Major League Baseball: Paying More For Less Performance?

Ben Hovey, David Agard, Joseph Nolan

Introduction

The capitalist system continually demands that people get 'more bang for the buck', but such a concept seems absent in the realm of sports contracts.

This study examines salaries per annum and player performance in Major League Baseball, focusing on relationships with age and a player's position. Fans, front offices, and contract-based fantasy players may find the relationships uncovered to be of particular interest.

Data

Data were collected for Major League Baseball (MLB) covering the 2000–2013 seasons.[1] Variables recorded include annual salary (adjusted for inflation), age, position, and wins above replacement (WAR).[2]

The final data set, used for all analyses, consisted of no less than 20 players at each age. Only players with six or more seasons of play within the time frame 2000–2013 were included.
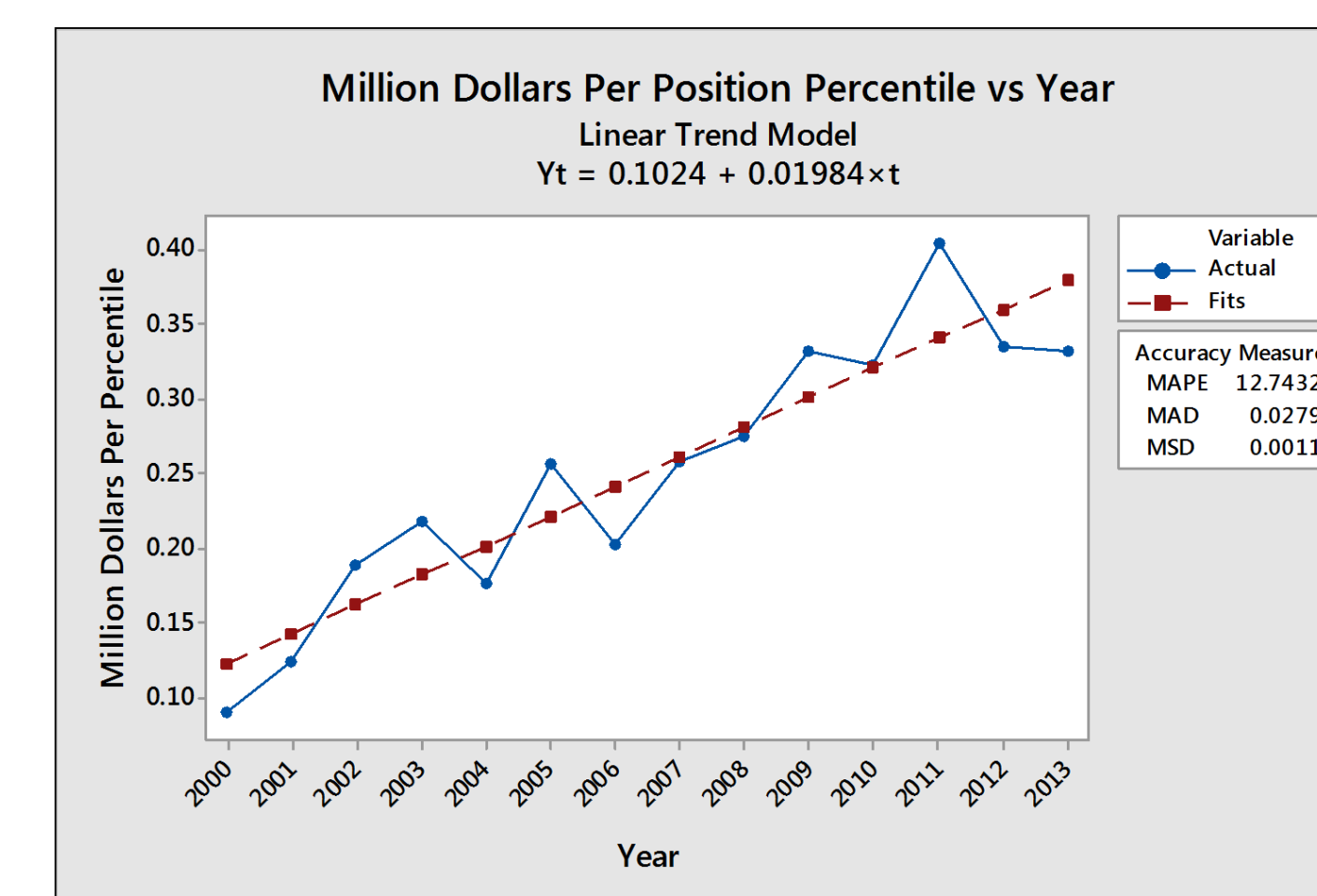
Methods

Time series trend-analysis was used to analyze the relationship between salary (in millions of dollars) per positional WAR percentile by year (salary/WAR). A general linear model was employed to explore the relationship between salary/WAR and age, position, and their interaction. In addition, graphics were used to visually compart trends in performance and salary across different ages.

1. All data collected from www.baseball-reference.com
2. WAR is a single number that presents and estimate of the number of wins the player added to the team above what a replacement player would add.

Results

A time series trend-analysis of salary per performance across the period 2000 to 2013. A trend of paying more per performance in major league baseball is evident even after appropriate adjustment for inflation has been made. The trend was analyzed using time series methods and a significant first-order auto regressive time series model was evident (t=6.25, p<0.0005).

Million Dollars Per Position Percentile vs Year — Linear Trend Model — $Yt = 0.1024 + 0.01984 \times t$

An analysis of covariance model fit to salary/WAR vs age, allowing for differences in position. The model indicates a quadratic relationship to age and the interaction between the age and position of a player were found to be significant (F=528.25, p<0.0005 and F=12.04, p<0.0005, respectively).

For all positions, there is clear evidence of paying higher salary relative to performance as a player advances in age. At some point, this starts to decline again, but this is very close to the end of a very typical player's career.
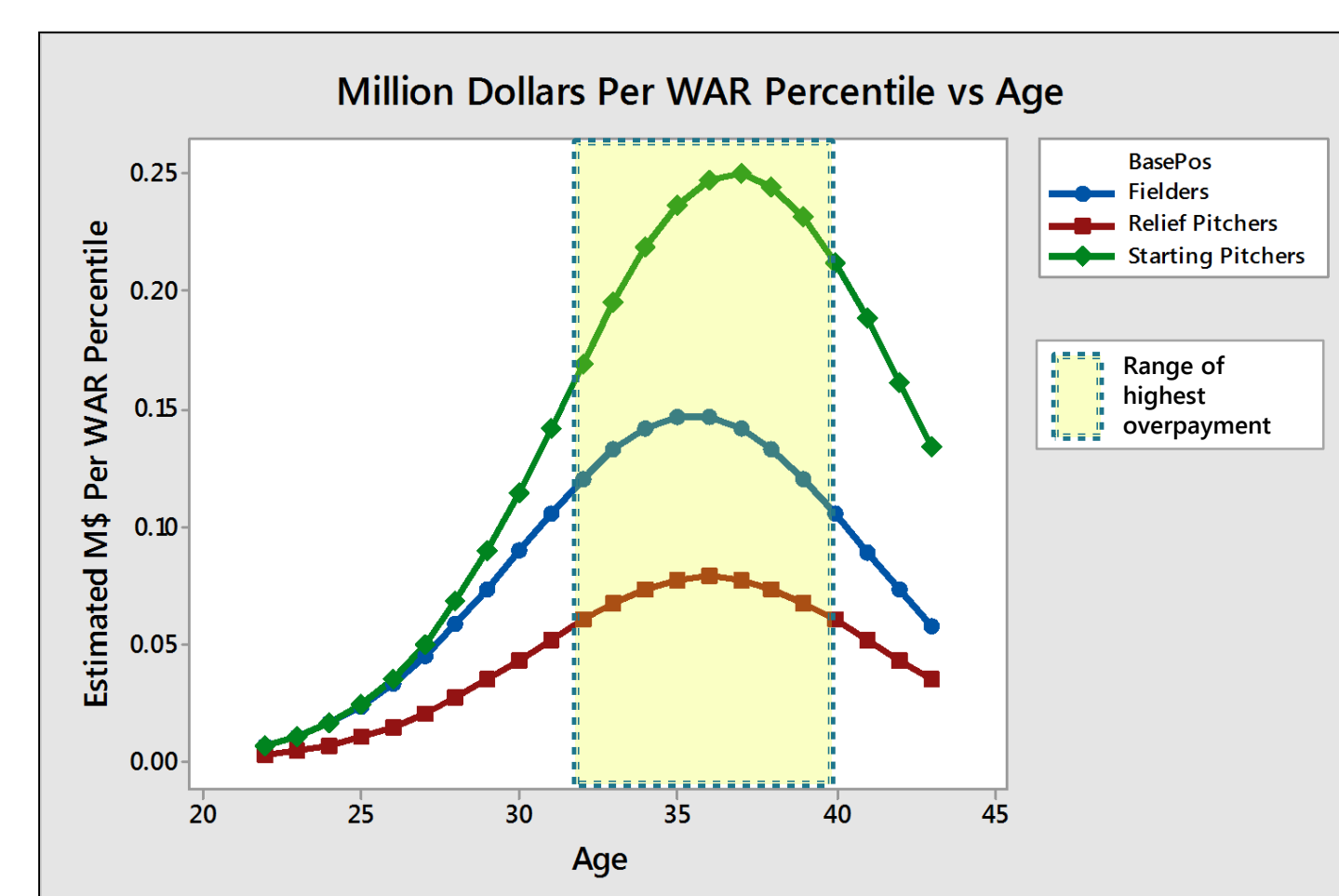
Million Dollars Per WAR Percentile vs Age

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Position	2	39.2	19.61	12.62	0.000
Age	1	1071.8	1071.83	689.81	0.000
Age*Position	2	37.4	18.71	12.04	0.000
Age*Age	1	820.8	820.80	528.25	0.000
Total	6658	14308.1			

Analysis of Variance

Mean WAR vs Age

Mean Salary vs Age
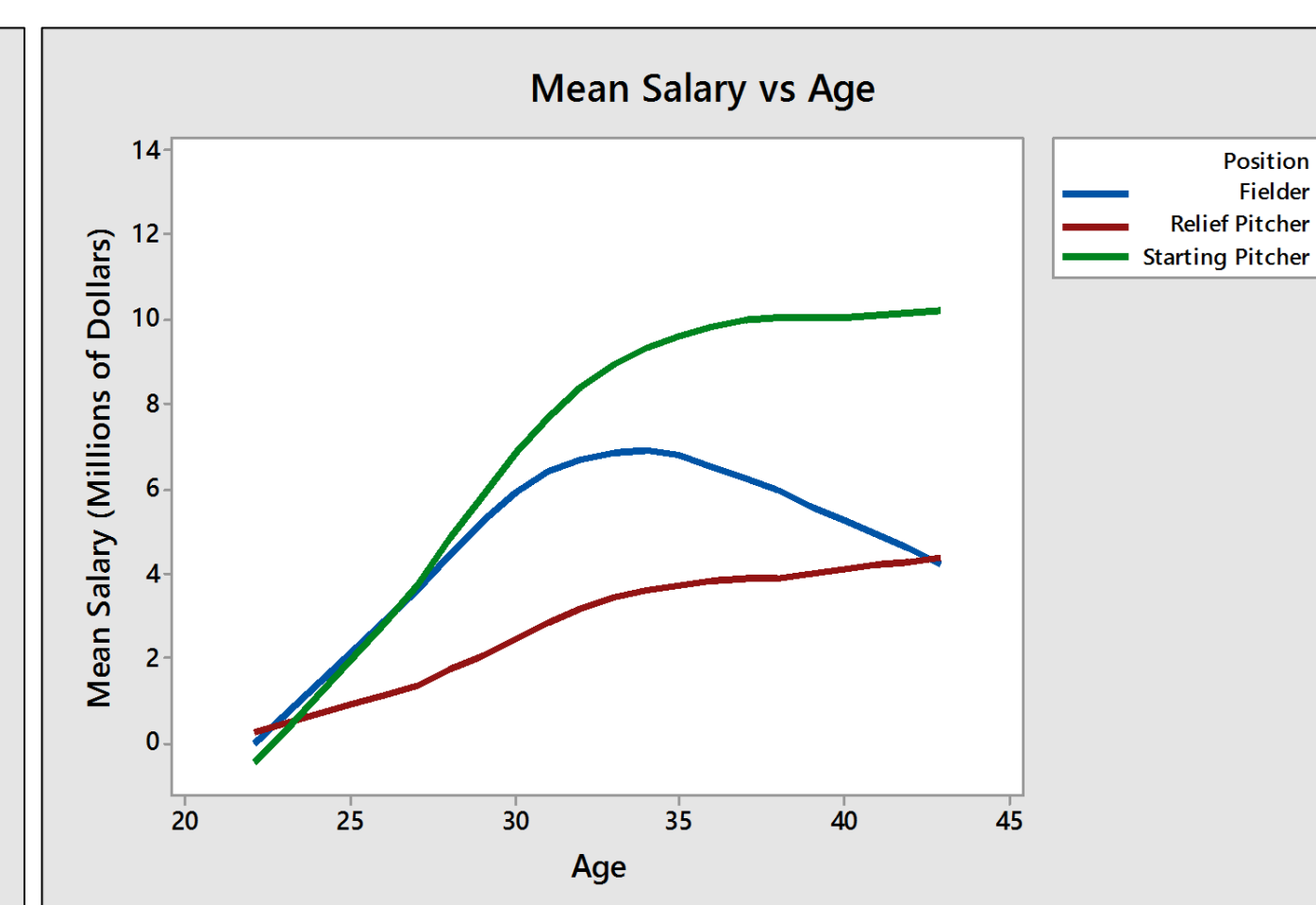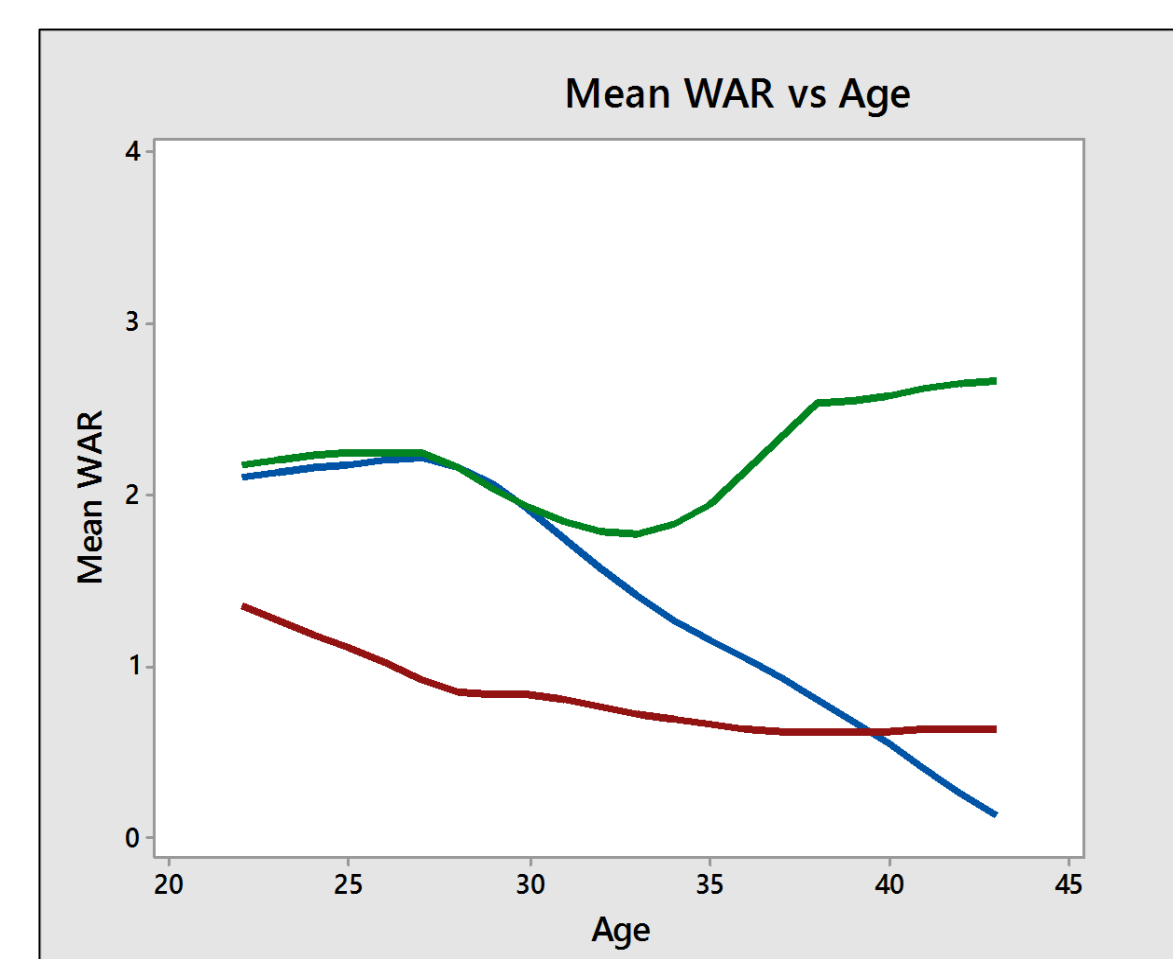
A two-way analysis of covariance was performed for WAR, and both significant age and position effects were found (F=12.47, p≅0.001, and F=48.20, p<0.0005, respectively). Starting pitchers, on average, had a significantly higher WAR than either relief pitchers (by approximately 1.5) or fielders (by approximately 0.8). Notably, there was a significant negative effect of age on WAR (t=−3.53, p≅0.001).

Likewise, a two-way analysis of covariance was performed for salaries, and the effects from age, WAR, and a quadratic term for age were all found to be significant (F=45.48, p<0.0005, F=40.67, p<0.0005, and F=34.35, p<0.0005, respectively). Starting pitchers had higher salaries on average compared to relief pitchers or fielders. In contrast to the previous analysis for WAR, the effect of age on salaries was found to be positive (t=6.47, p<0.0005).

Putting these together, as players age average performance decreases while salaries on average increase. This opposite movement of salary and performance is the paradox upon which contract and roster decisions must be based.

Conclusions

Evidence suggests that players are compensated differently per performance unit (salary/WAR percentile) based on age and position. As a player ages, their salary increases relative to performance, up until a point near the end of their careers. This increase is significantly larger for starting pitchers than for positional players.

What this suggests is that a general manager's focus should be on avoiding expensive mid-career pitchers. However, the quadratic relationship suggests an end to the age range where payment outstrips performance. In this range of highest overpayment, it is economically unsound to stick with a player, but 'bargain performers' are found at both ends of the age spectrum.

For hitters, overpayment is less severe, allowing for riskier contracts for batters.

This analysis points to a potentially 'optimal' composition for a team roster.

Limitations

The available salary data is incomplete, causing the sample sizes to be small.

The data set analyzed here was, to a point, longitudinal, which may have over-emphasized the salary increases as time progressed.

Future Work

Interesting related studies could investigate similar trends among athletes in other sports.

This study could be improved through the acquisition of more complete salary data which extended through a longer time frame.

Examining actual team success based on the composition of players, relative to what the analysis indicates is optimal.