Monopsony Power and the Tradeoff Between Return to Performance and Contract Length in Major League Baseball

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In Major League Baseball a player's negotiation rights are owned by his team for the first six years of his Major League playing career. As a result, teams enjoy a monopsonistic advantage over players during this time. A player takes his salary as given his first three years, is eligible for arbitration his fourth through sixth years and becomes a free agent after his sixth year. Past literature investigated the relationship between average salary and contract length for long-term contracts signed by free agents. However, these papers do not examine long-term contracts signed by players who have not yet attained free agency, which have become more common in recent years. This paper explores the effect of monopsony on the tradeoff between contract length and average annual salary in long-term contracts signed by players with less than six years of Major League service time.

This paper builds on existing studies on the construction of contracts and tradeoffs made by players. Krautmann and Oppenheimer (2002) study the tradeoff between salary and contract length and establishes that players' return to performance decreases with additional contract length. Link and Yosifov (2011) build on Krautmann and Oppenheimer (2002) and find that the relationship between return to performance and contract length is most strongly negative for players with more than 10 years of MLB service time, suggesting a higher risk premium. However, these papers examine samples consisting only of contracts signed by free agents with six or more years of Major League service time.

In this paper I extend previous literature to examine the tradeoff between contract length and average salary in contracts signed by players prior to free agency. This study will explore

how the degree of monopsony power affects both the tradeoff between return to performance and contract length and between contract length and average annual salary.

II. *Background and Literature Review*

i. Background

Players accumulate Major League service time for each full day they are on a Major League Club's active list (CBA 2012). A full year of Major League Service constitutes 172 days of service time, and players cannot gain more than one year of service in a championship season. For players' first three years of service time, they typically earn the major league minimum salary[1]. Eligibility for salary arbitration theoretically improves the bargaining power of players.

At the end of a season for which a player has more than three years but less than six years of service time, a player can file for salary arbitration if he and his club cannot agree to terms on a contract by the filing date for the upcoming season.[2] In salary arbitration, the club and the player submit final offer figures. Figures are then exchanged and the parties are free to continue negotiating up until the arbitration hearing. Arbitrations are heard by a three member panel of third-party arbitrators.[3] The panel then decides which final offer will serve as the player's salary for the upcoming season.

[1] Teams decide players' salaries unilaterally for their first three seasons, but can pay them more than the major league minimum. For instance, Mike Trout finished second in AL MVP voting in 2012 and received a $20,000 raise over the major league minimum (Heitner 2013)

[2] There is also a type of arbitration eligibility called "SuperTwo" status, whereby the top 22%(before 2012 it was 17%) of players with less than three years of service time and at least 86 days of service time are eligible for arbitration. They receive arbitration eligibility one year earlier, but still must wait six years for free agency.

[3] Arbitration criteria are "Player's contribution to his Club during the past season, the length and consistency of his career contribution, the Record of a player's past compensation, comparative baseball salaries…" Comparative baseball salaries places an emphasis on players no more than one annual service class above the player (CBA 2012).

Contract extensions serve as an alternative to the traditional service time process. Teams and players can lock in salary figures for multiple years and reduce the uncertainty both sides face in the future. Contract extensions for pre-free agency players were not common prior to 1992[4] and have increased in popularity since 2000 when there were only nine extensions in comparison to 38 in 2012. Extensions are also being signed at earlier stages in players' careers, buying out pre-arbitration years in some cases. The upwards trend in extensions can be seen in Figure 1 and summary statistics by year can be seen in Table 1.

ii. Literature Review

The effect of eligibility for arbitration and free agency on salary and contract duration is studied in Kahn (1993). Using a longitudinal data set, Kahn (1993) performs a fixed effects regression to separately measure the contributions of arbitration eligibility, free agency eligibility, and a multitude of performance statistics[5] to average annual salary and contract duration. The results provide evidence that arbitration eligibility and free agency increase salaries. However, only free agency is associated with a rise in contract duration.[6]

Intuitively, monopsony power has an effect on the player salaries during the period of arbitration eligibility because players can still only negotiate with one team instead of the whole market. The effects of monopsony are examined in Raimondo (1983) in light of the beginning of MLB free agency. The findings suggest monopsony has a large effect on the salaries players might otherwise make in free agency. I plan to further investigate the effect of monopsony with a focus on the tradeoff players face between return to performance and contract length.

[4] John Hart, the General Manager of the Cleveland Indians, pioneered the trend in the early 1990s (Holtzman 1995).
[5] Kahn (1993) uses performance statistics including batting average, extra-base hits, walks, stolen bases, gold gloves, and dummies for non-first base infield positions and catcher.
[6] The degree of salary increase is higher for the free agency dummy variable than for the arbitration eligibility dummy variable, but the coefficient on arbitration eligibility lies within the standard error for the coefficient on free agency.

The determination of contract length is explored by Maxcy (2004), who studies the choice between one year contracts and long term contracts both theoretically and empirically. Maxcy (2004) finds theoretically that teams decide contract length as a function of market uncertainty, defined as the amount of uncertainty over future market prices for talent, and player performance uncertainty. When market uncertainty is at its highest relative to player performance uncertainty, teams are more likely to prefer a long term contract. Empirically Maxcy estimates a binary choice probit model of the choice between one year and long term contracts. He finds empirically that long term contracts are more likely for arbitration eligible players than for players not yet eligible for arbitration and still more likely for free agents, controlling for player performance and measures of performance uncertainty. Importantly, Maxcy (2004) does not factor salary into the binary choice probit model, arguing that compensating wage differentials are unlikely to be important in markets for uniquely-skilled workers who cannot be easily replaced.

In Krautmann and Oppenheimer (2002) meanwhile, the authors allow for compensating differentials by investigating the impact of contract length, performance, and their interaction, on salaries. They find positive, statistically significant impacts on salaries of contract length and performance, but a negative, statistically significant coefficient on the interaction between performance and contract length. Their sample is limited to the salaries observed in the first year of free agent position player contracts signed from 1990-1994, and uses slugging average as the key performance statistic.

The findings are updated by Link and Yosifov (2011), who estimate compensating wage differentials using the same broad framework as Krautmann and Oppenheimer (2002). However, the study uses data over a longer sample period, experiments with average salary over the contract as the dependent variable, and uses winshares as an alternative performance statistic. Winshares should in principle be a more accurate measure of player performance than

slugging average, and in fact Link and Yosifov find a stronger negative correlation between contract length and return to performance using winshares rather than slugging percentage.

In this paper I will extend the methodology of Krautmann and Oppenheimer (2002) and Link and Yosifov (2011) to incorporate long term contracts signed by players prior to free agency. This will allow me to determine the effect of monopsony on the tradeoff between return to performance and contract length, as well as the risk premium between salary and contract length. I also plan to use the Krautmann and Oppenheimer (2002) specification, because I disagree with the argument presented in Maxcy (2004) that the market for Major League Baseball players is a market for uniquely skilled players who cannot be replaced. There is no uniform way to build a baseball club and different combinations of players create different team performance distributions. While players' specific skills cannot be easily replaced, their value can be substituted in other ways. The major contribution of sabermetric advances is the ability to recognize previously unseen value in baseball player performance, making it easier to unearth different player combinations that are of equal value. I plan to utilize these sabermetric advances as a way to control for player productivity more accurately than in previous studies.

In theory, either players or clubs might be willing to pay a risk premium, in the form of decreased return to performance, in exchange for a longer term contract. Player performance and health in future years are uncertain, so players might be willing to accept a lower return to their performance in exchange for a longer-term contract than they would expect to receive under a series of one-year contracts. On the other hand, the future market salary and availability of players with particular characteristics are also uncertain, so teams might be willing to pay a higher return to expected player performance in long-term contracts. There is a presumption that players are more risk averse than teams, but ultimately it is an empirical question whether the risk premium for long term contracts is paid by players or teams.

III. Data and Empirical Strategy

i. Empirical strategy

Every player that signs a long term contract potentially pays a risk premium, in the form of a lower return to performance over the life of the contract, than he would expect to receive from a series of short-term contacts. In order to measure the effect of monopsony power on this risk premium, this paper extends the methodology used in Krautmann and Oppenheimer (2002) and Link and Yosifov (2011).

The empirical model in Krautmann and Oppenheimer (2002) assumes that a player's salary is a function of expected performance, team specific characteristics, player specific characteristics, and market factors affecting salaries. As such, the paper uses the following specification:

$$Ln(SAL_{ij}) = \beta_{1+}\beta_2 PERF_{ij} + \beta_3 (PERF_{IJ} * LENGTH_{IJ}) + \beta_4 (LENGTH_{IJ}) + \beta_5 (PLAYER_I) + \beta_6 (TEAM_J) + \varepsilon_{IJ}$$

Where SAL_{IJ} is the annual salary for $player_i$ on the $team_j$, $PERF_{ij}$ is a measure of the player's expected productivity based on past performance, $LENGTH_{IJ}$ is the length of the contract negotiated between $player_i$ and $team_j$, $PLAYER_I$ measures player-specific characteristics, $TEAM_j$ measures team specific characteristics, and ε_{IJ} represents the error term including unobservable effects. For the purposes of this paper, I use the Krautmann and Oppenheimer (2002) specification to estimate the tradeoff between return to performance and contract length. While Krautmann and Oppenheimer (2002) and Link and Yosifov (2011) included only free agent contracts in their sample, I extend their approach to accommodate players who sign contract extensions before they reach free agency, with additional independent variables specifying percentage of the contract covering years before arbitration, arbitration eligible years, and free agency years.

I also update the performance variables used by Krautmann and Oppenheimer (2002) and Link and Yosifov (2011). Krautmann and Oppenheimer (2002) use Slugging Average as the performance statistic to estimate a player's productivity, which is calculated by dividing total bases by at-bats. The implicit assumption is that a home run is four times as valuable as a single, which overstates the value of extra base hits. Furthermore, using solely Slugging Average excludes other performance factors for which teams compensate players and measure productivity more accurately. Slugging average does not account for walks, sacrifices, base running, or defense. Link and Yosifov (2011) finds that using winshares generates a stronger tradeoff between return to performance and contract length. Winshares attempts to allocate the percentage of a team's actual wins in a year to a player based on his runs created. By using actual wins, the measure is subject to a significant amount of non-performance related biases that affect a team's wins and that are not captured by player performance alone. Winshares captures a broader range of offensive contributions than slugging percentage but still does not capture a player's contribution on the base paths.

I attempt to improve upon previous work by using Wins Above Replacement (WAR) as a measure of performance. WAR is arguably a superior performance measure for several reasons.[7] WAR measures a position player's contribution to his team as a function of weighted runs above average, defensive runs saved, and base running runs.[8] Using historical analysis of the number of runs likely to win a game and the league average scoring for a given year, WAR accounts for the added probability of winning produced by a player's individual contributions on the field. WAR is also measurable for pitchers, as a function of the pitcher's performance on

[7] A 2012 study demonstrated that WAR-based projection models account for 91% of variation in actual team performance (Dupaul 2012)

[8] Position player WAR consists of weighted Runs Above Average, Ultimate Base Running, weighted Stolen Bases, and Ultimate Zone Rating. The average player's contribution across hitting, base running, and defense is calculated and a player's marginal contribution above replacement level is converted into runs and compiled into his WAR.

outcomes within his control, which are home runs, walks, hit by pitches, and strikeouts[9]. A pitcher's WAR measures the added probability of winning without the effect of his defense. The added probability of winning for both pitchers and position players is measured against the average "replacement level" player a team could be expected to use in the event of a player injury. If a player gets injured, teams either replace him with another player on their roster, a minor leaguer, or a new acquisition. WAR focuses solely on a player's individual performance and is corrected for park, league, and position effects to create a context-neutral statistic for measuring player value. Because WAR incorporates all aspects of a player's value, it should be more strongly related to expected future performance and player salaries than other measures of performance.

I also extend the Krautmann and Oppenheimer (2002) sample by adding contracts for players who are not yet eligible for free agency and for pitchers. Adding these contracts will allow me to measure the degree to which monopsony affects salary tradeoffs by the inclusion of variables measuring the fractions of contracts' years that cover pre-arbitration eligibility, arbitration eligibility and free agency. Just as Krautmann and Oppenheimer (2002) measure tradeoffs through the interaction of performance and contract length, I measure the effect of monopsony on the tradeoff by including interactions of performance, length, and the fraction of contracts' years covering the different stages of monopsony. My specification is below.

[9] Pitcher's WAR is primarily made up of Fielding Independent Pitching(FIP). FIP is a weighted formula measuring outcomes the pitcher was in complete control of, including home runs, walks, hit by pitches, and strikeouts. The effect of his defense is neutralized and a league average for batting average on balls in play is used to convert FIP to Earned Run Average without the effect of defense a pitcher's defense.

$$\textbf{Ln(Average Annual Salary)} = \alpha + \beta_1 (WAR_{t-1}) + \beta_2 (Length_t) + \beta_3 (WAR_{t-1} * Length_t) + \beta_4 (pctMLM_t) + \beta_5 (WAR_{t-1} * pctMLM_t) + \beta_6 (Length_t * pctMLM_t) + \beta_7 (WAR_{t-1} * Length_t * pctMLM_t) + \beta_8 (pctArb_t) + \beta_9 (WAR_{t-1} * pctArb_t) + \beta_{10} (Length_t * pctArb_t) + \beta_{11} (WAR_{t-1} * Length_t * pctArb_t) + \varepsilon_{IJ}$$

Where Ln(Average Annual Salary) is the natural logarithm of the total value of the guaranteed portion of a contract averaged over the guaranteed contract length, WAR_{t-1} is the preceding year's WAR, $Length_t$ is the guaranteed length of the contract, $pctMLM_t$ is the percentage of the contract covering years prior to arbitration eligibility when the Major League Minimum salary is common, and $pctArb_t$ is the percentage of the contract covering arbitration eligible years. The terms are interacted with each other to capture the effects of monopsony on the tradeoff between contract length and return to performance.

The interactions between performance and contract length capture the effect of contract length on return to performance, much like the Krautmann and Oppenheimer (2002) specification. The two-way interactions of performance and length with percentage of years prior to arbitration eligibility and percentage of arbitration eligible years measure the effect of monopsony on the return to performance and the correlation between salaries and contract length. Finally, the three-way interaction terms estimate the impact of monopsony power on the tradeoff between return to performance and contract length. A significant negative coefficient on the three way interaction would suggest that monopsony increases the risk premium paid by players. Another addition I plan to make relative to Krautmann and Oppenheimer (2002) and Link and Yosifov (2011) is an analysis of the total effect of these interactions, by examining the empirical distribution of player performance, contract length, and degree of monopsony. Lastly, the specification allows for the measurement of the true risk premium. Theoretically, every player will have a negative risk premium, willing to trade off a year of contract length for some

amount of average annual salary. However, the endogeneity of contract length and salary makes the effect difficult to measure.

Reproducing the Krautmann and Oppenheimer (2002) specification with the addition of contract extensions and players not yet eligible for free agency is a first step in the process to measure the effect of monopsony on salary tradeoffs. However, there will always be unobservable player qualities that cannot be controlled for, which make it difficult to measure the tradeoff of contract length and return to performance.

The endogeneity of contract length and salary are also of concern, since both are decided at the same time. Krautmann and Oppenheimer (2002) and Link and Yosifov (2011) both use the number of days spent on the disabled list in prior seasons as an instrumental variable for contract length in a two-stage least squares regression, to try to remove some of the endogeneity associated with contract length. However, their two-stage least squares results were not significantly different from the ordinary least squares results and, a priori it is hard to justify the implicit assumption that injury history affects contract length but not annual salaries.

ii. Data

Each observation in the dataset is a contract signed by a player. The sample used in this paper consists of nearly every Major League Baseball free agent contract, minor league contract that became guaranteed, contract extension, and one year pre-free agency contract signed by Major League Baseball players between 2000 and 2013. Each observation also contains the player's position, a measure of service time by innings pitched or plate appearances, the player's age, the signing year, signing team, contract length, total guaranteed contract value, and previous year's WAR (Baseball Compensation Home 2014). Additionally, I have data on each player's performance statistics from 1992-2013, taken from Fangraphs.com, which produces a leading WAR statistic (Fangraphs 2014). WAR also corrects for position adjustments since some positions add more value defensively than others. For instance, shortstops account for more defensive runs saved than right fielders. In addition to the

preceding year's WAR, I have a player's monopsony status at the time of signing, average guaranteed annual salary, and player position.

Free agent contracts since the 2007 offseason were taken from ESPN's Free Agent Tracker and included the contract length and total contract value (ESPN Free Agent Tracker 2014). Extensions were taken from MLBTradeRumors.com's extension tracker and included the contract length and total contract value (MLB Trade Rumors 2014). Extensions are defined as any contract of two or more years signed by a player before free agency. However any contract signed before free agency but only covering free agent years is considered a free agent deal. The remaining free agent contracts from 2000-2006 were created by cross-referencing transactions from MLBTradeRumors.com's transaction tracker against annual salaries downloaded from Baseball Prospectus's Compensation home (Baseball Prospectus 2014). Contracts were then reverse engineered and fact checked through the Baseball Prospectus Compensation Home. One year contracts were also reverse-engineered by cross-referencing annual salaries against free agent contracts and extensions. Any player who received a salary from 2000-2012 and was not under an extension or free agent contract was assumed to be a pre-free agency player. Player service time estimates used 300 plate appearances or 50 innings pitched as one year of service. From there, player salaries were appropriately labeled as pre-arbitration or arbitration contracts, including corrections for Super Two players.

Lastly, options held by the player or held mutually were treated as new free agent deals if exercised. Options held by the club were treated as part of the initial total contract length and total contract value. When a player agrees to a club option, he essentially signs on for the additional years at the team's discretion. When a player exercises a player option, he is electing to re-sign because he feels it is his best available deal, since his alternative is free agency. In the rare case of a player opt-out, the opt-out is treated the same as a player option.

i. Pitchers

The summary statistics for pitchers are available in Table 2 and the contract distribution is available in Table 3. The dataset for pitchers consists of 4,581 contracts, of which 135 are extensions, 1,344 are free agent signings, and the remainders are one year contracts signed prior to free agency. The average annual salary for pitchers is $1.94 million with a standard deviation of $2.81 million and the average previous season's WAR is .96 with a standard deviation of 1.29. The average length of a pitcher contract is 1.20 years. In addition, Table 4 shows summary statistics for pitchers who signed extensions before free agency. Their average previous season's WAR was 2.88 with a standard deviation of 1.87 and their average salary was $5.4 million with a standard deviation of $3.7 million. Of the years covered by contract extensions for pitchers, 10% are pre-arbitration years, while 69% are arbitration years and the remaining 21% are free agent years. Figures 2 and 3 demonstrate the relationship between salary and contract length and the relationship between salary and WAR. Both trend upwards, suggesting better players get longer contracts and higher salaries and that players receive greater compensation for better past performance.

ii. Position Players

The summary statistics for position players are available in Table 5 and the contract distribution is available in Table 6. The dataset for position players consists of 4,681 contracts, of which 194 are extensions, 1,366 are free agent signings, and the remainders are one year contracts signed prior to free agency. The average annual salary for position players is $2.10 million with a standard deviation of $3.13 million and the average previous season's WAR is 1.16 with a standard deviation of 1.69. The average length of a position player contract is 1.30 years. In addition, Table 7 shows summary statistics for position players who signed extensions before free agency. Their average previous season's WAR was 3.43 with a standard deviation of 2.11 and their average salary was $6.0 million with a standard deviation of $4.4 million. The distribution of years covered by contract extensions is split into 7% pre-arbitration years, 69%

arbitration years, and 24% free agent years. Figures 4 and 5 demonstrate the relationship between salaries and contract length and how salaries relate to WAR. Again, both trend upwards, suggesting salaries have risen over time and players receive greater compensation for better past performance.

IV. *Results*

I ran ordinary least squares regression models with different combinations of variables. The results for pitchers are in Table 8 and the results for position players are in Table 9. For both position players and pitchers, Model 9 was the most fully specified and had the highest r-squared value. After performing a Chow test for pitchers and position players, and rejecting the null hypothesis that the coefficients on the independent variables were the same for pitchers and position players, I ran separate regressions. My key variables of interest are the interaction terms between performance, contract length, and degrees of monopsony.

The proper way to evaluate a player's full return to performance is to measure the derivative of a player's Ln(Average Annual Salary) with respect to performance as measured by WAR. For players who sign free agent contracts, the return to performance can be measured as $\beta_1 + \beta_3$*Length**.** For players under monopsony, the return to performance contains additional coefficients involving the interaction terms between WAR, length, and the percentage of their contract covering monopsony years.

Furthermore, the risk premium is evaluated by measuring the derivative of a player's Ln(Average Annual Salary) with respect to contract length. The risk premium for free agent contracts is $\beta_2 + \beta_3$*Length. The additional coefficients involving interaction terms between WAR, length, and percentage of a contract covering monopsony years are included in the derivative as appropriate for players under monopsony.

i. Return to Performance

For both position players and pitchers, the coefficient on the interaction between LastWAR and contract length is statistically significant and negative at the 1% level. For free agents, pitchers' return to performance decreases by 8.83 % for every one year increase in contract length, while position players' return to performance decreases by 5.92% for every one year increase in contract length. Evaluated at mean contract length of 1.46 years for pitchers and 1.62 years for position players, a player can expect an additional win above replacement to increase his salary by 33.6% and 29.1% respectively. However, because the return to performance varies with contract length and the coefficient on the interaction between LastWAR and contract length is negative, both position players and pitchers' salaries may decrease from an additional win above replacement when signing contracts of 7 years or more for position players and 6 years or more for pitchers. For free agents, 7 pitchers and 36 position players are calculated to have a negative overall return to performance, suggesting that given the lengths of their contracts, an additional win above replacement is expected to reduce their average annual salary.

In addition to the coefficients on LastWAR and the interaction between LastWAR and contract length, players under different levels of monopsony have different returns to performance as well. For a player whose contract only covers arbitration eligible years, the coefficients on the interaction between LastWAR and pctArb are negative and statistically significant at the 1% level. The coefficients on the interaction between LastWAR, contract length, and pctArb are not statistically significant and are likely too highly correlated with the previous interactions to have a measurable effect. For contracts covering only arbitration years, position players can expect an additional year of contract length to decrease return to performance by 15.2%, while pitchers can expect a decrease of 18.2% in comparison to free agents. When evaluated at the average length of contract for all contracts with more than 0% of length covering arbitration years, I used the mean contract length for non-zero percentage of

contract years for arbitration. The summary statistics for players with more than 0% of contract years covering arbitration can be found in Table 10. At a mean contract length of 1.16 years for pitchers and 1.34 years for position players, the return to performance decreases as the percentage of the contract covering arbitration years increases. The distribution can be seen in Table 11. At mean contract length of less than two years and when evaluated at 33% of contract years, the decrease in return to performance as a result of monopsony is 5.75% for pitchers and 4.85% for position players. Despite being very close to free agency, a player signing a contract under less than one year of monopsony is still calculated to trade off return to performance.

Lastly, the coefficients on the interactions between LastWAR and pctMLM are negative and statistically significant as well. However, the coefficients on the interaction between LastWAR, contract length, and pctMLM are not statistically significant because of multicollinearity. For contracts covering solely pre-arbitration years, position players can expect a decrease of 27.9% while pitchers can expect a decrease of 32.7% in return to performance for each additional year of contract length, in comparison to free agents. To better evaluate the effect of the different stages of pre-arbitration years, the mean contract lengths for contracts covering more than 0% of pre-arbitration years is used. The mean contract lengths are 1.07 years for pitchers and 1.09 years for position players and can be seen in Table 12. As expected, the return to performance decreases as the percentage of a contract's years approaches 100% pre-arbitration. For a contract covering 100% pre-arbitration years, a pitcher can be expected to receive 32.38% less in return to performance, while a position player can be expected to receive 27.38% less in return to performance. The full distributions are available in Table 13.

The different degrees of monopsony and their effects on return to performance can be better understood with a standard contract length and LastWAR. Assuming a contract length of 2.38 years for pitchers and 2.93 years for position players, which are both one standard

deviation from the mean for free agents, the return to performance decreases as levels of monopsony increase. The distribution of the effects of monopsony on return to performance can be seen in Table 14. For all levels of monopsony, return to performance is less than for a free agent signing a contract of equivalent length.

Furthermore, the monetary effect of monopsony on the return to performance can be evaluated at the 50th percentile and 75th percentile for WAR[10]. The 50th percentile of WAR for pitchers and positions players are .5 and .6 respectively and can be thought of as starting pitcher Jamie Moyer's 2009 season with the Phillies and shortstop Asdrubel Cabrera's 2013 season with the Indians. To determine the monetary differences between different levels of monopsony, the full returns to performance, as measured at the free agent mean contract lengths, are multiplied by the 50th and 75th percentiles of WAR.

The distribution can be seen in Table 15 and demonstrates the increase in return to performance as service time increases. At Jamie Moyer's level of 2009 performance, a free agent pitcher gains an additional $65, 280 for his performance, while a pitcher with a contract covering only arbitration years gains an additional $34,156. Lastly, a pitcher with a contract covering only pre-arbitration years gains only an additional $5,512 for a Jamie Moyer 2009 level of performance. Meanwhile, the distribution for positions players is more pronounced between free agents and arbitration contracted players, than for pitchers. The return to performance for Asdrubel Cabrera's 2013 WAR is an additional $103,266 for free agents, $52,538 for arbitration-only contracts, and $16,885 for pre-arbitration only contracts. Finally, as WAR increases, the monetary differences in return to performance between the different levels of monopsony for both pitchers and position players increases.

[10] The 25th percentile has a WAR value of 0.

ii. Monopsony

While monopsony has an effect on the return to performance, the specification also allows for an analysis of the effect of monopsony on average annual salary. To evaluate the effect of monopsony on salary, I measure the derivative of Ln(Average Annual Salary) with respect to pctArb and again with respect to pctMLM. The coefficients on pctArb and pctMLM are both negative and statistically significant at the 1% level for pitchers and position players, as expected. The coefficients on the interactions between LastWAR and pctArb and pctMLM are also negative and statistically significant at the 1% level for both pitchers and position players, suggesting that players receive less in salary despite better performance, while under monopsony. Interestingly, players with contracts covering arbitration years do not lose as much in average annual salary as players who are not yet eligible for arbitration.

Assuming a player's contract only covers arbitration years and is evaluated at one standard deviation above the mean for contract length for pitchers, 2.38 years, and position players, 2.93 years, a pitcher receives 26.3% less in salary for a WAR value that is one standard deviation above the mean. Additionally, a position player receives 34.21% less in salary for a WAR value that is one standard deviation above the mean in comparison to a free agent of equivalent performance and contract length. As expected due to bargaining power, pre-arbitration eligible players receive even less salary than arbitration eligible players.

iii. Risk Premium

While theory predicts the risk premium, as measured by the tradeoff of salary in exchange for contract length, should be negative, the coefficient on contract length is statistically significant at the 1% level and positive for both position players and pitchers. However, the endogeneity of contract length and average annual salary could be causing a simultaneity bias. Because contract length and average annual salary are mutually determined and better players get both longer contracts and higher average annual salaries, the tradeoff is

very difficult to measure. One promising solution is the inclusion of an instrumental variable which affects the contract length but does not affect average annual salary.

Two potential instrumental variables which can be explored are positional year to year volatility in performance and general managers. Positions like catcher and pitcher might be inherently more volatile and cause players at those positions to be more interested in a long term deal. If such volatility exists, there is a possibility they might prefer longer term deals. The second possibility intuits that despite the inclusion of team –fixed effects, general manager turnover is frequent and each general manager has different roster construction styles. Different general managers might prefer different lengths of deals. The issue needs to be explored further and is an important discussion point moving forward. Lastly, despite the difficulties in observing the risk premium, 61 free agent contracts and 4 contract extensions had negative risk premiums and the distribution of risk premium by contract length and monopsony can be seen in Figures 6 and 7.

V. *Conclusions*

The results are very promising and provide evidence of the negative return to performance and ultimately a form of compensating wage differential in contract extensions for players not yet eligible for free agency. The results are also consistent with both Link and Yosifov (2011) and Krautmann and Oppenheimer (2002). The distributions to return to performance as contract length and performance increase, suggest a tradeoff between return to performance and contract length for players under monopsony.

The full breakdown of returns to performance for extensions can be seen in Figure 8 and demonstrate that players at the highest performance levels with the longest contracts are actually receiving a negative return to performance. While other players have decreasing returns to performance, they do not cross over into negative. Of the 194 position player contract extensions, 51 have negative returns to performance while 19 of the 136 pitcher contract extensions have negative returns to performance. As seen in Figure 9, of the 1366 free agent

position player contracts 36 players have negative returns to performance, while 7 of the 1344 free agent pitcher contracts have negative returns to performance. While theoretically a player should have a positive return to his performance, the players with negative returns to performance have high annual average salaries, but the rate at which they are compensated for their performance is driven down by the length of their contract. The negative coefficients on the interaction terms including LastWAR suggest that despite superior performance to other players, some players are still not paid at the level they deserve given their WAR and are thus trading off their return to performance for additional years of contract length.

The results measuring the impact of monopsony on return to performance also call into question the effectiveness of arbitration in raising salaries to free agency level. In Kahn (1993), he asserts that arbitration and free agencies both raise salary, but only free agency raises contract length. The results indicate that arbitration does indeed raise return to performance in comparison to pre-arbitration players, but the return to performance is still lower than in free agency. Even in the event of a contract covering a minimal amount of arbitration years, when evaluated at one standard deviation from the mean of free agent contract length, a pitcher still receives 3.86% less in return to performance and position players receive 4.82% less in return to performance. For contracts of greater lengths, the return to performance only decreases.

While these results are very interesting and do provide evidence of a tradeoff between return to performance and contract length, a more thorough investigation of the true risk premium is necessary. I plan to continue my analysis and improve upon my specification with better controls for player quality and the potential inclusion of an instrumental variable.

VI. *References*

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VII. *Attachments*

Figure 1

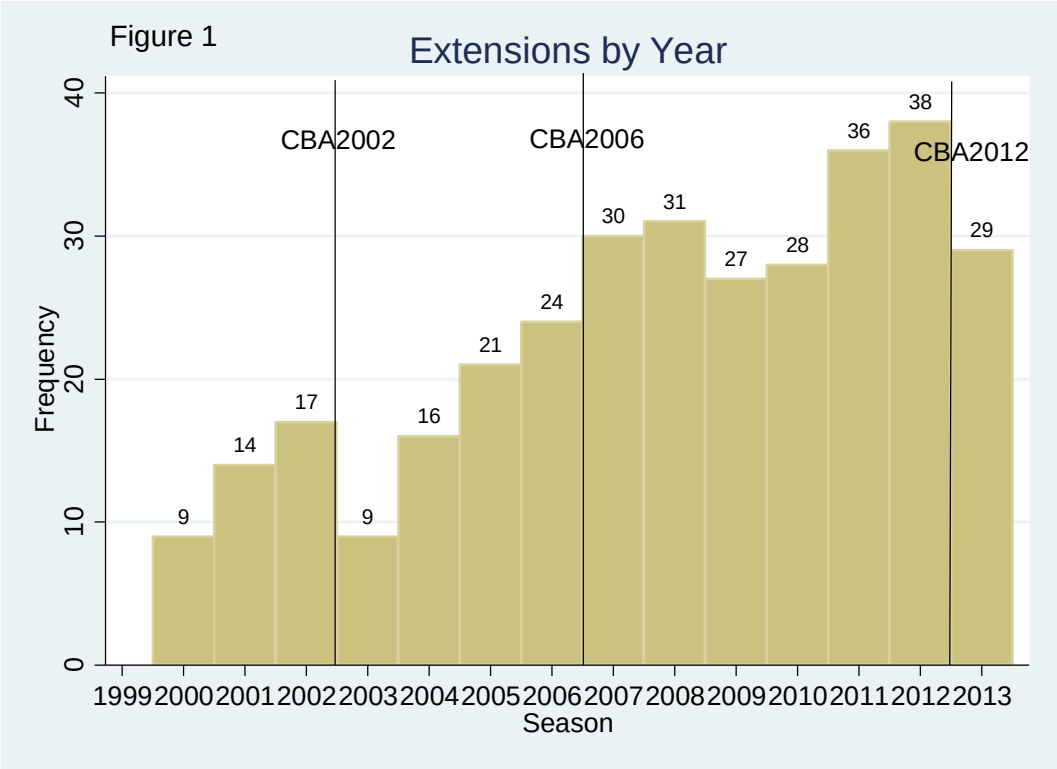


Table 1

Year	Pre-Arbitration	Arbitration Eligble	Total	Percentage	Cumulative Percentage
2000	2	7	9	2.42%	2.42%
2001	3	11	16	4.30%	6.72%
2002	5	12	19	5.11%	11.83%
2003	2	7	13	3.49%	15.32%
2004	1	15	22	5.91%	21.24%
2005	2	19	24	6.45%	27.69%
2006	8	16	27	7.26%	34.95%
2007	4	26	38	10.22%	45.16%
2008	10	21	34	9.14%	54.30%
2009	9	18	28	7.53%	61.83%
2010	5	23	28	7.53%	69.35%
2011	7	29	36	9.68%	79.03%
2012	12	26	39	10.48%	89.52%
2013	8	21	39	10.48%	100.00%
	78	**251**	**372**	**100%**	

Table 2

Summary Statistics for Pitchers					
	LastWAR	*Average Salary*	*Years*	*% MLM*	*% Arb*
Mean	0.96	$1,937,474.00	1.20	0.32	0.38
Standard Devation	1.29	$2,814,323.00	0.67	0.46	0.48
Min	-1.9	$100,000.00	1	0	0
Max	8.1	$28,000,000.00	8	1	1
Count	4581	4581	4581	4581	4581

Table 3

Contract Distribution for Pitchers		
Extensions	135	2.95%
Free Agent Deals	1,344	29.34%
Pre-Arbitration 1 year deals	1,701	37.13%
Arbitration 1 year deals	1,401	30.58%
Total	**4581**	**100%**

Table 4

Summary Statistics for Pitchers on Extensions					
	LastWAR	*Average Salary*	*Years*	*% MLM*	*% Arb*
Mean	2.88	$5,423,259.00	3.19	0.096	0.69
Standard Devation	1.87	$3,697,053.00	1.05	0.18	0.26
Min	-0.8	$900,000.00	2	0	0.2
Max	8.1	$20,300,000.00	6	0.67	1
Count	136	136	136	136	136

Figure 2

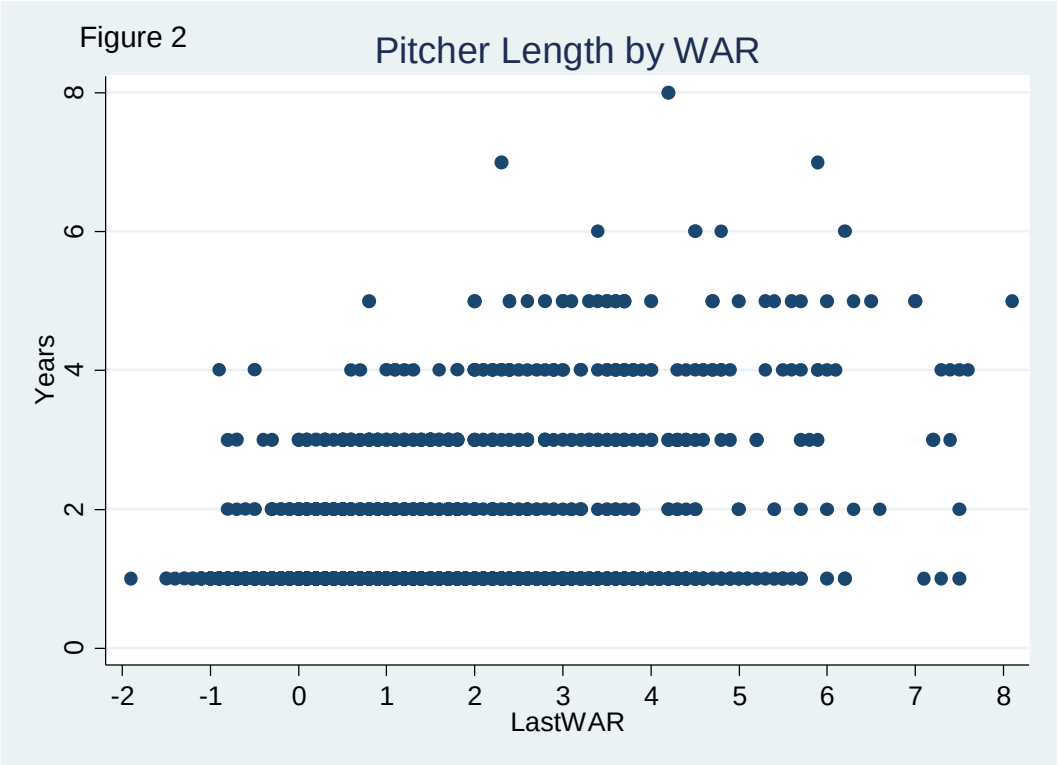


Figure 3

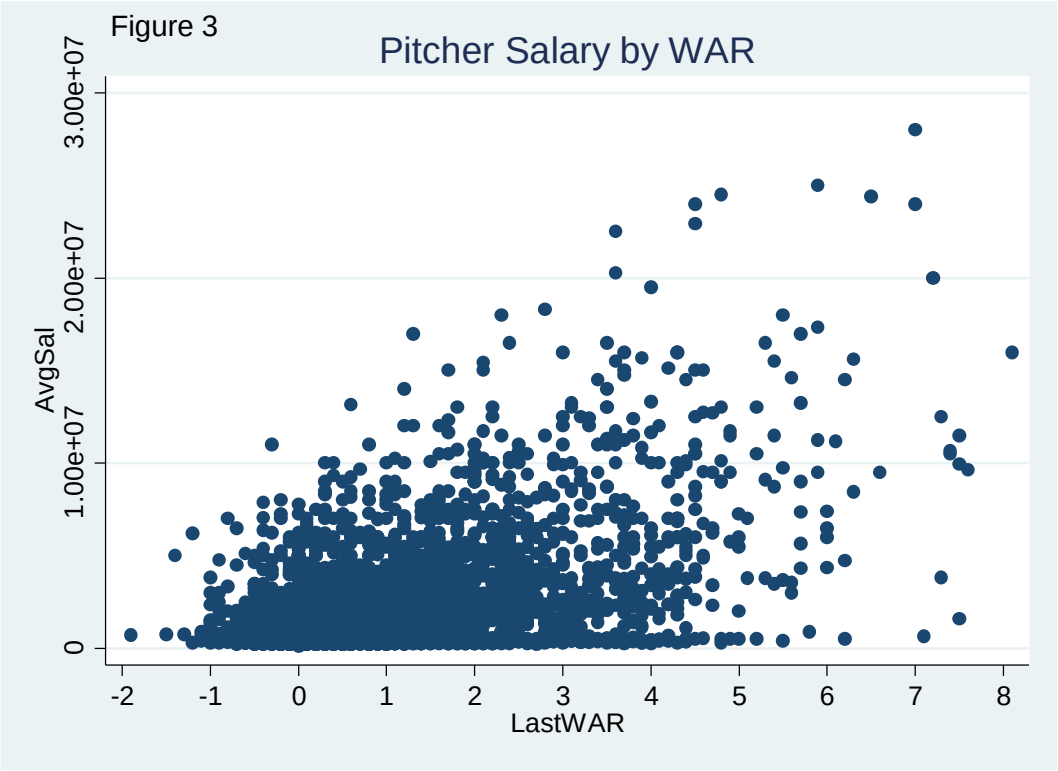


Table 5

Summary Statistics for Position Players					
	LastWAR	*Average Salary*	*Years*	*% MLM*	*% Arb*
Mean	1.16	$2,101,508.00	1.30	0.37	0.33
Standard Devation	1.69	$3,129,319.00	0.99	0.48	0.46
Min	-3.1	$50,000.00	1	0	0
Max	12.5	$27,500,000.00	10	1	1
Count	4681	4681	4681	4681	4681

Table 6

Contract Distribution for Position Players		
Extensions	194	4.14%
Free Agent Deals	1,366	29.18%
Pre-Arbitration 1 year deals	1,879	40.14%
Arbitration 1 year deals	1,242	26.53%
Total	**4681**	**100%**

Table 7

Summary Statistics for Position Players on Extensions					
	LastWAR	*Average Salary*	*Years*	*% MLM*	*% Arb*
Mean	3.43	$5,984,939.00	3.86	0.07	0.69
Standard Devation	2.11	$4,447,968.00	1.71	0.14	0.26
Min	-1	$762,500.00	2	0	0.13
Max	9.6	$25,000,000.00	10	0.6	1
Count	194	194	194	194	194

Figure 4

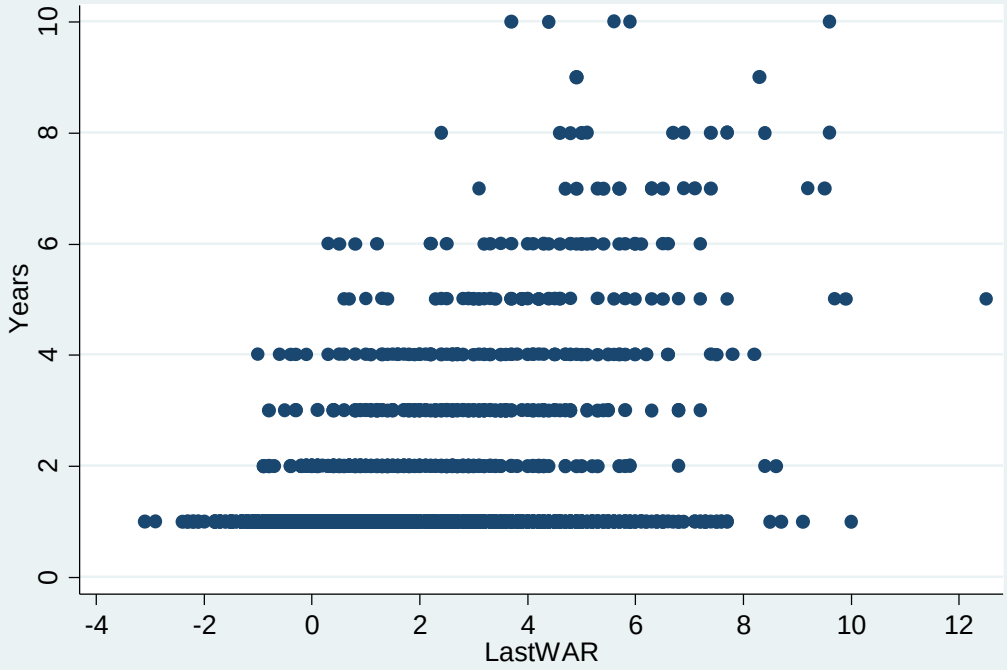
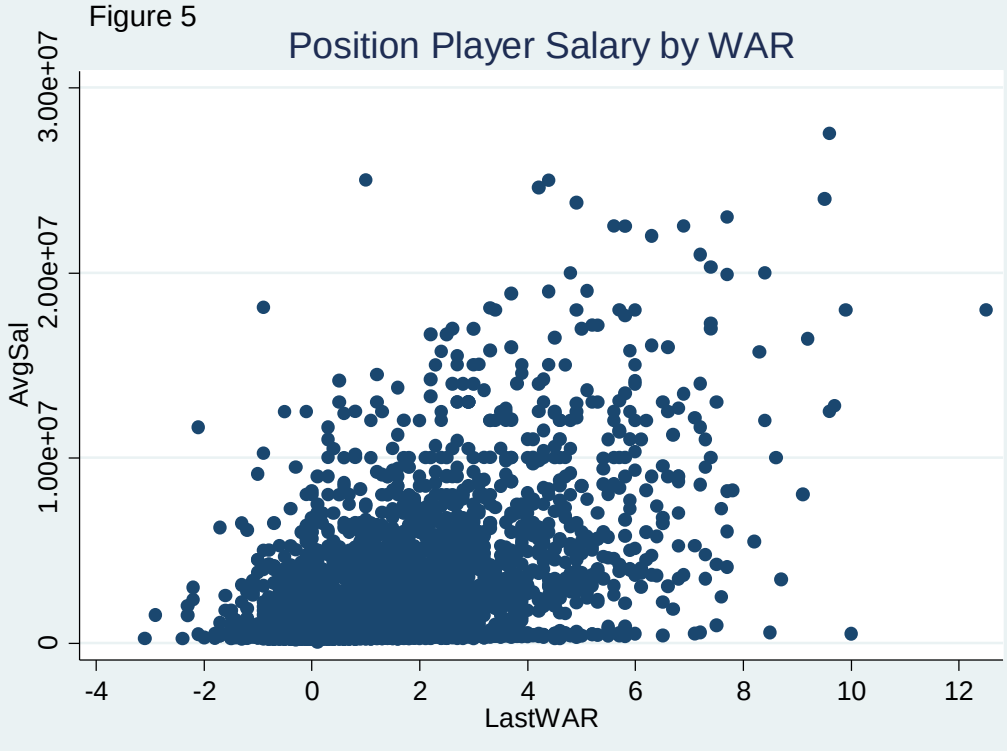


Figure 5



Pitcher Results

Table 8	(1) lnavgsal	(5) lnavgsal	(9) lnavgsal
LastWAR	0.226***	0.465***	0.465***
	(0.0105)	(0.0242)	(0.0242)
Years	0.383***	0.507***	0.506***
	(0.0171)	(0.0279)	(0.0348)
LastWAR_Years		-0.0882***	-0.0883***
		(0.00819)	(0.0104)
pctMLM	-1.341***	-1.094***	-1.089***
	(0.0401)	(0.198)	(0.297)
LastWARpctMLM		-0.365***	-0.368***
		(0.0607)	(0.0924)
YearspctMLM		-0.0245	-0.0289
		(0.192)	(0.293)
LastWAR_YearspctMLM		0.0400	0.0413
		(0.0515)	(0.0845)
pctArb	-0.722***	-0.691***	-0.696***
	(0.0351)	(0.115)	(0.120)
LastWARpctArb		-0.228***	-0.229***
		(0.0407)	(0.0413)
YearspctArb		0.142	0.148
		(0.0986)	(0.108)
LastWAR_YearspctArb		0.0478	0.0471
		(0.0256)	(0.0306)
Age	0.0269***	0.0297***	0.0297***
	(0.00390)	(0.00395)	(0.00349)
Team Fixed Effects	NO	YES	YES
Position Fixed Effects	NO	YES	YES
Year Fixed Effects	NO	NO	YES
Constant	13.05***	12.69***	12.87***
	(0.135)	(0.153)	(0.142)
Observations	4581	4581	4581
R-squared	0.599	0.641	0.642

Standard errors in parentheses

** p<0.01 * p<0.05 *** p<0.001

Position Player Results

Table 9	(1) lnavgsal	(5) lnavgsal	(9) lnavgsal
LastWAR	0.185***	0.386***	0.387***
	(0.00798)	(0.0169)	(0.0152)
Years	0.279***	0.437***	0.438***
	(0.0122)	(0.0216)	(0.0268)
LastWAR_Years		-0.0589***	-0.0592***
		(0.00464)	(0.00535)
pctMLM	-1.463***	-0.846***	-0.860***
	(0.0388)	(0.155)	(0.201)
LastWARpctMLM		-0.341***	-0.336***
		(0.0401)	(0.0580)
YearspctMLM		-0.306*	-0.291
		(0.147)	(0.197)
LastWAR_YearspctMLM		0.0628	0.0571
		(0.0342)	(0.0531)
pctArb	-0.642***	-0.536***	-0.528***
	(0.0345)	(0.0829)	(0.0916)
LastWARpctArb		-0.164***	-0.166***
		(0.0268)	(0.0258)
YearspctArb		0.131*	0.124
		(0.0585)	(0.0778)
LastWAR_YearspctArb		0.0126	0.0142
		(0.0126)	(0.0172)
Age	0.00473	0.0124***	0.0125***
	(0.00374)	(0.00367)	(0.00349)
Team Fixed Effects	NO	YES	YES
Position Fixed Effects	NO	YES	YES
Year Fixed Effects	NO	NO	YES
Constant	13.86***	13.14***	13.29***
	(0.132)	(0.155)	(0.145)
Observations	4681	4681	4681
R-squared	0.629	0.674	0.675
Standard errors in parentheses			
** p<0.01	* p<0.05	*** p<0.001	

Table 10

Summary Statistics for non-zero pctArb			
Pitchers	*LastWAR*	*Average Salary*	*Years*
Mean	1.25	$1,646,531.00	1.16
Standard Devation	1.41	$2,033,599.00	0.65
Min	-1.4	$200,000.00	1
Max	8.1	$20,300,000.00	6
Count	1797	1797	1797
Position Players	*LastWAR*	*Average Salary*	*Years*
Mean	1.63	$2,121,569.00	1.34
Standard Devation	1.87	$2,630,678.00	1.1
Min	-2.1	$179,258.00	1
Max	9.6	$25,000,000.00	10
Count	1621	1621	1621

Table 11

Non-Zero pctArb Return to Performance		
	Pitchers	Position Players
effect of average length for non-zero-.33	-5.75%	-4.85%
effect of average length for non-zero-.66	-11.51%	-9.70%
effect of average length for non-zero-1	-17.44%	-14.70%

Table 12

Summary Statistics for non-zero pctMLM			
Pitchers	*LastWAR*	*Average Salary*	*Years*
Mean	0.47	$534,431.00	1.07
Standard Devation	0.84	$826,624.00	0.45
Min	-1	$200,000.00	1
Max	5.6	$12,400,000.00	5
Count	1474	1474	1474
Position Players	*LastWAR*	*Average Salary*	*Years*
Mean	0.55	$571,219.00	1.09
Standard Devation	1.14	$952,071.00	0.62
Min	-3.1	$200,000.00	1
Max	10	$12,500,000.00	8
Count	1737	1737	1737

Table 13

Non-Zero pctMLM Return to Performance		
	Pitchers	Position Players
effect of pctMLM-.33 pctArb-.66- non-zero	-22.47%	-18.97%
effect of pctMLM-.66 pctArb-.33- non-zero	-27.27%	-23.04%
effect of pctMLM-1 pctArb-0 - non-zero	-32.38%	-27.38%

Table 14

Effect of Monopsony on Return to Performance*

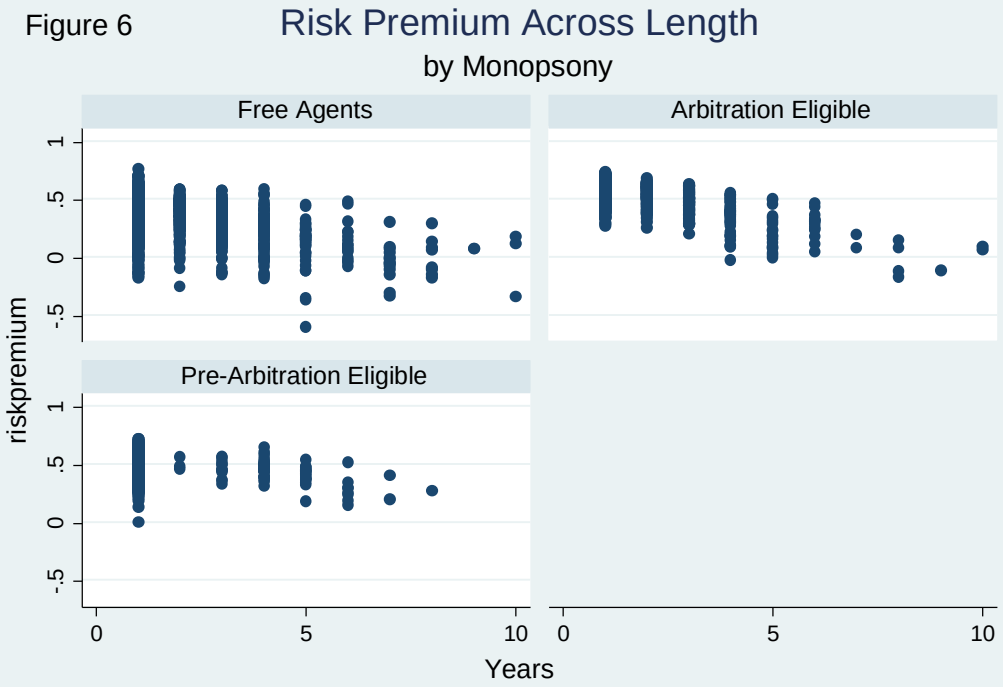
Level of Monopsony	*Pitchers*	*Position Players*
33% Arbitration, 0% MLM	-3.86%	-4.11%
66% Arbitration, 0% MLM	-7.72%	-8.21%
100% Arbitration, 0% MLM	-11.69%	-12.44%
66% Arbitration, 33% MLM	-16.62%	-13.78%
33% Arbitration, 66% MLM	-21.66%	-15.24%
0% Arbitration, 100% MLM	-26.97%	-16.87%

*Evaluated at 2.38 Years for Pitchers and 2.93 Years for Position Players

Table 15

Return to Performance in Monetary Value			
	Median WAR	75th pctile WAR	Mean Extensions WAR
Pitcher Free Agent Increase	$ 65,280.77	$ 195,842.30	$ 416,491.28
Pitcher Arbitration Increase	$ 34,156.82	$ 102,470.46	$ 217,920.51
Pitcher Pre-Arbitration Increase	$ 5,512.55	$ 16,537.64	$ 35,170.06
Position Player Free Agent Increase	$ 103,266.90	$ 327,011.86	$ 664,350.41
Position Player Arbitration Increase	$ 52,538.78	$ 166,372.80	$ 337,999.48
Position Player Pre-Arbitration Increase	$ 16,885.49	$ 53,470.71	$ 108,629.97
*Evaluated at 1.46 Years for Pitchers and 1.62 Years for Position Players			

Figure 6



Graphs by MLM and Arb

Figure 7

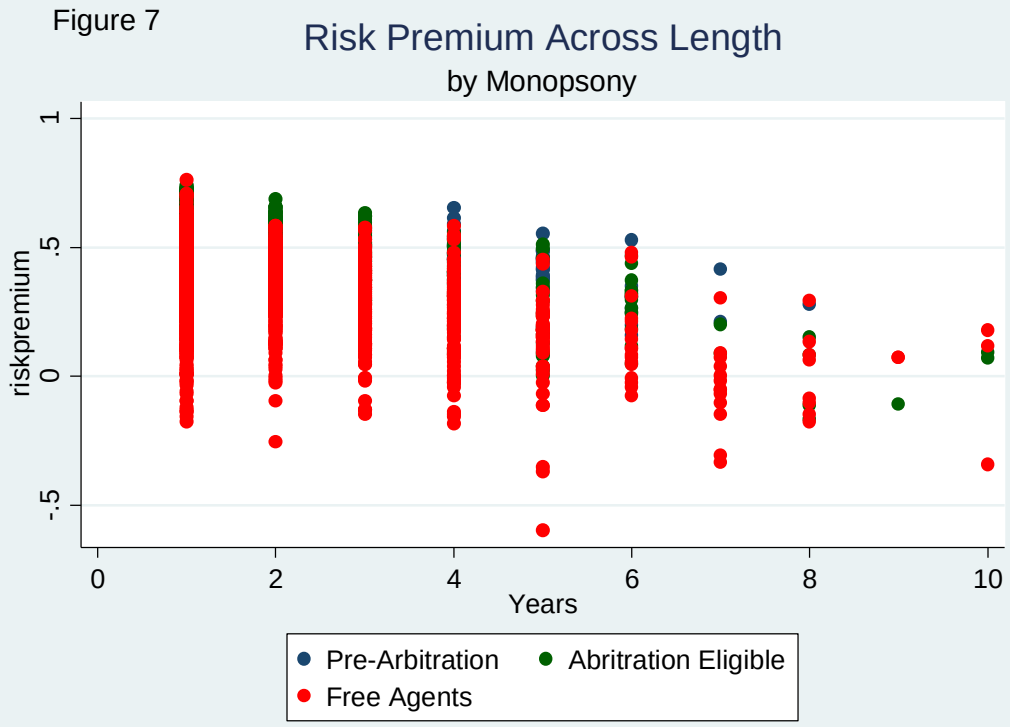
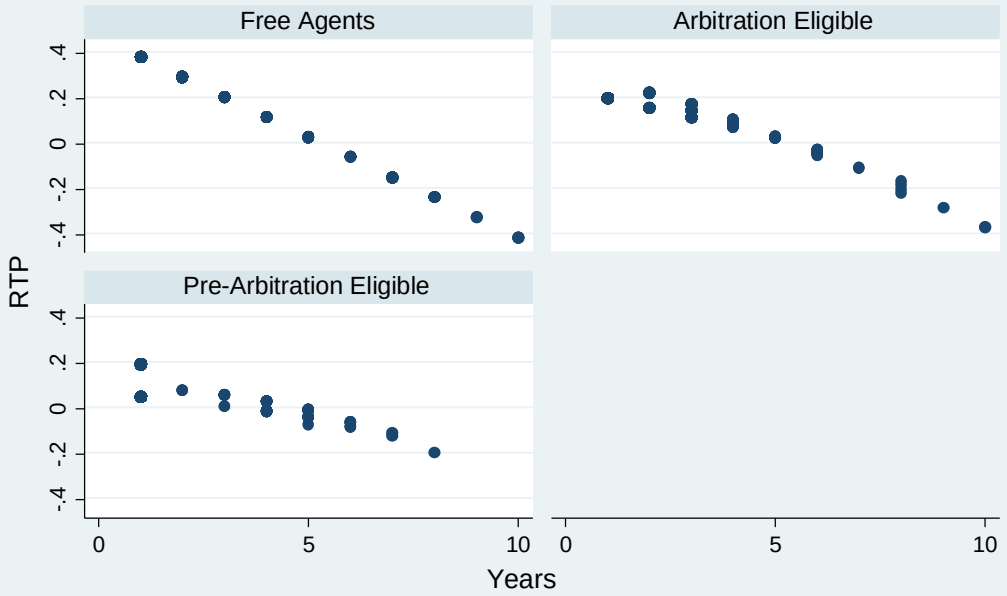


Figure 8



Graphs by MLM and Arb

Figure 9