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Is the Coach Paid too Much?: Coaching Salaries and the NCAA Cartel*

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Abstract

Recently a great deal of controversy has been generated from the salaries earned by head football coaches in the NCAA. On one level this seems odd since many figures in the world of sports and entertainment earn exceptionally high salaries. However, one important difference in the case of NCAA football is that the players themselves do not get paid. We develop a model which shows that a cartel agreement to not pay the players raises the coach's salary if some players choose where to play based on the identity of the coach. For some parameters, the gain in the coach's salary exceeds the loss in salary experienced by the player. On average, the agreement not to pay the players improves competitive balance.

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1. Introduction

Recently a great deal of controversy has been generated from the salaries earned by head football coaches in the NCAA. On one level this seems odd since many figures in the world of sports and entertainment earn exceptionally high salaries. However, one important difference in the case of NCAA football is that the players themselves do not get paid. [1] This may be one reason why a given salary paid by a college is viewed differently than the same salary paid by an NFL team.[2] Some of the discomfort with high coaching salaries may result from a sense that these salaries result, in part, from the fact that the players are not paid. We develop a model which supports this intuition. In this model, the collusion on player salaries results in a higher salary for the coach as long as some players choose the team based on the identity of the coach.

In our model, the teams (e.g., universities) compete for a rent in a contest, where the probability of winning the contest is an increasing function of the coaching and athletic talent employed by the team. Talented coaches and players are both in limited supply. Coaching talent is auctioned, with the most talented coach going to the team which pays the highest salary. Players go to the team offering them the highest utility where utility is increasing in salary for all player types. However, some players care about the identity of the coach for whom they play while the others care about the identity of the team. In the model in which open bidding on players is permitted, players evaluate the salary offer along with the other characteristics of the job (i.e., the identity of the coach and team). When there is salary collusion, the preferences over the coach or team become the sole determinant of the player's choice of team. If some players

[1] The discussion in our paper is framed in terms of college football, but the analysis applies equally to college basketball.

[2] For example, while Nick Saban's contract with the University of Alabama offered more security than his NFL contract, his salary as generally reported ($4 million per year) was actually somewhat lower than his salary in the NFL.

select the team based on the identity of the coach, the teams will bid more aggressively on the coach and part of the player's salary is transferred to the coach via this bidding process.

For some parameters of the model, the increase in the salary to the coach exceeds the loss in salary by the player. That is, the increased intensity of bidding on the coach is so great that it more than dissipates the rents that the teams could potentially receive by restricting player salary. While this is an interesting theoretical possibility, we would not expect to observe a cartel in existence if this case applied to the market in question. Even if this extreme case does not hold, however, it is possible that a large portion of the rents transferred from the player becomes reflected in the coach's salary. Interestingly, high profile coaches are often coveted for their recruiting ability. The greater the coach's ability to recruit, the higher is the percentage of the rent which is transferred from the player to the coach in the presence of collusion by the teams.[3]

There is one other interesting aspect of the collusion by the NCAA on player salaries, which is that, on average, this collusion leads to an improved competitive balance in our model. We assume that one of the two teams earns a higher rent from winning the contest than the other. The team earning the higher rent always has a higher marginal return from hiring the talented player than the team earning the lower rent. If the rent differential is high enough, then under open bidding for the players, the team earning the higher rent may be able to always hire the talented player, even when this player has a preference to play for the other team. When there is no salary competition, the team earning the lower rent will always be able to attract the player

[3] To date, there has not been a great deal of formal modeling examining the effect of the NCAA cartel on coaching salaries. The one previous work we are aware of is Fort and Quirk (1999). Our approach to modeling the market for players and coaches is quite different than the one taken in their paper. However, they also conclude that the restriction in the players markets should raise the coach's salary. Kahn (2007: 216-7) provides some informal discussion of the same issue.

with a preference to play for them. Thus, there may be a competitive balance rationale for the restriction on player salaries.[4]

In our framework, players and coaches are modeled as scarce talent in a very particular sense. Teams recognize that when they hire a talented player or coach, they are denying his services to their rival. This framework should prove useful in future studies of the NCAA. For example, this basic framework might be used to analyze whether the restriction on the competition for players helps fuel a facilities arms race between schools.[5] More generally, the analysis of sports has become an important area of application of contest theory.[6] The framework we use in this paper can provide a basis for analyzing other issues related to the economics of sports contests; for example, our framework would be well suited to an analysis of salary caps which are often employed in professional sports.

The scare talent framework we employ here (which was developed in Dakhlia and Pecorino 2006) can be applied in any business setting in which talent is sufficiently scarce such that firm 1 recognizes that part of the value of hiring a talented individual is the denial of her services to its rival, firm 2. For example, if executive talent within an industry is scarce, then part of the benefit of hiring a talented executive is denying her talents to your rival. To the extent that firms recognize this, it will raise their willingness to pay for scarce executive talent. Similarly, a patent race is a contest that employs the scarce talents of research scientists. Thus, part of the benefit of hiring a talented scientist working in a specialized area of research is preventing a rival firm from employing his talents. Influence peddling in Washington, D.C. is another area where

[4] The NCAA cartel has far ranging effects, some of which may appear undesirable and others of which may appear to be desirable. Our purpose in this paper is not to evaluate the desirability of the cartel, but rather to gain a positive understanding of the economic effects of the cartel.

[5] Excessive spending on facilities has been a major concern of the NCAA. See "A Weak Policeman Talks Tough When Tackling College Sports and Its Critics", *Wall Street Journal*, November 1, 2006, p. D10.

[6] This literature is surveyed by Szymanski (2003).

scarce talent may be particularly relevant. Certain former politicians may be uniquely well suited to influencing the legislative process. Thus, part of the benefit to the medical insurance industry of retaining a prominent former politician to lobby on their behalf is the denial of his services to the interest group representing doctors.[7]

The NCAA has several features which make it an interesting institution to study, and the restriction on player salaries is certainly one of those features. It is also worth noting that college sports is a fairly big business. Data presented in Kahn (2007: 220) indicates that revenue at the 117 division I-A schools topped $3 billion dollars in 2003. Thus, the NCAA is an economically important entity.

2. Previous Literature

We model both the coach and the player as scarce talent, and as such we draw heavily on the results of Dakhlia and Pecorino (2006). In our simple model, there are two teams and only one high talent coach and one high talent player.[8] In addition, there are a large number of low talent players and coaches. One key aspect of talent scarcity is that if team 1 hires the talented coach, it recognizes that it is denying the services of the coach to team 2. This increases team 1's willingness to pay for a given level of talent when it is scarce compared to when it is not scarce. The same situation applies to the bidding on the player when this is allowed. The Dakhlia and Pecorino paper is based on the rent-seeking literature emanating from Tullock (1980). This literature is surveyed by Tollison (1982) and Nitzan (1994). Of particular relevance is the

[7] Given the abundance of lawyers in the U.S., the law would not seem like an application where scarce talent would be relevant. However, Dakhlia and Pecorino (2006: 476) discuss the case of a corporation which retained a law firm which specialized in takeover activity, purely to deny the firm's services to its rivals.

[8] In the literature on the economics of sporting contests cited below, it is quite common to analyze a model with two teams. See, for example, the paper by Szymanski and Késenne (2004).

literature on contests with asymmetric rents. Examples of this work include Hillman and Riley (1989), Nti (1999) and Epstein and Nitzan (2002). [9]

By now, there is a well established literature on the economics of sporting contests to which this paper is related. A key concern of this literature is the effect of revenue sharing on competitive balance. Szymanski and Késenne (2004), for example, argue that competitive balance is likely to be reduced by the sharing of gate revenue.[10] By contrast, in our paper, we examine how collusion in the labor market affects the competitive balance. Other papers which address the competitive balance issue include Eckard (2001), Palomino and Sákovics (2004), Runkel (2005) and Késenne (2007).

Rottenberg (1956) famously argued that the reserve clause used in major league baseball did not affect competitive balance relative to a situation in which there existed a labor market with free agency. Rottenberg uses a Coase-like argument to make this point. We argue that labor market restrictions in our model do affect competitive balance. Because college players are not traded and cannot be sold, the Coase theorem will not apply. Thus, labor market restrictions can potentially affect competitive balance.

That the NCAA functions as a cartel is widely accepted and several authors have written about the organization in this context.[11] Fleisher, Goff and Tollison (1992) provide a book length analysis of the NCAA's cartel behavior, and Kahn (2007) provides a recent review article on this

[9] Our model has some features in common with the literature on combinatorial auctions. See Crampton et. al. (2005). In the combinatorial auction literature, bidding occurs on bundles of items rather than on individual items. In our model, the talented coach and player are never auctioned as a bundle, but acquiring the talented coach can influence a team's ability to acquire the talented player. In addition, in our setting, after the auction, the participants in the auction engage in a contest. Part of the value of winning the auction is that it reduces the other teams ability to win the contest which follows.

[10] Earlier analyses of this issue include Quirk and El Hodiri (1974) and Vrooman (1995).

[11] Some aspects of the NCAA's cartel power have been diminished. It lost two antitrust cases, one in 1984 involving its television contract and one in 1995 involving the pay of assistant coaches. See the discussion in Kahn (2007).

topic.[12] Eckard (1998) argues that increased enforcement of NCAA cartel's policies in 1952 led to reduced competitive balance in NCAA football. Sutter and Winkler (2003) find that competitive balance in NCAA football has been essentially unchanged since World War II, and in particular they argue that the adoption of lower roster limits did not improve competitive balance.

3. The Model with Competitive Salaries

In this section, we develop a model in which the players are paid competitive salaries. Consider a game in which two risk neutral teams compete for rents that result from winning a contest, where the probability of winning is a function of the quality of the teams' players and coach. For simplicity we assume that there exists one high talent coach and one high talent player, and large numbers of low talent players and coaches. There are two teams which compete for the services of the high talent coach and player. The coach only cares about salary in deciding which job offer to accept, but players care about job attributes in addition to salary. Type *c* players prefer to play for the talented coach and type *t* players have a preference over which team they play for. The player preferences are reflected in the following utility function:

$$U = IS^{\alpha}, \qquad (1)$$

where S is the salary paid to the player, $0 < \alpha < 1$. The variable I is an indicator variable with $I = M > 1$ if there is a preference match and $I = 1$ otherwise. With probability $1-\gamma$ the player is type *c* and there is a preference match if this player is on the same team as the talented coach. With

[12] An early analysis of the NCAA as a cartel is provided by Koch (1983).

probability γ, the player is type t_i and there is a preference match if this player is hired by team i, $i = 1, 2$. Half of the type t players are type t_1 and half are t_2.

The preference for playing with the talented coach could reflect the coach's ability to train the player for the NFL, or it could reflect a preference for winning (since the team with the talented coach has a higher expected winning percentage). The preference for a team could reflect school loyalty, geographic preference, or differences in academic requirements across universities.

The game is described as follows:

1. There is an auction for the services of the talented coach
2. The player type is determined and becomes common knowledge to the two teams.
3. There is an auction for the services of the talented player.
4. The teams engage in a contest whose outcome is determined, in part, by the coaching and player talent levels of the two teams.

Low talent players and coaches are available at the opportunity cost of their time. For the players, this cost is normalized to 1, while for the coaches, this cost equals S_C. Each team can hire only one player and only one coach. We assume throughout that teams which are unable to hire a high talent player or coach will find it profitable to hire a low talent player or coach.

The game will be solved by backward induction, so we will begin with the contest which occurs at step 4.

3.1. The Contest

The prizes for teams 1 and 2 from winning the rent-seeking contest are R_1 and R_2 respectively, where $R_1 > R_2$. The greater rent for team 1 reflects the idea that the revenue generating possibilities are not equal across all teams.[13] Let the quality of team *i* be denoted

$$Q_i = P_i C_i \quad , \tag{2}$$

where P_i and C_i reflect the player and coaching talent employed by team *i*.[14] If team *i* hires the talented player, $P_i = P_H > 1$ and if it hires the talented coach, $C_i = C_H > 1$. If team *i* hires the low talent player, $P_i = 1$, and if it hires the low talent coach, $C_i = 1$.

Team 1 wins the contest with the following probability:

$$p_1 = \frac{Q_1}{Q_1 + Q_2} \quad , \tag{3}$$

while team 2 wins with the probability 1- p_1.[15] Note that our results would be unchanged if, instead of a winner-take-all-contest, we let each team earn a share of their respective rent equal to $Q_i/(Q_1 + Q_2)$.

3.2. Auction for the talented player

First, we will calculate the maximum offer each team is willing to make for the talented player. In the auction, the teams simultaneously reveal their salary offers S_{1P} and S_{2P}. The player then chooses the team which offers the highest utility, taking the salary offer into account. If a player chooses to sign with a team, that team is obliged to pay that salary it bid in the auction. The loser

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[13] It is common in the sports economics literature to assume that revenue generating capacities differ across the teams. See, for example, Szymanski and Késenne (2004). In fact, this assumption is key when attempting to address issues related to competitive balance.

[14] Note that we could model this function using the more general form $Q_i = P_i^{\Psi_1} C_i^{\Psi_2}$. However, the parameters ψ_1 and ψ_2 have no impact on our results and merely serve to complicate the model. In addition, all of our main results would go through if we modeled *P* and *C* as perfect substitutes so that $Q_i = P_i + C_i$.

of the auction does not pay its bid, but will instead hire an untalented player at a price of 1. The maximum bid by each team is the difference in expected payoffs with and without the talented player. Assume first that team 1 has hired the coach. Then the maximum salary offer team *i* is willing to make is as follows:

$$S_{iP}^{Max} = R_i\left[\frac{P_H C_H}{1+P_H C_H} - \frac{C_H}{P_H + C_H}\right] + 1 = \frac{R_i C_H \left(P_H^{\ 2} - 1\right)}{\left(P_H + C_H\right)\left(1 + P_H C_H\right)} + 1,\ \text{i} = 1, 2. \tag{4}$$

The '+ 1' in the equation above reflect the salary of the untalented player who would be hired if the talented payer is not hired. It is easy to verify that if team 2 had hired the coach the maximum bids above would be exactly the same. The reason is that each team recognizes that if it fails to hire the talented player, the other team will. Thus, the net change in the probability of winning of the contest is independent of which team initially has the coach.

Note that $S_{1P}^{Max} > S_{2P}^{Max}$, since $R_1 > R_2$. If the player achieves a preference match with team 1, then team 1 obtains the player if the condition in (5a) holds, while if the player achieves a preference match with team 2, then team 1 obtains the player if the condition in (5b) holds:

$$S_{1P}^{Max} \geq S_{2P}^{Max} M^{-1/\alpha} \qquad \text{(Preference match with team 1)} \tag{5a}$$

$$S_{1P}^{Max} \geq S_{2P}^{Max} M^{1/\alpha} \qquad \text{(Preference match with team 2)} \tag{5b}$$

Since $S_{1P}^{Max} > S_{2P}^{Max}$, if the player achieves a preference match with team 1, he will always sign with team 1 (condition (5a) always holds). Thus, if team 1 hires the talented coach at step 1 then both the type *c* and type t_1 players achieve a preference match with team 1 and sign with team 1.

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[15] The sports economics literature considers the possibility that a sufficiently unbalanced contest will erode the rents earned by the winner of the contest. We are assuming that the imbalances induced by the signing of the high talent player and coach are sufficiently small so as to not erode the revenue earned by the team which wins the contest.

On the other hand, the t_2 player might sign with either team depending upon his strength of preference for playing with team 2, and the gap between R_1 and R_2.

At the time of the auction, there is complete information on the player's preferences and the valuations of both teams are common knowledge. Thus, the optimal winning bid is one which makes the player indifferent between the two teams.[16] For example, suppose there is a preference match with team 1 so that the player will sign with team 1. The optimal salary offer from team 1 to the player equals $S_{2P}^{Max} M^{-1/\alpha}$.

There are two possibilities for the outcome of the player auction and we will consider these case 1 and case 2:[17]

Case 1: Team 2 signs the type c player if and only if it hires the talented coach and team 2 always signs the type t_2 player. This is the balanced case.

Case 2: Team 2 is unable to sign the type c player even if it hires the talented coach and it is never able to sign the type t_2 player. This is the unbalanced case.

Keep in mind that since $R_1 > R_2$, team 1 always hires type c when it has the talented coach and it always hires type t_1. If the following condition holds, we are in case 1, otherwise we are in case 2:

$$M^{1/\alpha} > \frac{R_1 C_H \left(P_H{}^2 - 1\right) + \left(P_H + C_H\right)\left(1 + P_H C_H\right)}{R_2 C_H \left(P_H{}^2 - 1\right) + \left(P_H + C_H\right)\left(1 + P_H C_H\right)}. \qquad (6)$$

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[16] We are ignoring the ε extra in salary that would be required to give the player a strict preference.

[17] While the player preferences differ, the strength of their idiosyncratic preference is always the same. Thus, if team 1 can outbid team 2 for the type c player, even when team 2 has the talented coach, then it will also necessarily be able to outbid team 2 for the type t_2 player. If we allowed for additional preference heterogeneities (by allowing the strength of preference to differ across t_i and c players) we would generate more cases. We have worked this out, and while it generates additional complexities, it does not generate additional insight. On the other hand, if we allowed the frequency of t_1 and t_2 players to differ, this could affect our results. This is discussed in Section 5.

Thus, we are in case 1 if the idiosyncratic preference for playing with a particular team (reflected by $M^{1/\alpha}$) is strong enough to overcome the different level of rents earned by the two teams. If the idiosyncratic preference is weak (M is near 1), then even a small difference between R_1 and R_2 will put us into case 2. Case 1 is the balanced case because (in an ex ante sense) it is associated with a more equal distribution of talent than case 2.

We will first examine case 1. This requires that we compute the outcome of the player auction assuming that team 1 has the talented coach and then again assuming that team 2 has the talented coach. When team 1 has the talented coach, it signs the type c player and the type t_1 player at the following salary:

$$\text{Type } c \text{ and } t_1 \text{ salary} = \left(\frac{R_2 C_H \left[P_H^{\,2} - 1 \right]}{\left(P_H + C_H \right)\left(1 + P_H C_H \right)} + 1 \right) M^{-1/\alpha} . \tag{7a}$$

Team 2 signs the type t_2 player at the following salary:

$$\text{Type } t_2 \text{ salary} = \left(\frac{R_1 C_H \left[P_H^{\,2} - 1 \right]}{\left(P_H + C_H \right)\left(1 + P_H C_H \right)} + 1 \right) M^{-1/\alpha} . \tag{7b}$$

The salary in (7a) equals $S_{2P}^{Max} M^{-1/\alpha}$, while the salary in (7b) equals $S_{1P}^{Max} M^{-1/\alpha}$. If team 2 hired the coach in step 1, the only difference is that it would acquire the type c player at the salary given in (7c):

$$\text{Type } c \text{ salary} = \left(\frac{R_1 C_H \left[P_H^{\,2} - 1 \right]}{\left(P_H + C_H \right)\left(1 + P_H C_H \right)} + 1 \right) M^{-1/\alpha} . \tag{7c}$$

Now, suppose we are in case 2. Team 1 is able to sign all of the talented players, regardless of whether or not it has signed the coach in step 1. If it has signed the talented coach, it pays the following salaries:

$$\text{Type } c \text{ and } t_1 \text{ salary} = \left(\frac{R_2 C_H \left[P_H{}^2 - 1 \right]}{(P_H + C_H)(1 + P_H C_H)} + 1 \right) M^{-1/\alpha}, \tag{8a}$$

$$\text{Type } t_2 \text{ salary} = \left(\frac{R_2 C_H \left[P_H{}^2 - 1 \right]}{(P_H + C_H)(1 + P_H C_H)} + 1 \right) M^{1/\alpha}. \tag{8b}$$

If team 2 hired the coach at step 1, then team 1 will still hire the type *c* player, but at the higher salary given by (8c):

$$\text{Type c salary} = \left(\frac{R_2 C_H \left[P_H{}^2 - 1 \right]}{(P_H + C_H)(1 + P_H C_H)} + 1 \right) M^{1/\alpha}. \tag{8c}$$

Note that the salaries in (8b) and (8c) equal $S_{2P}^{Max} M^{1/\alpha}$.

3.3. Auction for Coach

Next, we consider the auction for the talented coach. For each team, we need to compute the expected payoff both with and without the coach. This will give us each team's maximum bid for the coach as well as the coach's salary (which is maximum bid of the team which loses at the auction). At the time teams compete for the coach, player type is unknown, but it is known that a type *c* player is encountered with probability 1-γ, type t_1 with probability γ/2 and type t_2 with probability γ/2. Assuming we are in case 1, we can use (7a-c) to obtain the following:

$$\Pi_1(\mathrm{C_H}) = (1-\gamma)\left(\frac{P_H C_H}{1+P_H C_H}\right)R_1 + \frac{\gamma}{2}\left(\frac{P_H C_H}{1+P_H C_H}\right)R_1 + \frac{\gamma}{2}\left(\frac{C_H}{P_H + C_H}\right)R_1$$
$$-\left(1-\frac{\gamma}{2}\right)\left(\frac{R_2 C_H\left[P_H^{\ 2}-1\right]}{(P_H + C_H)(1+P_H C_H)}+1\right)M^{-1/\alpha} - \frac{\gamma}{2}, \tag{9}$$

where $\Pi_1(\mathrm{C_H})$ denotes team 1's expected profit with the talented coach. Without the talented coach, team 1 receives

$$\Pi_1(1) = (1-\gamma)\left(\frac{1}{1+P_H C_H}\right)R_1 + \frac{\gamma}{2}\left(\frac{P_H}{P_H + C_H}\right)R_1 + \frac{\gamma}{2}\left(\frac{1}{1+P_H C_H}\right)R_1$$
$$-(1-\gamma) - \frac{\gamma}{2}\left(\frac{R_2 C_H\left[P_H^{\ 2}-1\right]}{(P_H + C_H)(1+P_H C_H)}+1\right)M^{-1/\alpha} - \frac{\gamma}{2} - S_c, \tag{10}$$

$\Pi_1(1)$ denotes team 1's expected payoff when it hires a low talent (*C = 1)* coach at the cost S_c. Taking the difference between (9) and (10) we obtain team 1's maximum bid for the talented coach:

$$\mathrm{S_{C1}^{Max}} = (1-\gamma)\left(\left(\frac{P_H C_H - 1}{1+P_H C_H}\right)R_1 - \left(\frac{C_H\left[P_H^{\ 2}-1\right]}{(P_H + C_H)(1+P_H C_H)}R_2 + 1\right)M^{-1/\alpha} + 1\right)$$
$$+\gamma\frac{P_H\left(C_H^{\ 2}-1\right)}{(1+P_H C_H)(P_H + C_H)}R_1 + S_C. \tag{11}$$

When the talented coach is hired, the team is also able to sign the talented type *c* player, where this player type appears with a frequency of 1-γ. The top line of (11) reflects the net benefit of having both the talented coach and the type *c* player weighted by this frequency. The second term on this top line reflects the net salary costs of hiring the type *c* player. With a probability γ, the talented coach does not help attract a talented player to the team, but still directly increases the probability of winning the contest. This is reflected by the term on the second line of (11) which is weighted by γ. The term S_C reflects the salary that will be paid a low talent coach in the event the high talent coach is not hired.

Through the analogous computations used to derive (11), we can obtain teams 2's maximum bid for the coach:

$$\begin{aligned}\mathrm{S}_{\mathrm{C2}}^{\mathrm{Max}} &= (1-\gamma)\left(\left(\frac{P_H C_H - 1}{1 + P_H C_H}\right)R_2 - \left(\frac{C_H\left[P_H^{\,2} - 1\right]}{(P_H + C_H)(1 + P_H C_H)}R_1 + 1\right)M^{-1/\alpha} + 1\right) \\ &+ \gamma \frac{P_H\left(C_H^{\,2} - 1\right)}{(1 + P_H C_H)(P_H + C_H)}R_2 + S_C.\end{aligned} \tag{12}$$

Since $R_1 > R_2$, team 1 will outbid team 2 for the coach and it will pay $\mathrm{S}_{\mathrm{C2}}^{\mathrm{Max}}$ from equation (12). The solution for the coach's salary leads to Result 1:

<u>Result 1</u>: In case 1, under open bidding for players, the coach's salary is

i. increasing in the team 2 rent, R_2;

ii. decreasing in the team 1 rent, R_1;

iii. increasing in the strength of the player's idiosyncratic preference M ;

iv. decreasing in γ.

Parts i – iii follow quite directly from the expression in (12). Part iv requires taking the derivative $dS_{C2}^{Max}/d\gamma$ and making use of (6). In case 1, the team which hires the talented coach is also able to obtain the type *c* player, where the frequency of type *c* players is 1-γ. As γ rises, this particular benefit from hiring the talented coach is diminished. The salary is increasing in R_2, because team 1's winning bid reflects team 2's willingness to pay. Note that an increase in R_1 increases what team 2 must pay the type *c* player, and this in turn reduces team 2's willingness to pay for the talented coach. Thus, the coach's salary is decreasing in R_1.

Next consider case 2 in which team 2 cannot attract the type *c* player even when it has the talented coach, nor can it attract the type t_2 player. The computations for this case are analogous to those performed for equations (11) and (12), except that we utilize equations (8a-c). The maximum bid for each team is given in (13) and (14).

$$\mathrm{S}_{\mathrm{C1}}^{\mathrm{Max}} = \frac{P_H\left[C_H{}^2 - 1\right]}{\left(P_H + C_H\right)\left(1 + P_H C_H\right)} R_1 + (1-\gamma)\left(M^{1/\alpha} - M^{-1/\alpha}\right)\left(\frac{C_H\left[P_H{}^2 - 1\right]}{\left(P_H + C_H\right)\left(1 + P_H C_H\right)} R_2 + 1\right) + S_C \qquad (13)$$

$$\mathrm{S}_{\mathrm{C2}}^{\mathrm{Max}} = \frac{P_H\left[C_H{}^2 - 1\right]}{\left(P_H + C_H\right)\left(1 + P_H C_H\right)} R_2 + S_C \qquad (14)$$

Since $R_1 > R_2$ and $M > 1$, team 1 will again outbid team 2 and will pay $\mathrm{S}_{\mathrm{C2}}^{\mathrm{Max}}$ in (14). Team 2's maximum bid reflects the increased probability of winning the contest with the talented coach plus S_C which is the salary they would have to pay the untalented coach. Team one's bid has an additional term which reflects the reduced salary payments it can make to the type *c* player if it hires the talented coach. This reduced salary is discounted by the probability, 1-γ, that the talented player will in fact be type *c*.

The salary in equation (14) leads to Result 2:

<u>Result 2</u>: In case 2, under open bidding for players, the coach's salary is

i. increasing in the team 2 rent, R_2;

ii. independent of the team 1 rent, R_1;

iii. independent of the strength of the player's idiosyncratic preference *M* and the frequency 1-γ of type *c* players;

iv. increasing in the level of the coach's talent C_H;

v. decreasing the level of the player's talent P_H.

Parts iv and v require taking the relevant derivative. Why is the coach's salary decreasing in the player's talent level? This simply reflects the form of the contest success function which guarantees that as the talent of the player increases, the direct effect of hiring the coach on the probability of winning falls. Since team 2 is never able to hire the talented player in case 2, hiring the coach never yields the indirect benefit of allowing team 2 to hire the type *c* player. This is the reason why the coach's salary is independent of *M* and γ.

4. The Model with Collusion in the Market for Players.

In this section, we assume that there is perfectly enforced collusion between the two teams. Under this collusive agreement, the two teams will pay the players (whether high or low talent) their opportunity cost of 1, and no more. Since the salary offers are identical under collusion, the talented player will always sign with the team which provides him with a preference match. Thus, the type *c* player signs with the team that has the talented coach, t_1 signs with team 1 and t_2 signs with team 2. Thus, case 1 and case 2 from the model with open bidding on the players both map onto a player allocation which corresponds to case 1 (the balanced case) in the model with collusion in the labor market. (In what follows, case 1 and case 2 refer to the talent allocation under open bidding for players.)

Using a computation similar to those presented earlier, the maximum bids for the talented coach are as follows:

$$S_{Ci}^{Max} = (1-\gamma)\frac{(P_H C_H - 1)}{(1+P_H C_H)}R_i + \gamma\frac{P_H(C_H{}^2 - 1)}{(1+P_H C_H)(P_H + C_H)}R_i + S_C \text{, i = 1, 2.} \qquad (15)$$

Again, since $R_1 > R_2$, team 1 will outbid team 2 for the coach. Team 1 will pay the coach S_{C2}^{Max} as computed from (15). The bids by both teams reflect two terms. With a probability 1-γ, hiring the coach also gains the team the talented player, and this is reflected in the first term in (15). With a probability γ, hiring the coach does not get the team the talented player, but it still improves the probability of winning the contest. This is reflected by the second term in (15). The outcome of the auction for the talented coach in both this section and section 3 yield Result 3:

> Result 3: Team 1 is always able to hire the talented coach whether we are in case 1 or case 2 and whether or not there is open salary bidding for the talented player.

Result 3 is an application of the results on bidding for scarce talent found in Dakhlia and Pecorino (2006). The result that scarce talent signs with the team earning the higher rent is quite general.[18] (See Dakhlia and Pecorino, 2006: 484-5.)

When the teams cannot openly bid on the players, they bid more intensely on the coach, because hiring the coach allows them (with probability 1-γ) to obtain a talented player they would be otherwise unable to sign. In case 1, the gain to the coach is the difference between equations (15) (with $i = 2$) and (12):

$$\text{Gain to coach in case 1} = (1-\gamma)\left[\left(\frac{C_H\left[P_H^{\,2}-1\right]}{(P_H+C_H)(1+P_H C_H)}R_1+1\right)M^{-1/\alpha}-1\right]>0 \qquad (16)$$

In case 2, the gain to the coach may be obtained by subtracting (14) from (15) (with $i = 2$):

$$\text{Gain to Coach in case 2} = (1-\gamma)\frac{C_H(P_H^{\,2}-1)}{(P_H+C_H)(1+P_H C_H)}R_2>0\,. \qquad (17)$$

[18] In contrast to the coaches, the players have idiosyncratic preferences unrelated to salary. Thus, the talented player does not always go to the high bidder.

We can think of 1-γ as reflecting the recruiting ability of the talented coach because it reflects the increased frequency with which a team with the high talent coach is able to obtain the high talent player. From (16) and (17), the gain to the coach is increasing in the coach's recruiting power. The analysis above leads to Result 4:

Result 4: A binding agreement to restrict player salaries raises the salary paid to the talented coach. This increase in salary is

i. increasing in the coach's recruiting ability, 1-γ;

ii. increasing the player's talent level P_H;

iii. decreasing in the coach's talent level C_H.

Parts ii and iii require taking the relevant derivative. The gain to the coach increases in the player's talent level because hiring the coach results, with probability 1-γ, in the team obtaining the talented player. The gain is falling in the coach's own talent level because highly talented coaches obtain a relatively larger salary when there is a free market for players. Thus, they have less to gain from the restriction in the market for players.[19] From a merit standpoint parts ii and iii of Result 4 would appear to be rather perverse.

Regardless of whether or not there is open bidding for the talented player, team 1 always hires the talented coach, the type c player and the type t_1 player. In case 2, when there is open bidding on the talented player, it also signs the type t_2 player. However, in the presence of collusion, the t_2 player signs with team 2. Under this set of circumstances, the collusion in the labor market improves competitive balance, since a contest in which one team has the talented

[19] Just to be clear, we are talking about gains here. Obviously, the level of the coach's salary is increasing in his talent level.

coach and the other the talented player is more balanced than a contest where one team has both. In all other circumstances, the collusion leaves competitive balance unaffected. Thus, the net effect of collusion is (in an expected value sense) to improve competitive balance. This is summarized as Result 5:

> Result 5: When there is a type t_2 player in case 2, collusion in the labor market improves competitive balance. In all other circumstances, collusion leaves competitive balance unchanged.

When the cartel agreement is in effect, the coach gains but the players lose. Under the collusive outcome, players only receive a salary of 1. Using the salaries from equations (7a-b), the player losses in case 1 can be summarized as follows:

The type c and t_1 loss = $\left(\frac{R_2 C_H \left[P_H^{\ 2}-1\right]}{\left(P_H+C_H\right)\left(1+P_H C_H\right)}+1\right)M^{-1/\alpha}-1$. (18a)

The type t_2 loss = $\left(\frac{R_1 C_H \left[P_H^{\ 2}-1\right]}{\left(P_H+C_H\right)\left(1+P_H C_H\right)}+1\right)M^{-1/\alpha}-1$. (18b)

To compute the total expected monetary loss for the player, we sum the losses across player types, where the type c loss is weighted by 1-γ, while the type t_1 and t_2 losses are each weighted by γ/2. In general we cannot say whether or not the expected loss to the player exceeds the gain to the coach. However, we can analyze some limiting cases. When $\gamma \to 1$, the gain to the coach approaches 0, so that the entire loss suffered by the player is retained by the team. This is true in both case 1 and case 2. When $\gamma \to 0$ in case 1, the coach's gain approaches

$\left(\frac{R_1 C_H \left[P_H^{\ 2}-1\right]}{\left(P_H+C_H\right)\left(1+P_H C_H\right)}+1\right)M^{-1/\alpha}-1$, while the loss to the player approaches

$\left(\frac{R_2 C_H\left[P_H{}^2-1\right]}{\left(P_H+C_H\right)\left(1+P_H C_H\right)}+1\right)M^{-1/\alpha}-1$. In this limiting case, the gain to the coach exceeds the loss to the player because $R_1 > R_2$.

The loss to the type *c* and type t_1 players is the same in case 2, while now,

the type t_2 loss = $$\left(\frac{R_2 C_H\left[P_H{}^2-1\right]}{\left(P_H+C_H\right)\left(1+P_H C_H\right)}+1\right)M^{1/\alpha}-1. \qquad (19)$$

If we again consider the limiting case where $\gamma \to 0$, we find that the gain to the coach approaches $\frac{C_H\left(P_H{}^2-1\right)}{\left(P_H+C_H\right)\left(1+P_H C_H\right)}R_2$, while the loss to the player approaches $\left(\frac{C_H\left(P_H{}^2-1\right)}{\left(P_H+C_H\right)\left(1+P_H C_H\right)}R_2+1\right)M^{-1/\alpha}-1$. Since $M > 1$, the gain to the coach again exceeds the loss to the player in this limiting case.

Thus in both cases 1 and 2, we have the team gaining from collusion in the market for players as $\gamma \to 1$ and losing from collusion as $\gamma \to 0$. What can we say about intermediate values of γ? In both cases, the gain to the coach is monotonically decreasing in γ, while the loss to the player is monotonically increasing in γ.[20] Thus, within each case, there is a unique critical value of γ (call it γ^*) such that when $\gamma < \gamma^*$, the gain to the coach exceeds the loss of the player and for $\gamma > \gamma^*$, the gain to the coach is less than the loss to the player. Note that γ^* is strictly interior, meaning it will not lie at the endpoints of 0 or 1.

This analysis above leads to Result 6:

[20] Within each case, the loss to type *c* and type t_1 players is equal and this loss is less than the loss suffered by type t_2 players. Since type t_2 players are encountered with probability $\gamma/2$, the expected loss for the player is monotonically increasing in γ.

<u>Result 6</u>: For both case I and case II, there is a critical value of γ, unique to each case, such that the gain to the coach exceeds the loss to the player for $\gamma < \gamma^*$ and the gain to the coach is less than the loss of the player for $\gamma > \gamma^*$, where $0 < \gamma^* < 1$.

When $\gamma < \gamma^*$, the teams lose from collusion in the players market so that the returns from forming the cartel are negative. This is an interesting theoretical possibility, but if this condition held, we would not expect to observe the cartel. Even if $\gamma > \gamma^*$, it is possible that the increased salary of the coach under collusion substantially diminishes the percentage of the rents that the teams are able to retain.

How is it possible that increased bidding on the coach more than offsets the savings in player salaries? When there is open bidding on the players, there is a sequential aspect to the game. First the coach is hired, then the player is hired. By the time the bidding on the player occurs, one team has already hired the coach and the contest has become unbalanced.[21] It is known from the literature on rent seeking, that total rent dissipation is lower in an unbalanced contest. (See Gradstein 1995.) When there is not open bidding on the players, there is a single round of bidding which simultaneously determines the allocation of the talented coach and the type *c* player. Thus, the implicit bidding for the player occurs at a point where the overall contest is more balanced, and this leads to greater rent dissipation. Running counter to this effect is that with probability γ, the coach does not influence which team obtains the talented player. This provides the source of possible gains to the teams under the collusive arrangement.

5. Discussion

The main results of the paper concern the effect of the restriction in player salaries on both the salary of the coach and on competitive balance. In this section we will discuss the robustness of both sets of results to some possible extensions to the model.

5.1. The effect on the salary of the coach

The result that restricting player salary raises the salary of the coach will still hold if we add more teams or more players to the model. Suppose there were, say, eight teams, where teams are numbered by the size of the rent they earn with team 1 earning the highest rent and team 8 the lowest. The competition for the coach would be very similar to the description in our paper as teams 1 and 2 would be the two highest bidders for the coach. The joint probability that teams 1 and 2 win the contest will no longer equal 1, and this will change some of the expressions in the paper, but it will still be the case that part of the value of hiring the coach is denying him to your competitor. In addition, the coach's salary will rise when players are not paid because signing the coach will still attract type c players to the team.

There is one additional complication that can be contemplated when there are more than two teams. If is possible that, for example, team 2 is unable to bid for the coach because it has a coach under long-term contract and the costs of dismissal are high. Competition for the coach would then be between team 1 and team 3, but the basic thrust of the results would not change. The coach's salary would still be higher when the players are not paid, as long as signing the coach attracts some players to the team.

Adding more players to the model should also not affect the main thrust of this result, as long as signing the talented coach allows the team to acquire more talented players when there is collusion in the labor market.

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[21] That is, unbalanced to a greater extent than already implied by the rent differential across teams.

5.2. The effect on competitive balance

The result that the restriction in player salaries improves competitive balance is fairly robust when there are two teams, but the extent of its applicability when there are more than two teams is uncertain. In addition, even with two teams, it is possible to outline a situation under which the competitiveness result would not hold. Below, we will discuss the competitiveness result when there are two teams and when there are many teams, and in each case, we will allow for there to be many types of players. Our formal model could be interpreted as the two highest revenue teams competing for the services of the top quarterback recruit. Below, we allow for the possibility that they will compete over running backs, wide receivers and so on.

This discussion below draws heavily on a result in Pecorino and Dakhlia (2006: 484-5). Thus it is worth discussing their result in some detail. In a model with two teams, Pecorino and Dakhlia find that when talent is scarce, the team earning the higher rent always outbids the team earning the lower rent, regardless of the existing talent levels on the two teams. This implies that even if team 1 has hired the best ten best players for 10 of its eleven positions on offense, it will outbid team 2 for the 11th position as well. Why does this result hold? Hiring scarce talent has both a direct and indirect effect on the probability of winning. The direct effect is the increase team 1's probability of winning holding team 2's talent constant. This effect diminishes as team 1 accumulates talent. The indirect effect is the benefit of denying team 2 the talented player signed by team 1. As team 1 accumulates talent, the indirect effect increases. In fact, the sum of the two effects on the probability of victory is the same for the two teams.[22] The total benefit of hiring a player is the sum of the direct and indirect effect on the probability of winning times the rent received. Thus, team 1 always outbids team 2.

[22] Team 1's direct effect is team 2's indirect effect and vice versa. This is not true with more than two teams and is the reason why the Dakhlia and Pecorino result will not generalize to more than two teams.

5.2.1. The Competitiveness Result with Two Teams.

First, consider the case of two teams. One implication of the analysis above is that team 1 will, regardless of the number of players involved, always hire the talented coach, all the type *c* players and all the type t_1 players. When there are only two teams, the issue of competitive balance will always therefore hinge on what happens to the type t_2 players.

In our model, collusion in the player's market improves competitive balance (on average). The reason is that the lone asymmetry in the model is that team 1 earns a higher rent if it wins the contest. Preventing a direct dollar competition for players partially offsets this advantage. How could the result on competitiveness be overturned? They key is to add an asymmetry to the model which strongly favors team 2 when there is collusion in the labor market. Suppose that there are very few type *c* and t_1 players so that most players have a preference for team 2. Further assume that this preference for playing for team 2 is of varying intensity across players. Under open bidding, team 1 can hire some of the players with a preference to play for team 2 (those with weaker preference for doing so). Thus, open bidding on players will, in an ex ante sense, lead to a more equal distribution of player talent compared to the case with collusion in the player's market. If each team hires only one player, a more equal distribution of player talent will lead to a less balanced contest. The reason is that team 1 will always hire the talented coach. The unequal distribution of player talent under collusion helps to offset this and leads to a more balanced contest. Suppose instead that the two teams hire many players (i.e., that there are many different positions to fill) and that a strong majority of these players has a preference for team 2. If players in the aggregate are much more important in determining the outcome of the contest than the coach, we may have a more balanced contest under open bidding because it leads to a more equal distribution of player talent. Of course, if the percentage of t_1 and t_2 players is similar or if there are a significant percentage of type *c* players, the result from the main body of the paper will continue to hold; collusion in the labor market will, on average, improve competitive balance when there are only two teams.

5.2.2. The Competitiveness Result with more than Two Teams.

Suppose now that there are more than two teams, where as before they are ordered such that team 1 earns the highest rent. The Pecorino and Dakhlia result does not generalize to this case. This means we can no longer be certain that the team earning the highest rent will outbid all other teams for the most talented player at each position. This raises the possibility of the following scenario:[23] Suppose all players are type *c* and that under open bidding team 1 does not hire the best player at each position. Thus, under open bidding, team 1 locks up some, but not all of the best talent. This is now possible, because the Pecorino and Dakhlia result does not generalize to a case with more than two teams. If there is collusion in the labor market and team 1 hires the talented coach, it will then sign all of the type *c* players and lock up all of the top talent (because all the type *c* players want to play with the talented coach). This shows how collusion could reduce the competitive balance rather than increase it. This certainly does not rule out other instances in which collusion increases competitiveness. A more realistic model would include multiple teams, player types (i.e., positions), and multiple quality gradations. With this added degree of dimensionality, there is as yet no strong presumption as to the effect of labor market collusion on competitive balance.

6. Conclusion

Obviously, our model is highly stylized, but we believe that it captures important elements of the NCAA cartel. One of our key results concerns the effects of the cartel agreement to restrict player salaries on the salary of the coach. In particular, we find that this restriction will raise the coach's salary, and if the recruiting ability of the coach is sufficiently high, the reduction in player salaries may be more than offset by the increase in the coach's salary. While the cartel would not persist in this extreme case, it raises the possibility that a significant portion of the cartel rents are dissipated via higher coaching salaries. Because the teams cannot compete openly via salary offers to the players, they compete indirectly via competition for talented coaches.

We also show that the restriction in the market for players improves competitive balance (on average). [24] For some parameter values, the team earning the lower rent is never able to attract the talented player, even when that player has a preference to play for them. This occurs when the team earning the higher rent has a sufficiently high willingness to pay for talent relative to the team earning the lower rent. When the teams are prohibited from open bidding on the player, the team earning the lower rent is able to attract some players who have an idiosyncratic preference to play for their team.

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[23] We would like to thank an anonymous referee for pointing this potential case out to us.
[24] However, as discussed in Section 5, this result is not robust.

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