Do Team-Specific Revenues Matter in Baseball's Arbitration System?

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Abstract: According to baseball's collective bargaining agreement, arbitrators may not consider team finances when rendering a decision. I develop two theories to examine the setting of final offers. In the first theory, final offers are simply functions of the arbitral criteria and are, therefore, not a function of the revenue-generating capability of the team. In the second theory, I argue that teams may trade some talented and, thus, high-priced arbitration-eligible players, resulting in an implicit premium embedded in the final offers. The empirical analysis suggests that there are no such premiums embedded in the final offers.

Keywords: Arbitration, team finances, player salaries, game theory

1. Introduction

Baseball's arbitration system is a variant of final-offer arbitration and was originally introduced to appease the players' union in its push for free agency. In setting final offers, a player and his team consider what each expects to receive if the case proceeds to arbitration. If an arbitrator is asked to resolve a dispute, he/she may consult six criteria outlined in the Major League Baseball Collective Bargaining Agreement (MLBCBA) when rendering a decision. According to Article (VI) Section (F) Paragraph (12a) of the 1996-2000 (2001) MLBCBA, the basic criteria are:

1. the contribution of the player to his team
2. the length and consistency of his career contribution
3. the player's past compensation
4. comparable baseball salaries
5. the existence of any physical or mental defects on the part of the player
6. the recent performance of the club (including but not limited to league standings of the team and attendance)

Arbitrators may not directly consider the financial position of the team or the player when rendering a decision. Since negotiators will set their final offers with an eye towards what each expects to receive if a dispute occurs, are their final offers also independent of the team's revenue-generating capabilities? That is the question that we explore in this paper.

There will be some indirect relationship between team revenues and salaries determined in the arbitration system. For example, each of the six criteria will be at least somewhat correlated with team revenues. Higher quality players will have a larger marginal contribution to a particular team's quality, all else equal. In addition, arbitrators must consider the salaries of other players that they deem comparable when rendering a decision. Some of these comparable players earn salaries determined in baseball's competitive free agent market, bringing the effects of this market into baseball's arbitration system. Consequently, there will be some relationship between the revenue generating ability of a team and the choices made by negotiators in the free agent system.

The quality of players that arbitrators can deem as "comparable" is also dictated in the MLBCBA. According to the 1996-2000 (2001) MLBCBA, an arbitrator (or a panel of arbitrators) may only examine the salaries of those players who have no more than one additional year of experience (as defined by the MLBCBA) than the player in question if that player has less than 5 years of major league service. Arbitrators are provided a list of salaries of all major league players as of August 31st of the previous year, broken down by years of service (Article VI, Section 13 of the 1996-2000 (2001) MLBCBA), and they must consider the salaries of all players that are deemed to be comparable, not just any one player. Thus, what arbitrators can examine are the salaries of comparable players across teams without regard to which team each played for.

The arbitral criteria thus do not allow arbitrators to differentiate between the revenue-generating capabilities of individual teams. They merely allow them to observe the absolute quality of the player and the team as well as the salaries comparable players earn across all teams.

In the present paper, we examine if there is a relationship between team-specific revenues – a relationship over and above the absolute quality of a player – and the final offers chosen by the player and his team. This paper therefore provides researchers with a better understanding of how arbitration processes work and whether negotiators use prohibited criteria in setting final offers. Below, I focus on the effect that team-specific revenues have on the choice of final offers made by negotiators. I develop a theory that explains how final offers are set. The theory suggests that the final offers will not be a function of team-specific revenues although the revenues of a specific team will affect the team's utility. We examine the results empirically by modeling the final offers set by the player and the team. After controlling for player and team quality, if no additional relationship exists between the final offers and team revenues, then we should find no revenue-specific differentials included in the final offers. The results show evidence that final offers are not correlated with team revenues after controlling for the basic arbitral criteria. The rest of the paper is organized as follows: section 2 presents the theories; section 3 presents the empirical model, describes the data, and presents the empirical results; section 4 concludes.

2. The Theories

Baseball employs a version of final offer arbitration (FOA). In FOA, if negotiators fail to reach an agreement, they proceed to a hearing in which they submit final offers to the arbitrator and each makes a case for his own side. The arbitrator (or panel of arbitrators) then renders a decision by choosing one of the final offers as the binding settlement. The seminal rigorous formal examination of FOA was performed by Farber (1980). In Farber's model, the negotiators fail to reach an agreement, set final offers, and proceed to arbitration. Baseball's system differs from the Farber model since it allows the negotiators to continue to bargain after the setting of final offers up until the time the arbitrator (or arbitration panel) renders a decision. Papers by Faurot and McAllister (1992), Miller (2000a), and Faurot (2001) have examined various facets of this type of system.

In the present paper, I examine a two-stage bargaining game that blends both cooperative and non-cooperative bargaining models. In the first stage, the player and the team submit final offers to be presented to the arbitrator(s) in the event of a disagreement. In the second stage, the player and the team cooperatively bargain and reach a mutually-agreeable settlement. I use backwards induction to examine the model.

2a. General Assumptions and Basic Notation

I assume that player quality is measured in units of talent and a player with "t" units of talent generates gross revenues of R(t) for his team. I assume that a team's gross revenue function is a strictly increasing function of "t". The units of talent are assumed to be exogenously-determined and, consequently, R(t) is exogenously-determined.

The player and the team choose final offers of w_e and w_f respectively. The arbitrator is assumed to choose a preferred settlement, w_a, after examining the facts of the case. The arbitrator's preferred settlement is assumed to be exogenous. For an examination of how an arbitrator's preferred settlement is generated, the interested reader is directed to Marburger (2004), Gibbons (1988), and Ashenfelter (1987).

I assume that the arbitrator picks the final offer that is closest to the settlement that the arbitrator prefers. Hence, the arbitrator will pick the team's final offer if $w_a \leq \frac{w_e + w_f}{2} \equiv \overline{w}$. The probability that the team's offer is chosen is given by the cumulative distribution function $F(\overline{w})$. Neither negotiator knows the arbitrator's preferences but both have equal knowledge of the distribution. Both negotiators are completely informed of each other's preferences and we assume that all negotiators are risk neutral. Hence, assume that the team and the player have the following utility functions: $U_f = (R(t) - w) = R(t) - w$ and $U_e(w) = w$ respectively.

Below, I present two alternative theoretical models. The first model is a two-stage model of bargaining within an FOA model. In the second model, I examine a three-stage model of bargaining within an FOA model.

2b. Theory 1 – Two Stage Model

2-bi. Stage 2 – Cooperative Bargaining

In this stage, the negotiators have set their final offers which both observe. Information in this stage is uncertain but symmetric, complete, and perfect. If the player and the team have not voluntarily settled when the stage ends, they give the final offers to an arbitrator who renders a decision by choosing one of the final offers based upon the arbitral criteria. If the negotiators reach a voluntary settlement, there is no uncertainty in the second stage since the only uncertainty is that associated with the disagreement outcome. Consequently, the payoffs in the second stage are the utilities evaluated at the negotiated wage. Hence, in this framework, the Nash (1950) bargaining solution to the second stage is given by

$$w_s^* = \arg\max_{w_s} \left[\left(R(t) - w_s \right) - d_f \right] \left[w_s - d_e \right]. \tag{1}$$

w_s^* is the negotiated settlement and d_e and d_f are the disagreement outcomes of the player and the team respectively. These outcomes are their expected arbitration outcomes:

$$d_f = F\left(\overline{w}\right)\left(R(t) - w_f\right) + \left[1 - F\left(\overline{w}\right)\right]\left(R(t) - w_e\right)$$

$$d_e = F\left(\overline{w}\right) w_f + \left[1 - F\left(\overline{w}\right)\right] w_e$$

Maximizing (1) yields the solution to the second stage with the first-order condition given by

$$-\left(w_s^* - d_e\right) + \left[\left(R(t) - w_s^*\right) - d_f\right] = 0. \tag{2}$$

Note that the second-order condition for a maximum is satisfied. Note that $w_s^* - d_e \geq 0$ and $\left(R(t) - w_s^*\right) - d_f \geq 0$ since the utility from reaching a negotiated settlement cannot be less than the expected utility of disagreeing for either negotiator. Hence, the Nash bargaining solution to the second stage is directly derived from (2) above and given by $w_s^* = \dfrac{\left(d_e - d_f\right) + R(t)}{2}$. Substituting for the disagreement outcomes yields the expression $w_s^* = F\left(\overline{w}\right) w_f + \left[1 - F\left(\overline{w}\right)\right] w_e$. Hence, the negotiated settlement is the expected outcome from proceeding to arbitration. Note that this settlement is not a function of the revenue generated by the player. It is, however, a function of the arbitral criteria.

Before proceeding it is necessary to consider the possibility that a case may go to arbitration. For instance, in the face of high negotiating costs, the negotiators may find it optimal to forgo bargaining and instead opt for an arbitrated solution. Hence, the model predicts that there will always be a negotiated solution and, consequently, does not describe the process that causes disagreements. Other authors overcome this problem by introducing incomplete information regarding the preferences of negotiators. For instance, Faurot (2001) introduces incomplete information about the risk preferences of one of the negotiators. I simply note that disagreements in the present context can occur due to non-modeled informational asymmetries.

2b-ii. Stage 1 – Setting of Final Offers

In this stage, the negotiators non-cooperatively set final offers to maximize the utility from the shares received in the second stage. Thus

$$w_f^* = \arg\max_{w_f}\left(R(t) - w_s^*\right) \tag{3}$$

$$w_e^* = \arg\max_{w_e} w_s^* \ . \tag{4}$$

Differentiating (3) and (4) with respect to w_f and w_e respectively yield the following first-order conditions:

from (4): $$\frac{\partial w_s^*}{\partial w_f} = F\left(\overline{w}\right) + \frac{1}{2}F_{w_f}\left(w_f - w_e\right) = 0\,; \tag{5}$$

from (5): $$\frac{\partial w_s^*}{\partial w_e} = \frac{1}{2}F_{w_e}\left(w_f - w_e\right) + \left(1 - F\left(\overline{w}\right)\right) = 0\,. \tag{6}$$

The sign of the second order conditions depend on the relative magnitudes of the marginal densities and the derivatives of the marginal densities, so for simplicity I assume that these conditions each satisfy the sufficient condition for a maximum. Hence, (5) implicitly defines the equilibrium final offer of the team (w_f^*) and (6) implicitly defines the equilibrium final offer of the player (w_e^*). Because w_s^* is a function of the arbitral criteria, both of the final offers will be a function of these criteria. Note that neither (6) nor (7) are functions containing R(t) as an explicit argument. Hence, neither w_f^* nor w_e^* are functions of the revenues generated by the player.

The MLBCBA specifically disallows the use of team financial information when an arbitrator renders a decision. If players and teams only account for the arbitral criteria, then they will not explicitly account for team-specific revenues when setting final offers. However, it may be the case that although teams and players do not explicitly account for team-specific revenues, their final offers may implicitly account for revenue differentials. Theory two, described in the next subsection, describes how this may occur.

2c. Theory 2 – Three Stage Model

In this theory, the arbitration process is modeled as a three-stage process. The last two stages are exactly as described in 2c-i and 2c-ii as above and will not be described here. However, I add another stage that occurs at the beginning of the process (before the setting of final offers), which I call "Stage 0" for convenience, in which teams decide whether or not to keep arbitration-eligible players on their roster. This stage is described below.

2c-i Stage 0 – The Team's Decision Whether to Trade

In MLB, every player with less than 6 years of major league service is bound to his current team by the reserve clause. The player essentially has no choice if he wants to continue playing baseball, but the team has a choice whether to trade him.[1] In this stage I assume the player has no move: the decision solely belongs to the team. If the team does not trade the player, the player and the team proceed through the arbitration process as described above.

The team thus decides whether to proceed to arbitration with the player or to trade him and obtain a substitute player. I assume the team has two strategies which both the team and the player observe: trade[2] or not trade. If it does not trade the player, then they will proceed through stages 2 and 3 of the game described above and the team will receive a surplus of $R(t) - w_s^*$. If the team trades the player, it obtains a substitute player for him and the game ends[3]. The substitute player possesses t_{sub} units of talent, earns a salary of w_{sub}, and generates a surplus of $R(t_{sub}) - w_{sub}$ for the team. For simplicity we assume that w_{sub} is exogenously-determined.

Assume initially that the arbitration-eligible player has more absolute talent than his substitute player: $t > t_{sub}$ which implies that $R(t) > R(t_{sub})$. Note that the net-surplus that the team will receive if it keeps the player is $(R(t) - w_s^*) - (R(t_{sub}) - w_{sub})$. Lastly, we assume that if the net-surplus is zero (the team will be indifferent between trading and not trading), then the team will not trade the player.

An equilibrium choice of the team is to trade the player if he generates a smaller surplus than his substitute,

$$(R(t) - w_s^*) < (R(t_{sub}) - w_{sub}). \qquad (7)$$

This will be the case if

$$\left(R(t)-R(t_{sub})\right)+w_{sub}<w_s^*. \quad (8)$$

This inequality will hold if the substitute player is relatively low-paid and/or the difference between R(t) and R(t_{sub}) is small. But if $\left(R(t)-R(t_{sub})\right)+w_{sub}\geq w_s^*$, then the team will not trade the player. Therefore, given w_{sub}, if the arbitration-eligible player cannot generate sufficient revenue to cover his salary, the team will trade him

Now suppose that the arbitration-eligible player is less-talented than the substitute ($t < t_{sub}$). Thus, $R(t)<R(t_{sub})$. Since $R(t)-R(t_{sub})<0$, the player will be traded whenever $w_s^*\geq w_{sub}$.

But if $w_s^*<w_{sub}$, the arbitration-eligible player will be traded only if

$$\left(R(t_{sub})-R(t)\right)+w_s^*>w_{sub}. \quad (9)$$

$\left(R(t_{sub})-R(t)\right)$ represents the forgone net revenue if the player is not traded. Therefore, $\left(R(t_{sub})-R(t)\right)+w_s^*$ represents the total cost of not trading the player. Hence, if the total cost of keeping the arbitration-eligible player exceeds the salary of the substitute player, the team has an incentive to trade him even if he earns a lower salary than his substitute. Given w_{sub}, the larger the difference between $R(t_{sub})-R(t)$, the more likely the arbitration-eligible player is to be traded for the more-talented substitute.

Although we do not explicitly model the decision of the other team involved in the trade, it would be similar to what we describe here. The player would be traded to a team for which he would generate a net-surplus larger than what his substitute would generate. If each team has a substitute available who will be paid a salary consistent across teams, the arbitration-eligible player will be traded to a team that will generate sufficient revenue to cover the player's salary.

Given the substitute player's salary, for any one arbitration-eligible player, the team's decision of whether to trade him thus depends on the difference between $R(t)$ and $R(t_{sub})$. This difference depends on two things: 1. the difference in the talent levels of the arbitration-eligible player and his substitute; 2. the marginal revenue function of the team. Given the difference in talent levels, the high marginal revenue teams will be more likely to keep or acquire the higher-talent players. If high revenue teams are also high marginal revenue teams[4], the high revenue teams are more likely to acquire or keep the higher quality players and the low revenue teams are more likely to acquire or keep the lower quality arbitration-eligible players. Consequently, we should see a positive relationship between the revenue-generating capability of the team and the final offers.

Although the Collective Bargaining Agreement specifically disallows the use of team financial information when an arbitrator renders a decision, the theory suggests players will gravitate to the teams that are willing and able to pay their salaries. This suggests that after controlling for the basic arbitral criteria, if the higher-paid players are proceeding through the arbitration system with teams that value them the most, we should find a premium embedded in the final offers set by the players and the teams.

2d Theoretical Conclusions

Above I have developed two competing theories that reach two different conclusions. In the first theory, players and teams set their final offers with an eye only towards the criteria spelled out in the MLBCBA. If so, then I expect that team-specific revenues will not be correlated with the final offers. In the second theory, final offers will be correlated to team specific revenues implicitly because players will tend to be traded to the teams that value them the most. Empirically, if there is no relationship between the final offers and team-specific revenues, there should be no evidence of a differential embedded in the final offers set by the players and the teams. This is a testable hypothesis that I explore below.

3. The Empirical Models, the Data, and the Empirical Results

3a. The Empirical Models

The theoretical models suggest that the final offers will be a function of the arbitral criteria but not team-specific revenues if teams trade players to other teams that value them more. Thus, several models of the following form will be estimated:

$$\ln FO_{i,t} = X_{i,t-1}\beta_1 + \mathrm{Rev}_{i,t-1}\beta_2 + \varepsilon_{i,t}\,.$$

$\ln FO_{i,t}$ is a vector of final offers set by i = (player, team) in year t. $X_{i,t-1}$ is a matrix of variables lagged one year that control for the general arbitral criteria and $Rev_{i,t-1}$ is a matrix of team-specific revenues lagged one year. I use lagged terms because the arbitrators and negotiators will use past information about the player and the team as indicators of player and team quality. All monetary values are in real US dollars (Base =

1982-1984). β_1 and β_2 are vectors of unknown parameters to be estimated. ε_i is a vector of i.i.d. error terms. I examine player and team final offers separately.

I perform separate analyses for batters and for pitchers. The general arbitral criteria included in the X matrix for batters are lagged slugging percentage, lagged on-base percentage, lagged career slugging percentage, lagged career on-base percentage, and lagged career games (both being measures of the length and consistency of a player's career as well as mental and physical deficiencies of the player). Note that I include lagged career games as a quadratic term. I also include lagged team winning percentage as a measure of the quality of the team. I include the lagged value of the average real free agent salary, entered logarithmically, to control for comparable baseball salaries.

The general arbitral criteria included in the X matrix for pitchers are the lagged values of the strikeout-to-walk ratio, the number of appearances, the number of games started, the number of innings pitched, the career number of innings pitched, the number of saves, the pitcher's career strikeout-to-walk ratio, career appearances, career games started, career saves, and the logarithm of the average free agent salary. To control for differences between starters and relievers, I include the proportion of last season's games pitched as a staring pitcher. I also include lagged team winning percentage as a measure of the quality of the team.

We do not include the player's previous compensation in the batter or pitcher regressions because of the correlation it will have with a player's career performance. Additionally, there may be some dependence between this variable and the error term for each player.

3b. The Data and Data Assumptions

All productivity and final offer data was obtained online from the Sean Lahman Baseball Archive. 1992-2001 arbitration data was obtained from various issues of USA Today and the Sporting News. Arbitration data for 2002 was obtained from Doug Pappas' Business of Baseball website. Team financial information was obtained from the Pappas website and consists of estimates on team revenues and franchise values for all Major League franchises, information initially published in various issues of Financial World (1991-1996) and Forbes (1997-2001). The free agent salary data was generously provided by Daniel Marburger via personal correspondence.

From the data, we generated one record for each player in each year. For each player who played with more than one team during a year, all individual productivity and salary statistics were summed over all the teams for which he played. Since we must include team statistics in our analysis, we attach the statistics of the team for which each batter had the most plate appearances (defined as hits + walks + hit by pitches) in each particular year. For pitchers, we attach the statistics of the team for which each pitcher had the most innings pitched.

The team revenue included in each record is the lagged value for the team with which the player exchanged final offers. So, if a player played for the Twins in 2001 but went through the arbitration system with the Cubs, the Cubs revenue from the previous year is used in the estimation.

3c. The Empirical Results

Table 1 presents the summary statistics of the variables used in the batters' analysis. Table 2 present the estimated regression parameters for the team and batter final offers. In each model, all significant parameter estimates have the expected signs. Both lagged slugging percentage and lagged career slugging percentage are positive and highly significant in every model. Lagged career games have a significant and increasing and concave effects on team and player log final offers in all models (as evidenced by the positive coefficient estimate for career games and the negative coefficient estimate on its square). Lagged winning percentage has a positive coefficient in models B and D, but is not significant in either regression. Thus, the evidence suggests that batters and their teams believe that a given batter's impact on his previous team's winning percentage is negligible.

According to the estimates, players tend to put more emphasis on last season's slugging percentage when setting their final offers, but teams put a slightly higher emphasis on lagged career slugging percentage. This suggests that teams pay relatively less attention to "what have you done for me lately?" compared to the attention that batters pay to "what have I done for you lately?" when accounting for slugging percentage. Players put more emphasis on career on-base percentage.

In every model, the coefficient on the average free agent salary is positive and highly significant suggesting that higher free agent salaries lead to higher final offers, as expected. However, revenue does not have a significant impact on the final offers after controlling for other factors. This suggests that neither players nor teams account for the revenue-generating capabilities of the team once the negotiators become involved in the arbitration process.

Table 3 presents the summary statistics of pitchers. Table 4 presents the regression results for pitchers. All the coefficients on the productivity measures are highly significant except for lagged strikeout-to-walk ratio, lagged games pitched, and lagged career innings pitched. Lagged games started has a negative and significant coefficient suggesting that players and teams set lower final offers for more games started after accounting for the number of innings pitched.

The estimates suggest that pitchers and teams put similar emphasis on last season's productivity. As found in the batters' regression, teams place slightly higher emphasis on career productivity measures than on last season's productivity except for lagged career innings pitched. Players put more emphasis on the proportion of last-season's games started. Recall that in cases involving batters, neither batters nor teams put any significant emphasis on team winning percentage when setting their final offers. But the results suggest that team–pitcher pairs believe that an individual pitcher's marginal contribution to team wins is more important than an individual batter's marginal contribution.

The estimates on lagged real revenue are positive and significant in regression C suggesting that the higher a team's revenue, the higher the final offers will be. However, when lagged team winning percentage is added in, the R-squared of the pitcher and team regressions increase. Moreover, the coefficients on lagged real revenue decrease and become insignificant, suggesting that there is an omitted variables bias in regression C. Lastly, comparing regressions A and C, adding team-specific revenue to the regressions did little to add explanatory power to model. We take these collective results as evidence that neither pitchers nor teams account for team-specific revenues when setting final offers.

In summary, the empirical analysis provides evidence that players and team final offers are not correlated with team-specific revenues, as predicted by the theory. Consequently, the results suggest that each team pays the same price for each "unit" of talent possessed by each player with no differential based on team revenues. If a given player is paid an above average salary, he is paid such because he is either a better player, is playing on a more successful team, or is a better player playing on a more successful team. But the final offers that he and his team set pay no heed to the team's revenue-generating capability.

4. Discussion and Conclusion

In this paper I examine the effect that team revenue-generating capabilities have on final offers set within Major League Baseball's arbitration system. According to baseball's collective bargaining agreement, arbitrators may not consider team finances when rendering a decision. I develop two theories to examine the setting of final offers. In the first theory, final offers are simply functions of the arbitral criteria and are, therefore, not a function of the revenue-generating capability of the team. In the second theory, I argue that teams may trade some arbitration-eligible players, resulting in an implicit premium embedded in the final offers. The empirical analysis suggests that there are no such premiums embedded in the final offers.

What explains why the final offers would not be a function of prohibited criteria? In the theory, an arbitrator picks that final offer which is closest to the arbitrator's preferred settlement. The arbitrator's preferred settlement will be a function of the arbitral criteria. If a team's final offer is set too low based on the arbitrator's examination of the relevant criteria, the arbitrator would be more likely to deem it to be unreasonable and would be less likely to choose it. If the player's offer is set too high, the arbitrator would be more likely to deem it to be unreasonable. Therefore, both the player and the team have an incentive to set a reasonable offer and to not account for unallowable criteria.

Suppose a low-revenue team sets a final offer that reflects its revenues but the player does not. Based on the arbitral criteria, when examining the offers, an arbitrator would likely consider the team's offer to be "unreasonable" and would be less likely to pick it. A similar argument can be made when a player of a high-revenue team makes an offer that reflects the team's revenues but the team does not.

Lastly, I offer an answer regarding why team-specific financial criteria are disallowed in the arbitral process. Since this prohibition is in the MLBCBA, both the teams and the players' union agreed to it. While this prohibition surely protects the privacy rights of teams, it also provides some insurance to players and teams as well. If a player goes through the arbitration process with a low-revenue team, should the case reach an arbitration hearing, the team could argue that it is in no financial position to pay the player what he is asking. On the other hand, if the player goes through the arbitration process with a high-revenue team, the player could argue that the team could afford to pay him the salary he is asking. The prohibition against using team-specific revenues in rendering a decision effectively rules out both of these strategies.

This paper provides a deeper understanding of the processes guiding negotiators in arbitration systems and how those processes guide negotiators. The Nash solution is attractive in examining settlements negotiated within an arbitration system because 1. the negotiators can bargain for and enforce a binding contract and 2. the negotiated outcome is an explicit function of the disagreement outcomes – what a negotiator receives in negotiations is related to what he expects to receive if he cannot reach an agreement. Because the disagreement outcome in a final offer arbitration system is the expected arbitration outcome, the disagreement outcome will be a function of criteria that arbitrators may use when rendering a decision. Rules prohibit certain items from being directly addressed in arbitration cases, and the paper provides evidence that those involved follow those rules.

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[1] In reality, the team has other choices. It could simply release the player or it could send him to the minor leagues. If it releases the player and another team picks him up, then his original team loses him without compensation. The team would have been better off trading this player to that team, even for a pack of baseball cards.

[2] We do not fully consider the bargaining between teams that occurs when trades occur. We assume that there is another team out there who is willing to trade for the player.

[3] The substitute player does not have to play the same position as the arbitration-eligible player. This substitute player is merely a substitute for the arbitration-eligible player's roster spot.

[4] For example, if teams produce winning and fan demand curves for winning are linear.

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Table 1 - Summary Statistics of Variables Used in Batter Analysis

Variable	Label	Mean	Std. Dev.
rcfo	Real Club Final Offer	982730.2	848630.6
rpfo	Real Player Final Offer	1358776	1051787
slg_1	Lagged Slugging Percentage	0.414412	0.0740187
obp_1	Lagged On-base Percentage	0.3327021	0.0388171
cslg_1	Lagged Career Slugging Percentage	0.3993479	0.0531559
cobp_1	Lagged Career On-base Percentage	0.3240209	0.0286667
cg_1	Lagged Career Games	493.447	197.848
rfreesal_1	Lagged Real Free Agent Salary	1469613	437314
rrev_1	Lagged Real Revenue	45.58236	17.95788
wpct_1	Lagged Team Winning Percentage	0.5077697	0.0650575

N = 443

Table 2 - Batter Regressions

Parameter Estimates (Std Errors are given below estimates)

	A		B		C		D	
Variable	**Team Final Offer**	**Player Final Offer**	**Team Final Offer**	**Player Final Offer**	**Team Final Offer**	**Player Final Offer**	**Team Final Offer**	**Player Final Offer**
slg_1	2.064453***	2.398026***	2.074666***	2.413979***	2.077662***	2.368705***	2.081223***	2.377232***
	0.5998323	0.5781689	0.6015609	0.5797489	0.6052737	0.5833261	0.6061114	0.5839305
obp_1	-1.037063	-1.45375	-1.075029	-1.513057	-1.046785	-1.43217	-1.076686	-1.503769
	1.085561	1.046355	1.095034	1.055329	1.088206	1.048747	1.096422	1.056298
cslg_1	2.862391***	2.353725***	2.842668***	2.322917***	2.8483***	2.385003***	2.836592***	2.356966***
	0.7470548	0.7200744	0.7511154	0.7238806	0.7522532	0.724976	0.7546341	0.7270179
cobp_1	3.576057***	3.705646***	3.599235***	3.741852***	3.584935***	3.68594***	3.601944***	3.72667***
	1.315918	1.268393	1.319879	1.272021	1.318374	1.270568	1.32169	1.273322
cg_1	0.0054855***	0.0050789***	0.0054815***	0.0050727***	0.0054845***	0.0050812***	0.0054813***	0.0050737***
	0.000288	0.0002776	0.0002886	0.0002782	0.0002884	0.0002779	0.000289	0.0002784
cgsq_1	-0.00000237***	-0.0000022***	-0.00000237***	-0.0000022***	-0.00000237***	-0.0000022***	-0.00000237***	-0.0000022***
	0.000000191	0.000000184	0.000000192	0.000000185	0.000000191	0.000000185	0.000000192	0.000000185
lnrfreesal_1	0.6837526***	0.6353386***	0.6828385***	0.6339106***	0.6799843***	0.6437032***	0.6807596***	0.6455597***
	0.0666372	0.0642306	0.0667867	0.0643651	0.0701335	0.0675904	0.0702833	0.0677112
wpct_1	-	-	0.0823823	0.1286883	-	-	0.0738078	0.1767356
			0.2923891	0.2817873			0.3060503	0.2948502
lnrrev_1	-	-	-	-	0.0073446	-0.0163029	0.0042373	-0.0237435
					0.0421758	0.0406465	0.0441439	0.0425284
constant	-1.036571	0.3289104	-1.055536	0.2992851	-1.009814	0.2695175	-1.038125	0.2017248
	0.9379469	0.9040723	0.9413506	0.907218	0.9514821	0.9169807	0.9597233	0.9246017
R-square	0.7603	0.7499	0.7603	0.7500	.7603	0.75	0.7603	0.7502

Table 3 - Summary Statistics of Variables Used in Pitcher Analysis

Variable	Label	Mean	Std. Dev.
rcfo	Real Club Final Offer	979502.7	747831.5
rpfo	Real Player Final Offer	1363173	910769.4
kw_1	Lagged Strikeout-to-Walk Ratio	2.103825	0.8284789
ckw_1	Lagged Career Strikeout-to-Walk Ration	1.944409	0.5296686
g_1	Lagged Games Pitched	42.53061	17.1774
cg_1	Lagged Career Games Pitched	171.5153	73.67899
gs_1	Lagged Games Started	14.95918	14.01071
cgs_1	Lagged Career Games Started	64.44133	60.18825
ip_1	Lagged Innings Pitched	129.9362	64.12038
cip_1	Lagged Career Innings Pitched	546.1037	328
sv_1	Lagged Saves	4.165816	8.772227
csv_1	Lagged Career Saves	13.74745	26.13148
prgs_1	Lagged Proportion of Games Started	0.4971908	0.4612416
rfreesal_1	Lagged Real Free Agent Salary	1573669	454428.9
rrev_1	Lagged Real Team Revenue	47.57876	19.96733
wpct_1	Lagged Team Winning Percentage	0.5081684	0.0654421

N = 392

Table 4 - Pitcher Regressions

Parameter Estimates (Std Errors are given below estimates)

	A		B		C		D	
Variable	**Team Final Offer**	**Player Final Offer**	**Team Final Offer**	**Player Final Offer**	**Team Final Offer**	**Player Final Offer**	**Team Final Offer**	**Player Final Offer**
kw_1	-0.0170587	0.0060809	-0.0269969	-0.0027811	-0.013609	0.0081568	-0.0245901	-0.00207
	0.0341028	0.0293195	0.0328148	0.0281202	0.0338549	0.0292461	0.0328209	0.0281884
ckw_1	0.2007549***	0.148978***	0.1930649***	0.1421208***	0.2115175***	0.1554545***	0.1991216***	0.1439102***
	0.0537887	0.0462443	0.0517016	0.044305	0.0535107	0.0462261	0.0518234	0.0445089
g_1	-0.0019978	-0.0010578	-0.0019456	-0.0010113	-0.0021895	-0.0011732	-0.0020482	-0.0010416
	0.0031695	0.0027249	0.0030455	0.0026098	0.003145	0.0027168	0.0030427	0.0026132
cg_1	0.0040344***	0.0035254***	0.0040292***	0.0035208***	0.0040993***	0.0035645***	0.0040632***	0.0035308***
	0.0008425	0.0007243	0.0008095	0.0006937	0.0008361	0.0007223	0.0008089	0.0006947
gs_1	-0.0355519***	-0.0344624***	-0.0350021***	-0.0339721***	-0.0364809***	-0.0350214***	-0.0355178***	-0.0341245***
	0.0108009	0.009286	0.0103787	0.0088939	0.0107202	0.0092608	0.0103728	0.0089088
cgs_1	0.0051978*	0.0049769**	0.0044126*	0.0042767*	0.0051628*	0.0049559**	0.0044433*	0.0042858*
	0.0027374	0.0023535	0.0026339	0.0022571	0.0027156	0.0023459	0.0026308	0.0022595
ip_1	0.0107773***	0.0098464***	0.0105834***	0.0096734***	0.0107266***	0.0098159***	0.0105692***	0.0096692***
	0.0017642	0.0015168	0.0016956	0.001453	0.0017503	0.001512	0.0016935	0.0014545
cip_1	-0.0003801	-0.0003969	-0.0002965	-0.0003224	-0.0003871	-0.0004011	-0.0003054	-0.000325
	0.000507	0.0004359	0.0004874	0.0004176	0.0005029	0.0004345	0.0004868	0.0004181
sv_1	0.0167898***	0.0169502***	0.0179304***	0.0179673***	0.0178957***	0.0176157***	0.0184325***	0.0181156***
	0.0043739	0.0037604	0.0042075	0.0036056	0.0043586	0.0037653	0.004218	0.0036226
csv_1	0.0066906***	0.0062142***	0.0057694***	0.0053927***	0.006252***	0.0059502***	0.0055995***	0.0053425***
	0.0016362	0.0014067	0.0015805	0.0013544	0.0016314	0.0014093	0.0015833	0.0013598
prgs_1	0.7591921***	0.8048602***	0.7988246***	0.8402004***	0.8131964***	0.8373583***	0.8243438***	0.8477399***
	0.1689005	0.1452105	0.1624405	0.1392011	0.1687662	0.1457916	0.1632848	0.1402383
lnrfreesal_1	0.7376993***	0.649657***	0.7336196***	0.6460192***	0.6647056***	0.6057317***	0.6960447***	0.634918***
	0.0682236	0.0586545	0.065558	0.056179	0.0729888	0.0630526	0.0708703	0.0608675
wpct_1	-	-	1.581722***	1.410422***	-	-	1.483202***	1.381315***
			0.2774697	0.2377739			0.2861061	0.2457244
lnrrev_1	-	-	-	-	0.1181908***	0.0711234*	0.0612526	0.0180966
					0.0442553	0.0382307	0.0442006	0.037962
_cons	0.5288449	2.374212***	-0.1722124	1.749079**	1.091764	2.712959***	0.1631881	1.84817**
	0.9741464	0.8375123	0.9440736	0.8090111	0.9890799	0.8544335	0.9734927	0.8360914
R-Squared	0.7746	0.7972	0.7924	0.8145	0.7787	0.7991	0.7935	0.8146