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David Adler   April 6, 2011

Revenues vs. Wins: Motivations of General Managers in Major League Baseball

by

David Adler

David Frisvold
Adviser

Department of Economics

David Frisvold

Adviser

Hugo Mialon

Committee Member

Jose Soria

Committee Member

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Abstract

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Using data on free agent signings in Major League Baseball, this paper examines the value added by free agents to their new teams and develops a new statistic called Wins Above Current. By converting the Wins Above Current into dollar terms and comparing it to the difference in salaries between the old and new players, the signings can be classified as revenue maximizing or win maximizing. It is shown that both teams and individual signings are predominately revenue maximizing, indicating that the current policy of revenue sharing in Major League Baseball serves to weaken the competitive balance. A McFadden's choice regression determines revenue maximizing teams tend to pick players with more home runs, or players that will continue to bring fans and excitement to even non-competitive teams.

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I. Introduction

Fans assume that general managers are trying to build teams to win as many games as possible, but that may not be the case. While winning gets fans to the ballpark and thus increased attendance and total revenue, there is a price or cost of winning: the larger salaries paid to players with higher levels of performance. This may lead teams to cut costs and sign free agents that increase profits, but also weaken the teams' performance on the field. For this reason, Major League Baseball utilizes revenue sharing, which in theory is designed to help small market teams compete with large market teams by sharing revenue across the board so small market teams have the financial means to compete for players. According to the current Major League Baseball Collective Bargaining Agreement, thirty-one percent of local revenue from each team is pooled and split evenly among the thirty MLB teams, along with a portion of Major League Baseball's Central Fund based on their relative revenues. It has been suggested that the revenue-sharing in baseball actually gives incentives not to invest in the team, depending on whether teams are motivated by win maximization or revenue maximization (Késenne, 2006). And so the question we want to answer is: Do general managers aim to maximize wins or revenue?

This paper uses data from free agent signings during the offseasons prior to the 2007 and 2008 Major League Baseball seasons. By comparing the Wins Above Replacement of both the newly signed free agent and that of the player being replaced, we calculate the expected added value of the free agent in wins. This added value of the free agent is then put into a dollar equivalent using the going rate for a win and subsequently compared to the difference in salaries between the two players. Depending on whether this ratio is greater than or less than one, free agent signings are classified as either maximizing wins or revenue, respectively. There is a

roughly even mix of both, with revenue maximization shown to outweigh win maximization in both the number of teams (thirteen to eleven) and overall free agent signings (fifty-one to forty-five percent).[1] Based on these results and the theories stated in the existing literature, revenue sharing is not an effective policy in promoting competitive balance in Major League Baseball.

This paper provides the first empirical study of the maximization of revenues or wins through free agent signings. A statistic called Wins Above Current is created, and is calculated as the difference in the Wins Above Replacement values between a free agent and the player he replaces. Using this new statistic, a method is developed to determine whether free agent signings are revenue maximizing or win maximizing. Determinants of free agent added value and free agent signings are also analyzed for the first time.

II. Background Information

Alexander (2001) shows that Major League Baseball owners exhibit profit maximizing behavior by pricing tickets as monopolists despite the presence of other competing forms of entertainment, confirming Ferguson, Stewart, Jones and Dressay's (1991) earlier findings on owner pricing practices in the National Hockey League. However, an owner can be committed to maximizing wins with his team's roster while still exhibiting profit-maximizing behavior in his ticket pricing practices. Therefore, there is still a need to analyze the owner's behaviors in relation to his team's efforts to acquire and retain talent. To analyze the owner's impact on his team, we look at the general manager's decision making through their team's free agent signings. Scully (1974) sets the stage for future research by showing that a player's ability (measured using several offensive or pitching statistics, depending on the player's position) will affect team

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[1] The remaining four percent of signings were inconclusive, with the free agent's added value equaling the difference in salaries.

performance and increase gate receipts and broadcast revenue. Scully (1974) also develops the key assumption used in many subsequent articles that a player's salary should equal his marginal revenue product. Using this assumption, we will classify free agent signings as either revenue maximizing or win maximizing, and thus determine the motivations of owners and general managers. Kahane and Shmanske (1997) find significant decreases in attendance with increased roster turnover, suggesting an additional sales benefit for owners and general managers aiming to maximize revenues who choose not to sign talented, high-priced free agents. Krautman (1990) examines the effects a multi-year contract has on player effort and performance, noting that performance can vary greatly for a player from year to year. Krautman's research brings up a valid point of concern for the analysis to be performed in this paper, but by examining league-wide performance in multiple offseasons there should be sufficient data to effectively eliminate issues with performance variation.

By analyzing free agent signings to determine whether teams aim to maximize wins or revenue, we can also gain insight into the effectiveness of Major League Baseball's revenue sharing policy. There is a theoretical framework in place to describe the impact of revenue sharing on the competitive balance of baseball:

> "It has been shown by Szymanski and Késenne (2004) and Késenne (2005) that revenue sharing worsens the competitive balance in a Nash-contest model if clubs are profit maximizers. However, in a league where clubs are win maximizers…any revenue-sharing arrangement that includes a net transfer of club revenue from the large market club to the small market club will improve the competitive balance because the small market club will increase its demand for talent while the large market club reduces its demand, ceteris paribus."[2]

If teams are shown to maximize wins, then the revenue sharing in Major League Baseball can be considered an effective policy. However, if it is shown that teams instead aim to maximize

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[2] Késenne, Stefan (2006) "The Win Maximization Model Reconsidered: Flexible Talent Supply and Efficiency Wages." Journal of Sports Economics 7:4, 421.

revenues, then revenue sharing may not be an effective policy in maintaining the competitive balance of the league, and it would indicate the inefficiencies of the current Major League Baseball policies as stated in the current Collective Bargaining Agreement set to expire on December 11, 2011 (assuming we can accept their stated objective that the policies are designed to keep the league competitive).[3]

III. Data and Empirical Methods

To determine the impacts of free agent signings and roster turnover, a dataset was constructed with salary and player performance data from the 2006-2008 Major League Baseball seasons. Player salaries for the 2006, 2007 and 2008 seasons were taken from the website of renowned sports economist Rodney Fort, who compiled his data from the USAToday Salary Database. Also taken from Fort's website were teams' winning percentages and yearly attendance totals for the 162-game regular season gathered from ESPN.com and BaseballReference.com.[4] The population of the metropolitan statistical area (U.S.) or census metropolitan area (Toronto, Canada)[5] where the Major League Baseball teams' stadiums are located is included in *POPULATION* to account for greater attendance sizes due to larger

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[3] From Article XXIV Section B 5(a) of the most recent Major League Baseball Collective Bargaining Agreement: "A principal objective of the Revenue Sharing Plan is to promote the growth of the Game and the industry on an individual Club and on an aggregate basis. Accordingly, each Club shall use its revenue sharing receipts (from the Base Plan, the Central Fund Component and the Commissioner's Discretionary Fund) in an effort to improve its performance on the field." http://mlbplayers.mlb.com/pa/pdf/cba_english.pdf

[4] Attendance figures from the 2006 and 2008 seasons were taken from ESPN.com, while the 2007 season data came from BaseballReference.com. Statistics from both sites were the total attendance per team for each 162 game regular season, and the values appeared consistent across the two sources.

[5] The Toronto Blue Jays are the only Major League team not located in the United States, and thus the only team for which data on a census metropolitan area is not available. Statistics Canada provides data on census metropolitan areas, or an "[a]rea consisting of one or more adjacent municipalities situated around a major urban core [with] a population of at least 100,000." This definition is similar to the U.S. Office of Management and Budget definition of a metropolitan statistical area as an area containing "a core urban area of 50,000 or more population... [that] consists of one or more counties," and for this reason Toronto's census metropolitan area population was included.

populations.[6] Additional statistics about the profitability and earnings of teams such as gate

receipts, total revenue and operating income for each season were obtained from Fort's

collection of Forbes' yearly rankings of Major League Baseball franchises by value.

Player performance is measured independently for pitchers and position players. For

position players, both offensive and defensive statistics are used to measure a player's total

production and value to his team. Traditional baseball offensive statistics such as batting

average (*AVG*), home runs (*HR*), and runs batted in (*RBI*) make up only part of the dataset.

Sabermetric statistics for offense including On-base Plus Slugging (*OPS*) and Weighted Runs

Created (*wRC*) are also used to see how these advanced measures of performance are reflected in

player salaries.[7]

For pitchers, common measures of performance such as innings pitched (*IP*), wins (*W*),

saves (*S*), and earned-run average (*ERA*) are used. In addition, pitcher performance is also

estimated by a newer statistic that measures a pitcher's performance using league average rates

of both opponents' batting average on balls put in play and the timing of these hits (i.e. a single

with the bases loaded versus a single with no runners on) called fielding independent pitching

(*FIP*).[8] *FIP*, as its name suggests, values the pitcher independent of his team's fielding

performance behind him, so that pitchers' performances can be compared directly to one another

regardless of team. It is worth noting that while pitchers in the National League do take at-bats

and have opportunities to provide offensive contributions to their ballclub, these contributions

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[6] Due to the presence of multiple MLB teams in some metropolitan statistical areas (Chicago, Los Angeles, New York, and Oakland and San Francisco), there are some population values that are not exclusive to one team.

[7] OPS is the sum of On-Base Percentage (OBP) and slugging percentage (SLG). OBP = (H+BB+HBP) / (AB+BB+HBP+SF), and SLG is the number of total bases divided by total at-bats, or ([Singles] + [Doubles * 2] + [Triples * 3] + [Home Runs * 4]) / (At-bats). The formula for wRC is: $(((wOBA - lgwOBA) / wOBAScale) + (lgR/PA)) * PA$. <http://www.fangraphs.com/blogs/index.php/wrc-and-wraa/>

[8] The formula for FIP is $((13*HR) + (3*(BB+HBP-IBB))-(2*K))/IP + constant$, where the constant is a value used to scale FIP to ERA. <http://www.fangraphs.com/library/index.php/pitching/fip/>

are assumed to be negligible and have been excluded from this analysis. A set of dummy

variables representing the divisions in Major League Baseball have been included to account for

any unmeasured aspects of player salary due to the league or division in which the player is

participating. A statistically significant positive coefficient on one of the National League

division variables could indicate that pitchers are being additionally compensated for their

performances offensively.[9]

The production of position players and pitchers are measured using WAR, or Wins

Above Replacement. Since 2008, the winners of the Cy Young (best pitcher) and Most Valuable

Player awards have gone to players ranked in the top 3 in their respective league in Wins Above

Replacement on FanGraphs.com. Wins Above Replacement encompasses all aspects of a

player's performance and is measured for both position players and pitchers.[10] For position

players, it includes their Ultimate Zone Rating (UZR), which measures the range and fielding

ability of the players by determining the number of runs saved or given up by their play in the

field weighted by position played. It also includes players' weighed Runs Above Average

(wRAA), a statistic that measures the offensive value of a player to his team by providing the

number of runs a player contributes to his team above what an average player would contribute.

For pitchers, rather than looking at their wins total for the season, the statistic is based off of the

previously discussed Fielding Independent Pitching (*FIP*). WAR gives the win value of a player

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[9] The default division for the set of division dummy variables is the American League East.

[10] Unlike the other statistics used in this paper, the calculation of WAR is not found in a simple formula.
FanGraphs.com describes how it calculates the WAR values used in this paper's analysis: "Offensive players –
 Take wRAA and UZR (which express offensive and defensive value in runs above average) and add them together.
Add in a positional adjustment, since some positions are tougher to play than others, and then convert the
numbers so that they're not based on league average, but on replacement level (which is the value a team would
lose if they had to replace that player with a 'replacement' player – a minor leaguer or someone from the waiver
wire). Convert the run value to wins (10 runs = 1 win)…
Pitchers – Where offensive WAR used wRAA and UZR, pitching WAR uses FIP. Based on how many innings a pitcher
threw, FIP is turned into runs form, converted to represent value above replacement level, and is then converted
from runs to wins." <http://www.fangraphs.com/library/index.php/misc/war/>

to his team, and can thus be compared across teams and time. Some general summary statistics from the dataset are presented in **Table 1**.

To determine whether general managers are maximizing revenue or wins, we use players' WAR to calculate a new statistic to be called Wins Above Current (WAC). Wins Above Current is an estimation of the number of wins a player brought in to a new team will provide above the number of wins added by the previous player at that position. The calculation of WAC is based on the Wins Above Replacement statistics for both players from the previous year. For example, the Kansas City Royals signed outfielder Jose Guillen in 2008, who posted a WAR in 2007 of +2.4 as a member of the Seattle Mariners. He was signed by the Royals to replace previous left fielder Emil Brown, whose 2007 WAR was +0.3. So, the WAC of the signing would be 2.4 – 0.3 = +2.1. Summing up the WAC of each signing to the Major League ballclub as in the example will give the projected number of wins added or lost to a team through player personnel decisions compared to the previous season.

Table 1: Selected Summary Statistics

	N	Mean	Std. Dev.	Min	Max
Salary	2399	$3,027,396	$3,949,910	$327,000	$28,000,000
Attendance[11]	90	2,599,969	723,962.3	1,165,120	4,298,655
Gate Receipts*	90	67.63	40.58	16	27
Total Revenue*	90	182.43	42.49	122	375
Operating Income*	90	16.54	13.99	-47.3	43.7
Population[12]	90	5,771,659	4,533,624	1,540,301	18,968,501
WAR	2399	1.24	1.75	-1.7	9.3
BA	1004	.270	.032	.137	.364
OBP	1004	.338	.038	.238	.480
SLG	1004	.428	.075	.229	.671
OPS	1004	.766	.104	.490	1.115
HR	1004	13.05	10.23	0	58
RBI	1004	55.36	29.52	7	156
wRC	1004	98.40	26.52	27	184
W	1006	5.72	4.86	0	22
SV	1006	3.25	9.03	0	62
ERA	1006	4.44	1.43	0.92	11.63
K/9	1006	6.86	1.98	2.78	13.92
FIP	1006	4.45	1.01	1.68	8.90

*Values in $(millions)

**Minimum 150 plate appearances for position players, 20 innings pitched for pitchers, excluding WAR and Salary data

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[11] Values are yearly attendance data according to ESPN.com (2006, 2008) and BaseballReference.com (2007).
[12] Estimated populations of Metropolitan Statistical Areas (U.S.) and Census Metropolitan Areas (Canada)

IV. Results

A breakdown of the WAC of free agent signings prior to the 2007 and 2008 seasons by year and team is shown in **Table 2**. The Baltimore Orioles led all teams with six of their free agent signings having a WAC greater than zero prior to the 2007 season. On the other side, Colorado signed four players before the 2008 season with a negative WAC. The Orioles were unable to follow up their aggressive offseason prior to the 2007 season with additional success, ending up with only about half of their free agent signings having a positive WAC. The teams that had the greatest percentage of positive WAC signings were the Los Angeles Angels at 80%, followed by the Atlanta Braves at 75% and the Kansas City Royals with a little over 70%. Detroit was the only team that made free agent signings over the observed period with no positive WAC signings, and not surprisingly was tied for having the most negative WAC signings along with the notoriously cheap Florida Marlins and Oakland Athletics.

By looking at the player's Wins Above Replacement from the previous year, we can compare their projected wins above what a team currently has at the position to the projected revenue gain (i.e. their salary which by assumption is their marginal revenue product). In other words, we calculate the rate of wins/salary (the going rate for a win), and determine whether the players teams sign are "overpaid" for wins, or if they are being signed as cost-cutting measures to increase team revenue. We use the going rate for a win from Fangraphs.com of $4.1 mil/win in 2007 and $4.5 mil/win in 2008, where the rates were calculated by dividing the sum of all contracts paid to free agents in each offseason by the players' average win values from the previous three seasons and multiplying by an aging factor of .95. Multiplying the going rate for a win in each season by the WAC of the free agent signing gives the added value of the free

Table 2: Free Agent Signings by Team[13]

Team:	N	WAC > 0				WAC < 0				WAC	
		07	08	All	%	07	08	All	%	Min	Max
Arizona	0	0	0	0	0.00	0	0	0	0.00	NA	NA
Atlanta	4	2	1	3	75.00	1	0	1	25.00	-1.1	1.4
Baltimore	11	6	0	6	54.55	2	0	2	18.18	-.7	1.1
Boston	12	5	2	7	58.33	1	0	1	8.33	-.1	3.4
CHI Cubs	12	4	1	5	41.67	2	0	2	16.67	-.7	3.5
CHI White Sox	4	1	0	1	25.00	0	1	1	25.00	-.1	.2
Cincinnati	9	2	2	4	44.44	1	3	4	44.44	-1.4	2.1
Cleveland	6	4	0	4	66.67	0	1	1	16.67	-.5	1.2
Colorado	12	2	0	2	16.67	2	4	6	50.00	-1.2	1.1
Detroit	3	0	0	0	0.00	2	0	2	66.67	-1	0
Florida	3	0	1	1	33.33	1	1	2	66.67	-2.8	1.6
Houston	12	4	3	7	58.33	1	2	3	25.00	-1.2	3.2
Kansas City	7	2	3	5	71.43	0	1	1	14.29	-.1	2.1
LA Angels	5	3	1	4	80.00	1	0	1	20.00	-.2	3.2
LA Dodgers	11	4	2	6	54.55	2	1	3	27.27	-.3	3.7
Milwaukee	7	1	3	4	57.14	2	1	3	42.86	-.9	1
Minnesota	7	1	2	3	42.86	1	1	2	28.57	-2.1	1.6
NY Mets	13	5	2	7	53.85	3	1	4	30.77	-1.4	3.5
NY Yankees	13	2	2	4	30.77	0	1	1	7.69	-.5	2.4
Oakland	6	1	1	2	33.33	2	2	4	66.67	-1.4	1
Philadelphia	8	3	2	5	62.50	0	2	2	25.00	-4	3.2
Pittsburgh	3	0	2	2	66.67	1	0	1	33.33	-.2	1.4
San Diego	10	1	2	3	30.00	3	2	5	50.00	-2.7	2.5
San Francisco	11	4	1	5	45.45	2	0	2	18.18	-1.9	3.6
Seattle	7	2	2	4	57.14	2	1	3	42.86	-1.8	2.3
St. Louis	15	3	2	5	33.33	3	1	4	26.67	-1.5	1
Tampa Bay	5	1	2	3	60.00	0	2	2	40.00	-.8	2.4
Texas	10	3	3	6	60.00	3	0	3	30.00	-1.6	2.4
Toronto	9	3	3	6	66.67	2	0	2	22.22	-2.5	2.2
Washington	11	0	4	4	36.36	2	2	4	36.36	-1	1.3
TOTAL:	245	69	49	118	48.16	42	30	72	29.39	-4	3.7

agent signed in dollar form. This can now be compared to the difference between the salaries of the free agent and the incumbent player who he is replacing to determine whether the signing is revenue maximizing or win maximizing.

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[13] Fifty-five free agent signings had a WAC equal to zero.

As an example, suppose a team signs a free agent third baseman for $5 million less than the team's previous third baseman. If the free agent's additional value to his new team, compared to that of the previous third baseman, is -$6 million, then the signing is considered revenue maximizing. From the team's perspective, they are reducing payroll by $5 million at a cost of more than $5 million in the team's expected performance on the field. This type of signing indicates willingness by ownership and the front office to sacrifice wins on the field for revenues in pocket, or revenue maximizing behavior. Now suppose the free agent signs for $5 million less but his value to his team above the third baseman he is replacing is only -$4 million. The team is in this scenario reducing payroll by $5 million at a cost of less than $5 million in the team's expected performance. Even though the team is reducing payroll, it is not decreasing estimated performance on the field by as large an amount and therefore is exhibiting win maximizing behavior. Suppose now a free agent starting pitcher has been signed for $5 million more than the team's previous pitcher. If the added value to his team is only $4 million, then the signing can be classified as win maximizing because the team is willing to pay above and beyond the player's contribution to the overall level of production. Conversely, when the free agent's added value to the team is greater than $5 million, the signing would be considered revenue maximizing. [14] To summarize:

*(1) |Salary Free Agent – Salary Incumbent| < |WAC * $ rate/win| → Revenue Maximizing*

*(2) |Salary Free Agent – Salary Incumbent| > |WAC * $ rate/win| → Win Maximizing*

Signings of free agents prior to the 2007 and 2008 seasons by team are classified as discussed above and listed by team in **Table 3**.

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[14] The key assumption here is that the market for talent in free agency is competitive, and therefore there is no such thing as a "good deal." If a player was worth more or less than the salary he is being paid, someone else would pay it and profit.

The San Francisco Giants made the most revenue maximizing signings in one offseason with seven prior to the 2007 season, and are tied with the Toronto Blue Jays and Washington Nationals for the most revenue maximizing signings overall with eight. Almost 90% of the Blue Jays' free agent signings were revenue maximizing, which certainly signals the front office put a premium on maximizing revenues above fielding a team better suited to compete with the likes of the Boston Red Sox and New York Yankees in the American League East. Other teams showing a strong tendency towards revenue maximization over win maximization are the Los Angeles Angels, the Philadelphia Phillies, the San Francisco Giants, and the Washington Nationals (with 80%, 75%, 73%, and 73% revenue maximizing signings respectively). The St. Louis Cardinals, meanwhile, demonstrated a willingness to spend to be competitive, with eight win maximizing signings in 2007 and a total of nine over the two offseasons, the most in Major League Baseball during this period. The Chicago White Sox were also committed to winning, with 100% win maximizing signings during the observed period. Five teams were tied with the second highest percentage of win maximizing signings at two-thirds, ranging from the free spending New York Yankees on one end of the spectrum to the frugal Oakland Athletics at the other. In all, thirteen teams displayed predominately revenue maximizing tendencies, compared to eleven teams whose win maximizing signings made up more than half of their total free agent signings. For the league as a whole, 51% of free agent signings during the two offseasons were revenue maximizing and 45% were win maximizing.

Now that we've identified which teams aim to maximize revenues and which spend money to win, we want to determine what contributes to the signing of these free agents. To do that, we will first look at what factors determine signings of higher quality free agents, based on the free agent's added value above replacement:

Table 3: Types of Free Agent Signings by Team[15]

Team:	Signed			Revenue Maximizing				Win Maximizing			
	07	08	All	07	08	All	%	07	08	All	%
Arizona	0	0	0	0	0	0	-	0	0	0	-
Atlanta	3	1	4	2	0	2	50.00	1	1	2	50.00
Baltimore	10	1	11	5	1	6	54.55	4	0	4	36.36
Boston	8	4	12	5	2	7	58.33	3	2	5	41.67
CHI Cubs	10	2	12	6	1	7	58.33	4	1	5	41.67
CHI White Sox	2	2	4	0	0	0	0.00	2	2	4	100.00
Cincinnati	4	5	9	3	1	4	44.44	1	4	5	55.56
Cleveland	5	1	6	4	0	4	66.67	1	1	2	33.33
Colorado	7	5	12	2	2	4	33.33	5	3	8	66.67
Detroit	2	1	3	0	0	0	0.00	2	0	2	66.67
Florida	1	2	3	0	1	1	33.33	1	1	2	66.67
Houston	5	7	12	3	3	6	50.00	2	3	5	41.67
Kansas City	3	4	7	0	3	3	42.86	3	1	4	57.14
LA Angels	4	1	5	4	0	4	80.00	0	1	1	20.00
LA Dodgers	8	3	11	3	3	6	54.55	5	0	5	45.45
Milwaukee	3	4	7	2	1	3	42.86	1	3	4	57.14
Minnesota	4	3	7	2	1	3	42.86	1	2	3	42.86
NY Mets	9	4	13	4	2	6	46.15	5	2	7	53.85
NY Yankees	5	7	12	3	0	3	25.00	2	6	8	66.67
Oakland	3	3	6	1	1	2	33.33	2	2	4	66.67
Philadelphia	4	4	8	4	2	6	75.00	0	2	2	25.00
Pittsburgh	1	2	3	0	2	2	66.67	1	0	1	33.33
San Diego	6	4	10	3	2	5	50.00	3	2	5	50.00
San Francisco	10	1	11	7	1	8	72.73	2	0	2	18.18
Seattle	4	3	7	1	3	4	57.14	3	0	3	42.86
St. Louis	10	5	15	2	3	5	33.33	8	1	9	60.00
Tampa Bay	1	4	5	1	2	3	60.00	0	2	2	40.00
Texas	7	3	10	4	1	5	50.00	3	2	5	50.00
Toronto	6	3	9	5	3	8	88.89	1	0	1	11.11
Washington	4	7	11	3	5	8	72.73	0	1	1	9.09
TOTAL:	119	96	245	79	46	125	51.02	66	45	111	45.31

$(3) Value = f$ (salary difference, attendance, revenue, division, awards, win percentage, δ)

where *Value* is a free agent's value above the player he is replacing, measured as WAC

multiplied by the going rate for a win in that season, *salary difference* is the difference in salaries

used above of (salary free agent – salary incumbent), *attendance* is yearly regular season

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[15] For nine free agent signings, the difference in salaries equaled the estimated dollar value of the new player.

attendance for each team, *revenue* is a team's total year-end revenue, *division* is a series of dummy variables representing the divisions in Major League Baseball, with the default being the American League East, *awards* is a dummy variable equal to 1 if a player received a Gold Glove, Silver Slugger, Cy Young, Rookie of the Year, or Most Valuable Player award from 2006-2008,[16] *win* percentage is team winning percentage, and δ denotes all other variables. First we perform an ordinary least squares regression of *(3)* for all free agent signings, and then we run separate regressions for position players and pitchers. The results of the three regressions are presented in **Table 4**.

The overall regression found a team's player expenses, *salary difference*, and *awards* to be statistically significant at the 5% level and positively correlated with *Value*. *Revenue* was significant at the 10% level, and interestingly was negatively correlated with free agent added value. This could be a result of teams with higher total revenues generally being teams with higher winning percentages, and therefore teams that when adding talent will not have the same added value compared to weaker teams with lower revenues. For example, when the Yankees re-signed Mariano Rivera in 2008 he had no added value because he replaced himself, but if Rivera had signed with the Orioles he would have had an added value of over $13 million.[17] *Revenue* was also found to be statistically significant in the regression of position player free agents at the 10% level. A player's number of plate appearances in a season and the metropolitan area's population were significant at the 5% level, and both were positively

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[16] The Gold Glove award is given to the best defensive player at his position in the American League and the National League. The Silver Slugger is awarded to the best offensive player at his position for each league. The Cy Young award is given to each league's best pitcher, and the Rookie of the Year award is presented to the best rookie in the American and National Leagues.

[17] Rivera's 2007 WAR was 2.2, compared to say the Orioles Danys Baez with a WAR in '07 of -0.8. Multiplying Rivera's WAC of 2.2 – (-0.8) = 3.0 by the going rate for a win in 2008 of $4.5 million gives $13.5 million.

Table 4: Regression Results using Free Agent Value as Independent Variable[18]

Dependent Variable	All	Std. Error	Hitters	Std. Error	Pitchers	Std. Error
Salary Free Agent – Salary Incumbent	0.000229	(0.000104)	0.0001079	(0.000175)	0.000404	(0.000129)
Team Win Percentage	617.925	(6152.724)	-2563.314	(9619.791)	2125.374	(7882.62)
Yearly Attendance	-0.000952	(0.00114)	-0.0000947	(.001979)	-0.00123	(0.00131)
Population	0.000163	(0.000126)	0.0004861	(0.000194)	-0.00019	(0.000151)
Year	42.326	(719.122)	904.627	(1238.992)	471.617	(864.495)
Gate Receipts	17.568	(27.926)	32.326	(40.552)	21.869	(39.127)
Total Revenue	-61.112	(32.798)	-90.162	(49.474)	-43.070	(44.042)
Player Expenses	61.889	(30.376)	39.222	(50.654)	75.424	(34.885)
Award winner (2006-2008)	6543.708	(2619.919)	2923.541	(3885.200)	11814.19	(4161.888)
AL Central	196.263	(1379.435)	88.071	(2280.395)	214.030	(1620.006)
AL West	-139.271	(1354.191)	-2554.547	(2061.664)	2075.983	(1636.563)
NL East	686.830	(1575.598)	-839.262	(2556.772)	2977.758	(2005.797)
NL Central	209.787	(1362.434)	-967.450	(2323.240)	662.636	(1622.579)
NL West	1332.342	(1551.350)	-510.883	(2540.321)	1623.574	(1958.260)
Games Played	-	-	-52.284	(34.689)	-	-
Plate Appearances	-	-	19.681	(8.211)	-	-
Avg on Balls In Play	-	-	13308.69	(15880.08)	-	-
Weighted On-Base Average	-	-	139140.7	(108015.6)	-	-
Weighted Runs Created	-	-	-232.423	(164.062)	-	-
Wins	-	-	-	-	-116.08	(211.175)
Saves	-	-	-	-	-5.234	(50.892)
Games Started	-	-	-	-	36.749	(68.600)
Earned Run Average	-	-	-	-	367.845	(282.407)
Fielding Independent Pitching	-	-	-	-	-810.860	(410.768)
Constant	-79300.29	(1443005)	-1833426	(2495511)	-943206	(1733877)
N	245		133		112	
R^2	0.0974		0.2062		0.2627	
Adj-R^2	0.0425		0.0727		0.1105	

correlated with *Value*. More plate appearances provide increased opportunities for a player to

produce offensively, while the significant positive coefficient on population holding *attendance*

constant could be illustrating the impact of TV revenues in the surrounding market. Or, perhaps

it is indicative of the appeal of teams in denser populated areas to the top free agents. It is worth

[18] The dependent variable is *Value*/1000 (used solely for scaling purposes).

noting here that free agents are free to select any team willing to take on their services, and if a star player is going to receive millions of dollars he might reasonably prefer to live as a twenty- or thirty-something in the New York or San Francisco area as compared to Kansas City or Milwaukee. The regression of free agent pitchers provided results consistent with the previous regressions, with player expenses, *salary difference*, and *award* all statistically significant at the 5% level. There was also a significant negative correlation between *Value* and FIP that accurately reflected the pitching statistic's measure of ability on value.

While these regression results help explain what contributes to the added free agent value, we still want to determine what motivates general managers to sign revenue maximizing free agents versus win maximizing ones. Instead of using standard OLS, we want to look at a discrete choice model to see what factors influence general managers' decisions to sign revenue maximizing or win maximizing free agents. We use a conditional fixed effects logistic model, or a McFadden's choice model:

(4) Max revenue = f (salary, attendance, revenue, division, win percentage, α)

where *Max revenue* is a dummy variable equal to 1 if a free agent signing is revenue maximizing, *salary* is a player's annual salary, *attendance*, *revenue*, *division*, and *win percentage* are defined as in *(3)*, and *α* corresponds to all other variables. For position players, in addition to the independent variables in *(4)* we include the number of games played, number of plate appearances, batting average on balls in play, number of home runs(*HR*), and number of stolen bases(*SB*). The theory for including *HR* and *SB* is that general managers may be more willing to spend money on free agents whose individual play on the field will get fans excited about their team even when the team is not winning (i.e. big home run hitters and speedsters). Similarly for pitchers, in addition to the independent variables in *(4)* we include wins, saves, games started,

innings pitched, earned run average, ground ball percentage(*GB%*),[19] and strikeouts per nine

innings pitched(*K/9*). *K/9* is included because of the excitement surrounding pitchers who amass

large strikeout totals in a game (as evidenced by the tradition of posting the number of K's for

the home team's pitcher in the stadium), and *GB%* is used as well since general managers may

wish to add pitchers who are less likely to give up home runs to the opponent. The results of the

conditional fixed effects logistic models are presented in **Table 5**.

.An increase in total revenue makes it more likely that a team would be willing to spend

money to win now with a decreased need to maximize revenue, and *revenue* is found to be

statistically significant at the 10% level and negatively correlated with free agent signings that

are revenue maximizing in the McFadden's choice conditional logistic model. Home runs are

positively correlated with *Max revenue* and statistically significant at the 5% level, and the

finding lends weight to the theory that general managers are attracted to the statistics that make

the headlines even above wins. Therefore, free agents with more home runs are predicted to be

signed by revenue maximizing teams looking to hold on to their fan base while cutting costs.

GB% is also positively correlated with *Max revenue* and significant at the 10% level, as general

managers look for pitchers who can foster hope in the team by keeping the ball in the ballpark at

minimal cost. While *GB%* could also be argued to be important for a win maximizing team,

more useful are pitchers who will pitch deep into games and provide many productive innings on

the field. This hypothesis is confirmed as innings pitched is negatively correlated with *Max*

revenue. A pitcher with a higher *GB%* could be effective in preventing an opponent from hitting

home run after home run (something that would turn off the casual fan to the team), but in

limiting the number of home runs he will inevitably increase the number of base hits allowed as

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[19] Ground ball percentage is a pitching statistic that refers to the percent of batted balls that are hit on the ground. "GB%, LD%, FB%," *FanGraphs.com* <http://www.fangraphs.com/library/index.php/pitching/batted-ball/>

Table 5: McFadden's Choice Model of Free Agent Signings by Type

Dependent Variable	All	Std. Error	Hitters	Std. Error	Pitchers	Std. Error
Salary	3.95E-11	(4.33E-08)	2.44E-08	(7.50E-08)	-1.49E-07	(1.01E-07)
Team Win Percentage	-0.834	(2.647)	-1.09	(3.66)	-0.398	(5.01)
Yearly Attendance	9.89E-08	(4.72E-07)	4.13E-07	(7.26E-07)	-2.73E-07	(7.59E-07)
Population	-2.81E-09	(4.90E-08)	8.06E-08	(7.06E-08)	-1.09E-07	(8.70E-08)
Year	-0.00909	(0.307)	0.503	(0.465)	-0.478	(0.522)
Total Revenue	-0.0217	(0.0123)	-0.0314	(0.0173)	-.0262	(0.0243)
Player Expenses	0.0172	(0.0133)	0.0138	(0.0199)	0.0417	(0.0251)
Award winner (2006-2008)	0.270	(1.17)	-2.59	(1.70)	-	-
AL Central	-1.08	(0.610)	-0.588	(0.970)	-0.865	(0.999)
AL West	-0.439	(0.579)	-1.71	(0.865)	1.19	(0.973)
NL East	0.346	(0.688)	-0.168	(1.01)	1.80	(1.27)
NL Central	-0.609	(0.590)	-0.568	(0.912)	0.0880	(0.964)
NL West	-0.229	(0.671)	-0.728	(0.999)	1.34	(1.18)
Games Played	-	-	-0.00694	(0.0153)	-	-
Plate Appearances	-	-	-0.00169	(0.00425)	-	-
Avg on Balls In Play	-	-	6.83	(5.12)	-	-
Home Runs	-	-	0.0997	(0.0489)	-	-
Stolen Bases	-	-	0.0324	(0.0294)	-	-
Wins	-	-	-	-	0.159	(0.152)
Saves	-	-	-	-	0.0329	(0.0339)
Games Started	-	-	-	-	0.0941	(0.0647)
Innings Pitched	-	-	-	-	-0.0282	(0.0158)
Earned Run Average	-	-	-	-	0.00532	(0.130)
Ground Ball %	-	-	-	-	5.30	(2.99)
Strikeouts per 9 Innings Pitched	-	-	-	-	0.0465	(0.126)
N	236		128		108	
Pseudo R^2	0.0346		0.1038		0.1554	

more balls are put in play. This in turn will lead to fewer innings pitched over the course of the season as the pitcher faces more batters. Pitchers with increased innings total are more valuable to teams looking to win now, as they help ease the load on the other pitchers on the team and are more consistent than pitchers with lower innings totals.

V. Conclusions

This paper compared the WAR and difference in salaries of free agents and the players they were replacing in the offseasons prior to the 2007 and 2008 Major League Baseball seasons. The number of teams that made predominately revenue maximizing free agent signings outnumbered those teams that were win maximizing, and the overall percentage of signings that were revenue maximizing was greater than the percentage of win maximizing signings (51% to 45%). Determinants of free agents' added value include a team's player expenses, whether the player had won an award recently, and the population of the surrounding metropolitan area (even holding attendance constant). Instead of improving their ballclub, teams with low total revenues use the money they receive from Major League Baseball's revenue sharing policy to make revenue maximizing free agent signings that increase total profits. Teams that choose to maximize revenue are more likely to sign home run hitters and pitchers that can keep the ball on the ground and inside the ballpark to keep casual fans interested in the team. While these players have value to a team, they are not the players that help an organization maximize their team's win total in a season. Pitchers who contribute a high number of innings pitched in a season are the type of players seen to be targeted by win maximizing teams. With over 50% of teams and free agent signings maximizing revenue, the theory in recent literature combined with our results indicate that Major League Baseball's existing revenue sharing policy in the current Collective Bargaining Agreement is ineffective in improving the competitive balance in baseball.

Future research could look at additional factors in the signings of free agents, such as player age at the time of free agency and years of service time in the Majors, and could include trades in the data analysis. Additionally, future researchers may be interested in examining a longer period of time than two offseasons, although it would be necessary to account for changes

in GMs or other factors such as teams that encounter other financial and legal troubles requiring changes in ownership (e.g. the New York Mets during this past offseason) that would become a factor over time.[20]

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[20] Belson, Ken and Sandomir, Richard (2011) "Mets Had Money Trouble Before Lawsuit Was Filed," New York Times March 9, 2011. http://www.nytimes.com/2011/03/10/sports/baseball/10wilpon.html?_r=1

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