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# FIELD OF GREEN: CONTRACTS, COMPENSATION, AND PERFORMANCE IN MAJOR LEAGUE BASEBALL

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*The research explores the relationship between a Major League Baseball (MLB) player's contract status and performance. Specifically this research looks at whether players who are in a contract year tend to perform better during that season, as opposed to a non-contract year. This is done by observing individual player performance during a contract-year as well as the season immediately after the player has received a multi-year contract. A player's Marginal Revenue Product (MRP) is calculated and compared to the player's actual salary to determine if the player is shirking. The results of this research indicate that players who receive multi-year contracts have a tendency to shirk in the first year of the contract. The results also determine that although players who receive one-year contracts experience a decline in performance, this is not a result of opportunistic behavior.*

JEL classifications: J3, J4, M5

Keywords: Major League Baseball, shirking, marginal revenue product, contracts, pay, performance

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## I. Introduction

Much research has been conducted within labor economics to determine if workers have an incentive to shirk following a promotion (Lazear and Rosen, 1981; Lazear, 2004; Pendergast, 1999). The basis of this reasoning is agency theory and the imperfect information structure of the employee-employer relationship. Agency theory, or principal-agent problem, deals with the issues that arise between an agent and a principal when the principal is hiring the agent to pursue the principal's interests. The theory states that when it is difficult for the principal to directly measure the agent's work performance, an imperfect information system arises in the relationship (Pendergast 1999). Imperfect information can lead to workers shirking on the job and not giving their full effort because there is no incentive to do so. A worker's tendency to voluntarily shirk in their performance is defined as shirking (Krautmann and Donley, 2009).

The tendency to engage in shirking behavior is consistent not only within firms, but in the modern day sports world as well. Athletes that sign professional contracts are guaranteed a salary from the team they play for. Above average player performance has been positively related to higher player salary (Brown and Jepsen, 2009). This has created a tendency among players to increase the amount of effort put forth in a contract year in order to maximize their potential for a multi-year contract the next season. A contract year is the last year in a player's contract with a given team, whereby the player will become a free-agent at the end of the season. A free agent is a player whose current contract has expired and is free to sign a new contract with another team. Given that he will become a free agent, if the player receives a multi-year contract there is a tendency for the player to experience a decline in performance in the first season of that-year contract. This decline in performance is often attributed to a lack of incentives for the player to perform well. The lack of incentives stems from the fact that the player is guaranteed a given sum of money within his contract. More so, if the player signs a multi-year contract, he now has the security of knowing that if he has a bad season, he is still under contract for the next year.

In this paper, I examine Major League Baseball (MLB) free agents over a set time period and determine if the incentive to engage in opportunistic behavior exists in MLB. This topic is of interest to economists because the actions of MLB players are similar to those of workers in the corporate world. It would help teams/firms determine how the contracts they offer their workers need to be structured and what changes need to be made to existing contracts in order to maximize worker effort while still being cost-effective for the firm. By calculating an individual player's MRP (Marginal Revenue Product) and comparing it to his salary, I can determine if the player is shirking or not.

My research differs from previous research in that it observes player performance both before and after receiving the contract, whereas past research focused on a single season. Observing player performance over consecutive seasons allows for a comparison between the two seasons to deduce if the player is exhibiting shirking behavior. I will also include players who are arbitration-eligible in my sample as well because previous research has only used eligibility for arbitration on compensation and contract length (Kahn, 1993). Arbitration-eligible players have just as much a reason to perform well as do players who are eligible for free agency because they are competing for the chance to receive a more lucrative contract for the next season.

Previous research on shirking within professional sports has not been conclusive with some discovering evidence of shirking (Krautmann 2009; Krautmann and Donley 2009; Stiroh, 2007), and others not (Maxcy et al. 2002; Berri and Krautmann, 2006). By including arbitration-eligible players and tracking player performance before and after receiving a new contract, I hope to show evidence of shirking.

## II. Literature Review

Skully (1974) provides the basis for much of the research that has been done regarding labor contracts within Major League Baseball (MLB). He studies the economic losses of players during the reserve clause era by comparing a player's actual salary to his predicted marginal revenue product (MRP). During the reserve clause era, even when a player's contract expired, the team still held the rights to that player. This meant that unless a player was traded or released, he would stay with the same team for his entire career and was subject to however much the team was willing to pay him. This often meant that a player, even if he performed well during the season, did not receive the salary equal to the value that he brought to the team. Taking a sample of 148 observations over the 1968 and 1969 seasons, Skully (1974) finds that average players received salaries equal to about 11 percent of their gross and 20 percent of their net marginal revenue products. Star players received about 15 percent of their net marginal revenue products. The researcher is able to confirm his hypothesis that MLB players experience significant economic loss due to the restrictions of the reserve clause.

Sommers and Quinton (1982) perform a study similar to Skully (1974) but instead analyze the first family of free agents following the abolishment of the reserve clause in 1975 by the United States government. The revised Skully model presented is based on the 1976 and 1977 data covering a cross-section of 26 teams. The authors use the same method as Skully by calculating the predicted winning percentage for each team the player was on, then using the predicted winning percentage to calculate each player's MRP. They then compare the free agent's MRP to the team average MRP to determine the net benefit that each player is receiving or losing. The evidence presented suggests that although the average ballplayer may still be grossly underpaid, the first family of free agents received salaries that were more on par with the value that they added to the team as opposed to their counterparts during the reserve clause. The reversal of the reserve clause has forced owners into a situation where there is a greater tendency to pay players according to the revenues that they bring to the team.

Kahn (1993) follows up Sommers and Quinton (1982) by questioning if MLB players have really benefited from free agency and arbitration by investigating its effects on contract duration and player compensation. The paper uses longitudinal data and fixed effects methods to estimate the impact of salary arbitration and free agent eligibility on compensation and contract duration of MLB players. The researcher uses salary data, contract information, player performance data and local market data collected for roughly all MLB players from 1987-1990. The author finds that while both arbitration and free-agent eligibility raised annual compensation for players, only free agency raised contract duration. This means that while most arbitration-eligible players do receive pay increases at the end of the season, most of the renegotiations will only be for a one year contract.

A subsequent paper by Marburger (2003) compares property rights assignment from the reserve clause era to free agency. During the reserve clause era when teams owned the property rights to the players, the rents from increased effort accrued to the owners and encouraged shirking. This would suggest that the implementation of free agency would eliminate the shirking incentive among players. However, the dawn of free agency also saw an increase in the amount of guaranteed multi-year contracts within the league which could lead to an incentive for players to shirk. The author creates an empirical model that reveals free agents with one-year and two-year contracts outperform comparable reserve era players over the same time frame. However, the performance of free agents with contracts exceeding 2 years do not differ from that of comparable reserve era players over the same time period.

Continuing the examination of player performance in professional sports, Berri and Kratumann (2006) takes the research done by Skully (1974) and (Sommers and Quinton, 1982) and apply it to basketball players in the NBA (National Basketball Association). The researchers' inquiry is the first to examine shirking in the NBA. They employ two different measures of player productivity: the traditional shirking deviation calculated by subtracting a player's predicted performance from his actual, and the player's marginal product. The research uses a sample that includes 515 player observations from the 2000-2001 seasons through the 2002-2003 seasons. When the shirking deviation method is used, the authors find evidence consistent with allegations of shirking behavior. However, when productivity is measured in a fashion more consistent with economists' definition of marginal product, the evidence of shirking disappears. The shirking deviation method discovered that over half of the player's in the sample experienced a performance fall-out after receiving a multi-year contract. On the other hand, when using marginal product, less than half of the player's experienced a fall-out in performance after receiving a multi-year contract. The authors conclude that the shirking debate arises primarily out of the metric used to measure player performance.

Prendergast (1999) provides an overview of the existing theoretical and empirical work on agency theory, and more specifically the incentives. The author analyzes an array of different mechanisms that can be used to induce workers to act in the interest of the employer. This includes reviewing the costs and benefits of many types of pay-for-performance systems such as piece rates, promotions, and long-term incentives. The researcher finds that there are strong effects for pay-per-performance on worker output, usually in situations where performance can be measured. While Pendergast is able to conclude that workers respond to pay-for-performance incentives, she states that there is less evidence that contracts are designed as predicted by the theory, and more research needs to be done in order to verify the theory. Her reasoning for this is that the true test of agency theory is not simply that agents respond to incentives, but that the contracts predicted by the theory are confirmed by the observed data.

Maxcy et al. (2002) also further investigate agency theory but instead apply it toward MLB players in an empirical analysis. They observe MLB players' contracts and determine whether players participate in shirking behavior despite the adaptation of incentives mechanisms into many players' contracts to deter them from shirking. The researchers compare players nearing contract negotiations and other players to detect *ex ante* strategic behavior (turning up performance just prior to contract negotiations) and *ex post* shirking (slacking off after signing the contract). The author's use three different productivity measures that reflect both the player's availability to play as well as his performance once he enters a game. The performance measures that the authors use are: Slugging Percentage (SLG), playing time (PT), and days on the disabled list (DL). Using a sample that includes 1,972 player observations, with 1,160 player-year observations on 213 hitters and 812 player-year observations on 140 pitchers, the data rejects strategic performance. This suggests that mechanisms aimed at curbing strategic performance by players such as performance incentives within contracts appear to be working well.

Krautmann and Solow (2009) also follow Prendergast (1999) and Maxcy et al. (2002). They examine the agency theory within Major League Baseball using an empirical analysis. The researchers analyze the conditions that arise under incomplete and asymmetric information between owners and players. They attempt to explain the change in performance that occurs depending upon whether a player expects to receive a multi-year contract or not. The researchers examine 527 free agent players from 1997-2007 based on the length of the contract and use OPS (on-base plus slugging) as their measure of performance. OPS is the sum of a player's on-base percentage and his slugging percentage. It measures how well a player gets on base and hits for power. They find results consistent with their hypothesis and report players who are less likely to sign a multi-year contract have a large and statistically significant reduction in performance compared to expectations. Subsequently, they find that players who expect to sign another contract largely perform to expectations.

## III. Theoretical Framework

MLB players have been known to exhibit characteristics consistent with the tournament theory which was first introduced by Lazear and Rosen (1981). The tournament theory has three basic premises: (1) Prizes are pre-determined and independent of absolute performance; (2) performance is measured relative to the workers surrounding the individual; and (3) individuals are rewarded for their performance with promotions. Along with the tournament theory, another model applicable to MLB contract research is referred to as the 'Peter Principle' which was first introduced by L. J. Peter. The 'Peter Principle' states that workers experience a decline in performance following a promotion (Lazear, 2004). One explanation for the decline in performance is that it is voluntary. The worker is displaying shirking tendencies because of a lack of motivation to keep performing well. This lack of motivation could be due to the fact that the worker probably will not receive another promotion for an extended period of time now that he/she has just received one. It could also be because the worker has exerted a great amount of effort to receive the promotion and now that it has been achieved, he/she will want to relax. The 'Peter Principle,' ties into the tournament theory because given a system where pay is pre-determined and above average worker performance is rewarded with promotion, there is an incentive for workers to shirk after they have been promoted.

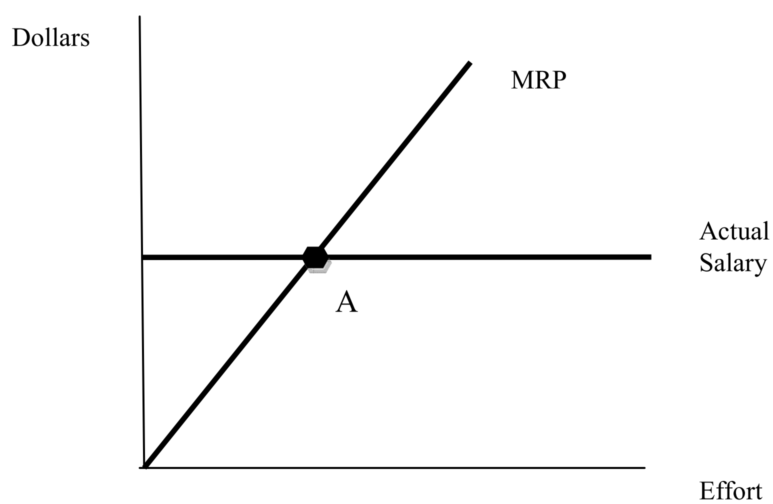
A system similar to this exists in the world of sports and in particular, MLB. Players receive contracts at the beginning of a season for a fixed sum of guaranteed money plus performance incentives that are activated when a player reaches a particular milestone. No matter how well the player performs that season, the team is obligated to pay him his portion of guaranteed money. During the season, players are judged based on how well they play. However, they are not judged by how well they perform overall but how well they perform relative to other players. For example, if a player hits 50 home-runs in a year but several other players hit 50 home-runs as well, than he is deemed just an above-average player. However, if in the next year, the player hits 40 home-runs but no one else does, then he is seen as a top performer in the league. If the player performs well enough relative to other players in the league during the season and he becomes a free agent, he has a very good chance of receiving a "promotion" in the form of a multi-year contract. In the case where a player is offered a multi-year contract with guaranteed money over several years, there can be a tendency for the player to shirk in the first year of the contract. This is because the player will receive the money no matter what his performance is so he has little incentive to exert much effort and therefore, his performance declines.

## IV. Marginal Revenue Product

One of the most important aspects of this paper is its use of the marginal revenue product

(MRP) to measure a player's true value to his team. MRP is defined as the additional revenue generated by a firm from hiring an additional worker. It is also the portion of the team's total revenue that the player contributes to. In the case of MLB, the team is the firm and the players are the workers. A team's revenue is predicted in order to determine what each individual player's contribution to that revenue is. Since performance is dictated by effort, it is assumed that players who put forth greater effort will perform better. It is also assumed that players who perform better will have a larger MRP because they are accounting for a larger amount to the team's success. Figure 1 presents the relationship between MRP and effort.

Figure 1. Effort and MRP




At point A, MRP is equal to the player's actual salary. At this point the player is being paid his true contribution to team revenue. The player's MRP is dictated by effort and the level of effort exerted by the player is dependent upon his contract status. A player in a contract year who will become a free agent is likely to exert more effort in order to maximize his potential for a multi-year contract. As the player increases his level of effort, his MRP increases because he is now contributing more towards the team's overall revenue. Most players in a contract year will produce at a point on the MRP line that is above point A. However, those players who receive a multi-year contract during the off-season are likely to change their effort in the following season. Since the players now have the security of a multi-year contract, there is no incentive to continue performing well. As a result, they decrease their effort. As the player decreases his level of effort, his MRP decreases because he is now contributing less to the team's overall revenue. The majority of player's in a multi-year contract will produce at a point on the MRP line that is below point A.

## V. Data

A data set of 255 players in the years 2009-2010 is used for this analysis. All of the baseball statistics are collected from two internet sources, www.baseballreference.com and www.baseballprospectus.com. Information regarding metropolitan statistical area populations and income per capita within the metropolitan areas is collected from the U.S. Census Bureau website (www.census.gov). Along with players who are eligible for free agency, I use players who are eligible for arbitration as well. A player is eligible to become a free-agent after 6 years of major league service. A player is eligible to file for arbitration if he has three or more years of major league service, but less than 6 years. A shortcoming of past literature has been to exclude arbitration-eligible players within their sample. Arbitration-eligible means that a player is eligible to re-negotiate his contract with his current team at the end of the year. The better a player performs, the more willing the team will be to offer him more money and a longer contract. This creates an incentive for players who are arbitration-eligible at the end of the year to exert an above average amount of effort in order to maximize their potential revenue and job security. Another important part of that data is the performance measure used to calculate MRP.

Traditionally, past literature has used either batting average (AVG), Slugging Percentage (SLG), or OPS as a measure of player performance in determining shirking. In this paper, an alternative statistical measure is introduced. The True Average (TAV) measures how many runs a player creates per plate appearance[1] and it is used to calculate a player's MRP. It uses the same scale as AVG which makes it easy to understand, but instead of measuring how well a player can hit, it measures how well the player creates runs relative to other players. By using TAV, I hope to more accurately capture player performance. A list of all variable used and their definitions is provided in table 1.

**Table 1: Variable Definitions**

| **Variable** | **Definition** |
|---|---|
| Following Year | Year following the contract year |
| Multi-year | A contract a player signs that is for more than one year |
| One-year | A contract a player signs that is for only one year |
| *TMWIN%* | Winning Percentage for the team (Wins/Total games played) |
| *TMTAV* | Team True Average- Measure of Performance that measures total offensive value per out for the team. TAV = 0.260 + (Runs Above Average/Plate Appearances)*0.9 |
| *REV* | Total revenue generated by the team that year |
| *GB* | Games back. Number of games the team finished out of a playoff-spot. 0 indicates that team made the playoffs |
| *TWOTM* | Dummy Variable that is equal to one if there is another team within a 100 mile radius of the team's stadium |
| *SMSA* | Standard Metropolitan Statistical Area- Population of the team's Metropolitan area |
| *ATTD* | Average attendance at home all home games |
| *IPC* | Average Income per Capita in the Team's SMSA |
| *CONT* | Dummy Variable that is equal to one for teams that either made the playoffs or who were 5 or fewer games out |
| *OUT* | Dummy variable that is equal to one for teams that were more than 20 games out of a playoff spot |

The descriptive statistics for the data is shown in table 2.

[1] Formula for TAV = $.260 + \frac{Runs\ Above\ Replacement}{Plate\ Appearances} * .9$

**Table 2: Averages for contract year and following year**

| | Contract Year | | Following Year | |
|---|---|---|---|---|
| | 2010 | 2009 | Multi-year | One-year |
| ***TMWIN%*** | 50.710 | 51.090 | 50.156 | 49.798 |
| | (6.402) | (6.740) | (7.000) | (6.680) |
| ***TMTAV*** | 0.260 | 0.260 | 0.261 | 0.260 |
| | (0.011) | (0.011) | (0.013) | (0.012) |
| ***REV*** | 191.470 | 195.450 | 204.470 | 196.920 |
| | (47.971) | (47.781) | (43.561) | (44.831) |
| ***GB*** | 10.790 | 11.200 | 11.530 | 11.640 |
| | (10.442) | (10.273) | (10.031) | (10.266) |
| ***ATTD*** | 29667.830 | 31058.190 | 30741.640 | 30221.630 |
| | (7871.232) | 8188.710 | 7676.400 | 8116.480 |
| ***SMSA (thousands)*** | 5219.698 | 5975.173 | 5498.363 | 5918.680 |
| | (3588.053) | (4512.324) | (3729.891) | (4550.471) |
| ***IPC*** | 45102.200 | 44462.000 | 44387.060 | 45471.180 |
| | (7114.634) | (6230.456) | (7334.675) | (7188.579) |

**Note: Standard deviations shown in parenthesis below the mean**

## VI. Empirical Model

Player MRP is estimated using two equations. Equation (1) relates team winning percentage to a number of internal team inputs. Equation (2) is the team revenue function and relates team revenues to team winning percentage, and a number of market characteristics for the area the team plays in. The reason for estimating these relationships separately is to capture both the team performance effects and the area market characteristics in the revenue function. Past research has discovered team performance has a closer relationship with team winning than it does team revenue (Skully, 1974). In order to capture team performance, team winning is estimated using team performance variables. The estimated team winning percentage is then used as an endogenous independent variable in the team revenue function. Therefore, equation (1) estimates team winning percentage using a number of team performance variables. Equation (2) estimates team revenue using the estimated team winning percentage and a number of market characteristics. The equation for the *TMWIN%* function is shown in equation 1:

$$TMWIN\%_t = \beta_1 + \beta_2 TMTAV_t + \beta_3 GB_t + \beta_4 CONT_t + \beta_5 OUT_t + \varepsilon_t \qquad (1)$$

Where subscript *t* indicates that it is a contract year. The independent variables used in this model include: Team True Average (*TMTAV*), games back (*GB)* and team intensity (*CONT* and *OUT)*. *TMTAV* is the team's average TAV for that season. *GB* is the number of games the team finished out of a playoff spot that season and has a negative relationship with a team's winning percentage. *CONT* is a dummy variable that is equal to one for teams that either made the playoffs or who were at most 5 games out of a playoff spot. *OUT* is a dummy variable that is equal to one for teams that were more than 20 games out of a playoff spot. The reason for their inclusion is that late in the season player effort will intensify for contenders and drop off for non-contenders. This often leads to contenders seeing a rise in their winning percentage, while non-contenders will see a decline.

The second equation in this analysis is the team revenue function. Revenue is a function of the estimated *TMWIN%,* as well as a number of market characteristics. The team revenue equation is shown in equation 2:

$$REV_t = \beta_1 + \beta_2 SMSA_t + \beta_3 TWOTM_t + \beta_4 IPC_t + \beta_5 ATTD_t + \beta_6 TMWIN\%_t + \varepsilon_t \qquad (2)$$

In this equation the independent variables are: metropolitan area (*SMSA)*, the presence of another team in a 100-mile radius (*TWOTM)*, average income per person (*IPC),* and average attendance at home games (*ATTD),* and an endogenous *TMWIN*% from equation 1. All variables are used by previous research (Skully, 1974; Sommers and Quinton, 1982) with the exception of *IPC. SMSA* is expected to have a positive relationship with team revenue because a larger population means more people willing to attend games. *TWOTM* is expected to have negative relationship with *REV* since a competing team is likely to take away ticket, concession, and merchandise revenue from the team. *IPC* takes into account the wealth of the population within the *SMSA.* It is expected to have a positive relationship with *REV* because areas that are wealthier are more willing to pay more for a ticket. *ATTD* is expected to have a positive relationship with *REV* since a team that draws more fans to its games will generate higher revenue through ticket sales. *TMWIN%* is the team's winning percentage that was calculated in equation (1) and is now being used to estimate *REV*. It is assumed that teams that win frequently are more likely to attract more fans to their home games and therefore, receive more revenue. It is classified as an endogenous independent variable.

Using equations (1) and (2), a two-stage least squares (2SLS) estimation is run. The reason for using 2SLS is because there is a system of two equations in the model that are overidentified. An equation is determined overidentified if the number of independent variables it excludes from the equation is greater than the number of equations in the model (Gujarati, 2009). Since equation (1) excludes all of the variables in equation (2) it is overidentified. Likewise, because equation (2) excludes all the variables used in equation (1) it is overidentified as well.

In addition to using a 2SLS estimation, player performance must be observed in consecutive seasons in order to accurately interpret if a player is in fact displaying shirking tendencies. Player performance is observed in the contract year, as well as the season immediately following. This allows the two seasons to be compared to each other to observe if there is a larger decline in performance in the contract year as opposed to the season after. This method eliminates external factors that might have an unintended effect on the analysis if different players were compared to each other such as: age, stage in contract, experience, and health.

In order to gage how valuable a player is to his team, the revenue that each player contributes to his team's overall revenue is calculated. The contribution is computed by multiplying his TAV by his fraction of the team's plate appearances. The player's contribution is than multiplied by the predicted team revenue. This is the player's MRP. The next step is to calculate the deviation between a player's actual salary and his MRP, defined as the dollar amount that contributes to shirking. This is done by subtracting a player's MRP from his actual salary. If a player's MRP > salary, than he is contributing more to team revenue than he is being paid, and it is determined he is not engaging in shirking behavior. If a player's MRP < salary, than he is contributing less to team revenue than he is being paid, and it is determined he is engaging in shirking behavior. The equations for calculating MRP and the deviation between the salary and MRP are shown in equations 3 and 4 below.

$$MRP = (TAV * \% \, TMPA) * Team \; Revenue \tag{3}$$

$$Deviation \; = Actual \; Salary - MRP \tag{4}$$

## VII. Results

Based on the results for the contract year, it appears that in the first stage of the regression *TMTAV* and *GB* were the best determinants of a team's winning percentage. Both variables were significant at the 1% level. This indicates that a team's ability to hit well is a significant determinant of winning. Likewise, a team's position in the standings relative to other teams is also an indicator of winning. The two dummy variables *CONT* and *OUT* are not significant determinants of a team's winning percentage. This result is not consistent with previous research. It shows that the intensity, or lack thereof, that manifests as the playoffs get closer does not significantly change team winning percentage. The insignificance of these two variables could stem from players who are about to become free agents and are trying to increase their value as much as possible before hitting the open market. It could also be a factor of teams who have already locked up a playoff spot resting their top players to avoid injury.

The second stage regression for contract year players shows that the market characteristics of the area the team plays in have a significant impact on team revenue. Team revenue is significantly dependent upon the *IPC*. The dummy variable *TWOTM* is also significant and has a negative relationship with players in a contract-year. The one non-market characteristic used in this equation is *TMWIN%*. The results show that at the 5% level, *TMWIN%* is a significant determinant of revenue. For every one-point increase in *TMWIN%, REV* increases by $706,500. This is consistent with prior research (Quinton and Sommers, 1982) and shows that the more games a team wins the more revenue it will generate because the team will be more popular. Table 3a displays first stage results for contract year players. Table 3b displays the second stage results.

**Table 3a: First stage regression results**[2]

| | **Contract year** |
|---|---|
| **TMTAV** | 1.0035*** |
| | (0.0799) |
| **GB** | -0.0055*** |
| | (0.0001) |
| **CONT** | 0.0007 |
| | (0.0024) |
| **OUT** | -0.0043 |
| | (0.0026) |
| **CONS** | 0.2996 |
| | (0.0232) |
| **Adjusted $R^2$** | 0.9716 |
| **Sample Size** | 253 |

*** Significant at 1% level; ** Significant at 5% level; * Significant at 10% level.
**Note: Robust standard errors in parenthesis below coefficients**

[2] Results broken down by year are shown in Appendix B

**Table 3b: Second stage regression results**

| | **Contract Year** |
|---|---|
| **TMWIN** | 0.7065** |
| | (0.2789) |
| **TWOTM** | -7.1597** |
| | (3.0290) |
| **SMSA** | 0.0046*** |
| | (0.0004) |
| **IPC** | 0.0012*** |
| | (0.0002) |
| **ATTD** | 0.0025*** |
| | (0.0002) |
| **CONS** | 71.3723 |
| | (15.3091) |
| **Adjusted $R^2$** | 0.6806 |
| **Sample Size** | 253 |

*** Significant at 1% level; ** Significant at 5% level; * Significant at 10% level.

**Note: Robust standard errors in parenthesis below coefficients**

In the first stage regression for players with multi and one-year contracts, *GB* and *TMTAV* are significant at the 1% level both groups of players. This indicates that a team's position in the standings as well as how well the team hits are significant predictors of winning. The two dummy variables *CONT* and *OUT* that were included in this first-stage regression did not appear to be significant determinants of a team's winning percentage for either group. Once again, this shows that while a team's overall placement in the standings compared to other teams is an indicator of winning, playoff intensity is not.

The second stage regression results for multi and one-year contract players show that variable significance is dependent upon the group. *IPC* is significant for players with multi-year contracts but not those with one-year contracts. One explanation of this is that teams in *SMSAs* with a higher income per capita generate more revenue for the team, and therefore can afford to offer more multi-year contracts. On the other hand, teams in *SMSAs* with lower income per capita generate less revenue and can only afford to sign players to one-year contracts. *TWOTM* is significant and has a negative relationship with players in the first year of a multi-year contract, but not for players in a one-year contract. This is likely dependent on the team's revenue and location. Team's that are located close to another team are often located in large *SMSAs* (New York; Los Angeles; Chicago). Due to large populations, these teams generate larger revenue streams than teams in other cities despite having another competitor in the area. Larger revenue streams allow these teams to be able to afford more multi-year contracts. In contrast, teams that are not close to another team are usually located in areas with smaller populations (Kansas City; Seattle; Cincinnati). Smaller *SMSAs* generate less revenue for the team and lead to the team offering less multi-year and more one-year contracts.

While previous research has found winning percentage to be a significant indicator of team revenue, the results are not the same in this analysis. In contrast to the contract year, the results for the multi and one-year contracts show that there is no relationship between *TMWIN%* and *REV*. This could be because a team's revenue is based less on how many games it wins but on market characteristics of that area. Therefore, teams that are located in more demographically favorable areas are likely to have higher revenue streams than teams that are in less favorable areas, independent of how many games the teams win. Table 3a displays first stage results for multi and one-year contract players. Table 3b displays the second stage results.

**Table 4a: First stage regression results**

| | Multi Year Contracts | One-year contracts |
|---|---|---|
| **TMTAV** | 0.5197*** | 0.5889*** |
| | (0.1616) | (0.0887) |
| **GB** | -0.0063*** | -0.0065*** |
| | (0.0005) | (0.0002) |
| **CONT** | 0.0095 | -0.0035 |
| | (0.0075) | (0.0033) |
| **OUT** | 0.0140 | 0.0144*** |
| | (0.0057) | (0.0039) |
| **CONS** | 0.4280 | 0.4160 |
| | (0.0473) | (0.0241) |
| **Adjusted $R^2$** | 0.9727 | 0.9639 |
| **Sample Size** | 53 | 197 |

*** Significant at 1% level; ** Significant at 5% level; * Significant at 10% level.

**Note: Robust standard errors in parenthesis below coefficient**

**Table 4b: Second stage regression results**

| | Multi Year Contracts | One-year contracts |
|---|---|---|
| **TMWIN** | 0.3888 | 0.1565 |
| | (0.5588) | (0.2654) |
| **TWOTM** | -17.1472** | -2.2214 |
| | (5.8274) | (43.3913) |
| **SMSA** | 0.0072*** | 0.0056*** |
| | (0.0017) | (0.0008) |
| **IPC** | .0017*** | 0.0002 |
| | (.0004) | (0.0002) |
| **ATTD** | 0.0024*** | 0.0023*** |
| | (0.0004) | (0.0002) |
| **CONS** | -0.4965 | 94.2463 |
| | (39.0748) | (21.4866) |
| **Adjusted $R^2$** | 0.7830 | 0.6690 |
| **Sample Size** | 53 | 197 |

*** Significant at 1% level; ** Significant at 5% level; * Significant at 10% level.

**Note: Robust standard errors in parenthesis below coefficients**

Now that the predicted team revenue has been calculated, individual player MRP can be computed which is shown in equation 4. Once each individual player's MRP has been created it can be subtracted from the actual salary to calculate the deviation. A few player examples of how the deviation is calculated are shown in table 5:

**Table 5**

| Year | Player | TAV | % of TM PA | Contribution | Team Rev (millions) | MRP (millions) | Salary (millions) | Deviation (millions) |
|---|---|---|---|---|---|---|---|---|
| 2009 | Rickie Weeks | 0.288 | 0.026 | 0.007 | $188.155 | $1.394 | $2.450 | $1.056 |
| 2010 | Carl Crawford | 0.252 | 0.084 | 0.021 | $213.808 | $4.522 | $14.857 | $10.335 |
| 2010 | Brendan Ryan | 0.251 | 0.083 | 0.021 | $166.099 | $3.449 | $1.375 | -$2.074 |
| 2010 | Casey Kotchman | 0.299 | 0.092 | 0.027 | $174.988 | $4.788 | $0.750 | -$4.038 |
| 2009 | Adam Everett | 0.176 | 0.014 | 0.002 | $180.717 | $0.448 | $1.550 | $1.102 |

Table 6 below presents the average estimated deviation between the player's actual salary and MRP for each sample:

**Table 6**

| | Contract Year | Multi-year contract | One-year contract |
|---|---|---|---|
| **Deviation (in millions)** | -0.198 | 2.979 | -0.700 |

Now that shirking has been computed, the last step in the analysis is a large-sample difference-in means test using the deviation calculation constructed in equation 4. The test is used to determine if there is a significant difference between player deviation in the contract year and the first year of a multi-year contract. The null hypothesis states that the difference of the means is equal to zero; therefore there is no significant change in a player's deviation from a contract year to a multi-year contract. The alternative hypothesis states that the difference of the means is not equal to zero; therefore there is a significant change in a player's deviation from a contract year to the first year of a multi-year contract. The hypothesis and formula for the difference-in means test is shown below:

$H_0: \mu_m - \mu_c = 0$

$H_a: \mu_m - \mu_c \neq 0$ Level of significance: α = .05

$$z = \frac{(x_m - x_c) - (\mu_m - \mu_c)}{\sqrt{\frac{s_m^2}{n_m} + \frac{s_c^2}{n_c}}} \qquad \text{Equation (5)}$$

Where subscript *m* denotes the multi-year contract players and subscript *c* denotes the contract year players. Plugging in the values from table 6, a test statistic of 5.49 is computed. The critical value for a two-tailed test at the 10% level is 1.64. Since $z > 1.64$, $H_0$ is strongly rejected and this concludes that there is a significant change in MRP from the contract year to the first year of a multi-year contract. Subsequently, a large-sample difference-in means test is conducted to determine if there is a difference between performance during the contract year and players who receive one-year contracts. Using the same null and alternative hypothesis' and the values from table 6, a test statistic of 1.94 is computed. The critical value for a two-tailed test is once again 1.64. Since $z > 1.64$, the test rejects the null hypothesis and concludes that there is a significant difference in deviation from the contract year to a one-year contract, although not as strong.

An additional large sample difference-in-means test is run to determine if a player switching teams has an effect on performance. The purpose of this analysis is to determine if the challenges that players face when going to another team have an impact on performance. The test is run separately for both players in multi and one-year contracts. Players in each group are separated by those who stayed with the same team and those who went to a new team and then compared to each other. The deviation average for each group is taken and used as the mean for the test. In this test, the null hypothesis is that there is not a difference between players that switch teams and those that do. The alternative hypothesis states there is a significant difference between the two. Using equation (5) and a confidence level of .05, a test statistic of .237 is computed for the multi-year contract group. The critical value for a two-tailed test is 1.64. Since $z < 1.64$, the test fails to reject the null hypothesis and it is confirmed that there is not a significant difference between the players that switched teams, and those that did not. For the one-year contract group, a test statistic of 2.703 is calculated. The critical value for a two-tailed test is 1.64. Since $z > 1.96$, the null hypothesis is rejected and it is confirmed that there is a significant difference between the players that switched teams, and those that did not.

## VIII. Conclusion/ Future Research

The purpose of this analysis was to estimate if there is a tendency among MLB players to shirk during the first year of a multi-year contract. Motivated by an interest in MLB as well as whether player effort is dictated by contract security, I found that players do engage in opportunistic behavior in the first year of a multi-year contract. This suggests that the motivation behind the level of effort a MLB player puts forth does not depend on his level of passion for the game, but contract security. In order to combat this problem, MLB teams should offer only one-year contracts or create contracts where the majority of the salary is dependent upon player performance. This would create an incentive for players to abstain from shirking in order to maximize their potential salary. A subsequent test reveals that players in one-year contracts experience a decline performance, although the results are not as strong. In addition, the average deviation for one-year contract players is negative which means MRP > salary. This indicates that players contribute more to team revenue than the salary they receive. Thus, while these results conclude that one-year contract players experience a decline in performance, they are not engaging in opportunistic behavior.

In addition, the results show that whether a player switches teams or not does not affect performance in the first-year of a multi-year contract. However, if the player receives only a one-year contract there is a difference in performance between those who switch teams and those who do not. Overall, I am able to confirm that players who receive multi-year contracts do engage in opportunistic behavior in the first year of the contract, regardless of whether they switched teams or not. The story is different for one-year contract players. According to the results, these players do see a decline in performance. However, because on average one-year contract players have an MRP > salary, they are not engaging in opportunistic behavior. This decline in performance could be attributed to the fact that some players signed with new teams. Joining a new team means that the player must become accustomed to an entirely new environment. This can have a negative effect on performance. However, player motivation to perform well and increase his chances of a multi-year contract prevents the player's performance from slipping too much. This explains why there is a decline in performance, but MRP is still greater than salary.

One of the shortcomings of my research and something I would hope to look into for future research would be accounting for the fact that teams have different revenue streams. In this paper I simply use a player's calculated MRP. The problem with this measurement is that it fails to account for the varying levels of team revenue that could inflate or deflate a player's MRP. For example, in one season a player might have a TAV of .300, take 9% of his team's at bats, and be on a team with revenue of $150 million. However, if the player signs with a new team with revenue streams of $200 million the following season, but has a TAV of .300 and 9% of the team at-bats again, his MRP could be distorted. By taking into account the different revenue streams for each team, I would be able to more accurately determine a player's contribution to his team's revenue.

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## Appendix A. Correlation Coefficients table for Independent Variables

**First Stage regression independent variables**

| | TMTAV | GB | COUNT | OUT |
|---|---|---|---|---|
| TMTAV | 1.000 | | | |
| GB | -0.517 | 1.000 | | |
| COUNT | 0.404 | -0.754 | 1.000 | |
| OUT | -0.366 | 0.807 | -0.365 | 1.000 |

**Second Stage regression independent variables**

| | TMWIN% | TWOTM | SMSA | IPC | ATTD |
|---|---|---|---|---|---|
| TMWIN% | 1.000 | | | | |
| TWOTM | -0.165 | 1.000 | | | |
| SMSA | 0.211 | 0.283 | 1.000 | | |
| IPC | -0.021 | 0.284 | 0.115 | 1.000 | |
| ATTD | 0.520 | 0.212 | 0.459 | 0.091 | 1.000 |

## Appendix B. Regression results by year

| **Contract Year** | **First Stage** | |
|---|---|---|
| | **2010** | **2009** |
| **TMTAV** | 0.9012*** | 0.9931*** |
| | (0.1137) | (0.1160) |
| **GB** | -0.0051*** | -0.0056*** |
| | (0.0003) | (0.0003) |
| **CONT** | 0.0036 | -0.0034 |
| | (0.0043) | (0.0044) |
| **OUT** | -0.0091 | -0.0069 |
| | (0.0057) | (0.0056) |
| **CONS** | 0.3231 | 0.3114 |
| | (0.0339) | (0.0343) |
| **Adjusted $R^2$** | 0.9721 | 0.9750 |
| **Sample Size** | 139 | 114 |

*** Significant at 1% level; ** Significant at 5% level; * Significant at 10% level.

**Note: Robust standard errors in parenthesis below coefficients**

| Contract Year | Second Stage | |
|---|---|---|
| | 2010 | 2009 |
| **TMWIN** | 78.8392*** | 82.7577* |
| | (36.4108) | (48.7844) |
| **TWOTM** | -4.2416 | -12.9010** |
| | (4.5374) | (6.0885) |
| **SMSA** | 0.0047*** | 0.0044*** |
| | (0.0006) | (0.0005) |
| **IPC** | 0.0010*** | 0.0014*** |
| | (0.0003) | (0.0003) |
| **ATTD** | 0.0024*** | 0.0029*** |
| | (0.0003) | (0.0004) |
| **CONS** | 84.1890 | 59.1068 |
| | (21.4379) | (23.3244) |
| **Adjusted $R^2$** | 0.6265 | 0.7279 |
| **Sample Size** | 139 | 114 |

*** Significant at 1% level; ** Significant at 5% level; * Significant at 10% level.

**Note: Robust standard errors in parenthesis below coefficients**