

Unraveling Yields Inefficient Matchings:
Evidence from Post-Season College Football Bowls¹

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Abstract:

Many markets have “unraveled” and experienced transactions at dispersed and apparently inefficiently early times. Often these markets develop institutions to coordinate and delay the timing of transactions. However it has proved difficult to gather data that allows the efficiency gains to be identified and measured. The present paper considers a market for which such data can be gathered.

Prior to 1992, college football teams were matched for post-season play, in “bowl” games, up to several weeks before the end of the regular football season. Since 1992, the market has undergone a series of reorganizations that postpone this matching until the end of the regular season. We show that this has promoted more efficient matching of teams, as measured by the resulting television viewership. The chief driver has been the increased ability of later matching to produce “championship” games.

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1. Introduction

Many market institutions have evolved to coordinate the timing of transactions, and, in particular, to prevent them from taking place too early, or at uncoordinated times. Some prominent examples of markets in which early transactions have been a problem are markets for new physicians, for new law graduates (particularly those who seek to become clerks to Federal appellate judges), and for undergraduate college admissions.⁵ At some points in the history of each of these markets, transactions have unraveled, i.e. have tended to be finalized earlier and earlier in advance of when the transacted relationship would begin (i.e. increasingly before graduation from medical school, law school, or high school).

There are good theoretical reasons for believing that early transactions may be (at least ex-post) inefficient; if information that is important to determining match quality evolves over time. In such markets, transactions arranged before critical information (such as transcripts of grades) becomes available will not be able to achieve matchings as efficient as could be made after the necessary information was available.⁶

However, except for evidence from laboratory experiments, there has so far been no direct evidence confirming that unraveling results in inefficiently early matches (i.e. confirming that unraveling occurs even when it is inefficient).⁷ This is largely because of the difficulty of measuring production, and how it varies with match quality, in medicine, law, education, etc. For instance, there has been no way to measure the effect, on the quality of American health care, of changes in the times at which resident physicians are hired by hospitals, or even on a narrower measure of efficiency like physician wages.

⁵ See e.g. Roth (1984, 1991), Avery, Jolls, Posner, and Roth (2001), Avery Fairbanks and Zeckhauser (2003). Roth and Xing (1994) discuss many other examples of such markets, including many centralized market mechanisms, while Niederle and Roth (2004) consider informal “market cultures” that influence transaction times.

⁶ For theoretical models expanding on this point, see e.g. Roth and Xing (1994), Li and Rosen (1998), Li and Suen (2000, 2004), Suen (2000).

⁷ For laboratory experiments in which early transactions occur despite being inefficient, see Kagel and Roth (2000), Haruvy, Roth, and Ünver (2001), McKinney, Niederle, and Roth (2004), and Niederle and Roth (2004). While experiments are well suited to showing that unraveling can occur even when it is inefficient, they do not demonstrate that the unraveling observed in the particular natural markets of interest is also necessarily inefficient. Nor do they give us any way to assess the *magnitude* of the inefficiency observed in natural markets.

The same can be said for the production of justice by judges and their clerks, the quality of education produced by colleges and undergraduates, etc.

Niederle and Roth (2003, 2004) took advantage of a disruption in the market for gastroenterologists to observe that periods in which transactions were made relatively early were marked by a decrease in the *scope* of the market. Gastroenterology fellows typically begin work after completing three years of internal medicine residency, and during periods in which contracts were signed relatively late, the market was more national in scope than when contracts were signed early. During periods in which contracts have been signed early, gastroenterologists were more likely to pursue their careers in the same local market in which they were internal medicine residents. So Niederle and Roth showed that a change in the timing of the market led to a change in the outcomes it produced. But, while a breakdown of the national market into local markets is likely to deprive the market of its ability to find the most efficient matches, Niederle and Roth's data do not show this directly, either in the narrow sense of medical revenues, nor in the wider sense of reduced incidence of gastroenterological disease.

We consider the market for post-season college football games, called "bowls." In the early 1990's, the determination of which teams would play each other in which bowls was often made when several games still remained to play in the regular fall season (cf Roth and Xing, 1994). This meant that the teams with the best end-of-regular-season records might not play one another, because at the time the matchings were determined it wasn't yet known which teams these would be. Over the last decade this market has undergone a number of reorganizations that have delayed this matching decision until the end of the Fall season.

Using Nielsen rating data on television viewership, and the AP Sports Writers' poll of team rankings, we will show that, by matching later, the chance of matching the best teams has increased, and the result is an increase in television viewership. Television viewership is related to both the broad measure of efficiency in terms of how much entertainment is provided by the games, and the narrow measure in terms of how much revenue accrues to the bowls and football conferences and teams associated with the organization of late season matching. Because there has been variation over the years in the rankings of matched teams, we will also be able to infer how different components of

the post season matches contribute to total television viewership of the bowl games. Efficient matching, it turns out, is at least partially assortative, and is especially sensitive to the presence of a “championship” game matching the two teams that are highest ranked at the end of the regular season.

The present paper provides, as far as we know, the first direct evidence and measurement of the inefficiency due to early transaction times in a naturally occurring market. When the bowl games have matched later, the quality of the teams matched to bowls has improved, the likelihood of a championship game has increased, and the total viewership of all the bowls in the late-matching consortia has increased.

2. Short History of College Bowls and Unraveling

Throughout the Fall of each year, college football teams play each other every weekend, and are ranked the following week in widely publicized polls of coaches and sports writers.⁸ After the end of the regular season, selected teams meet each other in postseason games, called bowls, which are played in late December and early January.

The bowls are independent businesses, each of which controls a stadium and makes contracts with corporate sponsors. Prior to 1992, most bowls had long-term contracts with football conferences. The Rose Bowl was a “closed” bowl, in which the champion of the Big Ten and Pacific Ten football conferences played each year.⁹ The Fiesta Bowl was an “open” bowl, which each year needed to find two teams to play against each other. The other major bowls were “semi-closed,” with a contract to host the champion of a particular conference, and needing to find a suitable opposing team.¹⁰

⁸ The Sports Writers’ Poll is sponsored by the Associated Press (AP). The (Division I-A) Coaches’ Poll is today sponsored by USA Today/ESPN, and was sponsored from 1950-1990 by the United Press International (UPI), and from 1991-1996 by USA Today/CNN.

⁹ The latter was previously called the Pacific Eight and Pacific Coast conference. The name changes reflected the changing team membership.

¹⁰ The champion of the Big Eight conference (now enlarged to the Big Twelve) played in the Orange Bowl, the Southeastern conference champion in the Sugar Bowl, Southwest in the Cotton Bowl, and the Atlantic Coast Conference (ACC) champion in the Citrus bowl (with some escape clauses in case the ACC champion was ranked highly enough in the UPI Coaches’ Poll to be a contender for the unofficial postseason “national championship” ranking in the AP Sports Writers’ and UPI Coaches’ polls following the bowl games). Not all teams belong to conferences; the independent teams included traditional football powers Notre Dame, Penn State (joined Big Ten in 1990), and Miami (joined Big East in 1991, moved to ACC in 2004).

The National Collegiate Athletic Association (NCAA) tried for a number of years to prevent unraveling of the dates at which bowls and teams finalized agreements about which teams would play in which bowls. However it gave up in failure following the 1990-91 football season, in which early matching (once again) led to poorly matched teams.¹¹ In particular, there was growing concern that interest in the bowl games was waning, and in particular that poor matches led to a lack of consensus on a “national champion” that would result if there were a bowl game in which the number 1 and 2 ranked teams played one another.

To summarize the situation prior to 1992, several institutional features prevented good bowl matches. The Rose Bowl was not involved in unraveling, since it had a long-term contract that brought it two conference champions. But because it dealt with only two conferences, these conference champions might not be closely ranked to one another (and would very seldom be the two highest ranked teams nationally). The other major bowls dealt with a substantial pool of conferences and teams, but because of unraveling of bids for their open slots, these were filled without knowing the end-of-season ranks of the teams invited to play. And because many bowls had one position reserved for a particular conference champion, this also limited the matching flexibility of each bowl, and of the market as a whole.

The decision of the NCAA to no longer try to prevent unraveling prompted a rapid reorganization of the market, as consortia of bowls and (enlarged) conferences formed to permit later matchings of teams and bowls. While there have been almost yearly changes in some of the details of how this market reorganization has proceeded (including changes in which teams belong to which football conferences), the major

¹¹ Through the 1990-91 season, the NCAA specified a date (colloquially called “Pick-Em Day”) before which bowls and teams were forbidden to sign agreements. However this agreement was widely and publicly flouted, and the NCAA abandoned its attempt to control this market after the 1990-91 season, in which, with four games still to go in the regular season, Notre Dame agreed to meet still undetermined Big Eight champion in the Orange Bowl, Virginia agreed to play in the Sugar Bowl against the still undetermined Southeastern Conference champion, and Miami agreed to play in the Cotton Bowl against the still to be determined Southwest Conference Champion. At the time of the agreement, Notre Dame was the number 1 ranked team in the nation, but between the agreement and the end of the season they lost a game and fell to number 5. Virginia lost two games, and fell entirely out of the top 25 AP rankings, and to 23 in the UPI poll. (See Roth and Xing, 1994, and, for accounts of prior years, e.g. Barnhart 1989, Harig 1990.)

changes can be grouped into three periods, called the Bowl Coalition, the Bowl Alliance, and the Bowl Championship Series.

The Bowl Coalition (BC) (1992-1994): The Sugar, Fiesta, Orange and Cotton Bowls, and the Atlantic Coast (ACC), Big East, Big Eight, Southeastern and Southwest Conferences and Notre Dame, organized to form the Bowl Coalition. Their agreement was that if the top two teams in the pool were from the Big East, ACC, or Notre Dame, they would play each other in the Fiesta Bowl. Otherwise the bowl whose host team (under the pre-existing semi-closed bowl agreements) was the highest ranked would get the highest ranked of the Big East, ACC, or Notre Dame teams, and the remaining teams would be allocated in order of rankings. The remaining teams needed to complete the four bowl matchups were to be selected among at-large teams. The Bowl Coalition also had agreements with some other bowls, known as Tier Two bowls, to place its conference runner-ups in a guaranteed bowl berth.

The Bowl Alliance (BA) (1995-1997): The Bowl Coalition format had not permitted a championship game to be played if the top two teams were the champions of two different conferences such as the Southeastern and Big Eight Conference. Hence three of the BC bowls, Fiesta, Sugar and Orange, and all of the BC conferences created the Bowl Alliance. A rotation system was agreed upon in which each year a different bowl had the first two choices, while a second bowl had the third and fifth choices and the third bowl would chose fourth and sixth. The tie-ins of conferences with bowls were de-emphasized. This format provided flexibility in creating the postseason matchups between the Alliance partners. Moreover, after the first year, the Southwest Conference was dissolved; therefore two at-large berths were available among the six positions available in the three bowls besides the champions of the ACC, Big East, Big Twelve (the mega conference which included several of the teams of the former Southwest Conference and all teams of the Big Eight) and Southeastern Conferences. In addition, Notre Dame was guaranteed a berth in a BA Bowl whenever they finished the season in the top ten.

Bowl Championship Series (BCS) (1998-present): The Bowl Alliance had left out the Rose Bowl, Big Ten and Pacific Ten Conferences (and thus precluded a championship game when these two conferences had exactly one of the top two teams).

With this in mind, all four conferences and the bowls of the Bowl Alliance joined with the Rose Bowl, Big Ten and Pacific Ten Conferences to create the Bowl Championship Series. As in the Bowl Alliance, the tie-ins between the participating conferences and bowls were de-emphasized. There are four bowls in the BCS: the Sugar Bowl, the Rose Bowl, the Fiesta Bowl, and the Orange Bowl. Two of the bowls are played on January 1st, one on January 2nd and the “national championship” is played on January 4th. The championship bowl is rotated between the different bowls, as in the Bowl Alliance, for example, the Rose Bowl will have the national championship game once every four years. A new BCS ranking system was created, with the particular aim of allowing a bowl matching whose winner would be recognized as a national champion.¹² The bowl designated for the championship game in a given year is obliged to select the top 2 BCS-ranked teams. The winners of the 6 major conferences (Big East, ACC, Southeastern, Big Twelve, Big Ten, Pacific Ten) are guaranteed automatic BCS bowl appearances. There

¹² BCS rankings are different from the AP Sports Writers’ or USA Today/ESPN Coaches’ Poll rankings, which are determined by surveying members, in the sense that surveys are only a part of the rankings, which consist of:

Polls: This part of the BCS ranking is the average of the teams’ ranks in the AP Sports Writers’ and USA Today/ESPN Coaches’ Poll. For example, a team ranked number one in one poll and number two in the other would receive 1.5 points.

Computer rankings: Seven computer rankings are used. Jeff Sagarin (USA Today), Dr. Peter Wolfe, Richard Billingsley, Colley Matrix, Kenneth Massey, Anderson & Hester and the New York Times (NYT). The computer component is determined by averaging six of the seven computer rankings; the lowest (worst) computer ranking is disregarded.

Strength of Schedule: This is the cumulative won/loss records of a team's opponents and the cumulative won/loss records of the team's opponents' opponents. The formula gives weights of 2/3 for the opponent's record, and 1/3 for the opponents' opponents record. A team's schedule strength is calculated to determine which quartile it will rank. 1-25, 26-50, 51-75, 76-100 and is further quantified by its ranking within each quartile (divided by 25). For example, if a team's schedule strength rating is 28th in the nation, that team would receive 1.12 points (28 divided by 25 = 1.12). All wins, unless used in the once every four year exemption, will be thrown out, but the losses will count.

Team Record: Each loss is one point.

Quality Wins: The quality win component rewards to varying degrees teams that defeat opponents ranked among the top 10 in the BCS standings. A team that beats the No. 1 ranked team will have 1.0 point deducted from its BCS score. A team that beats the No. 10 ranked team will have 0.1 points deducted from its score. If a team defeats a top-10 BCS team twice in one season, the victorious team receives quality win points only once.

Through the 2003 season, all five components were added together for a total rating. Starting from the 2004 season, the formulation was changed to take into account only polls (scoring was modified for the polls as well) and computer rankings (with the exception of the NYT poll). The team with the lowest point total ranks first in the BCS rankings, the team with the second lowest total ranks second in the BCS rankings, and so on.

Hence the No. 1 team in the AP Sports Writers’ or USA Today/ESPN Coaches’ Poll may easily not be the No. 1 team in the BCS rankings. For example in 2003 USC was No. 1 in the AP Sports Writers’ Poll and No. 3 in the BCS rankings.

are 2 “at-large” berths which can be granted to teams in those conferences that did not win their championship, to teams belonging to mid-major conferences, or to independent teams such as Notre Dame.¹³ Thus, from 1992 to the present, the market for postseason football bowls has undergone a number of changes, in the direction of allowing individual bowl matchings to be arranged after the end of the regular season, when all of the information from the regular season games is available, and from a large pool of teams, without constraints caused by traditional relationships between particular bowls and conferences (See Table 1).

3. Measuring Efficiency

A narrow measure of the welfare generated by a bowl game is the revenue it generates. A broad measure concerns the entertainment delivered to viewers of the game. These are of course connected, since more viewers mean more advertising revenues, and so TV networks pay more for more widely watched games. In the post 1991 era of bowl coalitions, the revenue from the coalition bowls is equally distributed among the participating conferences.¹⁴ The revenue accruing to the conferences is divided among the teams in the conference.

We use TV ratings measured by Nielsen Media Research Company as a proxy for both measures of welfare. A rating point corresponds to 1 percent of the whole TV audience in the USA tuning in to watch a game.¹⁵ We control the change in TV viewer population over years using the percentage system adopted by Nielsen. We obtained the ratings from Nielsen Media Research. We will use these data to investigate what kind of

¹³ Due to the nature of the BCS rankings, a team which did not win its conference can play in the national championship game. This happened twice. In the 2003 season, Oklahoma went to the BCS title game despite being defeated in the Big Twelve championship game by Kansas State. In 2001, Nebraska made the BCS title game despite not even qualifying for the Big Twelve championship game.

¹⁴ With two exceptions: (1) the Rose Bowl provides a separate purse for the conferences, and (2) a second team in the BCS bowls from the same conference brings additional revenue for that conference.

¹⁵ A rating point is calculated for the whole potential TV audience, but not for the fraction of the potential audience currently watching TV. The data for the Nielsen Media Research national ratings service in the United States are collected through electronic measurement meters. These meters are placed in a sample of 5,100 households in the U.S., randomly selected and recruited by Nielsen Media Research. A meter is placed on each TV set in the sample household. A meter measures two things - what program or channel is being tuned and who is watching. Meters are used to collect audience estimates for broadcast and cable networks, nationally distributed syndicated programs and satellite distributors. See <http://www.nielsenmedia.com> for further information.

Table 1. Summary of Matchups in College Bowls

		Rose Bowl	Fiesta Bowl	Orange Bowl	Sugar Bowl	Cotton Bowl
Starting Year		1902	1971	1935	1934	1937
Matchups prior to Bowl Coalition Era (- 1992)	First Team	Since 1947 - Champion of Big Ten Conference	Until 1978 – Champion of Western Conference Starting 1978 – At Large Team	Champion of Big Eight (Twelve) Conference	Champion of Southeastern Conference	Champion of Southwest Conference
	Second Team	Since 1947 - Champion of Pacific Ten (Coast or Eight previously) Conference	At Large Team	At Large Team	At Large Team	At Large Team
Matchups in Bowl Coalition Era (1992-1994)	BC Bowl?	No	Yes	Yes	Yes	Yes
	First Team	Champion of Big Ten Conference	At Large Team possibly to create 1 – 2 matchup	Champion of Big Eight (Twelve) Conference	Champion of Southeastern Conference	Champion of Southwest Conference
	Second Team	Champion of Pacific Ten Conference	At Large Team possibly to create 1 – 2 matchup	At Large Team possibly to create 1 – 2 matchup	At Large Team possibly to create 1 – 2 matchup	At Large Team possibly to create 1 – 2 matchup
Matchups in Bowl Alliance Era (1995-1997)	BA Bowl?	No	Yes	Yes	Yes	No
	First Team	Champion of Big Ten Conference	2 At Large Teams, ACC, Big East, Big – Twelve, Southeastern conference champions possibly to create 1-2 matchup in one of these bowl games			First Team from Big – Twelve Conference not going to BA Bowls
	Second Team	Champion of Pacific Ten Conference				A team from Pacific Ten or Western Conferences out of BA Bowls
Matchups in Bowl Championship Series Era (1998-)	BCS Bowl?	Yes	Yes	Yes	Yes	No
	First Team	ACC, Big East, Big Twelve, Big Ten, Pacific Ten, Southeastern conference champions, up to 2 highly ranked other conference or at large teams (with Notre Dame having priority) always to create always 1-2 matchup in BCS rankings in one of these bowl games				First team from Big – Twelve Conference out of BCS Bowls
	Second Team					A comparable team from Southeastern Conference

matching maximizes viewership. We will see that a partially assortative matching, that leads to a championship game and to the remaining highly ranked teams being spread among the bowls is more efficient than a matching that divides the teams among the bowls without producing a championship game. Thus the move towards later matching will turn out to have increased the efficiency of the resulting matches.

4. Data Analysis

The data consist of the Associated Press (AP) Sports Writers' end of regular season rankings of NCAA division I-A teams that played in the five bowls that were involved in a given year with either the Bowl Coalition (BC: 1992-1994), the Bowl Alliance (BA: 1995-1997) or the Bowl Championship Series (BCS: 1998-2002) (see Table 7 in the Appendix 1).¹⁶ These bowls are the Sugar, Fiesta, Rose, Orange, and Cotton bowls. The data cover all seasons since 1977. As of 1985, we also have the Nielsen ratings for each bowl, the regular season average Nielsen rating and the Super bowl Nielsen rating (see Table 8 in the Appendix 1).

Table 2. Probability of top 2 teams ending the season as top 2 in AP Poll

1 Week Prior	2 Weeks Prior	3 Weeks Prior	4 Weeks Prior
0.69	0.58	0.31	0.31

Table 2 shows how difficult it is to pick a championship game before the season ends. We look 1, 2, 3, and 4 weeks prior to the end of season for all years in the sample (1977-2002) and find the top 2 teams in that week (in the AP Sports Writers' Poll). Table 2 shows the probability that these two teams will be top 2 teams when the season ends. The top two teams 3 and 4 weeks prior to the end of season, will still be the top two teams when the season ends only 31% of the time. These probabilities increase to 58% and 69% 2 weeks and 1 week prior to the season ending, respectively. Hence 1-2 matchups determined 3-4 weeks before the end of the regular season (as became common

¹⁶ The AP Sports Writers' Poll is only one of the possible choices. One could also use the USA Today/ESPN Coaches' Poll or one of the many computer rankings. We chose the AP because it is a well established ranking and for reasons of data availability. Of course, many of the arguments we will make would be even easier to make (although almost tautological) if we used the BCS ranking. We obtained the weekly and end-of-regular-season AP Poll rankings and bowl matchup data from NCAA (2003) and Weekly AP Poll Rankings at <http://2cuz.com/weeks/weeks.html>.

prior to the formation of the Bowl Coalition in 1992) have very little chance of turning into real championship games when the season ends.

Not surprisingly, in the pre-coalition era, 1-2 matchups were the exception rather than the norm (see Table 7 in the Appendix 1). Between 1977 and 1991, there were only 4 championship games (in 15 years). The different coalitions that followed had mixed success, the BC produced championships in two of its three years, the BA had only one out of three, and the BCS had three out of five.

Note that the explanation for the lack of championships in the pre-coalition era is not primarily that the number 1 and 2 teams were in other Bowls than the ones we are considering. For our entire sample, there are only two years when one of the top two teams did not play in the 5 Bowls we consider: 1984 when the number 1 team (Brigham Young) played in the Holiday Bowl, and 1990 when the number 2 team (Georgia Tech) played in the Florida Citrus Bowl. So the top two teams almost always played in one of the current four BCS Bowls over our sample of years. (The Cotton Bowl hosted one of the two top teams only twice: the number 1 team in 1977 and the number 2 team in 1983.)¹⁷

This can be seen in Table 3, specification (1), which reports estimates of a probit where the dependent variable takes value 1 if there was a championship that year in that bowl (C) and the regressors are the different coalitions and year is entered linearly.¹⁸ The results indicate that both the BC and BCS succeeded at increasing the likelihood of a matchup between the number 1 and number 2 ranked teams. In fact, all three coalitions exhibit a positive coefficient estimate, although it is not statistically significant for the BA.^{19, 20} If a single dummy variable is specified to pick-up the effect of the coalitions

¹⁷ If we confine attention to the four BCS bowls, in the eleven years prior to 1992 the number 1 team was missing once, the number 2 team twice, and the number 3 team three times. In contrast, in the eleven years since 1992, the numbers 1,2,and 3 ranked teams at the end of the regular season have always played in one of the four BCS bowls.

¹⁸ That is $C_{B,Y} = 1\{a + b_1\text{Year} + d_1BC_{B,Y} + d_2BA_{B,Y} + d_3BCS_{B,Y} + e_{B,Y} \geq 0\}$, where $1\{\}$ is an indicator function taking value one if the statement inside the bracket is true and zero otherwise and $e_{B,Y}$ has the standard normal distribution function. The standard errors are corrected for correlations across bowls in a given year (see StataCorp (2001) for details of the specific correction used). Time is entered linearly because using time dummies leads to many perfectly predicted outcomes.

¹⁹ Note that this is where using the BCS rankings would make the exercise trivial. Of course, the BCS has increased the probability of a one-two matchup according to its own ranking since it is set up to ensure that outcome.

(that is a variable equal to BC + BA + BCS) in a regression like that of specification 1, then its coefficient estimate is 1.130 and it is statistically significant at the 1% level.

Table 3. Probit Estimates of the Effects of Coalitions on Championships

<i>Regressors</i>	Championship Spec. (1)
Year	-0.052*
	(0.031)
BC (1992-1994)	1.166***
	(0.442)
BA (1995-1997)	1.064
	(0.660)
BCS (1998-2002)	1.462**
	(0.594)
Constant	101.842
	-62.425
Observations	130
Clustered standard errors in parentheses	
* significant at 10%; ** significant at 5%; *** significant at 1%	

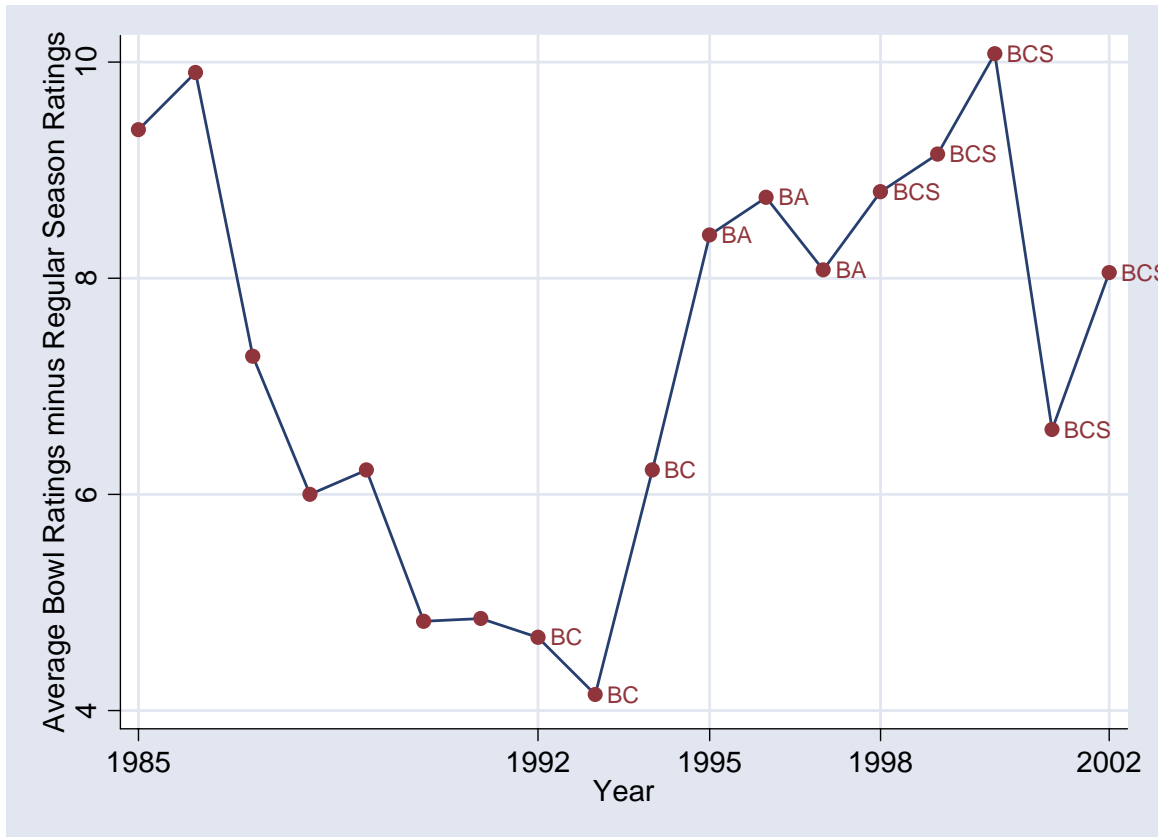
The effect that the coalitions have had on the probability of a championship is clear. The observations made from analyzing the results of specification (1) can be confirmed by simpler tests. Comparing the proportion of the years when there was a championship, the hypothesis that there were as many prior to 1992 as after can be rejected (Two-sample test of proportion, one-sided, 10% level). Similarly, the same conclusion can be reached comparing the BCS years to the pre-1992 era.

Another effect of the coalitions has been to improve the rankings of the teams playing in the top Bowls. For instance, although the Orange and Sugar Bowls have had the number 1 and 2 teams play slightly less often since the first coalition (the Orange Bowl has received the number 1 (2) team 7 (5) times in the 15 years prior to the BC and 3 (2) times in the 11 years after, and these numbers are 3 (6) and 3 (3) for the Sugar Bowl), the Rose and Fiesta Bowls have had an important increase: 1 (1) to 2 (2) for the Rose Bowl and 2 (1) to 3 (4) for the Fiesta. Overall, regressions provided in Appendix 2 (Table

²⁰ These results are robust to the exclusion of the Cotton Bowl from the sample.

11) show that, the rank of the best and worst teams in the BCS Bowls are better than in the period prior to the BC.²¹

Figure 1. Average Normalized Nielsen Ratings in BCS Bowls



In Figure 1, we can see the evolution of the average Nielsen ratings per year in the BCS Bowls, normalized by subtracting the average regular-season college football ratings for that year. As Figure 1 indicates, aggregate statistics suggest that the reorganizations after 1992 reversed the declining trend in the relative popularity of bowl games as measured by television viewership. Since the first Bowl Coalition, the fall in ratings in the Bowls as compared to the regular season seems to have stopped.²² This is confirmed in Table 4 which presents regression estimates of the average Nielsen ratings in the top four Bowls (Sugar, Fiesta, Rose, and Orange) on different specifications that indicate the correlation between those coalitions and the ratings controlling for time

²¹ This can be established directly for the best team by the statistical significance of the BCS in specification (12). For the worst, using estimates from (13), we can reject the joint hypothesis that all the year dummies prior to 1992 equal the estimates for the BCS.

²² However, it is important to note that the regular season ratings have been dropping (on average by 0.19 Nielsen ratings point per year over our sample period).

trends.²³ The different specifications include Year which goes from 1 (in 1985) to 18 (2002) or Year interacted with indicator variables for pre-1992 (Pre-Coalitions) or 1992 and above (Coalitions), indicator variables for the different coalitions (BC, BA, BCS), an indicator variable for the period prior to 1992 (Pre-Coalitions) and the regular season average Nielsen ratings for college football (Specifications 2,3,4,5). The estimations indicate that the fall in ratings has been stopped and they have bounced back up (although not to the 1985 levels).

Table 4. Evolution of Average Nielsen Ratings in BCS Bowls

<i>Regressors</i>	Average Nielsen Ratings			
	Spec. (2)	Spec.(3)	Spec. (4)	Spec. (5)
Year	-0.814***	-0.609**		
	(0.195)	(0.209)		
BC	2.133	1.148	13.935***	6.197
	(1.307)	(1.304)	(2.771)	(5.192)
BA	6.368***	6.860***	16.611***	10.312*
	(1.786)	(1.653)	(3.650)	(4.995)
BCS	9.005***	9.652***	17.169***	11.280*
	(2.452)	(2.268)	(4.816)	(5.635)
Average Regular Season		1.309*		1.089
Nielsen Ratings		(0.694)		(0.635)
Year (Pre-Coalitions)			-1.074***	-0.868***
			(0.212)	(0.230)
Year (Coalitions)			-0.295	-0.193
			(0.299)	(0.284)
Pre-Coalitions			17.518***	9.829*
			(0.947)	(4.567)
Constant	16.479***	7.409		
	(0.914)	(4.883)		
Observations	18	18	18	18
Standard errors are in parentheses				
* significant at 10%; ** significant at 5%; *** significant at 1%				

²³ Here the dependent variable is Nielsen ratings; it is not normalized by the ratings of the regular season. Specifications 3 and 5 control for the average ratings of the regular season.

Table 5. Estimates of the Determinants of Nielsen Rating of a Bowl

<i>Regressors</i>	Nielsen Ratings of a Bowl	
	Spec. (6)	Spec. (7)
Championship (No. 1 vs. No. 2)	3.222*	3.661**
	(1.586)	(1.401)
No. 1 Ranked Team	3.982**	3.742**
	(1.485)	(1.480)
Rank of Best Team (if not no. 1)	-0.196**	-0.196**
	(0.079)	(0.089)
Rank of Worst Team (if no Championship & not unranked)	-0.097	-0.106
	(0.056)	(0.067)
Unranked Team	-4.088***	-3.336***
	(0.933)	(1.143)
Regular Season College Football Average Nielsen's Rating	0.445*	0.889*
	(0.254)	(0.481)
Super Bowl's Nielsen Rating	0.211	-0.059
	(0.139)	(0.221)
Fiesta Bowl	0.506	0.486
	(0.975)	(1.017)
Orange Bowl	1.315	1.412
	(1.219)	(1.266)
Rose Bowl	5.562***	5.672***
	(1.087)	(1.136)
Cotton Bowl	0.059	0.016
	(1.097)	(1.138)
1986-1988		-2.568
		(1.684)
1989-1991		-4.037**
		(1.863)
1992-1994		-4.641***
		(0.974)
1995-1997		-2.242
		(1.390)
1998-2000		-1.874
		(2.065)
2001-2002		-3.667
		(2.161)
Constant	-0.327	11.865
	(7.020)	(11.540)
Observations	90	90
R-squared	0.72	0.76
Robust standard errors are in parentheses		
* significant at 10%; ** significant at 5%; *** significant at 1%		

Let us now turn to a more systematic analysis of the determinants of viewership at the Bowl level. Table 5 reports the determinants of viewership as measured by the Nielsen ratings. The basic estimation equation is:

$$N_{B,Y} = a + d_1 C_{B,Y} + d_2 \text{One}_{B,Y} + b_1 \text{Best}_{B,Y} + b_2 \text{Worst}_{B,Y} + d_3 \text{UR}_{B,Y} + b_3 \text{RSN}_Y + b_4 \text{SBN}_Y + \dots \\ d_4 \text{Rose}_{B,Y} + d_5 \text{Orange}_{B,Y} + d_6 \text{Fiesta}_{B,Y} + e_{B,Y}$$

where the dependent variable is the Nielsen rating in bowl B in year Y: $N_{B,Y}$. The regressors include two indicator variables: one taking value one if there's a championship and zero otherwise (C) and one taking value one if the best team playing is ranked number 1 and zero otherwise (One). It also includes the rank of the best (Best) and worst (Worst) teams playing except if that team is number 1, unranked or if there is a championship, in which case those regressors are set to zero.²⁴ There is an indicator variable taking value one if a team is unranked and zero otherwise (UR). This structure has the advantage of parsimony while allowing for non-linear effects for a championship game, having the number 1 team, or having an unranked team playing.²⁵ Other regressors include the regular season average Nielsen ratings (RSN) and the Super Bowl Nielsen rating (SBN) which are intended to capture general attitudes towards football and college football as well as seasons that may be more interesting than others. Finally, indicator variables for four of the five bowls, excluding the Sugar Bowl, and blocks of three years (two in the case of 2001-2002) for every year except 1985 are included. Specification (6) excludes the time dummies included in (7).

The specifications of Table 5 suggest that the effect of the rank of the best and worst team are of similar magnitude. In fact, the hypothesis that they are equal cannot be rejected in either specification (6) or (7) at the 10% level. Thus, we could alternatively control only for the average rank of the best and worst teams. This would allow us to investigate the effect of the distance in rank between the two teams. Table 6 presents results to explore this question as well as other specification issues. Namely, alternative specifications could allow for team specific effects and year fixed effects. This allows us

²⁴ One could alternatively not exclude from the variable tracking the rank of the best team the cases where that team is ranked No. 1. We have elected not to do this to make the results easier to read.

²⁵ The same specification adding an indicator variable for the cases in which the No. 2 team plays was conducted and indicates that having the No. 2 team playing doesn't have a nonlinear effect (that dummy variable was not statistically significant).

Table 6. Estimates of the Determinants of Nielsen Rating of a Bowl - Fixed Effects

<i>Regressors:</i>	Nielsen Rating of a Bowl		
	Spec. (8)	Spec. (9)	Spec. (10)
Championship (No. 1 vs. No. 2)	2.938*	3.066*	5.779**
	(1.496)	(1.620)	(2.467)
No. 1 Ranked Team	3.339**	3.203**	1.711
	(1.454)	(1.140)	(1.470)
Average Rank (if no 1 or unranked Are not playing)	-0.224	-0.388*	-0.187
	(0.192)	(0.194)	(0.205)
Difference in Rank (if no 1 or unranked Are not playing)	-0.184	-0.121	-0.478**
	(0.127)	(0.189)	(0.211)
Unranked Team	-7.185***	-4.959***	-4.271
	(1.427)	(1.604)	(2.871)
Fiesta Bowl	1.730	1.984	0.401
	(1.769)	(2.046)	(1.927)
Orange Bowl	2.602*	3.517**	2.753*
	(1.401)	(1.264)	(1.579)
Rose Bowl	8.618***	9.035***	10.265***
	(1.746)	(2.039)	(2.651)
Cotton Bowl	-1.736	-0.910	-2.165
	(1.857)	(1.771)	(2.240)
1986-1988		-2.174	
		(1.437)	
1989-1991		-4.385*	
		(2.159)	
1992-1994		-5.161**	
		(1.847)	
1995-1997		-3.828*	
		(1.891)	
1998-2000		-3.960**	
		(1.541)	
2001-2002		-6.055***	
		(1.413)	
Constant	18.433**	17.824**	
	(7.116)	(7.353)	
Team Dummies	Yes	Yes	Yes
Time Fixed Effects	No	No	Yes
Observations	81	81	81
R-squared	0.860	0.900	0.940
Robust standard errors in parentheses			
* significant at 10%; ** significant at 5%; *** significant at 1%			

to investigate if, for instance, the changes in ratings might be due to the fact that in different years the schedule of bowl games changed. Allowing for year fixed effects means that Regular Season Average Nielsen's Rating and the Super Bowl's Nielsen rating have to be dropped. It is excluded in all three specifications but in the cases in which it could have been included, neither ever comes in statistically significant. Including team specific effect will reduce sample size since there are teams that only play once in a bowl in our sample.

The team dummies are jointly statistically significant in all three specifications (p-value < 0.1). The time fixed-effects are not jointly statistically significant in specification 9 (p-value = 0.122),²⁶ but the null hypothesis that the time dummies in specification 8 are all equal to zero can be rejected at the 1% level. The average rank and difference in rank have the expected effect but they each are statistically significant in only one specification. Even though the teams have a jointly significant impact, only 3 teams have a statistically significant effect on their own in specification (8), there is no team in specification (9) that has a statistically significant effect on its own, and 4 teams have such an impact in specification (10). This suggest that it is difficult to distinguish if good teams, which happen to be famous most of the time, bring high ratings, or if famous teams, which happen to be good most of the time, are the cause of better ratings. However, the key result from these additional estimations is that the effect of a championship is still statistically significant (the sum of the coefficient estimate on the championship and No. 1 dummies is statistically different from 0 at the 1% level in all three specifications) and of similar magnitudes.

An additional concern could be the potential endogeneity of the start of the Bowl Coalition. That is the bowl coalition could have been created as a reaction to the declining ratings (instead of the unraveling problem) which would bias our estimates. To address this concern we re-estimate the main specifications on data prior to the start of

²⁶ Allowing for year fixed-effects allow us to control for the fact that in different years, the schedule of Bowls was different (when different Bowls were played). This could be important as Bowls sometimes overlapped. Thus the fact that the championship indicator variable still has a positive and statistically significant coefficient estimate indicates that we are not confounding the effect of scheduling with that of championships.

the coalitions. The main result (see Table 9 in Appendix 1) is that having a Championship is still a statistically significant factor.

Finally, because Nielsen Ratings are given as percentages, simply using OLS for estimation can lead to problems (for instance predictions outside the range of possible values). Table 10 in Appendix 1 shows that using appropriate methods for fractional dependent variables does not qualitatively affect the results (for those estimates the dependent variable was redefined as the Nielsen Ratings divided by 100). The method used is the one developed in Papke and Wooldridge (1996). That is, the same estimates are statistically significant, and those have kept the same sign.

Efficiency:

Figure 1 suggests that the Bowl consortia, which established a rotating championship game, increased the attractiveness of the bundle of bowl games.

Let us now consider how the matching of teams affects the Nielsen ratings. We will focus on estimates from specification (7). Start from the hypothetical case in which a bowl can host a game between teams ranked 3 and 4. Increasing the rank of the best team by 1 would result in a change in ratings of $(2-3) \times 0.196 = 0.196$. The average Nielsen rating is 11.652, thus this represents an increase of about 2% of the average. The effect of improving the worst team by one rank, from 4 to 3, would similarly increase the ratings by 0.106, or 1% of the average. Although small changes in Nielsen ratings might represent serious sums of money, these look like modest changes.²⁷ But when increasing a team's ranking by only one rank means getting the No. 1 team, the effect is large: $3.742 - (2 \times 0.196) = 4.134$ or 35.479% of the average. Similarly, going from a No. 1 versus No. 3 match to a championship (1 versus 2) game would increase ratings by $3.661 - (3 \times 0.106) = 3.979$ which represents 34.149% of the average rating. Another important factor is hosting an unranked team in a Bowl. This decreases the ratings by $3.336 - (25 \times 0.106) = 0.686$ or 5.887% of the average rating.

These numbers suggest that agreeing not to go early, to improve the quality of the teams playing in Bowls, and to increase the chance of having a championship, has

²⁷ But we have compared increases in only one position. Matching 2 versus 3 instead of e.g. 12 versus 13 (as in the 1981 Rose Bowl) would yield an increase in ratings of 3.02 or 25.918%

substantial effects on viewership. To see this, consider the hypothetical case in which four bowls get to split the top 8 ranked teams. Comparing the case in which the matches are 1-2, 3-6, 4-7, 5-8 compared to. 1-5, 2-6, 3-7, 4-8, we observe that the total Nielsen ratings would be higher by 3.603 or about 7.11% of four times the average Nielsen rating per bowl.^{28, 29}

This is not a negligible increase from a financial point of view. The cost per rating point for a 30 second Super Bowl ad in 2000 was \$70,000. Even if the cost per rating point is lower for a college bowl game, this suggests a difference in revenue in the millions of dollars per year in television advertising due solely to having a championship. This is not even considering the other benefits of matching late, like the ability to pick better teams for all bowl games.³⁰

Thus a market organization that allows sufficiently late matching to allow a championship can have beneficial effects on average for *every* member of the coalition.

Diversity:

When labor markets unravel, the resulting loss of mobility (cf. Niederle and Roth 2003) suggests that there may also be a loss in diversity of employees, particularly at the most competitive employers. But data that would allow this to be directly measured have so far been elusive in labor markets. In the context of football bowls, it is also clear how early matching can work to the disadvantage of “late bloomers,” and teams that are not traditional football powerhouses. And there has been a good deal of recent discussion among Division I-A football conferences about the extent to which the BCS is organized in a way that makes the major bowls accessible to a wide variety of teams. Although the

²⁸ The Nielsen ratings with the championship would be: $r+3.661+3.742-((3+4+5)\times 0.196+(6+7+8)\times 0.106)=r+2.825$; without the championship, the ratings are: $r+3.742-((2+3+4)\times 0.196+(5+6+7+8)\times 0.106)=r-0.778$ for some r . Thus the gain is the difference between the two, that is 3.603.

²⁹ It is straightforward to verify, given estimates from specification (7), that the matchup 1-2, 3-6, 4-7, 5-8 creates the highest cumulative rating in a four bowl coalition. Similarly, in the absence of a championship game, these estimates imply that 1-5, 2-6, 3-7, 4-8 is the best that can be done. Other rankings give cumulative ratings which are as high, for instance with a championship, teams 6, 7, and 8 could be interchanged without affecting the predicted cumulative rating. However, specifications 8-10 imply fully assortative matching as the most efficient, i.e. 1-2, 3-4, 5-6, and 7-8.

³⁰ In 2004, the television revenues of the BCS bowls were reported to be in the neighborhood of \$100 million (see e.g. Drape, 2004).

numbers of bowl teams are small, we can see some effect of the bowl consortia on increasing the diversity of the teams that play in top bowl games.

In the 11 years prior to the BC, 29 different teams participated in the four BCS bowls. In the 11 years of the coalition system, that number has increased to 37. If we count the number of appearances by teams that have played in both eras we observe that the same teams played more often before the coalition. Using a sign test, we can reject the hypothesis that they played as many times since 1992 as before (against the one-sided alternative that they played more often before 1992, p-value 0.07). More specifically, 12 teams played more often in the pre-coalition era while 5 played more often since 1992 and 4 played exactly the same number of times.

So, since the formation of the Bowl consortia in 1992, a more diverse collection of teams has played in the top Bowls.

5. Conclusion

Prior to 1992, the matching of football teams to postseason college bowls had become deeply unraveled, with teams and bowls making commitments with as much as four games remaining in the regular season. This resulted in considerable loss of information: as Table 2 shows, there is only a 31% chance that an apparent championship match made four weeks early will in fact remain a championship match by the time the game is played.

In 1992 the market began a series of reorganizations into consortia of bowls and conferences that have allowed matching to occur later, when more reliable information on rankings is available, and among a broader pool of conferences and teams.³¹ This has led to more championship games, which in turn has led to more viewers. To the extent that the number of viewers is a measure of the output of this industry, this allows us to see how changes in the organization of the market led to improved matching, and substantially increased output and efficiency. The evidence suggests that further changes

³¹ Further reorganization in the same direction is presently being contemplated. Most recently, it has been announced that a fifth bowl will be added to the BCS (Drape, 2004).

in market organization, if they increase the likelihood of producing a “national champion,” might achieve further gains.³²

In many other markets that experience unraveling, i.e. early matching at dispersed times in consequently thin markets, no data exist to directly measure the effects on output and efficiency. But information is also lost in these markets, e.g. when law clerks are hired on the basis of only their first year grades, when gastroenterologists are hired after only the first year of internal medicine residency, etc. So the fact that unraveling hurt efficiency in the matching market for college football games is strongly suggestive that the same may be true for other markets with similar histories. This helps explain the many market structures, organizations, and rules designed to regulate and coordinate the timing of transactions, and the function they play in the maintenance of well functioning marketplaces.

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³² Such changes might be in the direction of enlarged consortia, or might be in the direction of a series of playoff games, as in some other sports.

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Appendix 1:

Table 7. AP Rankings of Teams that Participated in the Bowls

Year	Rose Bowl		Fiesta Bowl		Orange Bowl		Sugar Bowl		Cotton Bowl	
	Winner	Loser	Winner	Loser	Winner	Loser	Winner	Loser	Winner	Loser
1977	13	4	8	15	6	2	3	9	5	1
1978	3	5	8	15	4	6	2	1	10	9
1979	3	1	10	26	5	4	2	6	8	7
1980	5	16	10	11	4	2	1	7	9	6
1981	12	13	7	8	1	4	10	2	6	3
1982	5	19	11	12	3	13	2	1	4	6
1983	26	4	14	15	5	1	3	8	7	2
1984	18	6	14	13	4	2	5	11	8	26
1985	13	4	5	7	3	1	8	2	11	16
1986	7	4	2	1	3	9	6	5	11	8
1987	8	16	3	5	2	1	4	6	13	12
1988	11	5	1	3	2	6	4	7	9	8
1989	12	3	5	6	4	1	2	7	8	10
1990	8	17	18	25	1	5	10	26	4	3
1991	2	4	6	10	1	11	18	3	5	9
1992	7	9	6	10	3	11	2	1	5	4
1993	9	14	16	10	1	2	8	3	4	7
1994	2	12	4	26	1	3	7	5	21	26
1995	17	3	1	2	8	6	13	9	7	12
1996	4	2	7	20	6	10	3	1	5	14
1997	1	9	8	21	2	7	3	12	5	20
1998	9	6	1	2	7	18	3	8	20	25
1999	4	22	3	6	8	5	1	2	24	14
2000	4	14	5	10	1	3	2	7	11	21
2001	1	4	2	3	5	6	12	7	10	26
2002	8	7	2	1	5	3	4	16	9	26

Table 8. Nielsen Ratings of College Bowls and Super Bowl (%)

Year	Rose Bowl	Fiesta Bowl	Orange Bowl	Sugar Bowl	Cotton Bowl	Super Bowl
1977	-	-	-	-	-	-
1978	-	-	-	-	-	47.1
1979	-	-	-	-	-	46.3
1980	-	-	-	-	-	44.4
1981	-	-	-	-	-	49.1
1982	-	-	-	-	-	48.6
1983	-	-	-	-	-	46.4
1984	22.3	8.8	14.8	4.6	19.6	46.4
1985	20	14.7	21.3	6.8	12.7	48.3
1986	17.7	25.1	16	8.6	13.6	45.8
1987	16.5	8.7	20.8	7.9	10	41.9
1988	10.8	17	12.8	8.1	9.8	43.5
1989	15.6	9.9	18.5	11.4	7.5	39
1990	11.9	6.2	18.3	4.9	9.9	41.8
1991	15.4	7	11	10.8	10.3	40.3
1992	17.7	7.2	4.07	18.2	11.5	45.1
1993	11.3	7.9	17.8	5.2	11.3	45.4
1994	18.2	6	18.9	14.9	4.6	41.3
1995	19.3	18.8	12.5	5.5	5.6	46.1
1996	16.5	10	7.8	17.9	6.3	43.3
1997	16.8	5.8	13.3	11.2	6.9	44.5
1998	13.3	17.2	8.4	11.5	6.2	40.2
1999	14.3	9.6	11.4	17.5	4.1	43.2
2000	15.1	10.7	17.8	13	4.7	40.4
2001	13.8	10.7	9.5	8.6	4.2	40.4
2002	11.3	17.2	11.7	9.2	4.2	40.7

Table 9. Estimates of the Determinants of Nielsen Rating of a Bowl (Pre-1992 Data)

<i>Regressors</i>	Nielsen Ratings of a Bowl	
	Spec. (11)	Spec. (12)
Championship (No. 1 vs. No. 2)	5.176*	5.139*
	(2.34)	(2.39)
No. 1 Ranked Team	4.969**	4.987**
	(1.80)	(1.88)
Rank of Best Team (if not no. 1)	-0.258	-0.252
	(0.15)	(0.16)
Rank of Worst Team (if no Championship & not unranked)	0.059	0.055
	(0.06)	(0.09)
Unranked Team	1.275	1.117
	(2.50)	(2.88)
Regular Season College Football Average Nielsen's Rating	2.140	2.233
	(1.26)	(1.34)
Super Bowl's Nielsen Rating	0.334	0.386
	(0.19)	(0.21)
Fiesta Bowl	2.933	2.906
	(1.93)	(2.05)
Orange Bowl	4.278*	4.260*
	(2.03)	(2.10)
Rose Bowl	7.963***	7.954**
	(2.08)	(2.18)
Cotton Bowl	3.619**	3.586*
	(1.47)	(1.63)
1986-1988		0.377
		(0.78)
1989-1991		0.635
		(1.24)
1992-1994	-19.554***	-22.812**
	(3.37)	(7.87)
1995-1997	5.176*	5.139*
	(2.34)	(2.39)
1998-2000	4.969**	4.987**
	(1.80)	(1.88)
2001-2002	-0.258	-0.252
	(0.15)	(0.16)
Constant	0.059	0.055
	(0.06)	(0.09)
Observations	90	90
R-squared	0.72	0.76
Robust standard errors are in parentheses		
* significant at 10%; ** significant at 5%; *** significant at 1%		

Table 10. Estimates of the Determinants of Nielsen Rating of a Bowl (Papke-Wooldridge QMLE)

<i>Regressors</i>	Nielsen Ratings of a Bowl	
	Spec. (13)	Spec. (14)
Championship (No. 1 vs. No. 2)	0.231**	0.224**
	(0.11)	(0.10)
No. 1 Ranked Team	0.279**	0.286**
	(0.12)	(0.12)
Rank of Best Team (if not no. 1)	-0.029***	-0.030***
	(0.01)	(0.01)
Rank of Worst Team (if no Championship & not unranked)	-0.011**	-0.010*
	(0.01)	(0.01)
Unranked Team	-0.648***	-0.614***
	(0.08)	(0.09)
Regular Season College Football Average Nielsen's Rating	0.047**	0.032
	(0.02)	(0.04)
Super Bowl's Nielsen Rating	0.020*	0.023
	(0.01)	(0.01)
Fiesta Bowl	0.062	0.058
	(0.09)	(0.09)
Orange Bowl	0.131	0.130
	(0.11)	(0.11)
Rose Bowl	0.523***	0.521***
	(0.10)	(0.10)
Cotton Bowl	-0.010	-0.011
	(0.13)	(0.12)
1986-1988		0.091
		(0.10)
1989-1991		0.015
		(0.09)
1992-1994	-3.160***	-3.204***
	(0.59)	(0.68)
1995-1997	0.231**	0.224**
	(0.11)	(0.10)
1998-2000	0.279**	0.286**
	(0.12)	(0.12)
2001-2002	-0.029***	-0.030***
	(0.01)	(0.01)
Constant	-0.011**	-0.010*
	(0.01)	(0.01)
Observations	90	90
Robust standard errors are in parentheses		
* significant at 10%; ** significant at 5%; *** significant at 1%		

Appendix 2:

We look at the ranking of teams picked by top bowls throughout the season. For the BCS era we use Rose, Orange, Sugar, and Fiesta (namely 4 BCS) Bowls, for BA era we use Orange, Sugar, and Fiesta (namely 3 BA) Bowls, for BC era we use Orange, Sugar, Fiesta, and Cotton (namely 4 BC) Bowls, and for the decentralized era, we use the BC Bowls, as well. We exclude the Rose Bowl in all periods except the BCS era, since it used to select champions of two conferences automatically.

Table 11 reports how the ranking of the best and worst team in these bowls evolve over time and with the different coalitions. It also looks at the determinants of a championship game (a bowl involving the 1 and 2 ranked teams). Specifications (15), (16), and (17) are ordered probits.³³ For the *Best* and *Worst* regressions, the regressors are dummies for different time periods (blocks of three years) and as of 1992, dummies indicating the different coalitions for bowls that were part of them and a dummy for bowls that are not part of a coalition after 1992 (this represents the Rose Bowl between 1992 and 1995, and the Cotton Bowl from then on). The excluded category is the three years prior to the first coalition (1989-1991). For the *Best* regression (11), the time dummies between 1977 and 1988 are not jointly statistically significant (at %10 level) and thus we report specification (15) which exclude those.

Looking at Table 11, specification (16), we observe that since the BCS has been instated, Bowls that are members of it have showcased a best team with a better ranking than before 1992. On the other hand, neither the BC nor the BA seem to have had a significant impact on the rank of the best team. Clearly, Bowls who have not been part of the different coalitions, the Rose Bowl during the BC and the Cotton Bowl since the BA, have been doing worst, their best team was not as good, when comparing to the years prior to 1992.

For the results for the *Worst* team, specification (17), one result in particular stands out: with the exception of 1983 to 1985, all time periods dummies (1977 to 1988) and coalition dummies (BC, BA, BCS) have a negative coefficient estimate. This indicates that for the 1989 to 1991 and 1983 to 1985 time periods, the worst team in any

³³ All regressions adjust standard errors to correct for possible correlation within bowls that took place the same year.

matchup had the worst rank of all time periods. In particular, the 1986 to 1988 period was statistically significantly better than 1989 to 1991. This sharp decline in quality in the top Bowls is suggestive of the reasons that prompted attempts at reorganizing the market. Again we can see that the Bowls excluded from the post 1992 coalitions have not been doing well. Finally, the BCS is doing statistically better by improving the ranks of the worst teams in its member bowls.

Most results are robust to alternative specifications: using a logistic distribution for the error term, or estimating OLS for best and worst teams. One fact that might be of concern is that we are describing the evolution of the matchups but the Rose bowl prior to 1998 had pre-arrangements to automatically take conference champions (no at large selection). Thus, there is no sense in which, for instance, market conditions make them “go early” in some years. Hence the specifications of Table 11 were re-estimated using alternative samples: that is excluding the Rose Bowl prior to 1998. The results are robust to those changes. Estimates are available from the authors.

Table 11. Evolution of ranking of the best and the worst teams in each bowl matchup

<i>Regressors:</i>	Best		Worst
	Spec. (15)	Spec. (16)	Spec. (17)
1977-1979	-0.079		-0.36
	(0.258)		(0.234)
1980-1982	0.014		-0.239
	(0.240)		(0.214)
1983-1985	0.157		0.163
	(0.307)		(0.279)
1986-1988	-0.029		-0.578***
	(0.257)		(0.204)
BC (1992-1994)	0.016	0.003	-0.260
	(0.295)	(0.191)	(0.379)
BA (1995-1997)	0.003	-0.01	-0.131
	(0.249)	(0.082)	(0.326)
BCS (1998-2002)	-0.311	-0.323***	-0.530**
	(0.241)	(0.087)	(0.218)
Not BC, Not BA, Not BCS after 1992	0.619	0.605*	0.769**
	(0.405)	(0.326)	(0.345)
Observations	130	130	130
Clustered standard errors in parentheses			
* significant at 10%; ** significant at 5%; *** significant at 1%			