

**Salary Arbitration:
The Arbitrator's Decision and Wage Determination in
Major League Baseball**

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April 2006

I would like to thank my advisor, John F. O'Connell, and Robert Baumann for their guidance and support throughout the course of this study.

Abstract

Labor arbitration, a process of conflict resolution, has been modeled based upon data from a number of occupations. This study examines the process of salary arbitration in Major League Baseball, introducing established arbitration modeling of the arbitrator's decision and examining its effectiveness in this case. The study of the arbitrator's decision leads to an examination of the player's wage. To that end, a wage determination function based on a least squares model is constructed using variables the arbitrator is instructed to consider, as well as those the arbitrator is instructed to disregard. A market wage is estimated for each player who has gone through the arbitration process since the inception of the program in 1974. This market wage, along with the wage offers of both the player and the club, are introduced to an established modeling of the arbitrator's decision. Results suggest that the arbitrator, in concert with the two parties to the dispute, serve as a reasonable substitution for the market.

I. Introduction

Eric Gagne of the Los Angeles Dodgers went through Major League Baseball's salary arbitration mechanism in February of 2004. His arbitrated salary was \$5,000,000 for the 2004 season, which amounted to an increase of over 800-percent from his \$550,000 salary during the 2003 season.¹ This is but one example of the results attained by the league's system of salary arbitration. Each year, a number of baseball players and their teams use salary arbitration to resolve a disagreement over the player's salary for the coming season. This paper will examine salary arbitration in Major League Baseball, introducing established modeling to the arbitrator's decision.

Labor arbitration is prevalent among many occupations when negotiations between the parties reach an impasse. In these situations, a third party hears the arguments of the two parties to the dispute and then makes a decision. These agreements most often involve the wage to be paid for a laborer's services, but may also include benefits such as working conditions, health insurance, and paid leave.

Salary arbitration may be broken down into two categories, the second having been developed based upon the perceived shortcomings of the first. The first general type of salary arbitration is known as "conventional arbitration." Under conventional arbitration, each party to the conflict, in the course of making their case, presents their own notion of a "fair award." The arbitrator is then charged to find his or her notion of a fair award. In conventional arbitration, this notion of a fair award may be any wage. For reasons that will be discussed

¹ Fort, Rodney. "Rodney Fort's Sports Economics Sports Business Data." <www.rodneymfort.com> Accessed 15 October 2005.

shortly, a second general type of “final-offer arbitration” was formally crafted in the 1960s. Under final-offer arbitration, each party to the conflict presents his or her own notion of a fair award, as is the case with conventional arbitration. It is at this point that the mechanics of final-offer arbitration depart from those of its precursor. In final-offer arbitration, the wage level that the arbitrator is able to select is limited to one of the two parties’ offers.

The outcome of both conventional and final-offer arbitration depends upon the perception of a “fair award” by the arbitrator. Knowing as much as possible about the arbitrator should make the offer presented by the party to the dispute more informed, and, therefore, more likely to be accepted. As a result, a sizable literature has evolved to explain the behavior of the arbitrator. Much of this modeling has been fashioned and empirically tested on homogeneous, oftentimes unionized, labor. The specific modeling to be examined in this paper was fashioned and tested on municipal police and fire employees in New Jersey. There are two important factors that these groups of laborers all share in common. First, the variation in the skill set among individual members in a particular group is negligible. To put it simply, substituting one firefighter for another on the back of a fire truck, so long as they are not in a position of management, will not notably alter the fire company’s capacity to extinguish a fire. As a consequence, the wages that are earned by laborers in these groups, such as firefighters and policemen, are all quite similar. In the case of unionized workers, wages are typically uniform for a laborer of a given experience and skill level.

This paper will, in part, test the flexibility of the generally accepted modeling for final-offer arbitration by applying it to salary arbitration in a labor force that does not generally adhere to the above mold. The labor force to be discussed is that of professional baseball players. Unlike police or fire personnel where there are a large number of

homogeneous employees, a team's roster consists of relatively few (the maximum is kept to twenty-five by an agreement amongst the teams) and the skills displayed by individual players may vary widely, as will their productivity. The second factor discussed above was that wage levels did not vary greatly among individual workers. In Major League Baseball, wage levels vary greatly, ranging from the league minimum (\$300,000 in 2004²) to the \$21,726,881 commanded by Alex Rodriguez of the New York Yankees that same year.³

The final-offer salary arbitration proceedings in Major League Baseball may be studied from at least two perspectives. The first is the decision process of the arbitrator: a decision that consists of selecting one offer or the other presented by the parties to the dispute. The second perspective is the extent that the wage settled upon reflects market forces. Pursuit of this second stage led to the construction of a wage determination function. Empirical testing in this area should give us a glimpse of the sign and significance of a number of variables that should be taken into account in the construction of a wage offer. These variables will include those that the arbitrator is instructed to consider – a player's performance during the previous year, a player's career performance, a player's career length, a player's previous compensation, and the club's previous performance. Also included will be variables that the arbitrator is not instructed to consider, including a player's position and the specific collective bargaining agreement under which the hearing occurred, as well as the metropolitan population of the team's location and the condition of the team's stadium.

Salary arbitration in Major League Baseball is a relatively new phenomenon, with the first hearings taking place prior to the start of the 1974 season. Before 1974, the movement of

² League minimum salary data provided by Major League Baseball Players Association.

³ Fort, Rodney. "Rodney Fort's Sports Economics Sports Business Data." <www.rodneymfort.com> Accessed 15 October 2005.

players among clubs was governed by the “reserve clause.” Under this system, a player signed a one year contract with a club at the beginning of his career. Each year, the club would renew the contract without any negotiating occurring between the player and the club. Clubs other than the player’s current employer were prohibited from negotiating with the player. This ban on competition between clubs for the services of a player kept wages artificially low, as clubs exerted “monopsony power.” Monopsony describes a situation where the employer has discretionary power over the wage. As a result, the employer is able to pay a wage less than the player’s marginal revenue product.

Today, with “free agency,” players negotiate with the highest bidders once a contract has expired. This competition has allowed some players to sign contracts worth many millions of dollars. Some examples of these large contracts include Alex Rodriguez’s 252 million dollar contract reached with the Texas Rangers in 2001, and Manny Ramirez’s 160 million dollar deal reached with the Boston Red Sox in 2000. The free agency that today’s players enjoy was first introduced with the signing of the 1976 Basic Agreement between the union that represented the players in the league and the owners of the league’s franchises. Under the 1976 Agreement, a player with six years major league service time upon expiration of his contract was made eligible for free agency. This time frame on free agency, which still exists today, allows players to negotiate with any and all employers. Prior to the introduction of free agency in 1976, players were in a sense “owned” by a single club for their entire career. Players were only able to move to a new club as the result of a financial arrangement between two clubs through which the player’s contract was sold. The new club would then retain ownership of the player’s contract, enjoying the control that the original club previously had.

Salary arbitration proceedings determine a wage for one year, with the contract expiring at the end of the following season. Currently, players and clubs must notify each other of their intention to seek arbitration during the first half of January. The parties must then make their final salary offers within three days of their declaration to pursue salary arbitration. The parties continue to negotiate following this presentation of offers; many negotiations reach a settlement during this period, eliminating the need to enter final-offer arbitration. For cases where a settlement is not reached between the parties, hearings are scheduled in the month of February where each party will have the opportunity to present its case.

From its inception, salary arbitration in baseball has always followed the model of final-offer. Since 1973, six collective bargaining agreements have gone into effect, each reinforcing the principals of final-offer arbitration. The 1973 Basic Agreement made arbitration available to all players with two years of experience after contract expiration, beginning prior to the 1974 season. The original system remained unchanged until the 1985 Basic Agreement altered the experience required to be eligible for salary arbitration, raising the minimum from two to three years experience after contract expiration. The 1990 Basic Agreement made a slight change to the experience required to be eligible for arbitration, allowing for the creation of a group of second year players that came to be known as “super-twos.” This group, which was made eligible for arbitration, consists of the top 17% of second year players in terms of experience (measured in games played). Eligibility for those with three years of experience and for a portion of “super-twos” remains in effect today.

Section II of this paper will contain a literature review, tracing the research on which this study is built. Section III will be a discussion of the theory and Section IV will address

the methods and empirical results of this paper. Finally, Section V will consist of a summary and conclusion of the lessons to be taken from this paper.

II. Literature Review

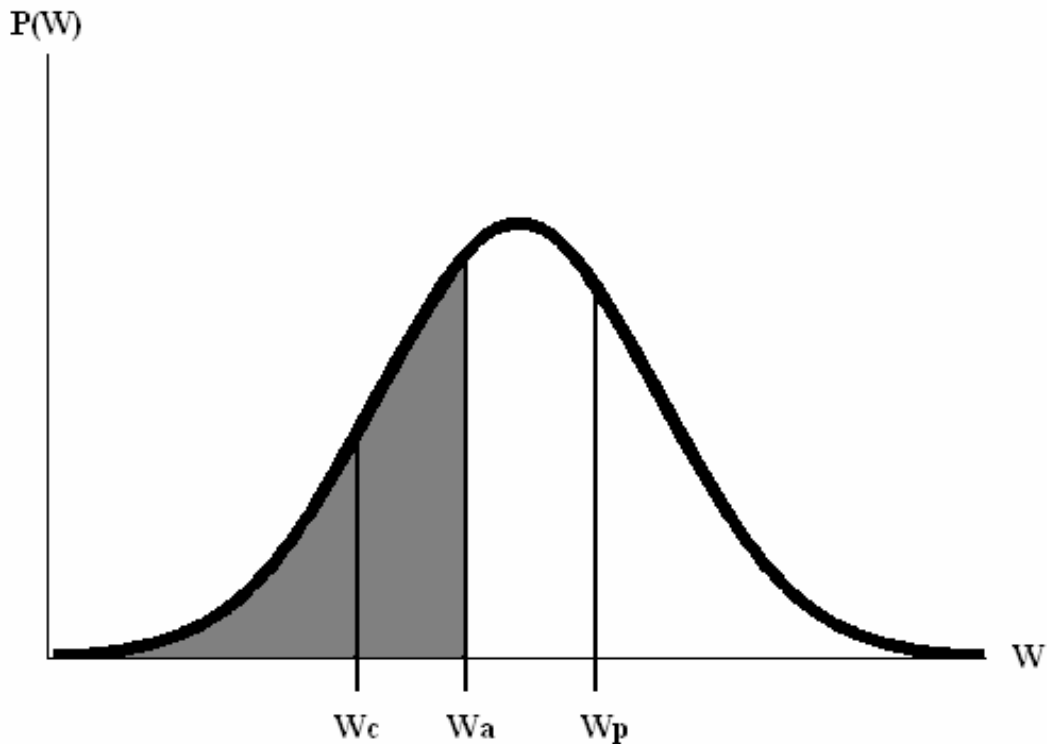
Final-offer arbitration was first suggested by Carl Stevens (1966) as a solution to the growing problems evident in conventional arbitration. In conventional arbitration, the arbitrator made a final offer that was usually positioned between the offers of the two parties. The parties' offers were intended to serve as a signal of the parties' notion of a fair offer to the arbitrator. Over time, the parties, having noticed that the arbitrator's position was located relatively near the mean of the two offers, pushed their offers to extremes. This process was originally intended to make the outcome more favorable to the party that moved their offer. As both parties continued to move their offers further and further towards an extreme, the result was that little information was relayed to the arbitrator through the party offers.

Stevens suggested that each party involved in the arbitration be required to submit an offer, after which the arbitrator would be required to select one of the two offers, with no compromise allowed. If each side knows that the arbitration proceeding is one of win or lose, theory suggests the pressure exists for parties to bring their offer towards an equilibrium. This equilibrium would be located at the arbitrator's personal notion of a fair award.

In theory and practice, as shown by Vincent Crawford (1979), the arbitrator's notion of a fair award is not known to the participants. If the arbitrator's fair award was known to all parties, the offers of the two parties would meet at the arbitrator's award, precluding negotiating impasses and the need for arbitration. It is because there is some uncertainty in the location of this fair award that the offers of the two parties will not meet. Speculation

surrounding the notion of a fair award by the arbitrator may have a substantial effect on the calculations made by each party in their offer.

Orley Ashenfelter (1987) has suggested a theory of arbitrator exchangeability, meaning that arbitrator's decisions are statistically exchangeable. Self-interest on the part of the arbitrators lends itself to the theory of arbitrator exchangeability. All arbitrators, at some level, rely upon both parties to the dispute for continued employment. If the decisions of a specific arbitrator represent a departure from those of his or her colleagues in favor of one side, then the opposing side will object to the arbitrator's continued employment. An arbitrator, operating in his or her personal best interest to ensure further employment, would make his or herself as indistinguishable from his colleagues as possible. Ashenfelter's theory of arbitrator exchangeability implies the decision of the arbitrator should not be a function of the individual arbitrator but the distribution of the offers. Specifically, arbitrator's decisions contain an unpredictable component that may be characterized by a probability density function. The following is a graphical presentation of a normal probability density function for wages. The cumulative probability, the integral of the probability function indicated by the grey area, represents the probability that the club's offer will be selected. On the graph, the offer made by the club is denoted W_c , while the offer of the player is denoted W_p . The graph below shows that increases in either W_c or W_p will increase the probability that the employer's offer will be selected. The point denoted W_a is the arbitrator's notion of a fair award, the wage that the arbitrator would select if he were not constrained by the rules of final-offer arbitration



$$W_a = \frac{(W^c + W^p)}{2}$$

This paper will accept this conclusion so that the identity of an individual arbitrator in Major League Baseball's salary arbitration process need not be considered.

Orley Ashenfelter and David Bloom (1984) examined the decision made by the arbitrator. This examination was based primarily on the assumption that the arbitrator would consider the offers of the employer and the union, selecting the offer which is closer to the arbitrator's notion of a fair award. They suggested a number of statistical observations that could be made in order to examine aspects of the arbitration process. First, arbitration strategy would develop and adapt over time and as the parties gained more experience in the arbitration system. In their paper, they demonstrated that this occurred by showing that the percentage of filed cases that went to final hearing tended to decrease over time. I examined this and found that in the case of Major League Baseball, the percentage of filed cases that

went to final hearing did indeed decrease over time. Data to support this relationship may be found in Table 1 and Figure 1. Ashenfelter and Bloom also suggested that the decisions made by the arbitrator would, over time, come to be evenly split between the two parties involved. In their paper, the authors demonstrated that this occurred by showing that the percentage of final hearing decisions that were settled on the side of the employer moved towards 50%. I examined this phenomenon and did not find as clear a relationship over time. Data relevant to this relationship may be found in Table 2 and Figure 2.

Ashenfelter and Bloom used a simple probit model to explain the arbitrator's decision. The independent variable was the average of the offers of the employer and the union. Some literature has examined the use of a different means of incorporating the two offers. John Fizek (1994), looking specifically at the case of Major League Baseball, suggested that a better measure is the ratio of the player's offer to the club's offer. This measure is seen as valuable because it remains relatively consistent over time, a fact which Fizek suggests means that the use of a ratio captures changes over time that both players and clubs have perceived to alter the value of players. This study will use the average of the two offers as was done by Ashenfelter and Bloom.

Once the arbitrator's decision has been modeled, the next question is whether or not that decision reflects market factors. Gerald Scully (1974) examined the labor market in baseball in light of the first players' strike in 1972. Scully hoped to measure the monopsony pressures present in the labor market. It is important to note that at the time that the work of Gerald Scully was published in 1974, salary arbitration was a phenomenon relatively new to baseball, and he did not address it. Towards the end of quantifying monopsony pressures, Scully attempted to estimate an individual player's marginal revenue product, the value of the

individual player's contribution to the enterprise. In a competitive labor market, a player's marginal revenue product is equal to his wage. Scully's method of marginal product calculation could be applied more specifically to the process of salary arbitration in future research.

David Faurot and Stephen McAllister (1992) examined the written records of baseball arbitration cases from 1984 through 1991, thoroughly outlining arbitration proceedings as they occurred each February in Major League Baseball. The authors, in particular, took note of a number of variables that an arbitrator is instructed to consider, including the player's performance during the previous season, the length and consistency of a player's career performance, previous compensation, and the club's recent performance. In addition, the authors examined one variable that is not included in an arbitrator's instructions, player position. Faurot and McAllister then constructed a wage function, examining the wage a player received as a function of the aforementioned variables. They moved beyond the strict marginal product modeling of Scully to examine the wage as a function of a number of variables outside of what would be considered the player's marginal revenue product. It is interesting to note that Faurot and McAllister briefly mentioned the modeling of the arbitrator's decision as presented by Ashenfelter and Bloom. Faurot and McAllister did not apply the model to Major League Baseball, preferring instead to concentrate strictly on wage determination.

Recently, John Burger and Stephen Walters (2005) adapted the basic model of arbitrator behavior to Major League Baseball. Burger and Walters supplemented the basic assumptions by attempting to define the inputs into the arbitrator's notion of a fair award. These inputs include arbitration-acceptable information and information inadmissible at the

evidentiary hearing, as well as possible sources of bias. The authors outlined two types of bias, “external bias,” which consists of information that the arbitrator was not instructed to include in his or her decision, and “internal bias,” which includes actions of self-interest and personal values.

Burger and Walters constructed a wage determination function based upon the calculation of a player’s marginal product. This wage function followed the work of Gerald Scully. Once the wage function was created, the characteristics of each player were then used, in concert with the wage function, to estimate the player’s market wage. This market wage was used as an input to the authors’ regression to examine the arbitrator’s decision. Burger and Walters developed a probit regression of their own in order to calculate the probability that one offer was selected over another. The probit is slightly more complex than that presented by Ashenfelter and Bloom including measures of the two types of biases mentioned above.

Burger and Walters concluded that there was an internal, pro-team bias on the part of arbitrators in Major League Baseball. The authors find that final-offer arbitration provides clear evidence of arbitrators operating in their own self-interest. In addition, Burger and Walters state that the present day system in baseball exhibits clear signs of inequity and inefficiency. The data contained in Table 2 and Figure 2 attached appears to support the conclusion of a pro-team bias. The percentage of cases decided in favor of the club has increased over time.

III. Theory

I modeled the process of salary arbitration in two stages: the arbitrator's decision and the wage determination. While modeling of the two stages may be done separately, the two are closely related under the umbrella of the salary arbitration process.

Arbitrator's Decision

The theory contained in this paper regarding the decision process of the arbitrator is modeled closely on the work of Ashenfelter and Bloom (1984). They assume that the arbitrator arrives at his or her own notion of a fair award in each case. This fair award, which will be denoted by W^a , should be between the offers made by the two parties to the dispute. In the following discussion, the offer of the club will be denoted by W^c , while the offer of the player will be denoted by W^p . The basic model constructed by Ashenfelter and Bloom (1984) states that the arbitrator will select the offer that is closer to his or her own notion of a fair award, W^a . Based upon this established reasoning, the employer's offer should be selected if the following is true.

$$(W^a - W^c) \leq (W^p - W^a)$$

or

$$W^a \leq \frac{(W^p + W^c)}{2}$$

This equation assumes that while final-offer arbitration requires the arbitrator to select one of the offers of the involved parties, the arbitrator still creates his own notion of a fair

award (W^a) based upon information that is presented by the parties, as well as upon the opinions and biases of the arbitrator. As was previously stated, the empirical work in this paper operates under the assumption of arbitrator exchangeability established by Ashenfelter (1987). Therefore, the arbitrator opinions and biases that are said to be factored into the notion of a fair award are those of a generic arbitrator.

The parties to the dispute better their chances of victory by moving their wage offer closer to the arbitrator's notion of a fair award. A strict interpretation of the theory states that the offers put forth by the two parties should, in fact, meet at the arbitrator's notion of a fair award. This statement makes the assumption that the arbitrator's preferences, bias, and wage determination are known to the parties involved. In practice, it appears that experience gained through repeated arbitration proceedings has led to the convergence of the offers of the two parties in a number of cases. In these situations, the two sides agree upon a wage and the case does not continue through to the end of the arbitration process. Evidence of this convergence has been shown in Table 1 and Figure 1 attached. There remain a number of cases where the two offers do not converge to the arbitrator's notion of a fair award. The fact that the offers put forth by the two parties to the dispute do not converge implies the existence of an unpredictable and unknown component.

Wage Determination

Theory traditionally views the need for arbitrator action as the failure of the two parties to reach an agreement on their own. In these situations where negotiation between the two sides cannot come to an agreement, a binding final solution is arrived at by the arbitrator. This wage selected by the arbitrator may be modeled as a function of a number of variables that describe the player in question, the team involved, and the current economic climate. If

the arbitrator's wage is largely explained by market factors, then it may be said that the salary arbitration process serves as an effective resolution to the negotiating impasse.

V. Methods and Results

Arbitrator's Decision

Final-offer arbitration culminates with a decision made between two competing offers, with no room for compromise. As such, it may be modeled through the use of a binary variable: zero or one. A variable value of zero means that the player's offer was selected, while a value of one means that the club's offer was selected. With a dependent variable that is between zero and one, least squares estimation is inappropriate and we will instead use probit maximum likelihood estimation. Ordinary least squares (OLS) is commonly used when the dependent variable is not constrained in any way. A probit regression will be used to examine an arbitrator's decision-making as a function of the offers made by the two parties involved.

The probit regression that was used by Ashenfelter and Bloom (1984) will be tested in order to examine its ability to capture the proceedings of final-offer arbitration in Major League Baseball. The dependant variable used in the probit estimation is a binary variable with value one when the decision was made for the club and zero when the decision was made for the player. The independent variable used in the probit estimation is the average of the club's offer and the player's offer.

$$P = \left[\beta_1 \left(\frac{(W^p + W^c)}{2} \right) + \beta_2 \right] \quad (1)$$

The equation was estimated annually. The coefficients that are derived through the use of a probit regression may not be interpreted as marginal effects. In order for that interpretation to be viable, further statistical work is required. The raw coefficients resulting from a probit regression may be interpreted for their sign and significance.

Ashenfelter and Bloom (1984) show that from the coefficients in the probit model, one can derive estimates of the mean (μ^p) and the standard deviation (σ^p) of the arbitrator's notion of a fair award. Ashenfelter and Bloom (1984) were able to verify that the coefficients served as accurate estimators because their data set, that of unionized municipal law enforcement and fire protection employees, included both final-offer arbitration results and conventional arbitration results. The authors used the conventional arbitration results, where the arbitrator was able to reach a decision based upon his or her notion of a fair award between the offers of the two parties, to verify that the coefficients were accurate estimators. The following equation shows specifically how the coefficients of the regression estimate the mean and standard deviation of the arbitrator's notion of a fair award:

$$P = \left[\frac{1}{\sigma^p} \left(\frac{(W^u + W^e)}{2} \right) - \frac{\mu^p}{\sigma^p} \right] \quad (2)$$

The inverse of the coefficient on the average of the two parties' offers, β_1 , serves as an accurate estimate of the standard deviation of the arbitrator's notion of a fair award. The ratio of the coefficients, β_2/β_1 , estimates the mean of the arbitrator's notion of a fair award.

Since salary arbitration in baseball began prior to the 1974 season, this study will include data from all hearings which occurred from the program's inception through the hearings that occurred prior to the 2004 season. The data set includes observations on 460 arbitration hearings spanning the thirty-one years of the Major League Baseball program. I estimated the probit regression with annual subsets of the data set as was done by Ashenfelter and Bloom (1984) in their modeling. The number of observations by year ranged from 35 in 1986 to 5 each in 1997 and 2002. The model was also estimated with the entire data set. This regression on the entire data set was conducted twice, first with the nominal figures from all 31 years and then with real figures. In order for the second of these tests to be conducted, nominal salaries from the 31 years of the salary arbitration system were adjusted to real figures with a base year of 2000. Annual mean salary data were used to construct a Major League Baseball wage index.⁴ This index was then used to prepare real wages for comparison.

The success or failure of our attempted application of arbitrator decision modeling to the case of Major League Baseball is best ascertained by comparing our regression results to those of Ashenfelter and Bloom (1984). They had the luxury of verifying their results by comparing the coefficients stemming from final-offer arbitration regressions to the recorded results of conventional arbitration. Unfortunately, the salary arbitration system in Major League Baseball relies solely on final-offer arbitration, so this paper does not have the same means of comparison.

Examination of the results reported in Ashenfelter and Bloom (1984) provides an indication of the sign that should be expected in the probit regression results. Specifically, the

⁴ Mean salary data collected by ESPN, reported by Rodney Fort.

regression results reported by Ashenfelter and Bloom (1984) all contained a positive sign on both the regression coefficient and the constant. Our regression coefficients are found in Table 3 attached. The regression results do not boast the same uniformity of sign. In addition, a number of the estimators calculated from the regression coefficients are not reasonable estimates of the mean and standard deviation. For example, the estimated mean arbitrated wage in 1991 based upon the calculations of this study was approximately four million dollars. During 1991, the actual mean arbitrated salary throughout all of Major League Baseball was only \$891,188. When the regression was estimated with the entire data set, the results succeeded in showing the uniformity of sign reported by Ashenfelter and Bloom (1984). This uniformity of sign was present when the test was conducted with both nominal and real figures. Estimating the regression once for the entire data set may introduce changes in the climate surrounding the arbitration proceedings. These changes, if they exist, are not controlled for in the model and may, therefore, alter the regression results.

There is yet another manner in which the results obtained from the Ashenfelter and Bloom (1984) model may be examined. I compare the mean of the predicted awards to the mean of the actual awards. The mean of the actual awards, reported in real terms, is \$800.50 with a standard deviation of \$1,204.59. The predicted mean of the predicted awards is \$4,034.53 with a standard deviation of \$27,624.31. These results would suggest that the model does not accurately predict the real awards. In addition, the McFadden R^2 was very small and the coefficients were statistically insignificant using the usual level of significance.

Wage Determination

The wage that is determined by final-offer salary arbitration will be examined in order to show how well it is explained by a number of factors, both those that the arbitrator is and is

not instructed to take into account. The dependent variable will be the natural log of the wage. Use of the natural log of the wage is convenient because coefficients on the regressors may be interpreted as indicating a percentage change in the wage. Nominal wages awarded by the arbitrator were all adjusted for inflation using the Bureau of Labor Statistics Consumer Price Index for All Urban Consumers reported in year 2000 nominal dollars.

The variables used were those common to wage determination functions. The variable Career Length is measured as the number of seasons in which the player has recorded experience at the Major League level, measured in whole years. The variables Career Performance and Previous Performance are measured as the number of “win-shares” attributed to a player over his entire career and in the previous season. The win share is a relatively new baseball statistic developed by Bill James, renowned as one of the forefathers of the study of baseball statistics, known as sabermetrics. By definition, each game that a team wins allows for the allocation of three win shares to the team’s players. A win share is a single number assigned to a player to represent his contributions to his team’s wins. Bill James’ win share is adjusted for variables such as ballpark, league, and era. The statistic is useful because it allows for the comparison across different time periods and different positions on the baseball field. The variable Team Performance is the winning percentage of the team involved in the proceedings in the previous season. The variable Previous Compensation is the player’s salary in the previous season, adjusted for inflation using the Bureau of Labor Statistics’ Consumer Price Index for All Urban Consumers and reported in year 2000 nominal dollars. The variable Age of the Stadium is the number of seasons that have passed since the stadium first officially opened. The variable for the presence of a New Stadium is binary, which takes a value of one if the stadium was built since 1992 and a value

of zero if the stadium was constructed prior to 1992. New stadia are typically able to take advantage of more and varied revenue streams stemming from concession and souvenir sales, as well as parking and luxury suites, than their predecessors which were built solely to hold spectators. The variable Metropolitan Population is the number of people residing in the metropolitan region as reported by the United States Census Bureau. Observations with players from the clubs in Canada, both in Montreal and Toronto, were excluded. The variables which address a player's fielding position are binary, which take a value of one if the player plays that position and a value of zero if the player does not play the position being addressed. The position of designated hitter will serve as the basic case, against which the effects of all other positions will be compared. The variables which address the various Collective Bargaining Agreements under which salary arbitration has occurred are binary variables. These variables take on a value of one if the arbitration proceeding occurred under the auspices of that agreement and a value of zero if the arbitration proceeding did not occur under the labor agreement being addressed. This first agreement, which covered arbitration proceedings which occurred prior to the 1974 through 1976 seasons, represents the excluded case, against which the effects of future agreements will be compared. Finally, a time series was included, where the year 1974 took on a value of 1, then the index increased by one as each year progressed. This variable was included to account for the growth in real salaries over the time period. The Consumer Price Index was utilized to account for inflation, but salaries in professional baseball have risen at a pace above and beyond that of nation-wide inflation. Since 1988, the CPI has increased at an average annual rate of 3.0 percent.⁵ Over

⁵ Data regarding the Consumer Price Index is compiled and released by the United States Department of Labor, Bureau of Labor Statistics.

the same time period, mean salaries in Major League Baseball have increased at an average annual rate of 12.7 percent.⁶

The regression results for various models may be found in Table 4. The first of these regressions focuses on four characteristics of the player (Career Length, Career Performance, Previous Performance, and Previous Compensation) and on four characteristics of the team (Team Performance, Age of Stadium, New Stadium, and Metropolitan Population). In addition, the time-variable was included. This will be considered the basic regression form, as all of these variables will be included in each of the three following regressions. The coefficients on the variables for Career Length, Career Performance, Previous Performance, Previous Compensation, and New Stadium are statistically significant at the 99-percent confidence level. In addition, the time-variable is significant at the 99-percent confidence level.

The second regression includes the variables from the basic regression, as well as binary variables for defensive positions on the baseball field. In this regression, the coefficients on the variables for Career Length, Career Performance, Previous Performance, Previous Compensation, and New Stadium are again statistically significant at the 99-percent confidence level. The time-variable is also significant at the 99-percent confidence level. None of the coefficients on the binary variables for defensive positions are significant at any conventional level of confidence. The second regression led to little change in explanatory power over the first regression, as measured by R^2 .

The third regression includes the variables from the basic regression, as well as binary variables for the various Collective Bargaining Agreements that have governed interactions

⁶ Salary figures in Major League Baseball were compiled and presented by Professor Rodney Fort of Washington State University.

between labor and management throughout the life of the salary arbitration program. In this regression, the coefficients on the variables for Career Length, Career Performance, Previous Performance, and Previous Compensation are again statistically significant at the 99-percent confidence level. The time-variable is also significant at the 99-percent confidence level. The coefficients on the binary variables for the Collective Bargaining Agreements that were active from 1977 through 1981, from 1982 through 1985, from 1986 through 1990, and from 1991 through 1995 were statistically significant at the 99-percent confidence level. In addition, the coefficient on the binary variable for the Collective Bargaining Agreement that was active from 1996 through 2001 was significant at the 95-percent confidence level. The third regression led to some notable gain in explanatory power over the previous two regressions, as measured by R^2 .

The fourth and final regression includes all of the variables that were previously mentioned, including those in the basic regression, as well as binary variables representing defensive positions and binary variables representing Collective Bargaining Agreements. In this regression, the coefficients on the variables for Career Length, Career Performance, Previous Performance, and Previous Compensation are again statistically significant at the 99-percent confidence level. The time-variable is also significant at the 99-percent confidence level. Finally, the coefficients on the binary variables for the Collective Bargaining Agreements that were active from 1977 through 1981, from 1982 through 1985, from 1986 through 1990, and from 1991 through 1995 were again statistically significant at the 99-percent confidence level. In addition, the coefficient on the binary variable for the Collective Bargaining Agreement that was active from 1996 through 2001 was significant at the 95-

percent confidence level. The fourth regression led to some gain in explanatory power over the previous three regressions, as measured by R^2 .

The sign of the coefficient on the significant variables in each of the regressions indicate whether the variable has a positive or negative effect on the arbitrated wage. These true signs may be compared to our intuition as to the effect of each variable. Throughout all four regressions, the sign on two of the coefficients of variables measuring the player's career proved to be as expected. Specifically, as a player's previous salary increases, so too does the wage. In the first two regressions, the sign on the coefficient of the variable measuring a player's career length is negative, while in the later two regressions, the sign on this same variable is positive. The negative sign indicates that as a career is lengthened, the arbitrated wage falls. This could be caused by the belief that there exist diminishing returns throughout the career of a baseball player. On the other hand, the positive sign indicates that as a career is lengthened, the arbitrated wage rises. This could be caused by some seniority effect that becomes more pronounced as the length of a career increases. The sign on the coefficient of the New Stadium variable had a sign opposite of that which was expected. When a new stadium is present and there are presumably higher revenue streams available to the employer, one would expect the predicted wage to rise.

In the later two regressions, the sign on the variables for each of the Collective Bargaining Agreements signifies an increase in the predicted wage over that in the excluded case of the Collective Bargaining Agreement in effect from 1794 through 1976. Perhaps a more telling test is how the coefficient on each Collective Bargaining Agreement compares to that of the previous Agreement. In order to examine this relationship, F-tests were conducted on the coefficients of the various Collective Bargaining Agreement variables. Results from

the F-tests are included in Table 5. There is a significant and positive effect on wage between the first Agreement of 1974 and the second Agreement of 1977. This significance may be interpreted from the coefficient on the variable for the 1977 Agreement in the third and fourth regressions. There is a significant difference between the Collective Bargaining Agreement of 1991 and the Agreement of 1996. The difference between these two Agreements has a negative effect on wages. There is also a significant difference between the Collective Bargaining Agreement of 1996 and the Agreement of 2002. The difference between these two Agreements has a negative effect of wages. This test does not find a significant difference between the Agreements of 1977 and 1982, the Agreements of 1982 and 1986, or the Agreements of 1986 and 1991.

The estimated wage functions explain a good deal of the variation in the wage. The most basic regression has an adjusted R^2 value of 0.885, and the most elaborate regression has an adjusted R^2 value of 0.950.

Following the individual examination of the two stages described in this paper, the two may be studied together, with a goal of estimating the player's market wage and predicting the arbitrator's decision. I will use the estimated wage function to predict a market wage for each player whose case proceeds through salary arbitration. That market salary estimate will be considered the arbitrator's notion of a "fair award." This notion of a fair award, along with the wage offers of the club and the player, will be incorporated into the basic model used by Ashenfelter and Bloom. Use of this basic model will allow me to predict the arbitrator's decision by observing which of the offers of the two parties is closer to the estimated arbitrator's notion of a fair award.

When the theory from the two separate tests in this paper was incorporated together, a market wage was individually estimated for each player whose case went through the arbitration process. This estimated wage, used to represent the arbitrator's notion of a fair award, was then used in concert with the wage offers of the two parties to predict the arbitrator's decision in each case. These predicted decisions were compared to the known decisions in each case to determine how well this process modeled the actual arbitration process. This paper's modeling was able to correctly predict the arbitrator's decision approximately 54-percent of the time.

VII. Summary and Conclusions

Baseball is but one of many cases in which arbitration is used to settle negotiating disputes. With so much riding upon the outcome of these proceedings, there is much to be gained from the strategic implications that would come with accurate modeling of the arbitration proceeding. The importance of accurate modeling led me to examine a number of established modeling techniques as they apply to the case of Major League Baseball.

The basic modeling of the arbitrator's decision by Ashenfelter and Bloom has been shown not to work in this case. When the probit regression is estimated annually, the coefficients do not always take the expected sign, and a number of the coefficients do not present reasonable estimates of the mean and standard deviation of the arbitrator's notion of a fair award, as was suggested in the theory. The coefficients do take the expected sign when the probit regression is estimated over the entire population. Unfortunately, the coefficients are not reasonable estimates of the mean and standard deviation of the arbitrator's notion of a fair award in the case of the entire population. While it is evident that the modeling of the

arbitrator's decision may not be applied in this case, the reasons for the model's lack of fit are less clear. This paper suggests that a number of characteristics of the labor market in Major League Baseball are different from those of the labor market in which the model was first constructed. First, there is a great deal of variation in the salaries commanded by baseball players, ranging from the league minimum (\$300,000 in 2004) to annual salaries numbering tens of millions of dollars. Variation was not present to the same extent in the salaries for municipal police and fire employees, the labor market first modeled by Ashenfelter and Bloom. Second, there is no typical productivity of a professional baseball player. The production statistics of a baseball player vary widely from the superstar to the journeymen filling out a roster. Skill differentiation was not as pronounced in the case of municipal police and fire employees.

Modeling a wage function based upon a number of market variables suggests that the final arbitrator's award is quite similar to a market determined wage. This would suggest that, ignoring costs associated with the arbitration process, final offer arbitration is a relatively effective substitute for a strictly market determined wage. Of course, the apparent precision of the final arbitrator's award is reflection of the two parties to the dispute, as the arbitrator is forced to make a selection of one of the two offers.

One of the motivations behind this research is the interest that both parties to an arbitration dispute have in properly modeling the proceeding. When the entire arbitration proceeding is modeled, from wage determination through arbitrator decision, this paper's modeling correctly predicts the decision approximately 54-percent of the time. This paper makes a step in the direction of modeling the arbitration process, but more work remains to be

done. Specifically, more precise wage functions or better models of the arbitrator's decision would increase the effectiveness of this modeling.

Major League Baseball salary arbitration is an event with increasingly high stakes where there is always one winner and one loser. Much of the modeling discussed in this paper was first designed and introduced to study other occupations. Any advances made in this modeling could quite effectively be applied to other industries with salary arbitration.

Table 1: History of Arbitration Filings and Hearings

Year	Cases Filed	Cases Heard	% Heard
1974	53	29	54.7%
1975	38	16	42.1%
1976	0	0	N/A
1977	0	0	N/A
1978	16	9	56.3%
1979	40	12	30.0%
1980	65	26	40.0%
1981	96	21	21.9%
1982	103	23	22.3%
1983	88	30	34.1%
1984	80	10	12.5%
1985	98	13	13.3%
1986	159	35	22.0%
1987	109	26	23.9%
1988	111	18	16.2%
1989	136	12	8.8%
1990	162	24	14.8%
1991	157	17	10.8%
1992	147	20	13.6%
1993	118	18	15.3%
1994	80	16	20.0%
1995	61	8	13.1%
1996	76	10	13.2%
1997	80	5	6.3%
1998	81	8	9.9%
1999	62	11	17.7%
2000	90	10	11.1%
2001	102	14	13.7%
2002	93	5	5.4%
2003	72	7	9.7%
2004	75	7	9.3%

Table 2: Historical Results of Arbitration Proceedings

Year	Cases Heard	Player Victory	Team Victory	% Team Victory
1974	29	13	16	55.2%
1975	16	6	10	62.5%
1976	0			
1977	0			
1978	9	2	7	77.8%
1979	12	8	4	33.3%
1980	26	15	11	42.3%
1981	21	11	10	47.6%
1982	23	8	15	65.2%
1983	30	13	17	56.7%
1984	10	4	6	60.0%
1985	13	6	7	53.8%
1986	35	15	20	57.1%
1987	26	10	16	61.5%
1988	18	7	11	61.1%
1989	12	7	5	41.7%
1990	24	14	10	41.7%
1991	17	6	11	64.7%
1992	20	9	11	55.0%
1993	18	6	12	66.7%
1994	16	6	10	62.5%
1995	8	2	6	75.0%
1996	10	7	3	30.0%
1997	5	1	4	80.0%
1998	8	3	5	62.5%
1999	11	2	9	81.8%
2000	10	4	6	60.0%
2001	14	6	8	57.1%
2002	5	1	4	80.0%
2003	7	2	5	71.4%
2004	7	3	4	57.1%

Table 3: Decision Modeling Results

n	Year	β_2		β_1		McFadden R ²		σ	μ
29	1974	0.59702	(0.56355)	-0.00882	(0.00974)	0.02130		-113.423	-67.7154
16	1975	-0.35349	(0.74861)	0.00967	(0.01001)	0.04785		103.3788	-36.5435
0	1976								
0	1977								
9	1978	-0.03594	(1.51290)	0.01119	(0.02078)	0.03474		89.34922	-3.21118
12	1979	-1.43893	(1.17630)	0.01558	(0.01709)	0.05579		64.20399	-92.385
26	1980	0.89391	(0.92102)	-0.00894	(0.00758)	0.07199		-111.891	-100.021
21	1981	0.17989	(0.57214)	-0.00108	(0.00228)	0.00786		-923.774	-166.177
23	1982	-0.10633	(0.64322)	0.00162	(0.00192)	0.02446		618.1531	-65.7255
30	1983	0.13515	(0.50982)	0.00009	(0.00132)	0.00013		10559.78	1427.197
10	1984	-7.69628	(0.07558)	0.02171	(0.00005)	0.00082		46.06584	-354.536
13	1985	0.05493	(0.64846)	0.00008	(0.00108)	0.00032		12182.42	669.1845
35	1986	0.13360	(0.44849)	0.00009	(0.00080)	0.00029		10592.94	1415.196
26	1987	1.41870	(0.70244)	-0.00169	(0.00102)	0.11326		-592.914	-841.165
18	1988	-0.41266	(0.68332)	0.00107	(0.00099)	0.06199		933.6505	-385.276
12	1989	0.97938	(1.12835)	-0.00168	(0.00153)	0.08630		-596.736	-584.432
24	1990	-1.35394	(0.66924)	0.00125	(0.00066)	0.12176		798.0911	-1080.57
17	1991	0.28006	(0.63874)	0.00007	(0.00039)	0.00138		14671.37	4108.861
20	1992	0.84948	(0.53149)	-0.00044	(0.00028)	0.10305		-2256.25	-1916.65
18	1993	0.72335	(0.61867)	-0.00016	(0.00029)	0.01320		-6257.79	-4526.58
16	1994	0.37807	(0.54331)	-0.00003	(0.00021)	0.00087		-35823.8	-13544.1
8	1995	1.12878	(1.08296)	-0.00019	(0.00039)	0.02601		-5232.88	-5906.76
10	1996	-0.20159	(0.71454)	-0.00015	(0.00027)	0.02544		-6637.47	1338.065
5	1997	3.24939	(3.29073)	-0.00138	(0.00167)	0.21099		-727.066	-2362.52
8	1998	2.27063	(1.33709)	-0.00163	(0.00127)	0.48434		-612.659	-1391.12
11	1999	4.17550	(2.77638)	-0.00102	(0.00075)	0.34054		-985.19	-4113.66
10	2000	-0.48510	(0.65155)	0.00040	(0.00034)	0.19367		2504.225	-1214.81
14	2001	0.55018	(0.66997)	-0.00015	(0.00023)	0.02237		-6788.58	-3734.97
5	2002								
7	2003	0.79324	(0.97844)	-0.00006	(0.00021)	0.00904		-17114.7	-13576.1
7	2004	-0.23600	(0.90367)	0.00017	(0.00033)	0.03212		5752.01	-1357.47
460	All Years								
	Real	0.14625	(0.07099)	0.0000421	(0.00005)	0.00120		23752.97	3473.872
	Nominal	0.14605	(0.07465)	0.0000362	(0.00005)	0.00091		27624.31	4034.53

* Figures for σ and μ are recorded in thousands of dollars.

(Standard Errors in Parenthesis)

Table 4: Wage Determination Regression Results

Regression		1	2	3	4
Constant		2.227549*** (0.235493)	2.330127*** (0.350954)	1.250610*** (0.194108)	1.119554*** (0.293746)
Career Length		-0.003089*** (0.001001)	-0.003739*** (0.001077)	0.002414*** (0.000759)	0.001934** (0.000869)
Career Performance		0.003286*** (0.000919)	0.003558*** (0.000926)	0.004428*** (0.000609)	0.004596*** (0.000694)
Previous Performance		0.048102*** (0.004689)	0.053304*** (0.004907)	0.041878*** (0.003420)	0.047706*** (0.003543)
Team Performance		-0.212436 (0.473163)	-0.423571 (0.463120)	0.524733 (0.353341)	0.298181 (0.341588)
Previous Compensation		0.000391*** (0.000063)	0.000374*** (0.000061)	0.000416*** (0.000038)	0.000398*** (0.000037)
Time Variable		0.177638*** (0.004928)	0.175981*** (0.006344)	0.154699*** (0.016581)	0.151026*** (0.016063)
Position 1B			-0.078111 (0.293507)		0.115498 (0.247914)
Position 2B			-0.234258 (0.291369)		-0.023804 (0.248482)
Position 3B			-0.252028 (0.213825)		-0.003852 (0.246534)
Position C			-0.080215 (0.297755)		0.151397 (0.259148)
Position OF			-0.213583 (0.286163)		0.070686 (0.242224)
Position P			0.108796 (0.284283)		0.359573 (0.241978)
Position SS			-0.276457 (0.306249)		0.179214 (0.255233)
CBA 2				1.018669*** (0.236717)	0.986674*** (0.194434)
CBA 3				1.256218*** (0.175029)	1.23399*** (0.171100)
CBA 4				1.231764*** (0.233001)	1.241598*** (0.225439)
CBA 5				1.329387*** (0.317397)	1.376053*** (0.311655)
CBA 6				0.808186* (0.419910)	0.858899** (0.410726)
CBA 7				0.431402 (0.484997)	0.415086 (0.470297)
Age of Stadium		0.887975 (0.001391)	0.001393 (0.001310)	0.001096 (0.001033)	0.001346
New Stadium		-0.496438*** (0.145192)	-0.474458*** (0.143005)	-0.076329 (0.106949)	-0.051848
Metropolitan Population		0.00000015 (0.000000013)	0.00000016 (0.000000012)	-0.000000004 (0.000000009)	-0.000000004
R²		0.887975	0.896275	0.946105	0.953532
Adjusted R²		0.884956	0.891185	0.943641	0.950337
(White Heteroskedasticity Standard Errors in Parenthesis)					
	*	90 -Percent Confidence Level			
	**	95 -Percent Confidence Level			
	***	99 -Percent Confidence Level			

Table 5: F-Test Statistics for Collective Bargaining Agreement Variables

Hypothesis	F-Stat	Prob	Conclusion
CBA 2 = CBA 3	1.918258	0.167014	CBA 2 = CBA 3
CBA 3 = CBA 4	0.007888	0.929285	CBA 3 = CBA 4
CBA 4 = CBA 5	1.633972	0.202081	CBA 4 = CBA 5
CBA 5 = CBA 6	14.89807	0.000137	CBA 5 \neq CBA 6
CBA 6 = CBA 7	15.31319	0.000111	CBA 6 \neq CBA 7

Figure 1

History of Arbitration Filings and Hearings

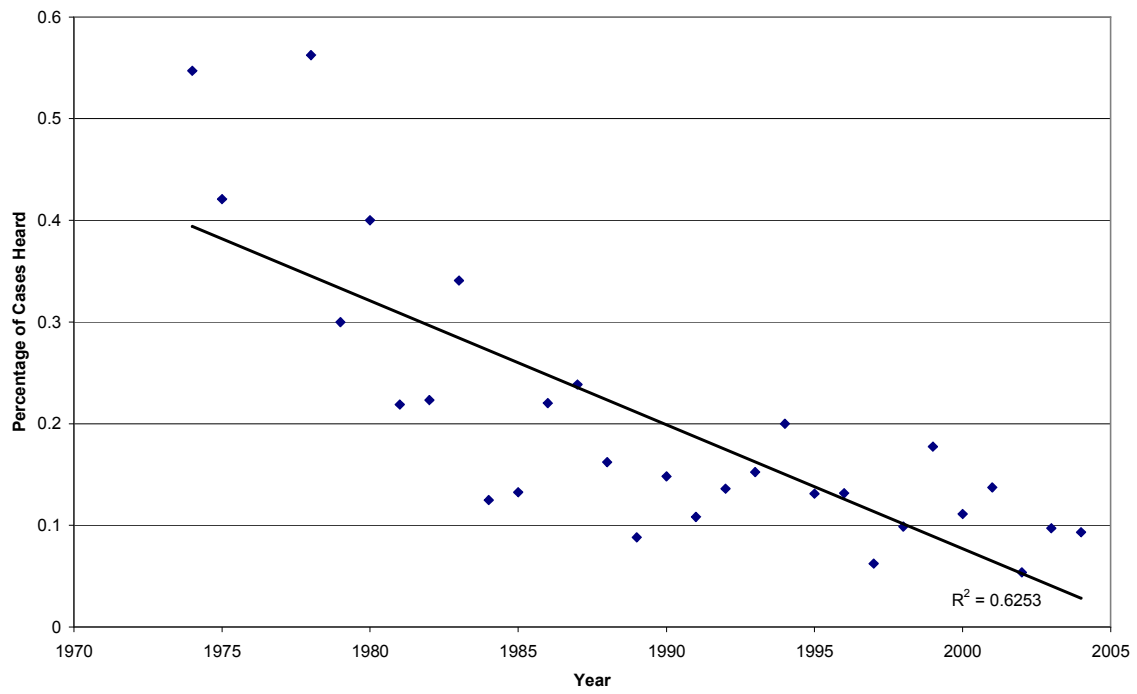
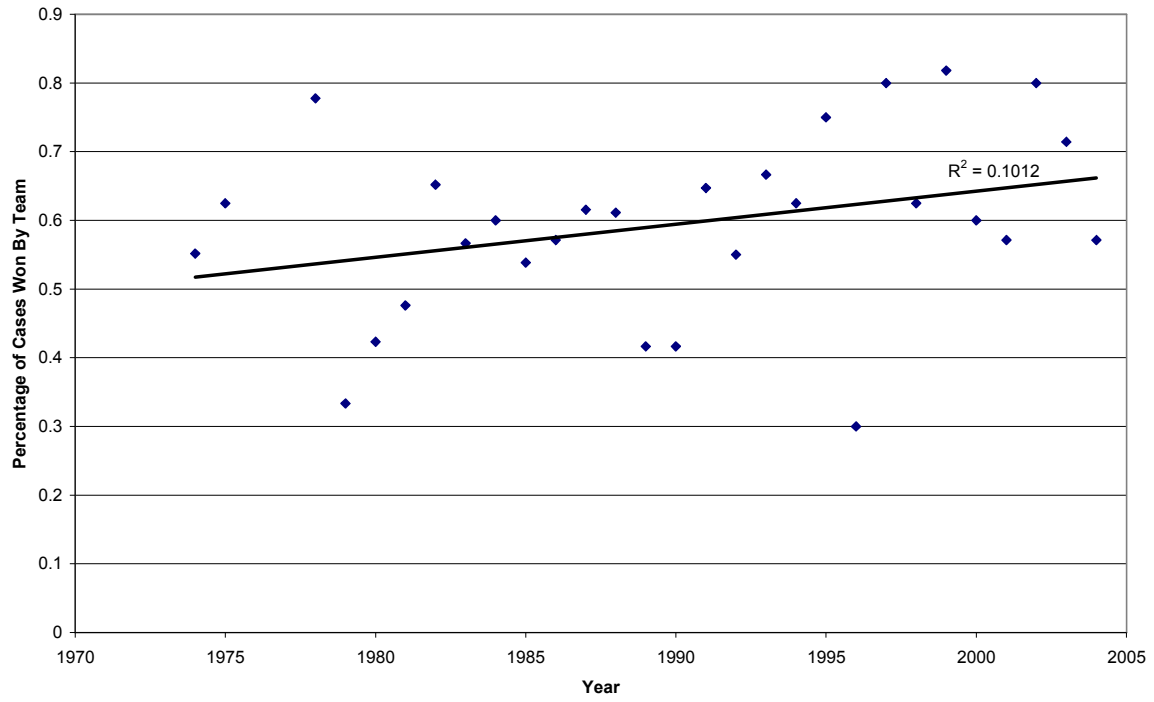


Figure 2

Historical Results of Arbitration Proceedings



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