Estimating the Value of Major League Baseball Players

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Abstract

This paper examines whether Major League Baseball players are paid their marginal revenue product. A two-step estimation technique is used with data from 1990 to 1999. First, I estimate a regression relating team revenues to the team's winning percentage and other explanatory variables. The second regression estimates the relationship between winning percentage and team statistics. Given the estimates from these two models I can calculate player marginal revenue product by first predicting how his statistics will affect the team's winning percentage and then relating the impact on winning percentage on team revenue. The results indicate that professional baseball players are underpaid in marginal earnings per dollar of marginal revenue product. Players were paid more of their marginal product after the 1994-95 strike and older players appear to receive a salary closer to their marginal products than younger players.

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I. Introduction

It is often debated whether or not professional baseball players are worth the large salaries they receive. Recent deals such as Alex Rodriguez's $125 million contract with Texas and Manny Ramirez's $96 million contract with Boston have caused many to speculate that baseball players are paid more than they are worth. A recent report from the Independent Members of the Commissioner's Blue Ribbon Panel on Baseball Economics concluded that from 1995-99 only three teams (Cleveland, Colorado, and New York Yankees) achieved profitability (Levin et al. 2000). These factors have resulted in arguments for revenue sharing, a tax on clubs with payrolls over a fixed threshold, and other measures to attempt to lower players' salaries.

Baseball is a game of statistics that has proven to be an interesting labor market for economists, providing detailed measures of individual productivity. Unlike other professions, there are lots of data on individual performance and productivity. In addition, the fact that baseball players' marginal revenue products are relatively independent, makes it easier to separate a particular player's contribution to his team (Krautman 369). Thus, one can potentially estimate a players' marginal revenue product and compare it to his actual salary.

The purpose of this paper is to analyze pay-performance results of Major League Baseball players in a refined Scully model. I follow the work of MacDonald and Reynolds (1994) using data from 1990-1999, and examine whether professional baseball players are paid their marginal revenue product. The paper also examines if there was a significant change after the 1994-95 strike. The next section provides some background on labor relations in baseball. Section III provides a literature review. The team model and marginal revenue product equations are in section IV with the data, variables, and descriptive statistics in section V. The last two sections provide the results and the conclusion.

II. Background

From 1879 to Major League Baseball's first collective labor agreement in 1968, various kinds of reserve clauses restricted the player's freedom of negotiation with the owner of the contract. The player's baseball services were bound to one team until that player's rights were transferred.   These contracts also were a privately and socially efficient means to finance player development and the inevitable failure of most minor league players to produce in the majors (MacDonald and Reynolds 1994). MacDonald states that the usual presumption is that the reserve clause kept salaries below those that might prevail in a more competitive environment. After 1968, compensation rules were modified but considerable controversy existed over the economic impact of the compensation scheme. In 1986-87, Major League Baseball players were grouped into three contract environments: 'rookies' in years 1-2 subject to a team reserve clause and ineligible for salary arbitration and free agency; intermediate players in years 3-6 eligible for final-offer salary arbitration but not free agency; and senior players after 6 years eligible for either final-offer salary arbitration or free agency. (MacDonald and Reynolds 1994). Free agency allows players to negotiate freely with any team.

Baseball does not have any form of salary cap, although it does have a luxury tax on teams that annually spend beyond a certain amount on salaries. The first discussion of salary cap in baseball negotiations occurred in 1989-90. The owners proposed a cap that would limit the amount of salary any team could pay to players. Those with six years of experience would still be free agents. However, a team would not sign them if doing so would put the team over the salary cap. Also part of the owners' proposal was a guarantee to the players of 43 percent of revenue from ticket sales and broadcast contracts, which was about 82 percent of owners' total revenue (Staudohar 1998).

The purpose of the proposed salary cap was to protect teams in small markets from having their talented free agents brought up by big market teams. In theory, teams in large cities would be unable to dominate the free agent market because the cap would limit the players they could sign. Also, because teams spend large sums in developing young players, a salary cap would allow them to retain more of their young players because free agency opportunities would be more limited (Staudohar 1998).

On December 31, 1993, baseball's 4-year collective bargaining agreement expired. Baseball, as other sports, had its big market and small-market teams and economic disparities between clubs. Baseball teams share money from the sale of national broadcast rights equally but kept all sales from local broadcast rights. As a result, the owners decided to share some of their local revenues, but only if the players accepted the salary cap. The owners also proposed to share their revenues with the players, 50-50. Depending on the players' share under the 50-50 split, no team could have a payroll of more than 110 percent or less than 84 percent of the average payroll for all teams. The Major League Baseball Players Association (MLBPA) rejected the salary cap and other major proposals. This set the stage for a strike that began on August 12, 1994 and lasted for 232 days – the longest strike ever in professional sports. In the end MLBPA accepted a modified version of the luxury tax. The early returns indicate that it is having little if any effect on average player salaries (Staudohar 1998), although results in this paper suggest there has been a significant effect.

III. Literature review

A number of previous studies have examined the marginal revenue product of professional baseball players. The pioneering econometric study on pay versus performance of Major League Baseball was provided by Scully (1974). While Scully's approach has undergone much scrutiny, it remains one of the primary methods of estimating a player's MRP. A number of studies have modified Scully's basic model, used more recent data, and improved estimation procedures. Scully (1974) estimates *MRP* in a two equation model. The first is a team revenue function which relates team revenues to the team win-loss record and the principal market characteristics of the area in which the team plays. Then he estimates a production function, relating team output and win-loss percentage to a number of team inputs. Scully's results show that players were paid only 10-20% of their marginal revenue product in data for the 1968-69 seasons. Scully found that the economic loss of professional baseball players under the reserve clause is of considerable magnitude (Scully 1974).

Krautman (1999) revisits the Scully technique for estimating the MRP of professional baseball players. Using a sample of available free agents from 1990-1993, he attempts to show that the Scully technique is sensitive to the manner in which marginal product is measured. The approach estimates the market return on performance from a regression of free agent wages on performance. These market returns are then applied to the performance of reserve-clause players, giving estimates their market values. Krautman's results indicate that the average apprentice (less than three years of Major League experience) receives about 25% of his MRP and the typical journeyman (more than three, but less than six, year of Major League experience) receives a salary that is essentially commensurate with his value (Krautman 1999).

MacDonald and Reynolds (1994) examine if the new contractual system of free agency and final-offer arbitration brought salaries into line with marginal revenue products. Using public data for the 1986-87 seasons, they include all players, both hitters and pitchers, who were on a major league roster as of August 31, 1986 and August 31, 1987. First, they analyze whether any economic evidence of owner collusion exist during the 1986-87 period. Secondly, they use a systematic analysis of final-offer arbitration in baseball – established three years before free agency – and find it has a stronger independent effect on salaries than the much publicized free agency. Last, they test the 'superstars' model of Rosen (1981) and find the salaries of the very highest paid players in Major League baseball disproportionately exceed their relative productivity advantage, as the 'superstars' model predicts. They find that major league salaries do generally coincide with the estimated marginal revenue products. Experienced players are paid in accord with their productivity; however, young players are paid less than their marginal revenue product, on average (MacDonald and Reynolds 1994).

Thus, the previous literature seems to agree that, on average, more experienced players are paid a wage approximately equal to their marginal product while younger players appear to be paid a wage significantly less than their marginal product. These previous studies have used data from a few seasons and from the early 90's or earlier. To my knowledge, no previous studies have utilized data over multiple seasons or as recent as the mid to late 90’s.

IV. Team Model and Marginal Revenue Product

Employing one more unit of labor generates additional income for the firm because of the added output that is produced and sold. Thus, the marginal income generated with a unit of input is the multiplication of two quantities: the change in physical output produced (marginal product) and the marginal revenue generated per unit of physical output. Thus, the additional income created from hiring an additional worker is termed the marginal revenue product (MRP). In theory, a firm would be willing to pay a worker a wage up to his MRP. In a competitive labor market we would expect workers to be paid a wage equal to their MRP.

The players’ marginal revenue product in baseball is the ability or performance that he contributes to the team and the effect of that performance on team revenue (Scully 1974). This effect can be direct or indirect. Ability contributes to team performance and victories raise gate receipts and broadcast revenues. Therefore a players’ market worth can be defined as the amount of team revenue produced by his contribution to attracting paying fans to see and hear the team compete (Scully 1974).

Ignoring special appeal for ‘superstars’, a player’s MRP essentially is based on each player’s contribution to significant team performance variables, the effect of these performance variables on winning percentage, and, in turn, the effect of winning percentage on team revenue. I also assume that the team production function is linear and is written as:

$$WINPCT = \alpha_0 + \beta_1 RC + \beta_2 ERA + \beta_3 NATLG + \beta_4 CONT + \beta_5 OUT + e \quad (1)$$

where *WINPCT* = percentage of games won by a team
RC = Total team runs created for the season
ERA = teams earned run average per 9-inning game
NATLG = 1 if team is in the National League, 0 otherwise
CONT = 1 if team finished within 5 games of first place in the division, 0 otherwise
OUT = 1 if team finished 20 or more games out of first place in the division, 0 otherwise

As described below, runs created is a useful measure of offensive production because it not only gives weight to hitting and slugging averages, but also to offensive production like walks, stolen bases, sacrifices, and similar efforts. *ERA* is the best overall defensive measure because it reflects a pitcher's ability to prevent runs from scoring. ERA is also a good defensive measure for team pitching, although it does not account for errors. However, more than just team hitting and pitching performance can determine winning. One or two runs win many games during the season. In this instance, pitching and hitting performance will make less difference in the outcome. The two dummy variables *CONT* and *OUT*, introduced by Scully (1974), adjust for these factors. The variable *CONT* captures team morale (hustle, quality of managerial and on the field decision making) which will substantially determine which team wins a higher share of these close games. The variable *OUT* captures the disheartenment of loosing and bringing up players from the minor leagues. The variable *NATLG* is specified to compensate for quality of play. The American League has a designated hitter to bat in place of the pitcher. This substitution, not allowed in the National League, should increases runs created in the American League.

The second team equation explains variation in team revenue as a linear function of *WINPCT* and team characteristics, and is given as:

$$TOTREV = \alpha_0 + \sigma_1 WINPCT + \sigma_2 NATLG + \gamma_1 TEAM + \gamma_2 YEAR + e \quad (2)$$

.

where *TOTREV* = total team operating revenues in millions
WINPCT = team winning percentage
NATLG = 1 if team is in National League, 0 otherwise
TEAM = vector of team dummies
YEAR = vector of year dummies (1990-1999)

The hypothesis is that fan attendance and thus, *TOTREV*, is positively affected by team wins. Fans respond to teams that win. The partial coefficient of *TOTREV* with respect to *WINPCT* is a measure of marginal revenue across teams. To adjust for the quality of play the *NATLG* dummy is created. Team dummy variables adjust for inter-team differences such as area size, TV contracts, and other team specific fixed effects. The year dummies capture differences in revenue across years. I use the estimations from these two equations to calculate predicted MRP for individual players.

V. DATA, VARIABLE CREATION, AND DESCRIPTIVE STATISTICS

1. Data

The data used in this project come from a number of sources. Team revenue from 1990-97 were obtained from Rodney Fort at Washington State University (http://users.pullman.com/rodfort/). Team revenues in 1998 were obtained from the July 2000 Report of the Independent Members of the Commissioner's Blue Ribbon Panel on Baseball Economics. The team revenues of 1999 were obtained in Forbes magazine. Rodney Fort also provided individual players' salaries data. Team and individual statistics were obtained from The Baseball Archive at Baseball1.com. Previous research in this area has utilized data from only a single year or pair of years. This paper is unique in that it uses data over the entire 1990-99 period yielding much larger sample sizes than previous studies. After merging together individual salaries and statistics by year for each team between 1990-99, the data set contains 7,047 observations. Salaries and revenues have been adjusted to 1999 real dollars.

2. Variable Creation

Because hitters and pitchers differ in the kinds of variables used to measure individual performance, two different measures are used. For hitters, individual performance is measured by Runs Created (*RC)*. Runs Created is calculated by:

$$RC = \frac{(Hits + Walks) * TotalBases}{AtBats + Walks}$$

This formula reflects two important aspects in scoring runs in baseball. The number of hits and walks of a team reflect the team's ability to get runners on base. The number of total bases of a team reflects the team's ability to move runners that are already on base. This runs created formula can be used at an individual level to compute the number of runs that a player creates for his team. Baseball researchers have proposed 'runs created' measures to remove situation dependency (Grabiner). In other words, runs created allows a player to be evaluated for what he does, not for what his teammates or manager do. MacDonald and Reynolds (1994) view runs scored as the best offensive production variable. The problem with runs scored is that unless the batter hits a home run or steals home, he needs his teammates' contribution to actually score a run, and he cannot do much to cause them to get hits once he is on base. Thus, if you bat in front of the best home-run hitters in the league, you will score a lot of runs, whether or not you have a good ability to score runs. Runs scored measures team offense very well, but it creates a problem when trying to measure individual contributions. RBI's are commonly used as a measure of player's offense, mainly because they are the only statistics easily available that look like a complete measure. RBI's however measure a lot of things that are not the player's own contribution. You cannot drive in runners who are not on base (except home runs), but your own batting doesn't put them there. If you bat behind good players you will get a lot of chances. In fact, leagues leaders in RBI are much more likely to be the players who batted with the most teammates on base or in scoring position (not the batter's contribution) than those who hit the best with runners on base or in scoring position. Thus RBI's are a better measure of who had the most chances to drive in runners than who was the best at driving in runners (Grabiner). Table 1 compares the Runs Created (*RC*), *RBI*, and *RUNS* of the top ten RBI producers in 1990 and 1999. RBI hitters usually bat third or fourth in the batting order and are hitting with people on base. For example, in 1990 Ryne Sandberg had more Runs than RBI's, and that is probably because he hit second and was driven in by other good hitters. It is clear that RBI's and Runs scored are not the only determinants of Runs Created. As Bonds and Sandberg indicate, on base percentage and speed can increase your runs created. Runs Created shows more of the complete player in offensive characteristics.

For pitchers, individual performance is measured by Earned Run Average (*ERA)*. Earned run average is calculated by:

$$ERA = \frac{EarnedRuns * 9}{InningsPitched}$$

ERA measures the average number of runs per nine innings pitched. For example, a pitcher with an ERA of 3.65 means that the pitcher gives up 3.65 earned runs per nine innings. An earned run is a run scored without any errors. In contrast, Scully (1974) and others claim a pitchers strikeout-walk ratio is the best measure of performance. The purpose of a pitcher, however, is to stop the other team from scoring. This could come in the form of strikeouts, ground balls, or fly balls. According to Zimbalist (199) and MacDonald (1994), *ERA* is highly significantly related to winning percentage and they argue it is the preferred pitching statistic.

3. Descriptive Characteristics

The descriptive statistics for team revenues over the 1990-99 period are given in Table 2. The New York Yankees had the largest average revenue of 130 million dollars, as well as the best winning percentage of .550. Colorado had the most runs created (875.794) as well as the highest ERA at 5.344. Many give credit to the runs scored in Colorado to the elevation and thin air. Demonstrating the saying that pitching wins games, Atlanta had the lowest ERA at 3.498 and was also within 5 games of first 80% of the time.

Table 3 shows the statistics for average team revenues and statistics over the ten-year period. 1999 had the largest average revenue of $95 million and the strike shortened year of 1994 had the lowest average revenue of $45 million. Runs created saw a great increase in 1996 and has remained pretty steady since. ERA has seen a steady increase over the years, partly due to the increased offensive production the game has achieved over the years.

The average salary among professional baseball players is shown in Table 4. Pitcher and hitter average real salaries remain pretty constant over the ten year span. As the real salaries increase, the standard deviation also increases. This suggests that there are some of the players that are making much more as the average real salaries increase. As expected, the average real salaries were greatest in 1999 and lowest in 1990 and 1996.

VI. RESULTS

The team winning percentage function was estimated with team data from 1900-99. The estimated equation is:

$$WINPCT = \underset{(.021)}{.547} + \underset{(.000024)}{.000235}RC - \underset{(.004)}{.052}ERA - \underset{(.004)}{.004}NATLG + \underset{(.005)}{.046}CONT - \underset{(.005)}{.043}OUT \quad (3)$$

$$DF = 272,\ R^2 = .764$$

A one run increase in team runs created raises the team winning percentage by .00024 points. Winning percentage is measured in thousandths. The effect of a 1 standard deviation increase in *RC* has a .026 $(108.53 * .000235)$ increase on *WINPCT*. A reduction of one run in a team's earned run average given up per nine innings raises winning percentage by .052. The effect of a 1 standard deviation decrease in *ERA* has a .031 $(.594 * .05196)$ increase in *WINPCT*. There is no significant difference in winning percentage between leagues. Contenders and cellar teams finish .046 and .043, respectively, above or below other teams with equivalent player performance. All of the coefficients are significant at the 1% level except for *NATLG*.

The team revenue function was estimated with team data from 1990-99 are shown in Table 5. The results indicate that raising the team winning percentage .1 point increases team revenue by 9.63 million dollars. A team who increases their WINPCT from .400 to .500 increases team revenue by 9.63 million dollars. The variable *NATLG* is not statistically significant indicating the difference in National and American League revenues are not significantly different. The team dummies show how the New York Yankees make $29.2 million more than the next highest team, the omitted variable Baltimore Orioles. Baltimore, Los Angeles, and the New York Mets have the same revenues with the other teams making anywhere from $10-$49 million dollars less than Baltimore. The year dummies show that the year of the strike (1994-95) had an effect on team revenues. Team revenues were considerably lower the years of the strike, but quickly recovered so that 1999 revenues were $27 million more than revenues in 1990.

To obtain player specific *MRP*, I assume that individual performance carries with it no externalities so that team performance is the linear summation of individual performance (MacDonald 1994). In other words, player productivities are independent, so that a good performance by one player does not affect the productivity of another. Determining whether major league baseball players are paid their marginal revenue product requires an independent calculation of individual *MRP*'s derived from the previous equations 1 and 2. On offense, the purpose of a team and its player is to create runs. From equation (1) a one point increase in *WINPCT* is estimated to raise *TOTREV* $96,306 and from equation (2) a run created raises a team's win percentage by .000235. Therefore the marginal revenue product of hitter is

$$MRP \text{ hitters} = .000235 * \$96{,}306 * \text{annual runs created} \quad (4)$$

For pitchers, ERA is the most popular statistic of performance. A pitcher can only prevent the other team from scoring runs against him. The lowest possible *ERA* is zero and an *ERA* of zero implies that a team's winning percentage (*WINPCT*) would equal the intercept (.556 in Equation 3) plus any offensive production. To produce an equation for pitchers, note that a one-point increase in winning percentage (*WINPCT*) is worth $96,306 and each one-point decline in team *ERA* raises *WINPCT* by .054. A team's *ERA* is not the sum of individual pitcher performances but a weighted average of individual ERA's – weighted by each pitcher's share of team innings pitched (*IP%*). Following

Medoff (1976), each pitcher's *ERA* productivity function is multiplied by personal *IP%* to obtain the following:

$$MRP \text{ pitcher} = \$96{,}306 * (.547 - (.054 * ERA)) * IP\% \qquad (5)$$

This equation implies that pitchers with an *ERA* above 10.30 will have a negative *MRP*. MacDonald and Reynolds (1994) calculate a pitcher with a career ERA over 5.34 will have a negative MRP. This difference may be explained, in part, by increased offensive production between the study periods.

Since the production function omits a number of potentially important inputs, the marginal revenue products of the players may be overstated. Some of these inputs include managerial ability, trading abilities, and stadium investment. Scully (1974) found little evidence to suggest any association of these inputs with *WINPCT*, however given the changes that have occurred in the 1990's this may no longer be the case. Unfortunately, these data are not readily available.

Table 6 provides a feel for the technique by producing some estimates of MRP and the actual salary for a set of players. The results show that a lower *ERA* and a higher percent of innings pitched will increase your MRP. The table shows four pitchers who are estimated to be overpaid and six who are underpaid. Those pitchers who are underpaid are underpaid a lot more than those who are overpaid. For hitters, the increase in runs created has an increase in MRP. The results show four hitters that are underpaid and six hitters that overpaid.

I next examine the relationship between estimated MRP and salary more formally by regressing salary on predicted MRP. That is I estimate:

$$salary_i = \alpha + \mu MRP_i + e_i \qquad (6)$$

where salary_i is the salary of player i and MRP_i is the estimated MRP. If baseball players are paid their marginal revenue products and the estimate of MRP is accurate, the estimate of μ should be equal to one: a one-dollar increase in MRP should result in a one-dollar increase in salary. To the extent there is measurement error in the estimate of MRP, estimates of μ will be biased downward.

Table 7 reports estimates of equation (6) for all major league baseball players from 1990-1999. The estimated *MRP* coefficient for all players is .493, which is significantly positive and different from zero. The coefficient suggests that baseball players receive .49 in marginal earnings per dollar of marginal revenue product. The coefficient is significantly different from 1 since $\frac{.44-1}{.014} = -40$. Thus, this literally suggests that players are "underpaid" since the coefficient is significantly less than one, suggesting that players are paid in accord to their marginal revenue product.

For hitters, the estimated *MRP* coefficient is .948, which is significantly positive and different from zero. However, the coefficient is significantly different from one at the 10% level. The coefficient suggests that hitters receive .948 in marginal earnings per dollar of marginal revenue product. The pitchers estimated *MRP* coefficient is .377, also significantly positive and different from one.

A second model was estimated including an interaction term for the post-strike period (post-strike*MRP). For all players, the MRP coefficient was .399, which is significantly positive and different from one. The coefficient on *POSTMRP* is .183, implying that players made .183 more in marginal earnings per dollar of marginal revenue product after the strike than before the strike. For hitters, the estimated MRP coefficient is .773. The coefficient on *POSTMRP*, is .256. This coefficient indicates that hitters received .256 more in marginal earnings per dollar of marginal revenue product after the strike than before the strike. For pitchers, the estimated *MRP* coefficient is .328 and is significant. The estimated *POSTMRP* coefficient is .097. Pitchers received .097 more in marginal earnings per dollar of marginal revenue product after the strike. Therefore the strike played a big role in the increase of major league players' salaries, or at least increased the correlation between salary and MRP.

The next regression included an interaction term including American League*MRP (ALMRP). All players had a MRP coefficient of .468. The coefficient on ALMRP was .051, which is significantly different from zero. Therefore players in the American League make .051 more per dollar of marginal revenue product. Pitchers have a *MRP* coefficient of .348 and a ALMRP coefficient of .050, which is significantly different from zero. Hitters have a *MRP* coefficient of .950, which is not significantly different from one, and an ALMRP coefficient of -.005. The coefficients on ALMRP show that pitching is more valued in the American League or that there is a higher premium placed on a given ERA.

The final salary regressions are run with hitters and pitchers who have salaries above and below the average salary of $1,400,000. The results are found in Table 8. Beginning with the upper salary bracket, hitters have an estimated *MRP* coefficient of .637, which is significant. Hitters making above the average salary receive .637 more in marginal earnings per dollar of marginal revenue product. This coefficient suggests that hitters above the average salary are underpaid. Hitters who make below the average salary have an estimated *MRP* coefficient of .075. This suggests that hitters making below the average salary are much underpaid. For pitchers, the estimated *MRP* coefficient is .210 and significant for those making above the average salary. Pitchers making below the average salary have an estimated *MRP* coefficient of .031. This estimate is significant. Pitchers below the average salary only make .03 earnings per dollar of marginal revenue product, indicating that they are greatly underpaid. These results show that both tiers of major league baseball players are greatly underpaid, but, consistent with previous research, younger players are paid a salary that is well below their contribution to team revenues as compared to older players.

VII. Conclusion

The purpose of this study is to determine if professional baseball players are paid accordingly to their marginal product. Estimating a team revenue regression and a winning percentage regression I calculate a player's marginal revenue product. The results indicate that professional baseball players are underpaid as compared to their contributions to team revenues. Players were paid closer to their marginal product post-strike and MRP's were about the same between leagues.

The goal of a well-designed sports league is to produce sufficient competitive balance. By this standard, Major League Baseball is not now well designed. What makes its current economic structure weak in the long run is that, year after year, too many clubs know in spring training that they have no realistic hope of reaching postseason play. This structure is negatively affecting the ability of most clubs to increase revenues and achieve operating stability. Too many clubs in low-revenue markets can only expect to compete for postseason berths if ownership is willing to incur staggering operating losses to subsidize a competitive player payroll (Levin et al. 2000).

If my MRP estimates are reasonable, there must be some explanations as to why owners are underpaying players as compared to his marginal revenue product. If my MRP estimates are correct, then exploitation of the players exists. The owners can misgauge a player's worth. This could lead to the underestimating of player expectations by the owners. These could easily lead to the underpayment of professional baseball players. If my MRP estimates are wrong, it could be the result of econometric bias. Another problem could be the use of wrong variables. Runs Created and ERA may not be the best statistic to measure offensive and pitching performance.

The Blue Ribbon Panel on Baseball Economics describes how the league needs to keep salaries low. They make suggestions to help out owners relative to the players. My results suggest the opposite. My results indicate that the league needs to raise the salaries. If my estimates are correct, the focus should be on helping players, relative to the owners, to help them receive their marginal revenue product.

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Table 1
RBI, Runs, and Runs Created of 1990 and 1999 RBI Leaders

	1990				1999		
Player	**RBI**	**R**	**RC**	**Player**	**RBI**	**R**	**RC**
Fielder, C.	132	104	170	Ramirez, M.	165	131	202
Williams, M.	122	87	113	Palmero, C.	148	96	204
Bonilla, B.	120	112	129	McGwire, M	147	118	229
Gruber, K.	118	92	121	Williams, M.	142	98	138
Carter, J.	115	79	102	Sosa, S.	141	114	183
Bonds, B.	114	104	191	Griffey Jr., K.	134	123	189
Strawberry, D.	108	92	143	DelGado, C.	134	113	157
McGwire, M.	108	87	142	Bichette, D.	133	104	138
Canseco, J.	101	83	136	Guerrero, V.	131	102	173
Sandberg, R.	100	116	156	Gonzlales, J.	128	114	155

Note: RBI are Runs Batted In, R is Runs Scored, and RC is Runs Created
Runs Created is calculated by:

$$RC = \frac{(Hits + Walks) * TotalBases}{AtBats + Walks}$$

Source: Baseball1.com – The Baseball Archive

Table 2
Team Revenues and Statistics from 1990-99

Team	REV	WINPCT	RC	ERA	OUT	CONT
Baltimore	97.5	.513	792.8	4.392	.300	.200
Boston	93.4	.523	803.6	4.246	.300	.300
California	61.9	.473	730.5	4.471	.400	.300
Chicago (AL)	76.4	.527	800.2	4.314	.200	.200
Cleveland	83.2	.534	851.8	4.380	.200	.600
Detroit	54.6	.452	775.9	5.011	.500	0
Kansas City	54.8	.470	738.5	4.418	.500	.100
Milwaukee	48.1	.477	751.9	4.466	.400	.100
Minnesota	47.8	.462	758.9	4.776	.500	.100
New York (AL)	130.3	.550	824.9	4.256	.300	.500
Oakland	61.1	.496	766.7	4.639	.200	.300
Seattle	63.2	.491	824.0	4.590	.200	.400
Tampa Bay	79.2	.407	760.8	4.705	.100	0
Texas	82.6	.517	826.3	4.619	.100	.500
Toronto	82.9	.513	786.0	4.275	.300	.400
Arizona	107.6	.509	814.5	4.205	.500	.500
Atlanta	85.9	.596	759.8	3.498	.100	.800
Chicago (NL)	80.1	.475	720.7	4.311	.200	0
Cincinnati	53.9	.523	770.2	4.018	.300	.300
Colorado	91.9	.478	875.8	5.344	.429	.286

Table 2 (continued)

Team	REV	WINPCT	RC	ERA	OUT	CONT
Florida	60.4	.442	683.5	4.397	.571	0
Houston	61.3	.524	746.9	3.824	.200	.300
Los Angeles	91.9	.513	705.9	3.692	.300	.600
Montreal	44.5	.504	708.4	3.848	.500	.200
New York (NL)	91.7	.493	706.1	3.891	.500	.200
Philadelphia	61.3	.471	712.7	4.298	.700	.100
Pittsburgh	48.0	.496	719.1	4.148	.400	.400
San Diego	56.9	.484	712.1	4.007	.200	.200
San Francisco	62.5	.506	736.8	4.222	.200	.200
Saint Louis	73.5	.487	730.5	4.122	.300	.200

Note: Revenues are in millions of 1999 dollars using the CPI Index
WINPCT is winning percentage, *RC* is Runs Created, *ERA* is Earned Run Average, *OUT* is a dummy variable for teams finishing twenty or more games out of first place in the division, and *CONT* is a dummy variable for teams finishing within five games of first place in the division.
California became Anaheim in 1997
Colorado and Florida entered the league in 1993, Arizona and Tampa Bay in 1998
Source: 1990-97 revenue data obtained from Rodney Fort, 1998 revenue data obtained from Blue Ribbon Panel on Baseball Economics, 1999 revenues obtained from Forbes, statistics obtained from The Baseball Archive at Baseball1.com

Table 3
Average Team Revenues and Statistics by Year

YEAR	REV	RC	ERA	OUT	CONT
1990	66.1	725.6	3.86	.308	.269
1991	70.8	720.5	3.91	.346	.192
1992	72.4	706.1	3.74	.423	.192
1993	73.1	776.7	4.18	.393	.214
1994	45.4	590.9	4.51	.071	.464
1995	55.1	728.3	4.45	.428	.321
1996	70.0	848.1	4.62	.214	.418
1997	82.1	817.7	4.39	.179	.321
1998	84.5	815.0	4.43	.433	.233
1999	94.6	865.0	4.71	.533	.267

[a] Revenue is measured in millions of dollars
WINPCT is winning percentage, *RC* is Runs Created, *ERA* is Earned Run Average, *OUT* is a dummy variable for teams finishing twenty or more games out of first place in the division, and *CONT* is a dummy variable for teams finishing within five games of first place in the division.
California became Anaheim in 1997
Colorado and Florida entered the league in 1993, Arizona and Tampa Bay in 1998
Source: 1990-97 revenue data obtained from Rodney Fort, 1998 revenue data obtained from Blue Ribbon Panel on Baseball Economics, 1999 revenues obtained from Forbes, statistics obtained from The Baseball Archive at Baseball1.com

Table 4
Average Salary Among Professional Baseball Players in Constant 1999 Dollars

Year	**Pitchers**	**Hitters**
1990	$763,856 (687,340)	$827,507 (745,348)
1991	$1,149,394 (1,135,239)	$1,122,047 (1,123,599)
1992	$1,320,195 (1,417,248)	$1,277,637 (1,411,698)
1993	$1,259,855 (1,492,623)	$1,257,828 (1,504,463)
1994	$1,249,382 (1,502,080)	$1,313,949 (1,545,810)
1995	$1,062,461 (1,643,588)	$1,213,318 (1,784,463)
1996	$858,016 (1,312,878)	$1,086,363 (1,623,599)
1997	$1,060,511 (1,512,825)	$1,304,520 (1,805,201)
1998	$1,221,230 (1,620,667)	$1,468,324 (1,989,561)
1999	$1,656,944 (2,004,616)	$1,748,757 (2,124,505)

Note: Standard deviations are in parentheses
Source: Salary data obtained from Rodney Fort

Table 5
Parameter Estimates of Team Revenue Function

Variable	Parameter Estimate	Standard Error
Intercept	43.252**	8.518
WINPCT	96.306***	13.640
National League	-2.766	10.782
Boston	-4.936	5.986
California	-31.762***	6.009
Chicago (AL)	-22.419***	5.988
Cleveland	-16.284***	6.043
Detroit	-36.981***	6.013
Kansas City	-38.497***	6.375
Milwaukee	-45.297***	6.025
Minnesota	-44.772***	6.006
New York (AL)	29.294***	5.990
Oakland	-34.636***	5.992
Seattle	-32.209***	5.985
Tampa Bay	-25.622**	10.601
Texas	-15.224**	5.985
Toronto	-14.460**	5.985
Arizona	-4.269	14.820
Atlanta	-16.750	12.418
Chicago (NL)	-10.971	12.326
Cincinnati	-41.741***	12.337

Table 5 (continued)

Variable	**Parameter Estimate**	**Standard Error**
Colorado	.109	12.615
Florida	-27.950**	12.629
Houston	-34.481***	12.338
Los Angeles	-2.816	12.332
Montreal	-49.302***	12.328
New York (NL)	-1.098	12.326
Philadelphia	-29.318**	12.327
Pittsburgh	-45.050***	12.327
San Diego	-34.972***	12.326
San Francisco	-31.527**	12.329
Saint Louis	-18.689	12.326
1991	4.672	3.712
1992	6.273*	3.712
1993	6.358*	3.655
1994	-21.286***	3.655
1995	-11.636***	3.655
1996	3.340	3.655
1997	15.439***	3.655
1998	17.284***	3.648
1999	27.436***	3.648

Note: *, **, *** indicate significance at the 90%, 95%, and 99* levels, respectively
Dependent variable is annual team revenue in millions of 1990 dollars
Source: 90-97 revenues-Rodney Fort, 1998 revenues-Blue Ribbon Panel, 1999 revenues-Forbes

Table 6
Estimates of MRP, Actual Salaries, and Production Statistics

PITCHERS

Player	YEAR	ERA	IP%	MRP	SALARY
Tim Belcher	1990	2.62	.14	$5,764,753	$573,604
Roger Clemons	1991	2.41	.19	7,487,971	3,180,323
Jeff Shaw	1992	8.22	.01	61,259	166,244
Kevin Appier	1993	2.56	.17	6,711,053	2,305,882
John Smiley	1994	3.86	.11	3,627,553	5,592,679
Dave Burba	1995	3.27	.04	1,575,915	655,906
Denny Neagle	1996	2.97	.16	4,777,413	2,442,192
Dennis Eckersly	1997	.61	.05	2,522,096	1,686,760
Jeff Nelson	1998	3.79	.03	946,522	1,805,684
Pedro Martinez	1999	2.07	.15	6,366,210	11,000,000

HITTERS

PLAYER	YEAR	RC	MRP	SALARY
Cal Ripken	1990	125.7	$2,848,908	$1,742,056
Billy Ripken	1991	22.9	520,020	856,241
Chris Sabo	1992	55.2	1,250,929	3,265,502
Ozzie Smith	1993	88.3	2,002,969	3,458,824
Javier Lopez	1994	38.4	871,398	125,533
Tony Gwynn	1995	133.9	3,035,192	5,037,719
Bill Spiers	1996	37.8	858,150	424,729
David Justice	1997	168.6	3,821,021	6,539,439
Sammy Sosa	1998	203.4	4,609,496	8,585,521
Ozzie Guillen	1999	28.1	657,806	500,000

Note: ERA is earned run average, IP% is percentage of team innings pitched, RC is runs created, MRP is estimated marginal revenue product in real 1999 dollars, and SALARY is the actual salary in real 1999 dollars
Source: Data obtained from Rodney Fort and Baseball1.com

Table 7
Salary Regressions on Major League Hitters and Pitchers

		a			*b*			*c*	
Variable	**All**	**Pitchers**	**Hitters**	**All**	**Pitchers**	**Hitters**	**All**	**Pitchers**	**Hitters**
Intercept	524060 (31098)	497614 (35772)	57970 (55899)	509632 (30863)	479670 (35809)	111348 (55634)	522645 (55925)	495962 (35746)	57744 (55925)
MRP	.493 (.014)	.377 (.014)	.948 (.029)	.399 (.016)	.328 (.016)	.773 (.035)	.468 (.016)	.348 (.017)	.950 (.033)
POSTMRP (POST*MRP)	-	-	-	.183 (.017)	.097 (.018)	.256 (.030)	-	-	-
ALMRP (AL*MRP)	-	-	-	-	-	-	.051 (.017)	.050 (.018)	-.005 (.029)
R^2	.155	.156	.247	.169	.162	.263	.156	.157	.247

Note: Regression *a* explains all players, regression *b* includes a dummy variable *POSTMRP* for MRP after the strike, and regression *c* includes a dummy *ALMRP* for MRP in the American League
Source: Data obtained from Rodney Fort

Table 8
Salary Regression of Major League Hitters and Pitchers [a]

	LOW		HIGH	
Variables	**Hitters** R^2 =.03	**Pitchers** R^2 =.017	**Hitters** R^2 =.137	**Pitchers** R^2 =.072
Intercept	351,474*** (14685)	341,172*** (9296.)	2,113,268*** (108690)	2,686,474*** (78920)
MRP	0.075*** (0.009)	0.031*** (0.005)	0.637*** (0.045)	0.210*** (0.023)

[a] The average salary from 1990-99 is $1,411,620.74. Players with salaries higher than the average are labeled 'HIGH' and players with lower than the average are labeled 'LOW'.
*** significant at 1% level
Source: Data obtained from Rodney Fort