Major League Baseball Salary Determinants: Contract Year or Career Average

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Introduction

Professional baseball is a very lucrative market where the athletes are compensated greatly. To determine the salary they make, there are multiple parties involved in the contract negotiations; the team, the player, and the player's agent (O'Neill). One of the most widely talked about subjects regarding a player's salary is how they perform in their contract year, the year prior to them signing a new contract. It is widely believed that having a strong performance in a contract year will lead to increase in salary, as it increase a players bargaining power (O'Neill). There is a typical belief that players perform better in their contract year so that they will gain this bargaining power. Due to this, many teams prefer to sign players to short-term deals, so they can continually incentivize players to perform. However, past studies on player performance show that players do not typically perform at any different level during their contract year as compared to a non-contract year (O'Neill). Despite how widely talked about contract year performance is, there are no studies on how teams value a players performance during a contract year versus a non-contract year (O'Neill). This study is attempting to solve whether players actually have additional bargaining power from good performance in their contract year, or is their bargaining power determined from their entire career performance. To determine this, Mincer's Wage equation will be used to find what characteristics affect a player's salary, and by how significantly they do. There are major characteristics in baseball that effect a players value, such as their age, batting average, number of homeruns, and wins-above-replacement (O'Neill). This study will break down these characteristics into

two separate categories; one that contains these statistics for the players contract year, and one that contains these statistics for the player's entire career. Using Mincer's Wage equation, we can assign a specific value to each of these characteristics, to see what their exact effect on salary is. In addition, Mincer's Wage equation will be used to test the discrete variable of being an all-star and determine whether there is a wage gap for being an all-star, versus not being one. Once the wage gap is determined, the Blinder-Oaxaca can show whether these wage gaps are a result of the endowments determined through the Mincer's Wage equation and how much of it is due to discrimination.

Table 1. Variables name, definition and expected signs

Name	Definition	Expected sign
Dependent variable		
Salary	Average Annual Salary	
Independent variables		
Age	Age of player when contract is signed	Negative
PriAVG	Batting Average of player the year prior to signing contract	Positive

PriHR	Number of homeruns hit the year prior to signing contract	Positive
PriRBI	Number of runs batted in the year prior to signing contract	Positive
PriWAR	Wins Above Replacement in the year prior to signing contract	Positive
CarAVG	Career batting average at time the contract is signed	Positive
CarHR	Career average homeruns per season when the contract is signed	Positive
CarRBI	Career average runs batted in per season when the contract is signed	Positive
CarWAR	Career average wins above replacement per season when the contract is signed	Positive
Resign	1 if player resigned with the same team, 0 if signed with new team	Unknown
PriALLSTAR	1 if player was an all-star the year prior to signing contract, 0 if the player was not	Positive

CarALLSTAR	1 if player has been all-star in	
Positive		
	career, 0 if they never have	

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As Table 1 notes, the expected coefficient signs in regards to salary are shown. Age has a negative coefficient estimate, as the older a player is in professional sports, the less chance of progress they have, so the lower their expected salary is. PriAVG has a positive coefficient estimate, as the higher the players batting average is, the more value they bring to a team, therefore they should receive a higher salary. PriHR has a positive coefficient estimate, as the more homeruns a player hits, the more value they bring to a team. PriRBI has a positive coefficient estimate, as the more runs a player drives in, the more value they bring to a team. PriWAR has a positive coefficient estimate, as the more wins a player brings to a team, the more value they bring to a team. CarAVG has a positive coefficient estimate, as the higher the players career batting average is, the more likely it is they will continue that trend and bring a positive value to the team. CarHR has a positive coefficient estimate, as the higher a players career homerun average for a season is, the more likely it is they will continue that trend and bring a positive value to the team. CarRBI has a positive coefficient estimate, as the higher the average number of runs a player drives in a season, the more likely it is they will continue that trend and bring a positive value to the team. CarAVG has a positive coefficient estimate, as the higher amount of wins a player brings to a team in a season on average, the more likely it is they will continue that trend and bring a positive value to the team. Resign is unknown, as it is

unsure if a player will make more by resigning with their current team, or by testing the open free agent market. PriALLSTAR has a positive coefficient estimate, as making the all-star team shows the player is elite at their position. CarALLSTAR has a positive coefficient estimate, as a player who has made the all-star team at some point in their career, is on of the top players at their position.

Full Model

$$PRICE = B_0 - B_1AGE + B_2PriAVG + B_3PriHR + B_4PriRBI + B_5PriWAR + B_6CarAVG + B_7CarHR + B_8CarRBI + B_9CarWAR + B_{10}Resign + B_{11}PriALLSTAR + B_{12}CarALLSTAR + €$$

Table 2: Summary Statistics

Variables	Expected Sign	Mean	Standard Deviation	Minimum	Maximum
Salary		7.40882	6.2719	.5075	27.5
Age	-	32.128	2.9402	25	42
PriAVG	+	0.2876	.2852	.12	.318
PriHR	+	13.84	9.87045	0	47
PriRBI	+	48.224	25.81068	3	127
PriWAR	+	1.4424	1.64303	-1.6	7.8
CarAVG	+	0.2586	.0204	.194	.314
CarHR	+	12.22128	7.0509	.57	36.02
CarRBI	+	48.86872	20.627	7.2	102.34
CarWAR	+	1.678	1.1372	-0.34	5.19
Resign	?	.272	.4467	0	1
PriAllSTAR	+	.128	.33543	0	1
CarALLSTAR	+	.408	.49344	0	1

According to Table 2, the average salary per year of a major league baseball player is $7.4088 million with a standard deviation of $6.27 million. The minimum salary of a player is $0.5075 million and the maximum is $27.5 million. The average batting average of the year previous to signing a contract is 0.288, with a standard deviation of .285. The lowest batting average was .120 and the highest was .318. The average number of homeruns in the year previous to signing a contract is 13.84, with a standard deviation of 9.87. The lowest number of homeruns was 0 and the max was 47. The average number of runs batted in, in the year previous to signing a contract is 48.22, with a standard deviation of 25.81. The minimum number of runs batted in was 3 and the max was 127. The average wins above

replacement in the year previous to signing a contract is 1.44, with a standard deviation of 1.64. The lowest WAR is -1.6 and the max was 7.8. The average career batting average of a player prior to signing their contract is . 258, with a standard deviation of .204. The minimum career batting average was .194 and the max was .314. The average number of homeruns a player hit in a season prior to signing their contract is 12.22, with a standard deviation of 7.05. The minimum average homeruns was .57 and the maximum was 36.02. The average number of runs batted in, in season prior to signing their contract is 48.87, with a standard deviation of 20.63. The minimum average runs batted in is 7.2 and the maximum is 102.34. The average number of wins above replacement per season for a player prior to signing their contract is 1.68, with a standard deviation of 1.14. The minimum average wins above replacement is -.34 and the maximum is 5.19. The percent of players who resigned with their team is 27.2% with a standard deviation of 44.67%. The percent of players who made the all-star in the year prior to signing their contract is 12.8% with a standard deviation is 33.54%. The percent of players who have made the all-star team at some point in their career before signing their contract is 40.8% with a standard deviation of 49.34%.

Table 3: Correlation Coefficients

Variables	**Salary**	**Age**	**PriAV**	**PriH**	**PriRB**	**PriWA**	**CarAV**

			G	R	i	R	G
Salary	1						
Age	-0.2050	1					
PriAVG	.0115	.1668	1				
PriHR	.5783	-0.0663	.0435	1			
PriRBI	.6513	-0.014	.0471	.9046	1		
PriWAR	.7626	-0.238	.04	.4641	.5793	1	
CarAVG	.3817	.2259	.0356	.0698	.2423	.2685	1
CarHR	.5177	.0303	.2069	.7303	.7163	.4260	.1399
CarRBI	.5039	.1542	.182	.5546	.6586	.4325	.4198
CarWAR	.5920	.0912	-0.017	.2671	.4271	.5154	.5396
Resign	.1507	.1575	.0622	.0557	.0541	.0633	.0386
PriAllSTAR	.628	-0.0576	.1839	.5104	.5332	.4744	.2161
CarALLSTAR	.5844	.0748	.0748	.4324	.5835	.4758	.5506

Variables	CarHR	CarRBI	CarWAR	Resign	PriALLSTAR	CarALLSTAR
CarHR	1					
CarRBI	.8670	1				
CarWAR	.4426	.5548	1			
Resign	.0277	.0596	.1368	1		
PriAllSTAR	.5139	.4615	.3475	.0349	1	
CarALLSTAR	.4758	.6171	.5708	.1876	.4615	1

Table 3 shows us the correlation coefficients between the variables used. Table 3 shows that the correlation coefficient between salary and age is -0.2050, which indicates a negative but weak relationship. The correlation coefficient between salary and PriAVG is 0.01, which indicates a positive but extremely weak relationship. The correlation coefficient between salary and PriHR is 0.58, which indicates a positive and relatively strong relationship. The correlation coefficient between salary and PriRBI is 0.65, which indicates a positive and strong relationship. The correlation coefficient between salary and PriWAR is 0.76, which indicates a positive and very strong relationship. The correlation coefficient between salary and CarAVG is 0.38, which indicates a positive but relatively weak relationship. The correlation coefficient between salary and CarHR is 0.52, which indicates a positive and relatively strong relationship. The correlation coefficient between salary and CarRBI is 0.50, which indicates a positive and relatively strong relationship. The correlation coefficient between salary and CarWAR is 0.59, which indicates a positive and relatively strong relationship. The correlation coefficient between salary and Resign is 0.15, which indicates a positive but very weak relationship. The correlation coefficient between salary and PriALLSTAR is 0.63, which indicates a positive and strong relationship. The correlation coefficient between salary and CarALLSTAR is 0.58, which indicates a positive and strong relationship. Table 3 also shows that the Career average and the prior year, for the same statistics tend be strongly correlated, with the exception of PriAVG to CarAVG, which has a correlation coefficient of .04 which indicates an extremely weak relationship. However RBI, HR, and WAR are strongly correlated between the Pri and Car averages.

Table 3 also shows that Age and Resign are not strongly correlated with any variables other than salary.

Table 4: Empirical Results

Variables	Full Model
Age	-0.03973*
	(-2.03)
PriAVG	0.0787
	(0.30)
PriHR	.040411***
	(4.11)
PriRBI	.020331***
	(6.45)
PriWAR	.302055***
	(7.77)
CarAVG	.67419***
	(4.53)
CarHR	.021325
	(1.55)
CarRBI	.00456
	(1.16)
CarWAR	.223647***
	(3.98)
Resign	.08291
	(0.71)
PriALLSTAR	.85215***
	(3.99)
CarALLSTAR	.744127***
	(5.12)
R^2 adjusted	0.6194
F	17.82***
N	125

Note: t-values are in parenthesis below the coefficient estimates. The stars *, **, and *** indicate statistical significance at .1, .05, and .01, respectively.

As table 4 notes, Age is equal to -0.039, which means for every extra year in age, a baseball players average salary per year will lower by 3.9%. PriAVG is equal to .0787, meaning for every incremental increase in batting average, the average salary per year will increase by 7.87%. PriHR is equal to .0404, meaning for every additional homerun hit in the year prior to signing the contract, the average salary per year will increase by 4.04%. PriRBI is equal to .0203, meaning for every additional run-batted-in in the year prior to signing the contract, the average salary per year will increase by 2.03%. PriWAR is equal to .3021, meaning for every additional win above replacement for a player in the year prior to signing the contract, the average salary per year will increase by 30.21%. CarAVG is equal to .6741, meaning that each 1.0 unit increase in career batting average, the average salary per year will increase by 67.41%. CarHR is equal to .0213, meaning that for each additional average homerun hit in a season for a players career, their average salary per year will increase by 2.13%. CarRBI is equal to .0046, meaning that for each additional average runs-batted-in in a season for a players career, their average salary per year will increase by 0.46%. CarWAR is equal to .2236, meaning that for each additional average win above replacement in a season for a players career, their average salary per year will increase by 22.36%. Resign is equal to .0829, meaning that if a player resigns with the same team, their average salary per year will increase by 8.29%. PriALLSTAR is equal to .8522, meaning that if a player made the all-star team the year prior to signing the contract, their average salary per year will increase by 85.22%. CarALLSTAR is equal to .7441, meaning that if a player made the all-star team at some point in their career prior to signing

the contract, their average salary per year will increase by 74.41%. Table 4 denotes very interesting statistical significance on the variables. The career averages for RBI and HR are not statistically significant, while the prior year RBI and HR are significant at the .01 level, showing that teams base their salary decisions base on the prior year, rather than career averages. However, this trend breaks when you look at batting average. The prior years AVG is not statistically significant, while the CarAVG is statistically significant at the .01 level. This breaks the trend from teams preferring to base salary on the prior year rather than the career average. PriWAR and CarWAR are both statistically significant at the .01 level showing that WAR is a very strong determinant in a players salary. Age is significant at the .1 level, showing that it does play a role in determining wage. Resign is not statistically significant, showing that whether a player resigns with the same team or a new team doesn't have a large effect on their salary. The $R^{2\ adjusted}$ for the model is .6194, showing that the model consists of 61.94% of the determinants of a players salary. The F score is significant at the .01 level, showing that the full model is statistically significant in determining salary wage.

Table 5: Decomposition of average All-Star or Non All-Star salary gap

	Non All-Star		**All-Star**	
	β^m	**σ^m**	**β^f**	**σ^f**
	Part A: Summary results of All-Star equation			
Intercept	-1.82		3.56	

AGE	-0.0062	-0.008	-0.082	-0.085
PriAVG	0.2535	0.225	-0.2051	-0.27
PriHR	0.01464	0.081	0.0095	0.009
PriRBI	0.00749	0.007	0.0041	.003
PriWAR	0.29778	0.256	0.10537	0.104
CarAVG	10.0815	9.52	1.209	7.37
CarHR	.01013	0.0004	0.0276	0048
CarRBI	-0.0072	-0.004	0.0101	-0.013
CarWAR	0.1653	0.136	0.08894	0.076

Part B: Decomposition

Ln(Salary) gap:	*-1.01147*
Due to differences in skills:	-0.5103
Due to discrimination	0.01481

The results in table 5 show that there is a Ln(Salary) gap of -1.011 between all-stars and non all-stars in baseball. If player is an all-star at some point in their career, they tend to make 101.1% more than players who have never made an all-star team. When decomposing these results, it is found that the difference in skill results in 51.03% of the wage gap. This shows that all-stars tend to be more endowed with skills that, teams value and will pay higher salary for. Further examining the wage gap, it is found that discrimination results in -1.48% of the wage gap. This shows that due to unexplained reasons, non all-stars make 1.48% more than all-stars. These results shows

that there is little discrimination in determining the wage gap and the wage gap is due to the value a player brings to the team.

Conclusion

Overall, the data shows that a player's salary is determined more heavily by their contract year performance rather than their career averages. The career average for players tends to not be significant for determining the average salary and they could be exempt from the model. The exception to this is a player's batting average where the results are reversed. When looking at the correlation coefficients, you can see that PriAVG isn't strongly correlated to the CarAVG, which shows that batting average fluctuates greatly for a player from year to year. Due to the volatility of the batting average statistic, the career average is preferred. However, power hitting numbers such as HR and RBI are heavily correlated between career average and the prior year, so teams will use the most recent year to estimate future production. Further, the results show that a players WAR is the most significant determinant in their salary. Both the PriWAR and CarWAR are statistically significant, showing teams base a large portion of their salary on that statistic. Also, as intuition would lead you to believe, being an all-star is a strong determinant in player's salary, and there is little difference in whether the player made the all-star team the year prior or just at some point in their career. Overall, these findings show that a player does need to be extra concerned with their performance in a contract year. While they may have performed very well over the duration of their contract, the most important variables in determining the next contract are ones that deal only with their most recent performance. This information can be used by all negotiating

parties. If a player has a very good year, the agent can push to sign them to a long-term deal, so they can capitalize on their high market value. Teams can push to sign players to short-term deals to incentivize their players for continual performance. One of the limitations for this study is that it does not take into account how the market changes for each year. For example, one year, there may be a large supply of high quality free agents, thus driving down the market price for them. As a result, the players receive less average salary per year. For another year, there may only be a few quality players that are free agents, so due to the shortage, teams will overpay the market price for them. This fluctuation in the market is not reflected in this study in any way. To further show how player's salaries are determined, I would recommend extending this study to allow for a market variable. Overall, the significance of this study is that it shows player's most recent performance is more significant than their career performance and from this knowledge, teams and players alike can negotiate better deals for themselves.

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