Does signing a contract affect player performance in Major League Baseball?

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Abstract: This paper provides an analysis of whether or not signing a contract affects player performance in Major League Baseball. Past studies have revealed inconsistent results on this particular issue due to the rudimentary econometric techniques used. This empirical study produces robust results that control for both batters and pitchers, and measures player performance across ten different performance measures. I utilize individual-level panel data that incorporates 4,100 player observations from the 2001 to 2015 seasons. Using year, player, and team fixed effects, I find consistent evidence that player performance declines after signing a contract.

I. Introduction

On January 6, 2011, the Atlanta Braves signed Dan Uggla to a 5 year contract worth $62 million dollars. Uggla was the most coveted second basemen of that year's free-agent class, and one of the premier infielders in the game. In the 2010 season, he batted 0.287, knocked in 105 runs, and finished the season with an OPS of 0.877.[1] His performance in that season earned him a Silver Slugger award and he was named a finalist in the Most Valuable Player contest. In the first season of his new contract, Uggla batted 0.233, was responsible for 82 runs batted in, and concluded the season with an OPS of 0.764. The next two seasons would only worsen as his batting average slipped to 0.149 and his OPS plummeted to 0.472.

In July 2014, Uggla was released from the Braves. Since the Collective Bargaining Agreement between Major League Baseball and the Player's Union guarantees that all contracts are paid in full, the Braves would still be paying the remaining $26 million dollars on Uggla's contract. This led to a rather bizarre incident when the Washington Nationals decided to add Uggla from the league waivers to their roster a few days before the teams played each other. This meant that the Atlanta Braves were literally paying Dan Uggla millions of dollars to beat them.

This phenomenon of free-agents not performing up to their expected value seems to be an ongoing trend in Major League Baseball (Szymborski 2016). From the Arizona Diamondbacks to the New York Yankees, every team has experienced underperformance by star players. But are these just outliers or is this evidence of a systematic problem with the incentive structure in professional baseball? As player salaries increase, professional teams are faced with a greater challenge to maximize wins given their constrained budgets. For small payroll teams, the

[1] On base plus slugging percentage (OPS) measures a player's ability to get on base as well as hit for power. The majority of MLB players have an OPS between 0.566 and 0.900.

consequences of signing “lemon” free-agents could spell disaster and lead to a complete organizational rebuild (Posnanski 2014). Since teams can only acquire players through drafts, trades, and free-agency, teams rely on signing accomplished, veteran players to improve their roster and win more games. In their pursuit of a championship, teams must internalize all financial risk when signing free-agents to guaranteed contracts.

In order to become a free-agent, a player must have six or more years of Major League experience and must not be under contract for the following season (MLBPA 2016). As long as a player does not commit a crime or violates a banned substance policy, he is entitled to every penny that he signs for. Recently, performance based incentives have been built in to free-agent contracts in order to prevent underperformance by players. However, the payouts of these incentives are negligible compared to the yearly salary players already make. For example, Giancarlo Stanton recently signed the most lucrative contract in baseball valued at $325 million dollars (Navarro 2014). Some of the performance incentives included in his contract include $50,000 dollars if he wins a Gold Glove or a Silver Slugger. In addition, he could potentially net an extra $900,000 if he is awarded the Most Valuable Player award. Nevertheless, these performance incentives are trivial when compared to his average yearly salary of $25 million dollars.

Since performance is mostly individualistic, easily quantifiable, and information on wages is publicly available, baseball serves as an unrestricted case study regarding performance-related pay. Since all contracts guarantee the full monetary amount that is initially agreed upon between owner and player, this presents a unique incentive structure. Players are thus compensated based on expected performance (which is based on past performance) rather than actual performance. Since players cannot increase their yearly salary while under contract, the incentive to perform

well weakens in comparison to the years before free-agency. Without a proper incentive structure that promotes and rewards performance on a year-to-year basis, Major League Baseball has unintentionally created an opportunity for players to shirk and still get paid.

In addition, asymmetric information between the player and owner has created a moral hazard in the free-agency market. Moral hazard occurs when an individual becomes more involved in risky behavior when that individual is protected from risk by another party (Pauly 1968). In regards to this topic, engaging in risky behavior for a baseball player may take the form of practicing less during the season, training less intensely in the offseason, gaining weight, partying the night before a day game, or showing up to games late and unprepared. These are all examples of risky behavior because they put the player's performance at risk. Before players are guaranteed a fixed salary with a contract, they are less likely to engage in these risky behaviors because that would jeopardize potential earnings in the future. When a player's salary is guaranteed with a contract, incentives may change and a player may begin to engage in more risky behavior since he is now financially protected.

This distorted incentive structure in professional baseball may also indicate changes in the Labor-Leisure function. In this economic model, individuals choose the appropriate amounts of income and leisure that maximize utility given their particular budget constraint. Individuals may choose to devote all of their time and energy in the pursuit of income, all of their time and energy to leisure, or any combination along their budget constraints. Since income is fully maximized for players under contract (excluding performance based incentives and endorsement deals), players may begin to consume more leisure in order to increase overall utility. This increased consumption of leisure may translate to a decreased level of effort, and thus be evidenced in the drop in performance for players under contract.

In the succeeding sections, this paper seeks to find statistical evidence on whether or not player performance is affected by signing a free-agent contract. Section II summarizes the previous research on this particular issue, and justifies the continued need for research on this topic. Section III describes the specific data used in this study as well as various data cleaning methods used. Section IV explains the empirical model and provides variable definitions. Section V interprets the OLS results generated from the model and explains the statistical meaning of significant estimates. Lastly, Section VI condenses the results in to definite conclusions and outlines a strategy for empirical improvement and further research.

II. Previous Literature

The existing research on performance pay in Major League Baseball is diverse and somewhat rudimentary. Past research varies in a number of different ways including the types of performance variables used, the quality of data gathered, as well as the specific syntax of the empirical model estimated. Some studies focus on one or two year periods while others analyze decades of data. Much of the previous literature focuses on player performance in seasons before free-agency in order to find whether or not a player improves his performance to garner a heftier payday. Other studies analyze performance after the contract is signed to see if players engage in shirking.

Ahlstrom, Si, and Kennelly (1999) conducted the first extensive study that analyzed player performance and contracts in the modern era. Using data from 1976 to 1992, the authors found that performance increased in the season before free-agency, and declined in the season following free-agency. The decline in performance for batting average was estimated to be 0.14 percentage points in the post contract season. When controlling for age, the results also showed

that players who sign long-term contracts spend fifty percent more time on the disabled list (unable to play due to injury).

Maxcy, Fort, and Krautmann (2002) published a similar study that also analyzed player performance in the years before and after free-agency. Instead of offensive performance measures, the authors use number of innings played as an indication of performance. They found that playing time increases in the year before free-agency, but found no evidence that players underperform in the season following free-agency. Their results actually show playing time increases in post-contract years. The authors admit that one possibility for this result would be that managers feel obligated to use the newly signed player more often than returning players.

Holden and Sommers (2005) studied how 210 players in the 2003 free-agent class performed in the years before and after signing a contract. They found no statistically significant effect that would indicate players improve their performance in the season before free-agency. However, their research produced statistically significant results that are associated with a reduction in player performance in post-contract seasons. Their results state that OPS decreases by 0.38 percentage points and WHIP decreases by 0.19 percentage points in the post contract season.

In more recent years, research has yielded similar results. Martin, Eggleston, Seymour, and Lecrom (2011) analyzed three year trends in free-agent eligible players using ANOVA methods. The authors gathered data on player performance in before contract years (BCY), contract years (CY), and after contract years (ACY). They estimated the mean batting average and mean slugging percentage for each player in each of the three years. They concluded that batting average was 0.275 in the BCY, was 0.282 in the CY, and was 0.269 in the ACY. The mean slugging percentage in BCY was 0.450, was 0.466 for CY, and was 0.433 for ACY. These

results reflect the recurring notion that players are boosting their performance in contract years to improve their future earnings, and then underperforming in years after receiving a contract.

A similar study to Martin et al. was conducted by Mark White and Kennon Sheldon (2014). They also used three year time trends to analyze player performance in BCY, CY, and ACY. They found similar results that players tend to underperform in post contract years compared to their performance in contract years. Their ANOVA results showed that performance declined in batting average, home run, slugging percentage, and on-base percentage to levels below pre-contract years.

In 2011 and 2013, economist Heather O'Neill published two studies that determined that baseball players engage in opportunistic behavior in the season before free-agency. O'Neill (2011) originally focused on players from the 2004 to 2008 seasons. Using OLS and pooled OLS estimation, she found that players improve their OPS in seasons before free-agency by 4.2% to 5.5%. O'Neill (2013) expanded on her previous study by including contract eligible players from the 2006 season to the 2011 season. Again, she uses OLS and pooled OLS estimation, and concluded that players increase their OPS in contract years by 1.09% to 1.8%.

The aforementioned research analyzes many different performance measures and employs a variety of statistical approaches. Past research illustrates that there is some evidence that players boost their performance in years before they qualify for free-agency, and underperform in years following free-agency. However, continued research is necessary to expand the existing knowledge of player performance in regards to free-agent signings. The business side of baseball is always in flux and new players hit the free-agent market every year. For that reason, this paper utilizes the most recent data available while providing a robust estimation of player performance.

III. Data

I incorporate two distinct types of data in my research. First, I use on-field player statistics that represent a player's performance during regular season games. The second type of data used is contract information of individual players. The methods I use for data collection create an unbalanced panel data set that begins in the 2001 season and ends with the conclusion of the 2015 season. A total of 4,100 player observations are included in this data set; where 2,191 observations are batters and 1,909 observations are pitchers.

The performance measure data was collected from the official Major League Baseball website. In order to get a more accurate assessment of a player's overall performance, I include five performance measures for batters and five performance measures for pitchers. Each measure serves as a dependent variable and a regression is conducted with each. The specific performance measures I collected for batters include home runs (HR), runs batted in (RBI), strikeouts (SO), batting average (AVG), and on-base percentage plus slugging (OPS). The five performance measures for pitchers includes wins (W), losses (L), earned run average (ERA), strikeouts (SO), and walks and hits per innings pitched (WHIP).[2]

Data on player contracts was collected from Baseball-Reference.com. Baseball Reference is a statistical database that provides specific information on player contracts. Since my research focuses on free-agent contracts, only players who have signed a contract are included in the data set. To further ensure accuracy, I established a minimum threshold to be considered contract eligible for this study. I determined this cutoff to be 2 years/$5million dollars. If a player signed

[2] ERA is the mean earned runs credited to a pitcher per nine innings pitched (excludes walks and errors). WHIP measures the number of baserunners a pitcher allows per inning pitched. A low ERA and WHIP represents better performance.

a contract that was less than 2 years in length or less than $5 million dollars in value, they are not contract eligible and are not included in this study. This threshold represents the lowest monetary bracket of players who are full-time, starting players (Silva 2015). Players who primarily serve as reserve or benched players usually have contracts that are below this threshold.

I also control for injuries and the number of innings played to strengthen the quality of the data. If a position player did not play in at least 725 innings and a pitcher did not play in at least 75 innings, they are not included in the data set.[3] This prevents biased data by excluding players who may have abnormal performance statistics as a result of a low amount of playing time.

IV. Empirical Model

In order to accurately determine if signing a contract affects player performance in Major League Baseball, I estimated the following model using Ordinary Least Squares (OLS):

$$PEF_{it} = \beta_0 + \beta_1 CONTRACT_{it} + \beta_2 ALLSTAR_{it} + \beta_3 YEAR_t + \beta_4 TeamFE_c + \beta_5 PlayerFE_i + \varepsilon_{it} \quad \textbf{(1)}$$

The dependent variable, PEF, represents the five performance measures for batters and the five performance measures for pitchers. To reiterate, I run ten different regressions with each of the performance measures serving as a dependent variable. The variable of interest in this model is the CONTRACT variable. This is a zero-one dummy variable that denotes a one for the baseball season that immediately follows a player signing a contract. I refer to the season that immediately follows a player signing a contract as an "impact season". The impact season represents the season that will most likely exhibit the potential effect signing a contract has on

[3] The 725 inning minimum for position players was calculated by multiplying 9 innings by 81 games. 81 games is exactly half of the regular season. The 75 inning minimum for pitchers was calculated by multiplying the average games started by starting pitchers (15) and the average innings pitched per start (5). Thus, this minimum serves as an appropriate threshold for both starting and relief pitchers.

performance. For example, if a player signs a contract between the 2012 and 2013 seasons, the CONTRACT variable will denote a one for the 2013 season since it is an impact season. The CONTRACT variable will denote a zero in the 2012 season as well as all other seasons that do not immediately follow a contract being signed.

My data set includes many players who have signed multiple contracts over their careers. Therefore, those players have multiple impact seasons. If a player has signed one contract in the 2002 offseason and signed a second contract in the 2009 offseason, that player will have two impact seasons. Those impact seasons would be the 2003 season and the 2010 season. The CONTRACT variable will denote a one for the 2003 and 2010 seasons, and will denote a zero for all other seasons in that player's career.

The remaining independent variables in my model include ALLSTAR, YEAR, team fixed effects, and player fixed effects. The ALLSTAR variable is also a zero-one dummy variable that indicates a one if a player is an All-Star in the year immediately following free-agency. This variable measures the impact free-agency has on player performance in All-Star and non-All-Star selected years. The YEAR variable is a linear time trend variable that measures unobservable differences across time. Some potential effects this variable may pick up would be rule changes that are developed by Major League Baseball. Examples of rule changes would be updating the list of banned substances, prohibiting collisions with catchers at home plate, and implementing time restrictions on batters. Team fixed effects captures unobservable differences across the thirty teams in Major League Baseball. The Arizona Diamondbacks are the omitted team in this model. Lastly, player fixed effects captures unobservable differences in players and accounts for player variables that do not change over time. Some examples of player variables that do not change over time include race, handedness, and nationality.

Table 1 displays the summary statistics for batters, and Table 2 displays the summary statistics for pitchers.

Table 1: Summary Statistics: Batters

Variable	Mean	Standard Deviation	Minimum	Maximum
HR	17.18667	11.02477	0	73
RBI	68.46052	27.53936	6	156
SO	87.75126	34.11369	17	223
AVG	.2756572	.0297393	.159	.372
OPS	.7914829	.106856	.475	1.422
CONTRACT	.2282063	.4197721	0	1
ALLSTAR	.2428115	.42888	0	1
YEAR	2008.153	3.914834	2001	2015

Observations = 2191

Table 2: Summary Statistics: Pitchers

Variable	Mean	Standard Deviation	Minimum	Maximum
W	8.671556	5.111189	0	24
L	7.486642	3.865731	0	19
SO	85.83814	49.34492	15	372
ERA	3.876647	1.097093	.6	8.42
WHIP	1.32989	.2079468	.68	2.07
CONTRACT	.2718701	.4450399	0	1
ALLSTAR	.1498167	.3569851	0	1
YEAR	2008.36	3.897538	2001	2015

Observations = 1909

Briefly summarizing the above tables, the mean for both CONTRACT variables signifies that most players in the data set signed an average of two contracts. The mean for the ALLSTAR variable for batters is almost a tenth of a point higher than the mean for the pitching ALLSTAR variable. The likely reason for this is because there are more slots for batters on All-Star rosters than pitchers. Lastly, the analogous strikeout mean for both batters and pitchers reflects the duality of player observations in the data set.

V. Results

Table 3 includes the OLS results for batters (see Appendix). The CONTRACT variable was significant for three of the five batting performance measures. At the 95% confidence level, the coefficient on the strikeout variable is associated with an additional 2.33 strikeouts in the season immediately following a contract being signed. This coefficient indicates that, on average, a player will strikeout 2 more times in the year after signing a free-agent contract. Considering that the mean strikeout rate for batters in the data set is 87.7, a reduction in performance of 2 additional strikeouts is not overwhelmingly harmful to a player's overall hitting performance.

The CONTRACT variable is significant at the 99% level for both batting average and OPS. The coefficient for batting average is associated with a 0.0059 percentage point decrease in batting average after signing a contract. This coefficient represents a relatively strong reduction in performance. A player that had a batting average of 0.300 the year before signing a contract would, on average, see his batting average decrease to 0.294 in the year following free-agency. Considering that most professional players have batting averages between 0.200 and 0.315, a 0.0059 percentage point decrease in batting average is actually meaningful.

The coefficient on the CONTRACT variable for on-base percentage plus slugging (OPS) represents a decrease in OPS by 0.0174 percentage points after signing a contract. The typical OPS range for batters is between 0.566 and 0.900; where the worst hitters have an OPS around 0.566 and the best hitters have an OPS around 0.900. If a player has an OPS of 0.800 before signing a contract, he will have an OPS of 0.783 in the season immediately after signing a contract; ceteris paribus. This reduction of 0.0174 percentage points also translates to a clear and considerable reduction in performance.

The coefficients on the ALLSTAR variables show an increase in performance in the year that player is elected to the All-Star game with the exclusion of strikeouts. If a batter is elected to an All-Star game, he will tend to strikeout 7.64 more times than players that are not elected to an All-Star game. One possibility for this counterintuitive result is that selection to the All-Star game is determined by fan voting rather than merit based. However, it is worth noting that all four other performance measures show an increase in performance for batters in All-Star selected years.

Table 4 includes the OLS results for pitchers (see Appendix). Across all five regressions, the only CONTRACT variable that is significant is for earned-run average (ERA). The coefficient 0.089 is significant at the 90% level. This coefficient is associated with a 0.089 percentage point increase in a pitcher's ERA in the year after signing a contract. Since ERA measures how many runs a pitcher gives up, a low ERA means that very few runs are given up and a high ERA means that many runs are given up. Therefore, the positive coefficient of 0.089 translates to a decrease in performance. An example of this would be if a pitcher had an ERA of 3.90 in the year before a contract, he will tend to have an ERA of 3.99 in the year after signing a contract. This translates to a reduction in performance of almost a whole tenth of a point.

The ALLSTAR variables reflected an increase in performance for pitchers in years they were selected as All-Stars with the exception of strikeouts and WHIP. The ALLSTAR variable was not significant at any level for strikeouts, but the ALLSTAR variable was significant at the 90% level for WHIP. The coefficient is associated with a 0.027 percentage point increase in a pitcher's WHIP in All-Star selected years. This coefficient is counterintuitive because pitchers are giving up more walks and hits in All-Star selected years. Again, one possibility for this coefficient is that pitchers are selected based on fan voting rather than strictly on performance.

VI. Conclusions and Limitations

My results show that signing a free-agent contract does have a negative effect on performance. This reflects most of the previous literature which also finds that performance tends to decrease in seasons that immediately follow free-agency. Not all of the CONTRACT variables I tested for were statistically significant. However, all of the CONTRACT variables that were statistically significant consistently show a reduction in performance. Since three of the five batting measures were significant but only one pitching measure was, the results suggest that position players may be affected more by signing a free-agent contract than pitchers.

Some of the limitations of this study include the fact that the empirical results only reflect player incentives after free-agency. In order to get an even more accurate assessment of how free-agency affects player incentives, I would need to test for player performance in the season immediately before free-agency. In addition, my results only account for the first season that immediately follows free-agency. A reduction in player performance that is caused by signing a contract may not show up until two or three years in to the contract. If a player performs well in the first year of his contract but underperforms in the next four years, this study would fail to reflect the true nature of that player's overall performance.

To further estimate the intensity of the potential effect signing a contract has on performance, I would need to account for performance in every year of a player's contract. If a player is nearing the end of his contract and wants to secure another lucrative contract, that player may attempt to boost his performance in the year leading up to free-agency. Estimating every year of a player's contract would analyze performance changes across the entirety of the contract. The results from that type of study may validate how player incentives change over the course of a

contract. Players may have little incentive to perform well in the beginning of the contract, but are later incentivized to perform well in order to secure another contract. An expanded study of this nature may yield a more accurate and robust assessment of player incentives across the entire duration of free-agent contracts. This may also determine the ideal contract length that prevents player shirking while maximizing performance.

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Appendix

Table 3: Regression Results for Batters

Dependent Variable: HR
Adjusted R^2= 0.6567

Variable	Coefficient	Robust SE	P>|t|
CONTRACT	-.3088647	.3140095	0.325
ALLSTAR***	6.269958	.4160515	0.000

*** Significance at 0.01 level

Dependent Variable: RBI
Adjusted R^2= 0.5736

Variable	Coefficient	Robust SE	P>|t|
CONTRACT	-.4338544	.912465	0.635
ALLSTAR***	17.29606	1.07073	0.000

*** Significance at 0.01 level

Dependent Variable: SO
Adjusted R^2= 0.6632

Variable	Coefficient	Robust SE	P>|t|
CONTRACT**	2.329873	1.001806	0.020
ALLSTAR***	7.644383	1.110703	0.000

** Significance at 0.05 level
*** Significance at 0.01 level

Dependent Variable: AVG
Adjusted R^2= 0.4422

Variable	Coefficient	Robust SE	P>|t|
CONTRACT***	-.0059737	.0011701	0.000
ALLSTAR***	.0201227	.0012562	0.000

*** Significance at 0.01 level

Dependent Variable: OPS
Adjusted R^2= 0.6073

Variable	Coefficient	Robust SE	P>|t|
CONTRACT***	-.0173939	.0034449	0.000
ALLSTAR***	.0737337	.0039029	0.000

*** Significance at 0.01 level

Table 4: Regression Results for Pitchers

Dependent Variable: W
Adjusted R^2= 0.4843

Variable	Coefficient	Robust SE	P>|t|
CONTRACT	-.142736	.201081	0.478
ALLSTAR***	3.887706	.285840	0.000

*** Significance at 0.01 level

Dependent Variable: L
Adjusted R^2= 0.3828

Variable	Coefficient	Robust SE	P>|t|
CONTRACT	-.0241298	.1674769	0.885
ALLSTAR**	-.4346372	.207619	0.036

*** Significance at 0.05 level

Dependent Variable: SO
Adjusted R^2= 0.7737

Variable	Coefficient	Robust SE	P>|t|
CONTRACT	.2438451	1.377772	0.860
ALLSTAR	.0157527	1.801135	0.993

Dependent Variable: ERA
Adjusted R^2= 0.3327

Variable	Coefficient	Robust SE	P>|t|
CONTRACT*	.0887658	.0502882	0.078
ALLSTAR***	-.8504279	.0558699	0.000

* Significance at 0.10 level
*** Significance at 0.01 level

Dependent Variable: WHIP
Adjusted R^2= 0.1028

Variable	Coefficient	Robust SE	P>|t|
CONTRACT	-.0021805	.0115512	0.850
ALLSTAR*	.0270398	.0141562	0.056

* Significance at 0.10 level