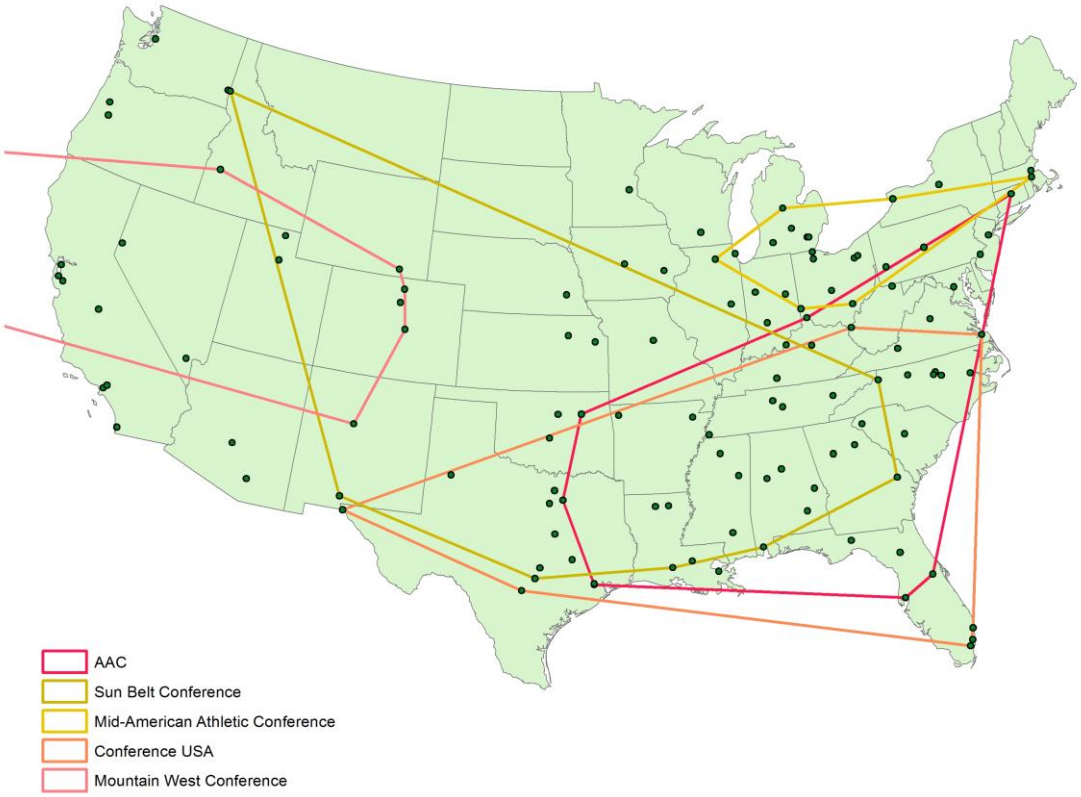

Figure 8: Mid-major conference footprints