Performance and Salaries: Are Major League Baseball Players Worth the Millions?

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Abstract

Major league baseball players earn salaries that are several times what an ordinary American makes. This paper conducts an investigation into the subject of their compensation, to see if it is "fair" based on assigned values, called marginal revenue products (MRPs). Individual MRPs can be obtained following the estimation of two regressions, one for team winning percentage, and the other for overall team revenues. Once the equations are established, MRP values can be calculated. Following this comparisons to actual salaries are made, allowing for a definite answer to the problem of "fair" pay.

Background and Problem Statement

Background

Fifty years ago, the Major League average salary was $13,300. Last season, this figure had reached nearly $2.5 million. In 2002, Alex Rodriguez of the Texas Rangers (the highest paid player ever to this time) received twenty-one million dollars, while average team payroll was over $65 million. This, when only ten years ago the *highest* team payroll was just under 50 million dollars. In 2002, the top team payroll was over $125 million (paid out, naturally, by the Yankees of the Big Apple). So what is the point lurking within all these numbers? That major league ball players have long been paid salaries far in excess of those received by ordinary working class citizens. And this income disparity has done nothing but grow since the middle of the 1970s, with player compensation averaging over 17% growth per year.

The Problem

Combine these salaries with the multiple strikes (or threats to do so) and the constant bickering through the media between players and team owners, and it's not hard to understand why many Americans see all those associated with Major League Baseball as greedy and overpaid. So why is it that almost two hundred position players (pitchers excluded) earned over 1.5 million last season[i]? There are several reasons.

The first is that even if people don't want to admit it, it is a fact that such players are in the position to command this money (and even more than they do

now – more on that later). This stems from one main issue—low supply. The supply of talented players is low, especially on a historical average (a problem that becomes even worse if pitchers are considered). Expansion of the league has diluted the pool of strong hitters, leading teams to pay well even for those who are merely average. And if the individual happens to be a star, watch out. When the off-season rolls around and big name players are up for free agency, new contracts nearly always set records. Secondly, it's a simple fact is that it costs money to field a good team. To remain profitable, a club needs to consistently win (among other things). Winning takes an entire lineup of solid hitters, usually with a couple superstars in the mix, and due to the scarcity of talent that cost is increasing.

After reviewing all this, a question is raised. Is the price too high, is it "unfair" what players are being paid, based on their revenue producing capabilities? Is there something to the popular perception of the people that players are overcompensated? This is the issue that I intend to resolve, answering it through the use of regression analysis and simple mathematics. I believe that contrary to popular opinion, most players are not being fairly compensated for their performance. By determining an individual's marginal revenue product (MRP), a predicted value of each player is derived. This allows for direct comparison to that which is actually paid.

Literature Review

Multiple studies have been performed over the last several decades investigating the issue of player performance, their marginal revenue products, and the salaries they receive. Gerald Scully, publisher of several articles and books covering the topic of compensation and performance, has done what are probably the most important and widely recognized studies. In "Pay and Performance…" and again in "The Business of MLB", he lays out an excellent framework for measuring an individual player's marginal revenue contribution. His method has been used in most of the subsequent studies since, either in original form or a slightly modified version of it.

The technique, called the Proportional method, involves two steps. In the first, the impact of team hitting and pitching on overall win percentage must be estimated. The second involves assessing the effect of final club standing, their respective market sizes, and variables such as stadium age and competitiveness on overall revenue. Major problems with the Proportional method include its tendency to overstate the MRP of all players, and that it is overly sensitive to input measures—such as the way total revenue is measured. Zimbalist points out one of the biggest issues is which statistical (performance) indicator to use when making the calculations. Final conclusions from the regressions will vary widely depending on the statistics chosen. But, as both Zimbalist and Scully conclude, a hitter's slugging percentage is the best for achieving accurate results.

Another more recent study was done by Anthony Krautmann. He points out that Scully's model "will systematically overestimate players' marginal values." (375) This naturally leads to overvaluing a player's contribution. Scully's Proportional method does this because it ignores completely the roles of quality management and a good minor league system. But despite exclusion of these variables, Scully does make a point of mentioning their impact is likely to be quite low—as shown by his model's high R^2 values (usually in the upper-80s)[ii].

Nonetheless, Krautmann proposes use of a very different method to calculate the MRP. Dubbed the Free Market Returns (FMRs) approach, it yields results that are (according to him) more consistent, realistic, and which allow for comparison across the varied classes of players. Using his FMRs approach, Krautmann estimates that players who have been in the majors for more than three and less than six years earn only "about 85% of his value", while Scully's (with the same data set) "suggests that such a player is paid only about 25% of his MRP." He goes on to explain much of the reason behind the underpaying of the players with less experience, the main one being the need for a team to recover costs of bringing a player up through the minor league system.

In an article by Sherwin Rosen, it is noted that there is indeed a separate class of players, "stars", who earn proportionally more that that suggested by statistics alone. The individual's ability to draw more fans or to dramatically increase the sales of merchandise bearing their name can have a substantial effect on their true marginal revenue product. This assists in the explanation of

very high salaries to players past their prime, or for any big name player who's contract guarantees a salary beyond what his MRP predicts[iii].

Method

The method I used is a modified version of the Scully Proportional technique. I feel that after reviewing the previous publications, that the Proportional method has the potential to yield highly accurate results with only minor tweaks. The differences between the original and mine are mainly in the measurements. I utilized only a portion of each team's overall annual revenue, instead of applying the total returns in the equation. This more accurately reflects the true marginal product of individual players, as it is highly unrealistic to apply every dollar of team revenue to the players on the field. I used only the ticket receipts part of the total when calculating the player marginal revenue products. Also I chose to ignore, and therefore leave out, the effects of pitchers on the team's revenue[iv]. This was due to the need for limiting the scope of the project to a single semester size. No serious negative consequences on the overall prediction power of the model arose from this exclusion[v].

Another modification was to eliminate the original's variable for the impact of black players on team revenues. This decision was made due to the change in societies' views since the mid-1970s[vi]. This point is driven home by the number of clubs that are recruiting out of the Japanese major league, from Cuba, or from other Caribbean countries.

Results

Part One

Once the necessary data was collected, the regressions could be run[vii]. The first estimates the role of the team slugging percentage (TS%), competitiveness, and which league a team is in (American or National) in predicting the final winning percentage of that team. Team slugging percentage simply takes a specific club's batting statistics—the number of at-bats, number of hits and what kind—and puts them together. It is, as previously mentioned, the single best indicator of hitting strength. The competitiveness measure is actually two separate dummy variables. The first (CONT) is labeled one if a team is within five games of the top squad in their respective division. The second (NONCONT) is one if the team is twenty or more games out of first place. This variable accounts for the effect consistently losing has on team play and morale. The last variable in the first part of the Proportional method is a dummy variable (NL) measuring any cross-league quality-of-play issues[viii].

The resulting regression (t-statistics in parentheses):

Win Percentage = -.08375 + 1.48166 TS% + .05741 CONT - .098331 NONCONT + .021845 NL

(-.493) (3.78) (2.779) (-5.367) (1.49)

R^2 = 85.84% Degrees of Freedom= 25

Interpretation of Part One

The coefficients are not complicated to interpret. The coefficients for team slugging percentage and non-contender were significant at the 1% level[ix]. The contender variable was very close to being significant at the 1% level, but was not. The constant term, while necessarily included to create a valid model, has no real economic interpretation. The team slugging percentage coefficient shows that for a single point increase in TS% (.400 to .401), a team's final win percentage will increase by 1.482 points.

Contender coefficient shows that consistent winners, and the resulting boost in hustle and morale, will account for about a 5 point higher win percentage than teams with the same performance from its players. Non-contender means that being out of first place by twenty games or more will cause winning percentage to be almost 10 points lower per season than teams with the same player performance. The NL variable was not significant at even the 10% level, showing that there is no longer a difference in the quality of play between the American and National leagues.

Part Two

The second step of the modified Proportional method has fewer variables. Here, the relationships of a team's winning percentage, the size of the market where a team's home stadium is located, and the age of a stadium to the overall ticket revenues are estimated. The variable for team winning percentage (Win%) is simply the number of wins from the 2002 season divided

by 162, the number of games in a season. The market size variable (POP) is the population of the team's host city, as of the census in year 2000. Obviously this is not a perfect measurement of the actual market size, as many people will drive a few miles to see a game, but it does allow for approximate values. The stadium quality variable (STAD) is a dummy, labeled one if a team plays in a facility that was built in 1970 or later, zero if their home field was built in 1969 or earlier. Again, this variable is also far from ideal (as far as calculating the effects of a better stadium on revenues), but enhancing the accuracy would be very difficult and time consuming. It would require quantifying such things as parking ease and the actual location of the field (whether a "nice" neighborhood or not), among others.

This yields the following:

Ticket Revenue = -68596 + 229641 Win% + .000068 POP - 907 STAD
(-7.12) (12.55) (.08) (-.24)

R^2 = 86.2% Degrees of Freedom = 26^x

Interpretation of Step Two

Again the constant (while significant) has no economic interpretation. A one point increase in team winning percentage (Win%) results in a $229,641 increase in ticket revenues. The population variable (POP) was not significant at any reasonable level. This implies that market size has *no* effect at all on a team's gate revenues, which was certainly unexpected. This would lead to the negation of arguments from the small-market teams. Clubs like the Kansas City Royals, Pittsburgh Pirates, and the Minnesota Twins maintain that they cannot generate the necessary money to draw in superstars and other above average

players, and therefore are not able to be competitive with teams from big markets like New York or Los Angeles[xi].

The stadium variable also returned as insignificant at any acceptable level. This may be surprising at first, but not after deeper investigation. Though a stadium may have been built long ago, that doesn't mean it has been neglected since then. Most teams will add luxury boxes, new concessions, or make parking easier if necessary. And several teams play in very old facilities, while having gate revenues among the highest in the league, most notably the Yankees, whose field opened in 1923, and the Red Sox, owners of the league's oldest stadium, which opened in 1912. In fact, much of these fields attractiveness stems from the nostalgic values and sense of tradition that they exude to the fans in attendance.

Method for Calculating MRPs

Creation of a player's marginal revenue product from this model is quite straightforward. As the name implies, it is a matter of calculating a player's contribution – his "proportion" of the overall team's production. To do this, I first gathered the necessary statistical data on individual players and their teams. This includes such things as at-bats and slugging averages, both for individuals and overall. The first step is calculating the percentage of the team's at-bats a player had. For the purpose of demonstration, I have selected to use Miguel Tejada and his statistical information.

1. Number of at-bats in 2002 = 662
   Total number of team at-bats in 2002 (Oakland As) = 5558
   Percentage of total => 662/5558 = .11911 %

After this, the amount of the individual's contribution to the team slugging average is figured. This is done by taking the product of the individual's slugging average and the percentage of total at-bats from step one.

2. Tejada's slugging average (2002) = .508
   Percentage of total => .508 * .11911 = .0605

Continuing the examples from above, the "60.5" points are plugged into the Win Percentage equation from earlier as the TS% variable.

3. His contribution to Win Percentage
   1.482 [.0605] = .089661

This number from step three above, when divided by the amount a single victory during a regular 162 game season adds to the team's winning percentage (.00617), provides the number of wins an individual was responsible for. In Tejada's case, his play was valued at approximately 14.5 wins to the A's in 2002. Once this is known, a final step can be taken to calculate a player's predicted value, his marginal revenue product. This entails taking the contribution to the team win percentage from step three and inserting it into the Revenue equation estimate previously.

1. (229641 [.089661]) 1000) = $20,592,107

So, according to the model, Miguel Tejada should have had a contract salary of about $20.6 million last season (when in reality, he was paid $3.625 million—ranked 122 of all position players). This same procedure can be applied to all players, assuming they played last season and had at least some of the team's at-bats.

Limitations, Conclusions, and Recommendations

Limitations of the Model

One of the model's weaknesses is that it does not take into account the defensive contributions of players. Not only can a player like Alex Rodriguez produce at the plate, he is also one of the best defensive shortstops in the league. Assisting in stopping runs by the other team is just as valuable as helping to score them for a player's own team. Historically both catcher and shortstop have been primarily defensive positions (meaning fielding is emphasized over batting), but this model does not allow for any additional compensation they may be entitled to based on their roles.

Another interesting thing to look at is the issue of league MVP (most valuable player). In 2002, those awards were presented to Barry Bonds in the NL, and Miguel Tejada in the AL. While their MRPs do reflect that each is valuable (ranked 10^{th} and 6^{th}, respectively), this status should introduce additional recognition when salary negotiations come around, and therefore should be represented in the equation.

Another question – is hitting power what makes every player valuable? I believe the answer to this is no, certainly not. There are variables that cannot be captured and put into numbers, things such as leadership and the passing of experience from veterans to younger team members. It may be valuable to pay an excellent leader or a veteran past his prime extra for the benefits and revenues that can be reaped. Short term benefits may be only a handful of wins

but over the long run, as the qualities of these players "rub off" onto their teammates, it might even assist in winning a pennant.

Another area the model comes up short is in its reliance on the number of at-bats a player has per season. In the way at-bats are counted, they exclude any appearance at the plate where a hitter draws a base on balls. If a player is quite dangerous (meaning he is an offensive threat), he may be intentionally walked or pitched around, all with the goal of preventing him from getting a hit. This is the case of several individuals, but I will focus on that of Barry Bonds. Last season he drew an all-time record 198 walks. Naturally, this lowered the number of counted at-bats he had (403). Since the Proportional model uses at-bats to calculate MRP, his was substantially lower than it would have been otherwise.

Bonds MRP (403 at-bats) = $19,935,343
Bonds MRP (601 plate appearances) = $29,729,879

So, according to this model it would be economically profitable for Bonds to pay off the pitchers in order to keep them from tossing him a free pass. This is the most extreme case as he was league leader in walks—by a substantial amount—but it has similar results for others (please see table four). For Delgado of the Blue Jays, the change in accounting makes the difference of whether he is overpaid (as per the original) or underpaid (the adjusted MRP).

Conclusions from the model

From the tables (please see in back), it is clear that a large disparity exists between most players' salary and their marginal revenue product. The club owners are taking an overwhelming majority of players in the sample for a

ride. From the sample average, it is shown that the typical player is being shortchanged by approximately 80%. This number was astonishingly high, as previous studies have found this exploitation to be much smaller[xii].

By seeing this figure, the evidence has been presented and the answer is unambiguous. Are the salaries being paid to players of Major League Baseball "fair" based on MRPs? No. The exceptions to the rule are limited and the model used to attach values to individuals is very strong. As stated earlier, players are in a position to demand fair pay, to insist on salaries that reflect their earning power for the club on which they play. But should they? Again, the answer is no, as it would most definitely require a strike. Another labor stoppage would be crippling to the league that even now struggles to gain back the fans lost from the strike in 1994. By insisting upon higher pay and taking the steps necessary to get it, the players would involuntarily defeat themselves. Instead, small measures need to be enacted slowly over time to boost all salaries to the proper levels.

Recommendations

The topic of Major League Baseball salaries is an excellent one for researching, and a big opportunity now exists for anyone who carries it out. A veritable flood of studies were done when free agency was introduced (nearly two decades ago), but that activity has slowed to only a trickle of what it was. If a person was so inclined to continue and improve upon the research begun here within these pages, there are a few recommendations I would make. The first, and main one, would be to use a different measure for calculating MRPs than

the number of at-bats. Total bases would give a truer estimate of offensive capabilities. Another would be to expand the number of explanatory variables in the model. To include pitchers, add dummy variables to better capture the effect of the catcher and shortstop positions, and also attempt to quantify things such as leadership abilities and experience. A further investigation into the effects of "superstar" status on salaries would also be interesting to see. The last recommendation I would make is to increase the accuracy of the stadium quality variable, by better gauging all the variables related to attending a game.

Table One

Top 15 Marginal Revenue Products

Rank	Player	Team	Actual 2002	Player's MRP
1	Alex Rodriguez	Tex	$21,000,000	$23,608,703
2	Vladimir Guerrero	Mon	$8,000,000	$22,198,869
3	Magglio Ordonez	ChiSox	$6,500,000	$21,811,084
4	Jeff Kent	SanF	$6,000,000	$21,510,817
5	Garret Anderson	Anh	$5,000,000	$20,611,599
6	Miguel Tejada	Oak	$3,625,000	$20,592,107
7	Sammy Sosa	ChiCubs	$15,000,000	$20,450,886
8	Nomar Garciaparra	Bos	$9,000,000	$20,231,411
9	Shawn Green	LA	$13,416,667	$19,968,120
10	Barry Bonds	SanF	$15,000,000	$19,935,343
11	Todd Helton	Col	$5,000,000	$19,895,966
12	Pat Burrell	Phi	$1,905,000	$19,643,510
13	Carlos Beltran	KC	$3,500,000	$19,622,627
14	Brian Giles	Pit	$8,063,003	$19,048,876
15	Rafael Palmeiro	Tex	$8,712,986	$18,886,202

Table Two

Top 10 Underpaid Players, based on Actual Salary vs. Marginal Revenue Product

Rank	Player	Team	Actual, 2002	MRP
1	Juan Encarnacion	FL	$1,550,000	$16,507,480
2	Pat Burrell	Phi	$1,905,000	$19,643,510
3	Eric Chavez	Oak	$2,125,000	$18,376,056
4	David Bell	SanF	$1,750,000	$14,471,607
5	Reggie Sanders	SanF	$1,750,000	$14,041,813
6	Todd Walker	Cin	$2,050,000	$16,315,701
7	Aaron Boone	Cin	$2,100,000	$16,455,617
8	Placido Polanco	StL	$1,750,000	$13,652,931
9	Torii Hunter	Min	$2,400,000	$18,475,377
10	Mike Lowell	FL	$2,300,000	$17,411,899

Table Three

Most Overpaid Players, based on Actual Salary vs. Marginal Revenue Product

Rank	Player	Team	Actual, 2002	MRP
1	Bill Mueller	ChiCub	$3,450,000	$123,609
2	Jay Bell	Ari	$8,000,000	$926,448
3	B.J. Surhoff	Atl	$4,500,000	$1,672,221
4	Greg Vaughn	TB	$8,750,000	$4,887,925
5	Ray Lankford	SanD	$8,100,000	$4,659,875

6	Ken Griffey Jr.	Cin	$8,557,223	$5,191,022
7	Homer Bush	Tor	$3,375,000	$2,133,071
8	Rusty Greer	Tex	$6,800,000	$4,544,753
9	Matt Williams	Ari	$9,500,000	$6,363,230
10	Darrin Fletcher	Tor	$3,825,000	$2,625,661
11	Juan Gonzalez	Tex	$11,000,000	$7,567,844
14	Carlos Delgado	Tor	$19,400,000	$16,906,329

Table Four

Adjusted MRPs – Based on Total Plate Appearances

Player	Team	Adjusted MRP	Original MRP
Barry Bonds	SanF	$29,729,879	$19,935,343
Brian Giles	Pit	$24,223,118	$19,048,876
Jim Thome	Cle	$16,570,421	$13,212,296
Jason Giambi	NYY	$22,438,677	$18,782,749
Chipper Jones	Atl	$22,075,795	$18,191,783
Rafael Palmeiro	Tex	$22,483,574	$18,886,202
Bobby Abreu	Phi	$21,702,362	$18,363,537
Sammy Sosa	ChiCubs	$24,239,450	$20,450,886
Carlos Delgado	Tor	$20,321,073	$16,906,329

[i] Here is a quick list of baseball terms that will be used throughout the paper.

Slugging Percentage – This number is reached by dividing the total number of bases of all base hits by the total number of times at bat.

Position Player – This includes all players except for pitchers.

League Expansion – The addition of new teams to the league. Recently, this includes teams like the Tampa Bay Devil Rays.

Divisions and Leagues – The Major Leagues are broken down into two main leagues, American (14 teams) and National (16 teams). Each of these is split into three smaller divisions, east, central, and west that include between four and six teams apiece.

[ii] Scully makes note of this in "Pay and Performance", on page 921.

[iii] This superstar status would be difficult to account for. The biggest problem would be obtaining the necessary data –an example of this is revenues from only "Sosa" jerseys.

[iv] Pitchers were left out due to the multiple roles, or classes of the position. There are starters, middle-relief, set-up men, and closers. Since each division has a different goal when on the field, it adds far too much complexity to the model to handle in a short period of time.

[v] The R^2 data from my two regressions were 85.8% and 86.2%, respectively. Scully's R^2 were very similar, with 88% and 75% respectively.

[vi] Fans and the public no longer penalize teams for having a multi-racial assembly of players.

[vii] The data needed is widely accessible through sports web sites; I collected most from ESPN.com and MLB.com. For measuring the strength of hitters I selected their slugging average, averaged over the past three seasons. This is nothing new. Both Scully and Zimbalist used the same measure, though a career average. I found a composite of only the recent years gives a more accurate picture of a player's current worth.

[viii] This has been minimized since the advent of inter-league play during the regular season.

[ix] TS% and NONCONT => significant at the one percent level
TS% t-stat = 3.78 > 2.787 = t-critical at 1% level with 25 df
NONCONT t-stat = -5.367 > 2.787 = t-critical at 1% level with 25 df

CONT => significant at the two percent level
CONT t-stat = 2.779 > 2.485 = t-critical at 2% level with 25 df

[x] Win% t-stat = 12.55 > 2.779 = t-critical at 1% level with 26 df
POP t-stat = .08 < 1.706 = t-critical at 10% level with 26 df
STAD t-stat = -.24 < 1.706 = t-critical at 10% level with 26 df

[xi] Simply looking at the data from the past decade or two, however, does seem to contradict the regression results. The teams located in larger markets *do* routinely out gross those from smaller cities – by several million dollars

[xii] Scully found the average player to be underpaid by approximately 75%. Zimbalist concluded that players are about a quarter *overpaid*, and Krautmann found that younger players are exploited by only about 15%.

References

Geohive. (http://www.geohive.com/)

Krautmann, Anthony C. "What's Wrong with Scully-estimates of a Player's Marginal Revenue Product?" *Economic Inquiry*, April 1999, 37(2), pp. 369-381.

Krautmann, Anthony C. and Oppenheimer, Margaret. "Free Agency and the Allocation of Labor in Major League Baseball." *Managerial and Decision Economics*, 1994, 15, pp. 459-470.

Major League Baseball. (http://www.mlb.com)

Microsoft Corporation (MSN). (http://sports.espn.go.com/mlb/index)

Rosen, Sherwin. "The Economics of Superstars." *American Economic Review*, December 1981, 71, pp. 845-898.

Rosen, Sherwin and Allen Sanderson. "Labour Markets in Professional Sports." *The Economic Journal*, February 2001, 111, pp. 47-68.

Rottenberg, Simon. "The Baseball Players' Labor Market." *Journal of Political Economy*, June 1956, 64, pp. 242-258.

_____. "Baseball and Billions: A Probing Look Inside the Big Business of Our National Pastime." *Journal of Economic Literature*, March 1994, 32(1), pp. 168-170.

Scully, Gerald W. The Business of Major League Baseball. Chicago: University of Chicago Press, 1989.

_____. "Pay and Performance in Major League Baseball." *American Economic Review,* December 1974, 64(6), pp. 915-930.

Zimbalist, Andrew. Baseball and Billions. New York: Basic Books, 1992.