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KATIE STANKIEWICZ

## I. Introduction

Fans of Major League Baseball (MLB) teams come to the ballpark to see some of their favorite players on the field. It is the responsibility of the owner and general manager to provide these players to their fans. This is accomplished by drawing up contracts for each player so that the players will be compensated for bringing the fans to the ballpark. A lot of money is spent by the fans to come see these players and that money is used by the owners to pay the players the amounts specified in the contracts. Since the owners and fans are spending so much money they want to ensure that they are receiving the best return for their investment. In other words, owners and fans expect MLB players to perform to their potential in every game.

The focus of this paper is to see if the length of a contract will have an effect on a player's performance during the period of that contract. The objective is to see whether a player is more productive with a one year contract, which is 172 days on a Major League roster, or a multi-year contract, which is four to seven years (Meltzer, 2005). Long-term contracts were not common in MLB until after free agency was developed in 1977. Today these contracts are rarely used for players who have below average skills, little experience, or are nearing their retirement age. The type of contract is important because teams have to pay each player the amount specified in the contracts even if a player does not meet performance expectations, becomes injured and cannot play, or is released from the team (Meltzer, 2005 and Dinerstein, 2007). Teams attempt to predict the future performance of a player before they decide which contract to offer him (Dinerstein, 2007 and Maxcy, 2004). However, owners have to be concerned about whether or not a player will shirk with a guaranteed contract (Krautmann, 1990). Shirking is when a player purposely does not perform to the best of his ability

and may occur when a player has a guaranteed salary. A longer contract gives a player more opportunity to shirk without losing their salary. This study will use productivity measures to determine if players actually do shirk when they have a multi-year contract.

The ability for teams and players to negotiate contracts will be affected by the negotiation status of a player. Contract lengths for players that have been in the majors for less than six years are not determined by free negotiations. Owners have an advantage over the players during these first six years since players are not able to freely move around the league. As a result, the data in this paper will only include players that are free agents.

Contract theory is the underlying theory for determining the significance of contract length on productivity. Teams and players will have risk preferences that will drive the choice of a contract. Owners will have to balance market and production uncertainty when they decide which contract to offer a player. The hypothesis of this paper is that, with other factors held constant, contract length will have a significant effect on the productivity of a player, and one-year contracts will cause players to be more productive than players with longer term contracts. To test this hypothesis an OLS regression will be run with the productivity of a player as the dependent variable and contract length (as well as control variables) as the independent variables.

## II. Literature Review

Using economic theories to analyze professional sports, particularly baseball, has become very popular over the last few decades. Multiple studies have been conducted that address the contracts, salaries and performance of MLB players. Some of these studies look at how previous performances will affect the contract length and the salary that the

player will receive (Meltzer, 2005; Dinerstein, 2007; and Tarman, 2005). These studies look at how owners evaluate players and examine contract determination from the perspective of the teams. They are also solid starting places for this study.

The common focus of contract studies is the relationship between performance and the salary or contract length of a player. In these studies the dependent variable is contract length or salary, and the independent variable is the productivity of the player. One of these studies was performed by Josh Meltzer (2005), who used a first stage regression to determine if performance is a significant predictor of a salary for a MLB player. His regression results demonstrated that performance is a significant predictor, which confirmed his hypothesis and the conclusion of other researchers. These results mean that the better player will receive a longer contract and often will lead to a salary premium on top of the length of the received contract (Meltzer, 2005). Therefore, young players that are improving and performing well will receive longer contracts while players who are injured or do not perform well will receive shorter contracts.

Krautmann and Oppenheimer (2002) perform a similar study linking contract length to the salary of a MLB player. The authors performed an OLS regression and determined that contract length is positively related to wages. Earlier in their study, Krautmann and Oppenheimer determined, based on their work and previous studies, that superior players tend to receive higher salaries. Consequently, contract length has a positive relationship to wages, since the best players will receive the longest contracts in addition to the highest salaries. These studies are very important to this research because they provide proof that a strong relationship exists between contract length and the performance of a player. This paper is furthering the existing research on this issue by determining if contract length will have a significant impact on how productive a player will be for the team. Contract length is also positively related to the past productivity of a player. However, issuing a long-term contract could result in a moral hazard regarding future productivity. The players know they have a guaranteed salary for a given period of time, and there is less incentive to perform to the best of their ability for that given period. The dependent variable of the previous studies now becomes the independent variable for this study. In addition to proving the existence of a relationship between contract length and performance, the studies of Meltzer and Krautmann and Oppenheimer offer important variables to be included in this

study. The dependent variable in my study is the performance of a MLB player during the years of their contract. Some common measurements of a player's productivity are the slugging percentage, the on base percentage (OBP), and the on base percentage plus slugging (OPS) of a player (Krautmann 1990; Dinerstein, 2007; Maxcy, 2004; Krautmann and Oppenheimer, 2002; and Tarman, 2005). The OBP is the percentage of times a player successfully reaches base without the other team making an error. The slugging percentage is the total number of bases that a player receives per at-bat (Krautmann and Oppenheimer, 2002). For example, if a player hits a home run he is credited with four bases. The OPS adds these two measures of productivity together and is often viewed as the best measure of productivity. A problem associated with OPS is that the statistic does not account for the amount of playing time a player has. This could be addressed by including a variable for a player's plate appearances. As a result, I have chosen to use the equivalent average (the total offensive value of a player per out) as my productivity measure, as it includes the plate appearances of a player in addition to the components included in OPS.

Naturally, there are important variables to control for when evaluating a player's productivity. One of these variables is the age of the player (Meltzer, 2005; Berri and Krautmann, 2006; Dinerstein, 2007; Maxcy, 2004; and Krautmann and Oppenheimer, 2002). Age can act as a proxy to experience for a MLB player and the more experienced that a player is, the more productive he tends to be (Maxcy, 2005). Players will learn techniques to help them get through a long season and with better results (Dinerstein, 2007). The development of such techniques is one reason that older players tend to receive longer contracts (Krautmann and Oppenheimer, 2002). However, there is an age where a player's productivity will begin to decrease due to loss of skill or increased probability of injury, and this may cause the player to receive shorter contracts (Maxcy, 2005; Berri and Krautmann, 2006; and Maxcy, 2004). Therefore, age will be included as an independent variable in this study.

Another important aspect of player performance that these studies address is that players get injured. When they are injured they are not able to participate in games, which decreases their productivity. A similar conclusion that these papers reach is that players with long-term contracts tend to be on the disabled list (Berri and Krautmann, 2006). In fact, as the number of years in the contract increases, the number of days that a player spends

on the disabled list increases by 25% (Krautmann, 1990). Berri and Krautmann used games played as proxy to account for the effect of injury on a player's productivity. I have chosen to also use games played to account for injuries sustained by players during the period of their contracts.

Outside forces can also affect how a player will perform on the field, such as the ability of his manager. The manager acts as head coach for the professional team and his ability to motivate and teach will effect how well a player will perform. Therefore, a successful coach will provide more tools to the players to make them more productive on the field than an unsuccessful coach (Berri and Krautmann, 2006). To control for managerial quality I have included the manager's winning percentage for each player in my data over the length of the contract.

There were many more variables that these studies included that I have elected not to use in my study. Some of these variables include team chemistry, shirking during the off-season (Berri and Krautmann, 2006), attitude, hustle, and intelligence (Maxcy, 2004). Each of these variables has a positive effect on how well a player will perform while playing with their team. However, these are difficult to quantify. As a result, these variables will not be included in my empirical model.

The idea of a player shirking was briefly addressed in the introduction of this study. Shirking is a very important concept because it could explain why a player is not as productive while under a multi-year contract. It is a common thought that players will put forth less effort when they have a long-term contract, and proven shirkers will develop a bad reputation, decreasing their chance of receiving a long-term contract (Berri and Krautmann, 2006). A player can shirk during the off-season just as easily as they can during the season. Players may not put in the necessary training time or eat properly, which will cause them to be less productive (Berri and Krautmann, 2006). However, it is also possible for owners to misinterpret a less productive year for a player as shirking. The owners of a team might offer a long-term contract to an average player after he has completed an exceptionally productive season, but after this very strong performance the player may naturally return to his average performance (Krautmann, 1990). Even with this possibility, it is important to consider the aspect of shirking when looking at multi-year contracts.

As mentioned in the introduction, the negotiation status of a player affects the type of contract that

player will be offered. One possibility for a MLB player is that he can become eligible for arbitration. A player becomes eligible after three years in MLB (Kahn, 1993). Once a player is arbitration-eligible, he can sign a new contract, but only with his current team. Arbitration gives a player the chance to negotiate for a higher salary but he cannot leave the team (Tarman, 2005). A player is eligible for free agency after six years in MLB (Kahn, 1993). Free agency allows a player to sign with any team in the league so they do not have to remain with the team they are currently on. Andrew Tarman states that because arbitration and free agency exist, "...all players in baseball are not in a truly competitive market." (1993). In his results, Kahn discovers that free agency will increase contract duration (Kahn, 1993). This is due to the fact that free agency puts extra risk on a team and long-term contracts will help to mitigate it (Maxcy, 2004). Therefore, players within these stages of their careers are not acting independently of the team when contracts are negotiated. As a result, there are no players that are eligible for arbitration or their first year of free agency in my data.

### III. Theory

In order to understand how contracts affect MLB players, it is crucial to understand contract theory in general and how it relates to the overall workforce. Owners and players have risk preferences that will affect their decisions. When salary is held constant for both types of contracts, the players will favor the long-term contract. Players desire a long-term contract to have a guaranteed income over multiple years. In this situation, owners will prefer short-term contracts so they do not have to pay the athlete for so long a period. Offering a player a long-term contract does not just involve a monetary cost for owners but also the cost of uncertainty toward a player's future productivity.

Joel Maxcy (2004) discusses the idea of productive uncertainty of a worker. Productive uncertainty is when a firm (in this case a ball club) is unsure of how well the worker (a player) will perform his job in the present as well as in the future. Baseball players will receive a short-term contract if owners are less certain about their future production. Young players will receive short-term contracts because they have yet to prove how productive they can be for the team. Older players also tend to receive short-term contracts because their productive uncertainty increases with their age. Even if they had proven that they were productive early in their career, older players are not able to perform at the same level as younger players and become more prone to injury.

Therefore teams will offer long-term contracts to players in the middle of their careers who have proven they will have consistent productivity. However, productive uncertainty is not the only issue owners have to deal with.

Productive uncertainty only addresses the question of how a player is going to perform and not how difficult it may be for an owner to replace a player. Market uncertainty refers to how easy it will be for a firm to find a worker that is equivalent to or better than the current worker. Maxcy (2004) found that market uncertainty will increase the chance of a player receiving a long-term contract. This is because a team protects itself from the risk of being unable to replace the skill level of the player. This is especially true for star players, who are very difficult to replace with players possessing similar abilities. In other words, Maxcy found that the players who receive long-term contracts are those that are least likely to be replaced (Meltzer, 2005).

The combination of market uncertainty and productive uncertainty creates a complex decision for the owners of a team. An aging player exemplifies this difficulty. Older age suggests that the player should receive a short-term contract but his uniqueness suggests a long-term contract (Tarman, 2005). Maxcy (2004) reconciles this problem by stating that if the market uncertainty of a player is greater than his productive uncertainty, an owner should offer a long-term contract. The hypothesis for this paper is that even though the player is a star player, the effect of aging (and therefore productive uncertainty) will take precedence in the owners' decision, and a shorter contract will be offered as the player nears the end of his career.

However, Maxcy's model does not include every aspect of contract theory. Allen and Lueck (2001) present the idea of shirking during a contract period. This model assumes that only the agent can shirk, but in reality the principal can shirk as well. For example, a firm may not provide all the necessary equipment for the worker to be productive. Therefore, this is a source of potential moral hazard. Allen and Lueck (2001) also present the transaction cost framework that is present in contract theory. The framework states that a principal (the firm) will create the terms of a contract while considering any transaction costs. These costs may include paying for the worker's training, building any incentives into the contract, and monitoring of the worker's productivity. In order to have a complete understanding of the effect of contracts on a player's

productivity, these two frameworks will be combined.

The tradeoffs of long-term contracts are felt by both the player and the owner. When players sign a long-term contract, they forfeit the opportunity to sign for a higher salary if their performance improves in the future (Meltzer, 2005). Owners risk a player's potential injury or performance decline throughout the contract period. Even if this occurs, the owner must continue to pay the player the salary listed in the terms of the contract (Meltzer, 2005). Owners also have to accept the risk of a player shirking during the long-term contract. Some owners rely on the incentives built into the contract to prevent a player from shirking (Berri and Krautmann, 2006). A player may still choose to shirk because his salary is locked in regardless of his performance. Therefore, he will shirk until the last year of his contract when he will perform the best he can to convince owners that he is worth having on their team (Dinerstein, 2007). A player exerts this extra effort in the last year of his contract because he expects significant benefits, such as a longer contract period. The results of Dinerstein's empirical study on this subject offer proof that players tend to try harder during a contract year.

#### IV. Data

The data to test my hypothesis come from two major sources. All of the productivity statistics are available from the website [baseballreference.com](http://baseballreference.com). This website does not explicitly state the equivalent average for MLB players, but it does provide each of the statistics that are needed to calculate equivalent average (EqA). EqA is calculated by  $(\text{hits} + \text{total bases} + 1.5 * (\text{walks} + \text{hit by pitch}) + \text{stolen bases}) / (\text{total number of at bats} + \text{walks} + \text{hit by pitch} + \text{number of times caught stealing} + (\text{stolen bases} / 3))$  (<http://www.baseballprospectus.com/article.php?articleid=2596>). When collecting the data for players with multi-year contracts, the equivalent average, games played, coach's success, age, and age<sup>2</sup> statistics are averaged across the time of the contract. Descriptive statistics for each of these variables can be found in Table 1. The data for each player's contracts come from the website <http://www.bluemanc.demon.co.uk/baseball/mlbcontracts.htm> (Meltzer, 2005).<sup>1</sup>

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<sup>1</sup> This website has been since removed but it can be found by using the archive website <http://web.archive.org/web/web.php>.

**Table 1: Descriptive Statistics**

Variable	One-Year Contract		Multi-Year Contract	
	Mean	Std. Dev.	Mean	Std. Dev.
<b>Dependent</b>				
EqA	0.75920	0.08795	0.85660	.09882
<b>Independent</b>				
Age	29.46	3.82905	30.11	3.75702
Games Played	123.74	29.08384	130.608	27.16546
Coach's success	0.49216	0.04263	0.50143	.04511

I have included one hundred different players and their statistics. Fifty of these players have a one-year contract, and the other fifty have a multi-year contract. The players in this study represent each of the positions of a MLB team except for pitchers. Pitching statistics are less universal than hitting statistics, and there are different types of pitchers. Each type of pitcher (starting and relief) has different statistics and responsibilities, making it difficult to measure a pitcher's productivity (Krautmann, 1990). As a result, not all pitchers are measured the same way. Position players are all measured in the same way when they are hitting, which offers a consistent measure of productivity (Meltzer, 2005).

Also absent in this study is a measure of a player's defensive ability. The statistics available to measure defense represent the mistakes that a player makes rather than a player's ability to make exceptional plays (Meltzer, 2005). For example, the fielding percentage of a player remains at one and it only decreases as a player makes an error. However, it will not increase if a player makes an extraordinary play. Without the ability to measure exceptional plays on defense, there is no accurate way to measure the productivity of a player's defensive ability. In addition to this, a player is acting independently of his teammates when he is hitting. The completion of a defensive play often depends on a player's teammates (Dinerstein, 2007). In other words, defensive statistics are not included in this study because of their ambiguity.

The main restriction of this data set is that it only includes published contracts. This means that this sample is not complete or random. For example, there are some players who do not have a major league contract but play at the major league level for a few games during a season due to injuries. These players are not represented in this data set. Neither are players with options such as an extension of a

contract for an extra year at a fixed salary that veteran players may have on their contracts.

**V. Empirical Model**

By combining all of the variables mentioned in the previous sections, an empirical model is created that will test the hypothesis that a one year contract will result in greater productivity of a MLB player. The model is:

$$\text{Productivity of Player} = \alpha + \beta_1(\text{one-year contract}) + \beta_2(\text{age}) + \beta_3(\text{age}^2) + \beta_4(\text{games played}) + \beta_5(\text{coach's success})$$

I expect each coefficient to have a positive sign, except for the age<sup>2</sup> coefficient, which will have a negative sign. The variables are summarized in Table 2.

**Table 2: Variable Definitions**

Variable	Definition
<b>Dependent</b>	
EqA	Total offensive value per out
<b>Independent</b>	
One-year contract (+)	Dummy; 1=one-year contract, 0=multi-year
Age (+)	The age of the player
Age <sup>2</sup> (-)	The age of the player squared
Games Played (+)	The number of games played by the player
Coach's success (+)	The winning percentage of the player's coach

A one-year contract may have a positive effect on the productivity of a player due to the pressure it produces. A player only has one year to prove to the manger, general manager, and owner that he is beneficial to the team. In order to do so, the player has to put forth his best effort during the one-year contract. Even if the player wants to leave his current team, a one-year contract will still encourage him to perform to the best of his ability, so that other teams see he is worth acquiring.

The age<sup>2</sup> variable is included in this model due to the aging of the players. As a player gets older he becomes more productive as he learns new techniques and adjusts to the demands of a professional baseball career. However, as the player continues to age his body will eventually be unable to continue at the same pace or level he was at during his early career. Therefore, there is an inverted

relationship between the age and productivity of a player.

I will run this model using OLS regression to determine the significance of each of the coefficients to the independent variables. Once the regression is run, it will be possible to see if contract length has an effect on productivity.

## VI. Results

The results of the OLS regression are summarized in the following table:

**Table 3: Regression Results**

Variables	Model A	Model B
<b>One-Year Contract</b>	-.084 *** (-4.853)	-.084 *** (-4.929)
<b>Age</b>	-.020 (-.674)	-.020 (-.629)
<b>Age<sup>2</sup></b>	.000 (.807)	.000 (.860)
<b>Games Played</b>	.001 *** (4.519)	.001 *** (4.649)
<b>Coach's Success</b>	.098 (.492)	----
<b>Adjusted R<sup>2</sup></b>	.350	.355
N=100		
Values in parenthesis represent absolute T-statistics		
*significant at .10 level		
**significant at .05 level		
***significant at .01 level		

The first regression includes each of the variables in the empirical model and is represented by Model A in the table above. Model A has an adjusted R<sup>2</sup> of .350 and only two of the variables prove to be significant at any level (.1, .05, or .01). These variables are the one-year contract variable and the games played variable. Both variables are highly significant with a significance value of .000. Model A supports the hypothesis that contract length does affect productivity when everything else is held constant. However, the sign in front of the one-year contract variable does not match the predicted sign. In Model A's results, the one-year contract variable has a negative sign which implies that a player with a one-year contract will be less productive relative to a player with a long-term contract. The coefficient for this variable is -.084. This means that if a player has a one-year contract, the equivalent average (and therefore productivity) of a player will decrease by .084. This result goes against the hypothesis that a

one-year contract will cause a player to be more productive.

The games played variable is also highly significant and it demonstrates the predicted sign. However, the coefficient is miniscule, with a value of .001. The amount of games that a player plays in will have a positive effect on the productivity of a player (everything else held constant), but an increase of one game will increase the equivalent average by .001. The rest of the variables were all insignificant. The most insignificant variable is the coach's success variable. This result implies that a coach's ability to lead a team will not have a significant effect on the productivity of a player. This supports the assertion that baseball is an independent sport. Another very interesting result from this model is that both age and age<sup>2</sup> variables are insignificant. A player's productivity is not affected by his age at all, which goes against all previous studies performed and baseball logic.

Model B is an attempt to improve the first regression. In order to do this the coefficient that was the most insignificant, coach's success, was removed from the regression. Once this variable was removed, the adjusted R<sup>2</sup> increases to .355. This implies that this model is a slight improvement over the original Model A. The one-year contract variable and the games played variable are as highly significant as they had been in Model A. In fact, both of these variables maintain the exact same coefficient and signs as they demonstrated in Model A. Unfortunately, the age and age<sup>2</sup> variables are still insignificant. Therefore, when included in this model age will not have any effect on the productivity of a MLB player.

The results of this study suggest that contract length does have an effect on the productivity of a MLB player. The causation of this result could be debated. Some may believe that the productivity and talent of a player will determine his contract length. This causation is true for the contract year of a MLB player. How well a player performs during his contract, particularly the contract year, will have a considerable effect on the next contract the owners will offer the player. Owners need to be cautious when determining the contract for a player because a player that performs extremely well may be having an unusual season (Dinerstein, 2007). A player may have the best season of his career, be offered a long-term contract by a team, and then return to his natural level of talent the next year. The player does not intentionally perform worse than the year before, but he had an extraordinary previous season and players will naturally move back to their ability level



(Dinerstein, 2007). This paper is looking at the situation in which a player has already determined what kind of contract he deserves. The performance of the player may change due to the possibility that he might shirk during a long-term contract. A one-year contract will always create the situation of a contract year, and players will need to prove that they deserve another contract. Therefore, a long-term contract and a one-year contract may have different effects on how productive a player will choose to be.

The hypothesis of this paper is that a one-year contract would cause a player to be more productive than a player with a long-term contract. The thought behind this hypothesis was that a player with a long-term contract would take advantage of the guaranteed salary and shirk during a few of the years covered by the contract. However, this study has proven that this is not the case. It showed that a player with a short-term contract will be less productive than a player with a long-term contract. This result supports the work of the previous studies. This regression may have produced this answer due to the absence of some important variables, such as team chemistry and shirking during the off-season. These variables may cause players to be more or less productive during their season, and may therefore change the regression results.

This model does not differentiate between the different types of players in MLB. It needs to be adjusted because the type of player may have an effect on what type of contract a player is receiving. For example, a young player with no experience in the major leagues will likely be offered a short-term contract because he has not proven to the owners that there is a reward for the risk the owners are taking by signing him. The opposite is true for a "star player." These are the players that attract fans to the ballpark and are household names. Examples of these kinds of players are Derek Jeter, Frank Thomas, Cal Ripken Jr., Babe Ruth, and Jackie Robinson. These players have proven that they are the best the league can offer, and so there is far less risk signing them to a long-term contract. Also, these players are the better players in baseball, so they will automatically have a higher productivity than those players with a one-year contract, even if they engage in shirking behavior. Therefore, the model should include a variable that represents the "star power" of a player due to the fact that the more "star power" a player has, the more likely it is that he will receive a long-term contract.

The results of this study may also be biased because other variables are left out. These variables include

team chemistry, attitude, hustle, and intelligence (Maxcy, 2004). The productivity of a player will be affected by how well he works with his teammates and how well they know the sport of baseball. Perhaps the most important variable not included in this study is the ability of a player to shirk during the off-season, as presented by Berri and Krautmann (2006). If a player does not take care of himself or prepare himself for the season he will not be as productive as he could be.

## VII. Conclusion

Society today is filled with people who love to win and who love watching winners. These people demand that their sports teams are set up for the best chance to win. The responsibility to provide these teams to the fans falls on the owners. Fans will come to the ballparks when they are confident that their teams are going to do well. Owners of MLB teams can now increase the chance of a team doing well by looking at the contract length of a player to determine how productive a team will be. Based on this study, offering long-term contracts to players may have a small advantage for the owners, but the true effect of the contract will depend on what type of player is receiving it.

By offering players long-term contracts and thus increasing the productivity of the players, owners will increase their profits. A more productive team will increase the likelihood of a victory and also the number of people who will be willing to come watch the team. People will come and enjoy the winning atmosphere, and as a result they will spend more money on team merchandise and on return trips. However, by choosing to offer more long-term contracts, some players may not be able to play in the major leagues. Only those players that provide a high enough reward over the risk of the contract for the owner will be offered a MLB contract. The competition to be a MLB baseball player will increase dramatically, and some players may not be given the opportunity to prove their worth.

To determine if these consequences are realistic, more studies should be performed with this topic. Another study should be completed which includes a variable to represent the "star power" of a player. With this variable included in the model, it could decrease some of the significance of contract length. Salary could be used as a factor of how much "star power" a player has, because the best players tend to have the highest salaries. Also, other studies should attempt to quantify the ability of a player to shirk during the off-season. This variable could have a strong impact on how productive a player will be,

and if they are worth the risk of a long-term contract. This study may have elements of a sample bias problem as there are many restrictions to the data. Finding a way to account for arbitration and free agency eligibility will increase the data set and will also be more realistic of the MLB players market.

Further work on this topic will offer owners vital information on how to create their teams, decrease their risk, and increase their profits. Fans in many cities would be much happier with their teams, and more people will be interested in becoming fans. This study is a good step towards further research on the relationship between contract length and productivity, and its continuation could improve the world of MLB contracts.

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