An Analysis of the Effects of Long-Term Contracts on Performance in Major League Baseball

Zachary Taylor

Haverford College
Department of Economics
Advisor: Dave Owens
Spring 2016

Abstract:
This study explores the effects of long-term contracts in Major League Baseball on players’ performance. By predicting performance of individual players using past performance, among other variables, this paper measures whether players perform as expected, or under/over-perform after signing a long-term contract in the free-agent market from the seasons 2006-2015. This paper analyzes pitchers and position players separately. It is expected that players with long-term contracts will underperform do to a disincentive to work hard based on the job security of a long-term contract. The results show that position players and pitchers do not underperform in the year after signing a new long-term contract, but there is a positive relationship between underperformance and total value of a contract. There may be a disincentive to perform after signing a contract for a specific amount of guaranteed money.
# Table of Contents

1. Introduction ................................................................................................................... 3
2. Literature Review ............................................................................................................. 5
3. Data .................................................................................................................................. 8
4. Methodology .................................................................................................................... 12
5. Results ............................................................................................................................ 16
6. Conclusion ....................................................................................................................... 18
7. References ....................................................................................................................... 20
8. Statistic Appendix .......................................................................................................... 22
1. Introduction:

Asymmetric information is when one party has more, or better, information than the other party when the two engage in a transaction. Two common types of asymmetric information are adverse selection and moral hazard. Adverse selection happens when one party has better information than another party and engages in a beneficial transaction that takes advantage of the other party. Moral hazard occurs when one party takes more risk because the other party incurs the cost of that risk after an agreement or transaction has taken place. An issue of moral hazard is believed to be present in professional sports, as some professional athletes may perform differently after signing a multi-year contract. Teams may offer a player a contract not knowing if the player will put in the same effort as previous years. Recently, Major League Baseball teams have agreed to sign players for more money and longer contracts, and studies have found signs of underperformance, or shirking, due to contract length (Krautmann 2002 & Woolway 1997). Shirking is another term for underperformance that will be used in this paper. It is possible that the job security of a long-term contract leads to issues of adverse selection and moral hazard. As players have a longer guaranteed contract, there is a disincentive to work as hard and perform as well.

This paper aims to examine the performance of Major League Baseball players after they signed a long-term contract from 2006 to 2015 using three different models. Each model uses a similar structure, but with different measures for performance and different playing time control variables. The first model analyzes the performance of position players using contract level data and WAR as a
measure of performance. An expected performance will be calculated for each player using past performance and other variables. This paper will create a measure of shirking called the “shirk value.” The shirk value is the difference between the expected performance and the actual performance of the player. Using an OLS regression, the effects of signing a long-term contract on shirking will be measured. The second model is similar, but uses OPS as a measure of performance, and calculates the expected performance and the shirk value in the same way as the first model. The last model is used to calculate shirking for pitchers, which uses WAR as a measure of performance. Predicting performance is carried out exactly as it is for position players, but innings pitched will be used as a control for playing time. Again, an OLS regression is used to analyze the effects of signing a long-term contract on the deviations from expected performance. Together, the three models should identify differences in the effects of contract length on performance between hitters and pitchers. It is important to note that in baseball performance is not always a great indicator of effort. Baseball is considered a game of failure, meaning players can fail more times than they succeed and still be considered successful. A successful player can get three hits in ten tries, and putting in more effort does not always yield greater success. Therefore, if a player’s effort increases or decreases, it may not be evident based on his performance. However, due to the inevitable failure in the game of baseball, it is more likely for decreased effort to result in worse performance than increased effort to result in better performance.
2. Literature Review:

Research on baseball has become more popular in recent years. Players’ contracts, wages, and performance have all been common subjects of analysis. Recently, more studies (Krautmann 2009 & Healy 2008) have been conducted focusing on the relationships between behavior and contracts in baseball such as the shirking effect or the contract year effect. The development of statistics that can measure the overall performance of a player is valuable for research. New statistics have been developed to measure performance, such as Wins Above Replacement. Researchers have used baseball as opposed to other sports due to the fact that performance is more measurable. Other sports have statistics that measure how well a player may do one specific action in a game, but most sports do not have an overall measurement of performance. Every pitch in a baseball game and the result of the pitch is recorded. Also, contract data is easily accessible, which allows researchers to analyze different relationships using this data. Researchers use this information to understand and predict the behavior of teams and players.

Andrew Healy of Loyola Marymount University investigates Major League Baseball teams’ use of prior performance information and its ability to predict future performance in Do Firms Have Short Memories?: Evidence From Major League Baseball from the Journal of Sports Economics. Healy examines hitters from 1985 to 2004. He predicts performance using past performance and other variables, similar to the methodology used in this paper. He then uses this predicted performance to predict salary. Healy finds that teams that win the most, while controlling for salary, use past performance most effectively when evaluating players and offering
contracts. While Healy analyzes how performance affects structure of contracts, some researchers analyze how contracts affect performance. There is often a sense of job security created from these contracts. Further research analyzes the effects of this job security on performance.

This paper uses past performance to predict performance and analyzes the effects of contract length on the deviation from predicted performance. While this paper examines job security that arises from the long-term contracts specifically in baseball, this effect can be found in other settings. In the *International Journal of Manpower*, Darwish A. Yousef examines the relationship between satisfaction with job security and job performance in *Satisfaction with Job Security as a Predictor of Organizational Commitment and Job Performance in a Multicultural Environment*. Yousef surveys workers in the United Arab Emirates and finds that satisfaction with job security is highly correlated with organizational commitment and job performance. Numerous attempts have been made to find this relationship in Major League Baseball. Anthony C. Krautmann conducts three studies that examine the effects of contract length on player performance. In the first study, Krautmann works with Margaret Oppenheimer to find the effects of contract length on performance in Major League Baseball. In *Contract Length and the Return to Performance in Major League Baseball*, published in the *Journal of Sports Economics* in 2002, they focus on Major League Baseball hitters from 1990 to 1994. The authors use an OLS and a Two Stage Least Squares to evaluate the relationship between contract length and salary. In their results, they find a negative relationship between players’ performance and contract length, which suggests that there may
be a disincentive to perform. Mark D. Woolway attempts to identify this “shirking effect” in his paper, *Using An Empirically Estimated Production Function For Major League Baseball to Examine Worker Disincentives Associated With Multi-Year Contracts*, from the *American Economist*. He uses cross-sectional data to compare the marginal product of newly signed MLB players from the 1993 season to the marginal product of their previous season. He calculates MRP of players in terms of wins contributed to the team, and finds worker disincentives that are associated with multi-year contracts.

In this 2007 paper, Krautmann and Thomas D. Donley use the idea of a player’s Marginal Revenue Product to look at shirking in *Shirking in Major League Baseball: Revisited* from the *Journal of Sports Economics*. In this study, the researchers tested for shirking using OPS which is On-Base Percentage + Slugging Percentage. They predicted OPS of Major League Baseball players using their actual past OPS, and analyzed the difference between the predicted performance and actual performance. The results showed no evidence of shirking. They tested for shirking a second time using the predicted marginal revenue product of each player and the realized marginal revenue product of each player. They calculate the marginal revenue product by combining a player’s on-field contribution to winning games and the value of those wins to the team’s revenue. The results indicate that players who sign multi-year contracts generate less value than expected for their team. Using the marginal revenue product as a measure of performance provides a different point of view of shirking.
The article that is most similar to this paper is *The Dynamics of Performance Over the Duration of Major League Baseball Long-Term Contract*, which was published in the *Journal of Sports Economics* in 2009. Anthony C. Krautmann and John L. Solow investigate the incentives and disincentives to perform after signing a contract. They calculated the SHIRK of each player by subtracting a player’s performance in the years after signing the contract from each player’s expected performance in those respective years. They qualified any multi-year contract as a long-term contract and analyzed 527 free agent hitters from 1997-2007. Krautmann and Solow also calculated the probability of retirement for each player in each season. They found that players who were not expected to sign a subsequent contract performed worse than expected, and players who were expected to sign a contract performed as expected. In their study, shirking is only evident in cases when the player is not expecting to sign another contract. This paper will take a similar approach, but it will use more recent player data, different measures of performance, and include pitchers as well as hitters. Longer contracts have become more prevalent in recent years due to the competition for free agents and increased revenue from TV contracts (Turvey 2013). More teams can compete for talented free agents, which drives up their prices.

3. **Data:**

This study uses contract-level data on Major League Baseball players from 2006 to 2015, which includes measures of performance, age, and playing time. Performance data is gathered from baseballreference.com. Contract data for each
player, including contract length and contract value, is from ESPN.com’s Free Agent Tracker, which is a website that displays all MLB free agent signings from 2006-2015. Each observation will be a contract signed by a free agent with at least three years of experience in Major League Baseball prior to signing the contract.

This study uses WAR and OPS as measurements of performance. WAR will be used as a measure of performance for position players and pitchers. WAR is a metric that measures how many more wins a player contributes to his team than a replacement level player. A replacement player would have a WAR of 0. Wins Above Replacement is a useful statistic because it measures offense and defense contributions. This study also uses OPS to analyze batters’ performances. OPS is the sum of a player’s On-Base Percentage and Slugging Percentage. On-Base Percentage measures how frequently a player gets on base without reaching on an error, a fielder’s choice, dropped third strike, fielder’s obstruction, or catcher’s interference. Slugging percentage measures the power of a hitter. OPS is the sum of these metrics, which measures pure hitting ability. A more detailed explanation of WAR and OPS is featured in the Appendix.

This study predicts the performance of Major League Baseball players in the season after signing a new contract using performance in the three seasons prior to signing the contract. Deviations between the predicted performance and the actual performance are used to identify shirking. In this study, contract length, the total number of years on a player’s contract, and contract value, which is the amount of money a player will make over the entirety of his contract, are used to examine
the effects on performance. Below are summary statistics for performance and contract data for position players:

**Descriptive Statistics for Position Players**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAR</td>
<td>6352</td>
<td>.92979</td>
<td>1.763329</td>
<td>-2.9</td>
<td>10.8</td>
</tr>
<tr>
<td>OPS</td>
<td>1495</td>
<td>.78990</td>
<td>.0921341</td>
<td>.545</td>
<td>1.114</td>
</tr>
<tr>
<td>Age</td>
<td>6353</td>
<td>28.335</td>
<td>4.171149</td>
<td>19</td>
<td>48</td>
</tr>
<tr>
<td>Total Contract Value</td>
<td>497</td>
<td>13,700,000</td>
<td>31,30000</td>
<td>400,000</td>
<td>275,000,000</td>
</tr>
<tr>
<td>Contract Length</td>
<td>621</td>
<td>1.7858</td>
<td>1.446082</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>

*OPS contains data for only batting title qualifying observations (pa >501)

The above statistics show that the average length of a contract signed in the free agent market from 2006-2015 by hitters is 1.7858 years. Therefore, we will define a long-term contract for position players as any contract of two years or more. The statistics for OPS represent free agents from 2006-2015 who have enough plate appearances to qualify for the MLB batting title. This qualification is 3.1 plate appearances every game played by that player’s team. The MLB regular season is 162 games long, so a player must record 502 plate appearances over those 162 games to qualify. This is explained more thoroughly in the Appendix section. It is important to note that the average WAR of a free agent position player is .9298, meaning an average MLB free agent from 2006-2015 creates .9298 more wins than a replacement player of the same position. A more detailed description of WAR can be found in the Appendix. The units for the variable Value is in dollars, and the average value of a free agent contract signed from 2006-2015 is $13,700,000.
### Descriptive Statistics for Pitchers

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAR</td>
<td>6,678</td>
<td>.6149745</td>
<td>1.409238</td>
<td>-2.8</td>
<td>10.4</td>
</tr>
<tr>
<td>Age</td>
<td>6,683</td>
<td>28.0003</td>
<td>4.18707</td>
<td>19</td>
<td>49</td>
</tr>
<tr>
<td>Contract Length</td>
<td>499</td>
<td>1.677355</td>
<td>1.14163</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Total Contract Value</td>
<td>420</td>
<td>11,700,000</td>
<td>22,100,000</td>
<td>380,000</td>
<td>210,000,000</td>
</tr>
</tbody>
</table>

Again, the average length of a contract signed by free agent pitchers from 2006-2015 is between one and two years. Therefore, long-term contracts for pitchers will also be defined as contracts of two years or more. The average free agent pitcher from 2006-2015 creates .6149 more wins than a replacement level pitcher, which demonstrates the differences between average pitchers and replacement level pitchers.
The four histograms above show the distribution of the length of contracts and contract value in logs for free agent pitchers and hitters from 2006 to 2015. The majority of free agent contracts signed are one-year contracts, as seen in Figure 1 and Figure 3. Position players tend to sign contracts of smaller value than pitchers as seen in the rightward skew of Figure 2 and the somewhat normal distribution of Figure 4.

4. Methodology:

**Calculating Expected Performance for a Position Player:**

In order to estimate shirking, performance must be predicted. This study uses an OLS regression of performance on lagged performance with a series of controls for age and playing time. It is important to note that each year has a different predictive strength, and not all three seasons should be weighted evenly. The coefficients for each prior year are used as the weights to predict future performance. Year_{t-1} is the year after signing the contract. Year_{t-1} is the year before signing the contract, and Year_{t-2} and Year_{t-3} are the two years prior. Two separate analyses will be performed for position players. The measures of performance used are OPS, also used by Krautman (2007), and WAR. All other variables remain the same in the two models. An OLS regression (below) is used, followed by a predict command, to generate the expected performance.
The equation above produces the weights for the different predictive variables, past performance, playing time, and age. Age is an important variable because performance should rise and fall throughout a career as age increases. Players get better as they gain experience, but their bodies start to deteriorate later in their careers. Plate Appearances is included to control for how often a player plays during a season. Once the weights of each variable are identified, they can be used to predict the performance of players in Year_t.

**Calculating Expected Performance for a Pitcher:**

A similar model is constructed for an analysis of pitchers in the free agent market. To predict the performance of pitchers, the performances in Year_{t-1}, Year_{t-2}, and Year_{t-3} will be used along with age and innings pitched. For pitchers, innings pitched is used to control for playing time throughout the season.

\[
Performance_t = \beta_1 + \beta_2 Performance_{t-1} + \beta_3 Performance_{t-2} + \beta_4 Performance_{t-3} + \beta_5 Age + \beta_6 Age^2 + \beta_7 Innings_t + u
\]

As mentioned in the section on predicting position players' performances, the weights for each of the above variables will be used to calculate an expected performance for pitchers. The coefficients on prior performance, age and innings pitched are used as these weights to predict performance.
Testing the Shirking Hypothesis:

We use an OLS regression to test the affects of long-term contracts on Major League Baseball players shirking. First, we measure shirking by finding the difference between a player’s expected performance and actual performance. We use both WAR and OPS as dependent measures of performance for position players, and WAR for pitchers. The difference between the expected performance and the actual performance is the estimate of shirking. Shirking is evident when the shirk value is positive.

Measure of Shirking:

\[ \text{Shirk Value} = \text{Expected Performance}_t - \text{Actual Performance}_t \]

For the purpose of this paper, any contract that is greater than the average contract signed from 2006 to 2015 (1.7858 for hitters & 1.6774 for pitchers) is considered a long-term contract. Therefore, any multi-year contract is a long-term contract. Regressing the shirk value on contract length and the log of the contract value will present the effect of signing a long-term contract on performance.

\[ \text{Shirk Value} = \beta_1 + \beta_2 \text{Contract Length} + \beta_4 \ln \text{Contract Value} + u \]

The null hypothesis is that players’ actual performance will be equal to the players’ expected performance after signing a long term contract, or that \( \beta_2 = 0 \). The alternate hypothesis is that the players’ actual performance will be significantly
less than the expected performance after signing a long-term contract. In other words, the coefficient on contract length will be significantly greater than zero.

\[ H_0 : \beta_2 = 0 \]

\[ H_a : \beta_2 > 0 \]

It is expected that both performance statistics for position players, OPS and WAR, should follow the same trends, but it is possible that one variable is more affected than the other. For example, as age increases, a player may be slower and make fewer plays on defense. Thus, age would have a larger effect on WAR than OPS because WAR measures offensive and defensive performance. Most of the past research has used OPS as a performance measure.

Using contract length as an independent variable determines the presence of shirking, but it does not specify how strong shirking is for each contract size. For this, we create dummy variables for the length of each contract from two years to ten years (10 years is the largest contract). An OLS regression is used with the shirk value as the dependent variable and the contract length dummy variables and log of contract value as independent variables.

\[
Shirk\ Value = \beta_1 + \beta_2 \ln\text{Contract Value} + \beta_3\text{two year} + \beta_4\text{three year}
+ \beta_5\text{four year} + \beta_6\text{five year} + \beta_7\text{six year} + \beta_8\text{seven year}
+ \beta_9\text{eight year} + \beta_{10}\text{nine year} + \beta_{11}\text{ten year} + u
\]

Similar to the null and alternative hypotheses for the previous equation, a positive coefficient on any of the dummy variables suggests that shirking occurs when a player signs a contract of that specific length.
5. Results:

<table>
<thead>
<tr>
<th></th>
<th>Hitter ShirkWAR (1)</th>
<th>Hitter ShirkWAR (2)</th>
<th>Pitchers ShirkWAR (3)</th>
<th>Pitchers ShirkWAR (4)</th>
<th>Hitters ShirkOPS (5)</th>
<th>Hitters ShirkOPS (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>-.2449675***</td>
<td>-.3064036***</td>
<td></td>
<td></td>
<td>.0041971</td>
<td></td>
</tr>
<tr>
<td>Ln Value</td>
<td>.2958487***</td>
<td>.2518702</td>
<td>.2184512**</td>
<td>.1322611</td>
<td>.0005444</td>
<td>-.0050867</td>
</tr>
<tr>
<td>Two year</td>
<td>-.0516092</td>
<td>.0142266</td>
<td></td>
<td></td>
<td>.0060772</td>
<td></td>
</tr>
<tr>
<td>Three year</td>
<td>-.7541139**</td>
<td>-.2925187</td>
<td></td>
<td></td>
<td>.0090666</td>
<td></td>
</tr>
<tr>
<td>Four year</td>
<td>-.1206821</td>
<td>.0895871</td>
<td></td>
<td></td>
<td>.0557399</td>
<td></td>
</tr>
<tr>
<td>Five year</td>
<td>-.2474795</td>
<td>-1.85869***</td>
<td></td>
<td></td>
<td>.0707758</td>
<td></td>
</tr>
<tr>
<td>Six year</td>
<td>-.2813638**</td>
<td>-1.407964</td>
<td></td>
<td></td>
<td>-.0354258</td>
<td></td>
</tr>
<tr>
<td>Seven year</td>
<td>-.2813638</td>
<td>-3.01924***</td>
<td></td>
<td></td>
<td>.075947</td>
<td></td>
</tr>
<tr>
<td>Eight year</td>
<td>-2.707672*</td>
<td></td>
<td></td>
<td></td>
<td>-.0260654</td>
<td></td>
</tr>
<tr>
<td>Nine year</td>
<td>-2.718829*</td>
<td></td>
<td></td>
<td></td>
<td>.0648018</td>
<td></td>
</tr>
<tr>
<td>Ten year</td>
<td>-2.895352***</td>
<td></td>
<td></td>
<td></td>
<td>-.0050867</td>
<td></td>
</tr>
<tr>
<td>R-squared</td>
<td>.0328</td>
<td>.0686</td>
<td>.0280</td>
<td>.0776</td>
<td>.0191</td>
<td>.1123</td>
</tr>
</tbody>
</table>

(*** significant at 99% confidence level, **significant at 95% confidence level, * significant at 90% significant level)

First, it should be acknowledged that each of the OLS regressions from this study have very small R-squared values. As mentioned before, when referring to baseball as a game of failure, effort is not always a good determinant of performance. The low R-squared values are products of the imperfect relationship between effort in performance in baseball. The results show that the models that use WAR as a measure of performance produce significant results, while the models that use OPS do not. This may have to do with the fact that the number of observations for the OPS analysis was significantly less than that of the WAR.
analyses. This is because we only looked at players with 502 or more plate appearances, which resulted in a large decrease in observations. While dropping observations leads to insignificant results, it is necessary because OPS is an average statistic rather than a cardinal statistic. Columns 1 and 3 in the results table above, show that each additional year on a contract leads to a lower shirk value, meaning a player performs slightly better than expected after signing a long-term contract. Columns 1 and 3 also show that contracts worth more money lead to a slightly higher shirk value, meaning a player shirks when signing a contract of greater financial value. This suggests that players may be less concerned with job security, and more concerned with guaranteed income. Further research should be conducted on the effects of guaranteed income on performance.

In columns 2 and 4, the larger contract length dummy variables have significant coefficients, which suggests that longer contracts lead to better performance than expected. The coefficients on the smaller contract length dummies are smaller and not significant. This may result from the best players or young prospects receiving the longest contracts. A team may sign a player to a long-term contract to guarantee that the player will reach his prime, or best performance, during his time on their team. While we hypothesized that players would shirk after signing a long-term contract, the opposite seems to be the case.

The scatterplots on the following page show the relationship between contract length and shirking and contract value and shirking. The results from the table can be seen through these scatter plots, as Scatter 1 and Scatter 3 show that shirking slowly decreases as contract length increases. Scatter 2 and Scatter 4 show
that shirking increases slightly as contract value increases, suggesting that there is a disincentive for the players to perform with a certain financial guarantee.

6. Conclusion:

This paper analyzes the effects of signing a long-term contract in the free agent market on player performance in Major League Baseball by using past performance to estimate predicted performance, and by comparing predicted performance to actual performance in the first year of a contract to estimate
shirking. The general assumption is that players who sign long-term contracts will underperform. However, the results of this paper indicate that players who sign long-term contracts actually perform better than expected. Teams assume risk when signing a player to a long-term contract, because the team does not know how the player will perform. This paper finds that players will perform as expected or better after signing a long-term contract, suggesting that the associated risk with long-term contracts is worth it. Players do not perform worse after signing a long-term contract, which is good for the game of baseball. With more teams competing in the free agent markets, players’ contracts may continue to grow in value and length. However, teams may need to take precautions, as there is also a positive relationship between contract value and shirking. This is an unexpected finding, and suggests a disincentive to perform when a certain amount of money is guaranteed. If teams guarantee players too much money, players will be more likely to shirk. Further research investigating the specifics of the relationship between contract value and players’ performance could shed more light on the related findings of this paper. Major League Baseball teams should consider this as an area of further research to illuminate the downsides of paying too much for players before it is too late.
7. References:


8. Appendix: Understanding WAR and OPS:

What is WAR?

Wins Above Replacement is a measure of how much a player has contributed to his team. It was developed by sabermetricians to encompass all aspects of the game of baseball. WAR is calculated for pitchers and position players in different ways. WAR for position players is made up of six components, batting runs, baserunning runs, net runs due to grounding into double plays, fielding runs, positional adjustment runs, and replacement level runs (Baseball-Reference.com). Pitchers’ WAR is much more complex and is calculated by adjusting for leverage, setting a replacement level, adjusting for park factors, team defense, and level of opposition (Baseball-Reference.com). WAR is unlike many other statistics because it includes offensive and defensive measures. The actual number is how many more wins a player contributed to his team compared to a “replacement level player”. A replacement player is defined as a player who could be added for minimum cost and effort. This usually means a player who is making the league minimum and is usually a non-roster invitee or a six-year minor league free agent (Baseball-Reference.com). The statistic does not use average players as a comparison, because average players are very valuable in Major League Baseball. When a starter gets hurt, he more often replaced by a below average player than an average player.

WAR can be used to compare players’ performances regardless of the year, park, league, or team. The calculation of WAR adjusts for all of these factors. It is important to note that WAR is cardinal. This means that someone with a WAR of 4 is twice as valuable as someone with a war of 2. Other performance measurements
such as batting average and OPS are not cardinal. Below is a chart from Fangraphs.com that approximates the general label of a position players and starting pitchers with the corresponding WAR value:

<table>
<thead>
<tr>
<th>Position</th>
<th>WAR Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scrub</td>
<td>0-1 WAR</td>
</tr>
<tr>
<td>Role Player</td>
<td>1-2 WAR</td>
</tr>
<tr>
<td>Solid Starter</td>
<td>2-3 WAR</td>
</tr>
<tr>
<td>Good Player</td>
<td>3-4 WAR</td>
</tr>
<tr>
<td>All-Star</td>
<td>4-5 WAR</td>
</tr>
<tr>
<td>Superstar</td>
<td>5-6 WAR</td>
</tr>
<tr>
<td>MVP</td>
<td>6+ WAR</td>
</tr>
</tbody>
</table>

Relief pitchers are undervalued in the measurement of WAR the position in general does not contribute many wins. Unlike a bench player in baseball, a relief pitcher is usually not a relief pitcher because he is not good enough to be a starting pitcher. Often, pitchers work from the bullpen because their skill set is best fit later in games. Even though they do not get as much playing time as starters, they are very valuable. It is best to compare relief pitchers with other relief pitchers, rather than relief pitchers with any other position.

What is OPS?

OPS is On-Base Percentage plus Slugging Percentage. Both of those metrics are calculated below:

\[
OBP = \frac{H + BB + HBP}{(AB + BB + HBP + SF)}
\]

\[
SLG = \frac{(1B + 2\times 2B + 3\times 3B + 4\times HR)}{AB}
\]
OPS is valuable because it measures overall hitting ability. It measures a player’s ability to get on base, and it also measures a player’s ability to hit extra-base hits. An extra-base hit is any hit that is more than a single. One argument among baseball statisticians is that OBP and SLG should not be valued the same. The experts at Fangraphs.com believe that OBP should be about 1.8 times more important than SLG. This is due to the fact that OBP is 1.8 times more effective in run scoring than SLG. Regardless, this study uses OPS because most of the past research uses it as a measure of performance. By using OPS and WAR, differences in the results of past research and of this paper can be identified.