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# The Efficiency of the Major League Baseball Free-Agent Market

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**ABSTRACT.** With the recent $325 million dollar contract sign by Giancarlo Stanton, baseball contracts have reached a new frontier. Baseball contracts have increased in value year after year since free agency began in 1976. Are these contracts efficient? A new approach to measuring the efficiency of baseball contracts makes use of the wins above replacement statistic. That statistic reflects the value and cost of a player compared to a replacement. I conclude that large long-term contracts are efficient right now, but with many contracts not yet finished, and players past their "prime," these contracts may become extremely inefficient.

## I. Introduction

2015 marked the first $300 million dollar man in Major League Baseball (MLB) history. Giancarlo Stanton signed a 13-year, $325 million contract with the Miami Marlins. While $325 million seems other-worldly for a baseball player, this is only the beginning of what's to come. Many experts anticipate this contract record to be passed in two years when Bryce Harper becomes eligible for free agency. Harper made his major league debut at the age of nineteen and won a National League MVP award at the age of twenty-three. He has publicly stated that it could take as much as $500 million to sign him. How can a player be worth $325 million, let alone $500 million?

Baseball is obsessed with statistics. Data is collected on every movement made by players throughout the course of a game. One of the new statistics is wins above replacement (WAR). This statistic attempts to measure the overall performance of a player during the season compared to his average replacement player. The higher the wins above replacement for a player, the better the season the player had. My research will use wins above replacement along with the average dollar value paid per win above replacement in free agency to test the efficiency of the MLB free agency system.

Free agency could be considered efficient if a player is paid approximately the value of what his performance suggests he should earn over a contract. If there is evidence that the markets are not efficient, then players are either outperforming their contracts or teams are

overpaying for the production they are purchasing. After looking at the overall market, a closer examination of the players that receive the largest contracts will be studied. Ideally, this paper will be able to determine if baseball players that receive these massive long-term contracts truly produce like the teams paying them think they will.

## II. History

Up until 1974, baseball players were controlled by the "reserve clause." This greatly benefitted the owners and left players with very few rights. Owners were allowed to keep the players on their team for the player's entire career. Players also had no negotiating power over the salary they were offered by the team owner. If they were unsatisfied, they had to give up baseball because the owners would not allow them to play for another team. The only way players were allowed to play for another team is if they were traded (Stone 2008).

In 1974, a new collective bargaining agreement between the players and the owners created new rules that created rights for players to file for arbitration. To be eligible for salary arbitration, a player had to have at least three years of service in Major League Baseball. Once a player became eligible for arbitration and a player was unsatisfied with the salary offer from the owner, he could take his case to an independent arbitrator. Both the owner and player would submit a salary number to the arbitrator. The arbitrator would then decide between the two offers and pick one of them to be the player's salary for the upcoming season. "In deciding which offer to choose, arbitrators looked at player performance during the past season, length and consistency of the player's career, comparative salaries, and the team's recent performance in the standings and at the gate" (Kahn 1993, 158). Because arbitrators were using benchmarks of other controlled players' salaries, salaries did not increase very quickly. This arbitration system only lasted two years before free agency was added to the collective bargaining agreement in 1976 (Gius 1999) .

With the advent of free agency, players with more than six years of MLB service time could declare free agency. When declaring free agency, the player could negotiate a contract with any team of his choice. This created an auction market for the services provided by the player. In many cases, the highest bidder would win the auction. This was the start of the explosion of players' salaries in MLB (Gius 1999).

## III. Literature Review

A lot of work has already gone into studying the effects of free agency on MLB. The first main argument against the efficiency of the free-agent market is that the competitive balance of the league would suffer. "Owners supporting the reserve clause, a system that allowed teams to retain a player's rights indefinitely, argued that free agency would lead to league domination by teams with the largest markets, destroying the competitive balance" (Fishman 2003, 86). Teams in the largest markets have greater financial resources and are able to consistently outbid the smaller-market teams. Rottenberg claimed:

> No team can be successful unless its competitors also survive and prosper sufficiently so that the difference in the quality of play among teams are not "too great." . . .The wealthy teams will usually prefer. . . winning by close margins to winning by wide ones. If their market behavior is consistent with this objective—that is, if they behave like rational maximizers—playing talent will be more or less equally distributed among teams. (1956, 254-255)

Woodrow Eckard's research supports this claim by showing that each additional playoff-contending season produces diminishing marginal returns. The diminishing marginal return reduces the incentives for successful teams to continually bid for the top players to remain in contention. "This in turn creates opportunities for "also rans" to improve their performance and become contenders" (Eckard 2001, 431). This research concludes that the introduction of free agency increases the competitive balance in the league.

Burger and Walters (2003) narrowed the research and looked at free agent signings by large-market teams. They argue that when large-market teams bid on free agents, large-market teams will value them up to six times more than a small-market team. Burger and Walters point out that each player has 30 different fair market values because there are 30 teams that play in different markets. Each player will have a different marginal revenue product based on the size of the market the (assessing) team plays in. Burger and Walter also mention that how close a player's salary comes to his marginal revenue product will depend on the number and identities of the bidders for his services and the agent's negotiating skills.

They conclude their paper by saying revenue sharing (in the form of a luxury tax) won't significantly affect players' salaries. Their best advice is to contract MLB and eliminate teams in the smallest market to reduce the difference in value between large-market teams and small-market teams.

John Vrooman (1996) wrote about the acquisition of free agents by a team. He claims that because of the limited supply of eligible free agents every year, the acquisition of free agents "is a negative sum game." "Free agency is more likely to pull superior teams apart rather than improve inferior ones" (1996, 340). Part of the negative sum game that Vrooman talks about can be a result of asymmetric information in the market. When a player hits free agency, the team he played for will know more about him than any other team in the league. It will know how the player prepares for a game, how the player eats, and how the player trains. All this information can be used to better project the player's performance in the future. Teams that do not have all of this information will make a different projection of future performance and be more likely to incorrectly value the player. This is supported by the observation that players who signed with new teams are more likely to experience "post contractual injury and lost playing time than those who re-signed with their original team" (Lehn, 1982).

While players are eligible for free agency after their sixth year of service, players have negotiating control after their fifth year of service. Vrooman noticed that many teams try to sign their star players to contract extensions before they hit the free agent market. Teams realize that they might have to pay more during the player's fifth year, but will anticipate spending less overall by not having other teams drive up the player's salary during free agency. When players do hit the free agent market, they have artificial monopoly power. With such a limited supply of free agents every year, the demand is always greater than the supply. With competition for this limited supply, teams will pay more than the value of the player.

Vrooman concludes his paper by stating that the arbitration and free agency rules should be relaxed. He proposes lowering the arbitration period from six years to four years. Many teams could be against this because arbitration years are when teams make up the cost of developing the player until he reaches the major leagues. Vrooman pointed out most major league players will have produced enough after four years that the team should be able to recover the development cost by the end of year

four. Also, by reducing the arbitration period to four years, there would be an increase in the supply of free agents. Vrooman anticipated the number of eligible free agents each season to increase by roughly 50 percent. With a larger supply of free agents, teams will be less willing to overspend on them.

Lawrence Kahn (1993) talks about the advantages players acquire by receiving long-term contracts. Many players are willing to take slightly less money per year to gain additional years on their contract. Players can think of this as insurance against career-ending injuries. Baseball contracts are fully guaranteed, so if a player never plays again he will still get the remaining value of the contract. Teams would prefer long-term contracts so they can keep productive players on their team longer without having to continually outbid every other team in free agency (Kahn, 1993).

Research has also been done to determine the effects long-term contracts have on player performance. Shirking may occur when there is less incentive to perform because of a guaranteed salary. If this was evident in baseball, the player should show a decline in production the first couple of years after signing a long-term contract and then an increase in performance toward the end of the contract. Research by Krautmann and Solow (2009) shows that for players that plan to receive a contract after the expiration of their current contract, the incentive to shirk is offset by the incentive to perform well. These players want to maximize the value of their next contract. However, Krautmann and Solow also found that for players that plan to retire when their current contract expires, the incentive to shirk is evident.

An important dynamic of free agency is that players become eligible around their "peak" performance, age 27-32. Gerald Mangine (2013) found that lower-body strength is maintained up until age 29 to 31. Lower-body strength is an essential part of hitting and pitching which historically increases pay. Jahn Hakes and Chad Turner (2011) also claim that the best players peak around two years later than the marginal players do. However, "there is no scientific evidence that players in the older age groups are able to maintain their physical performance levels, especially in the performance enhancement drug free era" (Mangine 2013, 380). Hakes and Turner agree by saying that the sharpest decline in production occurs for players that have the most ability. It is not a surprise to see that the largest salaries are for players older than 30 because it is advantageous for players to make sure they become free agents sometime

during their "peak years." Hitting free agency during those peak years allows players to make more money later in their contract when their production has significantly declined from peak levels.

Stone and Pantuosco (2008) estimated baseball salary equations from 1961 to 2005. They found evidence that owners are willing to spend more on players with higher slugging averages, durability, and consistency. Stone and Pantuosco (2008) conclude that "over the last 4 decades, major league baseball salaries have become more responsive to player performance measures as the market value of the created product, baseball wins, has increased." Later Stone and Pantuosco (2008) predict, "as the value of the product continues to rise: due to increases in television revenue, gate receipts, concessions, and merchandising, the more productive players will continue to see increases in their salaries."

## IV. Model and Data

To test the efficiency of free agency in MLB, I conduct two analyses. The first analysis focuses on the efficiency of the whole market since 1985. The second analysis is a case study of the efficiency of the largest free-agent contracts over the last few years. I want to look at whether these high-dollar long-term contracts are efficient and if the player or team benefits more. Every year, there are several new large contracts signed that make fans wonder if a player is really worth that amount of money.

Matt Swartz (2014) wrote a series of three articles on using cost per wins above replacement to evaluate how much teams are willing to pay based on the performance of a player. One of the challenges in baseball is how to assign the impact a player has on his team's success. Some players hit a lot of home runs and others might be pitchers that aren't expected to hit at all. Because of the difficulty, a product of the Sabermetric revolution in baseball was the statistic of wins above replacement. Wins above replacement takes into account all of a player's statistics and gives him a value for how many wins produced above the wins that a minor league replacement player is expected to produce.

In his articles, Swartz calculates Dollars-Per-Win-Above-Replacement for each free agency period. Swartz defines Dollars-Per-Win-Above-Replacement as "the average cost of acquiring one win above replacement on the free agent market." Swartz calculated the average value spent for each season since 1985. To calculate his results, he

looked at retrospective wins above replacement values. This means that when free agents signed new contracts, he used the wins above replacement from the previous season. Other authors suggest using prospective wins above replacement but this approach includes some bias. There is strong evidence that players have declines in their production after switching to new teams. Swartz also incorporated the cost of players attached to draft pick compensation. Teams that sign qualified free agents are required to send their highest draft pick to the former employer of the player. In his calculations, Swartz found that on average, players without draft pick compensation attached to them earned about $1 million more per win above replacement. (Swartz 2014)

In order to make use of his calculated values, he outlines some key elements. Swartz first points out that players are going to be valued differently by teams depending on where that team is on "the win curve." Teams that are located on the steep part of the curve will be willing to spend more per win above replacement than teams on the edges. Teams look at free agent contracts as investments. When determining the value of a player, teams will compare the potential revenues generated from making the playoffs against the increased probability the player brings of helping the team qualify for the playoffs. Playing in the playoffs is the largest determinant of additional revenue.

**Win Curve**

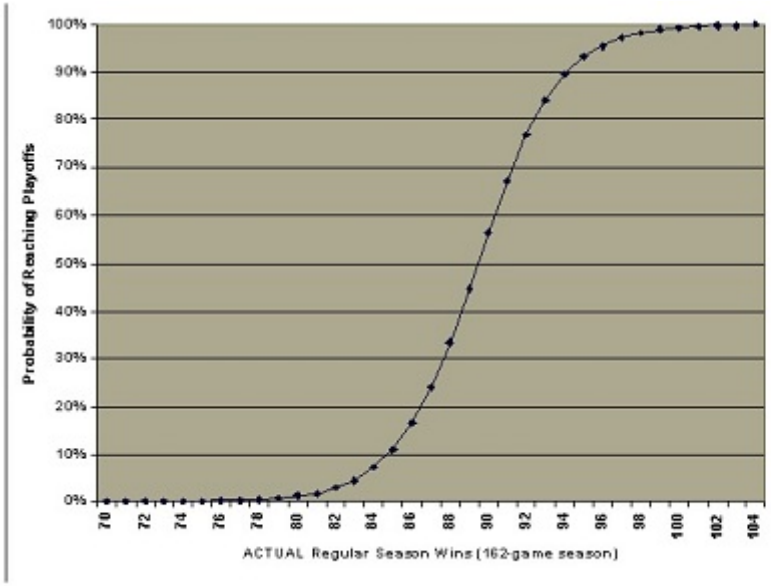


TABLE 1–Estimated Cost per War, 1985-2014

| *Year* | *RMM/fWAR* | *Year* | *$MM / fWAR* | *Year* | *$MM / fWAR* |
|---|---|---|---|---|---|
| 1985 | .68 | 1995 | 2.6 | 2005 | 4.7 |
| 1986 | .80 | 1996 | 2.0 | 2006 | 4.8 |
| 1987 | .68 | 1997 | 2.3 | 2007 | 5.6 |
| 1988 | .79 | 1998 | 2.2 | 2008 | 6.2 |
| 1989 | .94 | 1999 | 2.6 | 2009 | 6.4 |
| 1990 | 1.2 | 2000 | 3.1 | 2010 | 6.0 |
| 1991 | 1.6 | 2001 | 3.9 | 2011 | 7.6 |
| 1992 | 2.3 | 2002 | 3.9 | 2012 | 6.5 |
| 1993 | 2.4 | 2003 | 4.3 | 2013 | 7.4 |
| 1994 | 3.1 | 2004 | 4.2 | 2014 | 7.6 |

(Swartz, 2014)

To answer the question about the market efficiency, the model I plan to use is Efficiency = Actual Earnings/Performance Projected Earnings. Actual earnings is the salary the player earned for each season. Performance Projected Earnings is calculated as the wins above replacement produced during the season multiplied by the cost per win above replacement factor for that year located in Table 1. Only seasons where the player was in their sixth season of play or greater will be used in this analysis because players are not eligible for free agency until after their sixth season. The closer the value is to one, the more efficient the market is. Values less than one show that on average, players are outperforming their contracts. Values greater than one mean that players are being paid more than they are producing. Special consideration will need to be included for values less than one because of the tendency of players to take long-term deals that offer guaranteed income if the player has career-altering injuries.

To answer the second question, I will compile a subset of the data that

includes the players with contract values over $90 million or contracts that pay more than $17 million per season. Efficiency will be measured the same way. A number close to one indicates a fair deal, but if the player is outperforming or underperforming his contract, the value will be less than one or greater than one, respectively. Many of these contracts have not ended, but I will look at how efficient they are through the 2015 season.

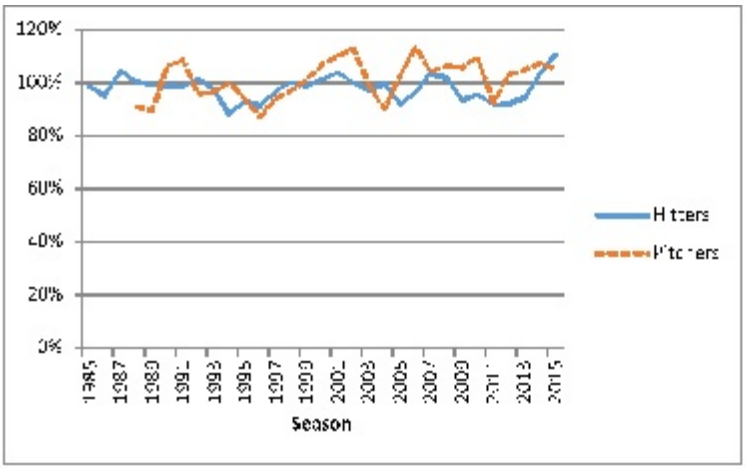
The data that I will be using comes from the database on baseball-reference.com. The dataset contains individual player statistics since 1871. Variables of importance that the dataset includes for each player are season played, salary for that year, wins above replacement for that season, team played for, and a dummy variable for pitcher or hitter. I will limit the data set to only the seasons from 1985 through 2015.

Because several players were not able to produce positive wins above replacements or small projected salaries based on their season performance, I had to set the players Performance Projected Earnings to be the maximum of the major league minimum for that particular season or the performance-projected value. The major league minimum value data was from baseball-reference.com. One other manipulation of the data set that was needed was to remove all of the lines where the salary or win above replacement value was "null." This should not affect the results as there are still over 37,000 lines remaining in the data set.

## V. Results

To summarize the calculation of the results, I first sorted the data so that only seasons studied were the seasons of players that had more than five years (entering sixth season) of experience. Then I calculated the efficiency for each season, starting with the 1985 season. Efficiency is calculated by summing up the total salary paid to each player during that particular season and then dividing by the sum of the product of the wins above replacement produced for that season multiplied by the salary factor in **Table 1**. The results for each season are shown below.

**Efficiency by Season**




The efficiency level for the entire league ended up efficient for each season. On average, the players are being accurately compensated for their performance. Every season had an efficiency value between .9 and 1.1. I was anticipating the efficiency to be mostly less than one. I thought that players would be willing to give up some money each year to have a longer duration contract. There is not much evidence of this. This analysis cannot fully explain the bigger question about the large contracts being efficient. We can see that on average there are enough smaller contracts to wash out the effects of the large contracts.

The second part of the analysis looked at individual players that have signed contracts for more than $90 million or more than $17 million in at least one of the seasons the contract existed. A few players had multiple contracts or contract extensions that fit the criteria so these contracts were split when the new contract or contract extension started. There were 78 total contracts meeting these criteria and covered seasons from 1999 through 2015. Surprisingly, there were six out of 78 contracts in this period where the player produced negative wins above replacement. This means that these players were getting paid at least $17 million in a season to play worse than what a minor league player could have produced playing at the major league minimum salary. These contracts are considered extremely inefficient.

The same efficiency formula was used: Efficiency = Actual Salary / (Wins Above Replacement * Salary Factor). The results are in Table 2.

TABLE 2

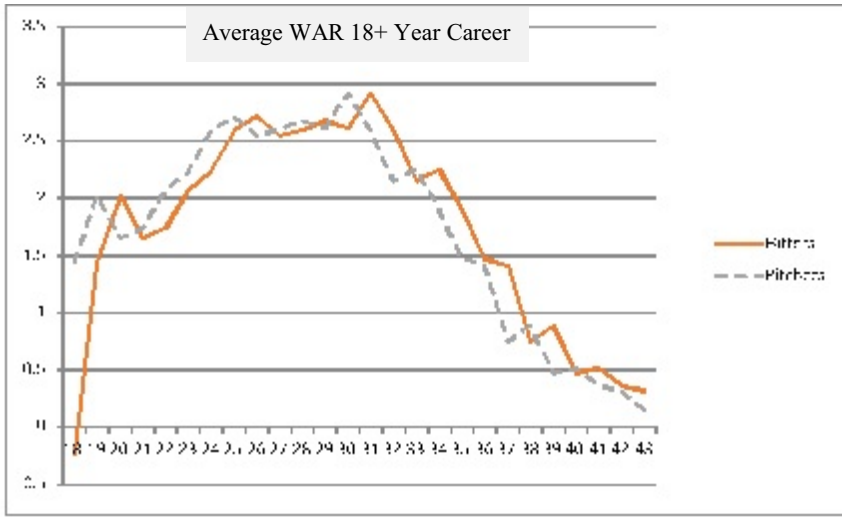
| | Mean Efficiency Re-scaled | Median Efficiency | Mean Efficiency No Re-scale | St. Deviation Efficiency | Avg. Age Contract Started | Avg. Age Contract Ended | Avg. Current Age | # of Cases |
|---|---|---|---|---|---|---|---|---|
| Contracts that have ended | 1 | 0.93 | 2.57 | 7.41 | 30 | 34.8 | - | 34/78 |
| Contract starts age 30+ | 1.05 | 0.96 | 3.36 | 7.68 | 31.8 | 36.9 | 33.7 | 25/78 |
| Contracts that have not ended | 0.98 | 0.93 | 3.38 | 8.2 | 29.4 | 35.1 | 31.8 | 44/78 (40 since 2012) |

When calculating these results, I ran into a problem of some contracts having large outlier values heavily influencing the average efficiency. The large outlier values were produced when a player significantly underperformed and was paid a large salary. This resulted in a large numerator and a small denominator for the efficiency ratio. This efficiency value could range from one to infinite while the opposite scenario, when a player performs well but is paid little, can range only from zero to one. To fix the problem of having extreme inefficiencies of contracts having unequal influences on the results, I recalled the efficiency values of only the players that had a raw efficiency value greater than one. I rescaled the values using the following equation: Rescaled Efficiency = 1 + 1 - (1/Efficiency). By making this rescale, the values are now bound between one and two. The most inefficient players still have the highest values, which are now capped at two, instead of infinity.

Contracts that have ended include all of the contracts that have been completed or terminated. Many of the recent contracts are starting to include player opt-out clauses where the player has the option to terminate the contract and seek a new contract. Players like this option because if they are underpaid, they can get out of the contract. Looking

at the mean efficiency rescaled for these contracts, it shows that efficiency is one, which is outstanding. However, when looking at the mean compared to the median, it shows that the data is skewed to the right. There are a few strong inefficient contracts pulling the average up. To explain this result, many of the contracts that were not opted out of tended to have efficiency values greater than one, which pulled up the average. However there were enough contracts where the player was underpaid, most of them resulting in players opting out, to cancel out the effects.

The contracts that have not ended had a mean efficiency just under one. The average age of the players who signed these contracts was 29.4, which is during the peak years of a player's career. I fully anticipate the efficiency of these contracts to start to become greater than one. The average age of these players is about 32 years old, and so there is sufficient evidence that their production will start to decline as they leave their peak years. The following chart shows the average wins above replacement for each age for players that had 18+ year careers. The evidence shows the steep decline in production takes place after age 32.



My observations show that the largest contracts tend to start during the middle of a player's prime performance years. It is no surprise players prefer to become free agents when they are at their peak performance levels, as this will lead to the highest pay. It appears that so far, on average, these large contracts have been fair for both sides. However, in the next few seasons as the players of these contracts get older and produce less but get paid the same yearly salary, the efficiency will likely become greater than one.

Table 3 looks at the differences when players decide to re-sign with their original team or sign with a new team.

**TABLE 3**

| | Sign with New Team | Re-sign with Current Team |
|---|---|---|
| Median Efficiency | 96% | 84% |
| Average Efficiency Rescaled | 108% | 90% |

There is some evidence that players accept contracts that are more team-friendly for their current team. This is a result of a combination of players taking a hometown discount and asymmetric information while the players are eligible for free agency. Players are generally willing to sacrifice a few dollars to stay in a location they are comfortable. The current team of a player will also have a better understanding how to value the player in the future after being around them for at least one full season.

## VI. Conclusion

There is no denying that baseball salaries have been on the rise since free agency began back in 1976. However, when players like Bryce Harper are saying that it might take $400-500 million dollars to sign him as a free agent, most baseball fans would find that absurd. After exploring the current largest contracts in baseball, there are two takeaways from the research. The first takeaway is when teams agree to the large contracts,

they take incredible amounts of risk, while the player has little risk. With baseball contracts fully guaranteed players have almost no salary risk. The team however, has the risk that the player produces just average numbers during the contract. If the player does not produce superstar numbers, then the team could have saved a lot of money and signed an average player.

This research shows that most of the large long-term contracts have been efficient. However, there are a lot of years left on the active contracts. If the contracts are efficient right now, that is a bad sign because as the players age, they will not produce as much. Many of these contracts have equal or higher yearly salaries in the future than what they are currently paying.

In 2017 if Bryce Harper is eligible for a free agent contract and I was a GM offering him a contract, I would be willing to offer him a seven-year deal worth between $250-300 million. I would not go out longer than seven years because that would keep Bryce Harper under contract after his peak years. I think that his offer would be an efficient deal on both sides. However, I predict that a seven-year deal for $250-300 million will not be enough to sign Bryce Harper. Some team out there, desperate for an outfielder, will tremendously overvalue Bryce Harper and offer him the money that he wants. Depending on the length of the contract and opt-out clauses, a team could be taking on a tremendous risk of having an inefficient contract on the books for many seasons to come.

## Limitations and Future Research

This study was entirely based on the cost values per win above replacement for each season calculated by Matt Swartz. Further research could take a closer examination of the cost per wins above replacement factor for each year. Also, similar research could be done in a few years on the large long-term contracts. In a few years, the players will be in the final few years of their large contracts and researchers will have a better understanding of how the player performed during the contract and how efficient of an agreement the contract actually was. I am sure within a few years Mike Trout and Brice Harper will have mega contracts, which will be scrutinized and studied closely as well. One thing is certain; baseball contracts will continue to grow as baseball revenues continue to grow.

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