MORAL HAZARD IN MAJOR LEAGUE BASEBALL: A CONTRACT'S EFFECT ON FUTURE PERFORMANCE

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Ryan J. Hedges

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Abstract

With the growing capital invested in Major League Baseball and the subsequent inflation of salaries, much scrutiny is given to a franchise's allocation of its budget. Long-term contracts are a tool used to manage risk, but also create the potential for players to shirk. Therefore, the question of how a contract affects performance has become increasingly pertinent. Past work has attempted to determine the effects through simple regression analysis and resulted in many conflicting conclusions. My work is rooted in a large data set of contract figures, performance statistics, and injury history. I analyze contract length, salary size, changes in salary, contract incentives, among other contract figures. An extensive inclusion of variables to determine expected performance is utilized to ensure utmost accuracy. Through various approaches, I examine how all aspects of a contract may impact future performance, including the effect on injuries. My findings show that specifically hitters engage in shirking, while there is no strong evidence for pitchers. However, pitchers are shown to display volatile year to year performance levels and higher paid pitchers exhibit weaker performance. Hitters are also found to be injured significantly less during their contract year. My findings have provided recommendations for a how a low-budget franchise can allocate its spending to increase its chances for success.

KEYWORDS: (Major League Baseball, MLB, shirking, long-term contracts, moral hazard, contract incentives)

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INTRODUCTION

In 1995, a 22-year-old starting pitcher named Mike Hampton brought hope and excitement to the city of Houston when he posted a 3.35 Earned Run Average (ERA) and averaged almost one strikeout per inning as a rookie. The next four years in Houston saw Hampton develop into one of the most dominant young pitchers in Major League Baseball (MLB). In 1999, Hampton led the National League (NL) with 22 wins and finished 2nd in the NL Cy Young voting (best pitcher in the league) to the great Randy Johnson. If he had yet to prove himself, in 2000 after being dealt to the New York Mets, Hampton posted an impressive 3.14 ERA while giving up just 10 home runs in 217.2 innings pitched, a ratio that could only be described as legendary. Hampton was dominant in the 2000 postseason achieving the National League Championship Series (NLCS) Most Valuable Player (MVP) award, further proving that he was a man to be desired if one hoped to win a World Series. Before the 2001 season, the Colorado Rockies signed Hampton to an 8-year, $121 million contract, in an attempt to bring a championship to Denver. This was the largest contract in the history of baseball. However, this signing will forever go down as arguably the worst bust in sports history. Up until this point, Hampton had been compensated via one-year contracts at reasonable salaries. In 2002, Hampton's ERA climbed to a burdensome 6.15 and he exhibited increasing control problems suggesting the pitcher was unfocused and unprepared. The remainder of Hampton's massive 8-year contract was plagued by injury and can overall be characterized as lackluster.

Hampton's story is not a pattern of events and numbers that is seldom seen. Baseball has a long history of players receiving preposterous amounts of money. During the past half century, along with the growing capital invested in the MLB, the average salary climbed from about $45,000 in 1975 to $3.34 million in 2010. In 1947, Hall of Famer Hank Greenberg was the highest paid major leaguer with a salary of $100,000. Over 50 years later in 1999, Kevin Brown held the same mark with a yearly income of $15 million. Not only did the frequency of long-term contracts skyrocket in recent decades, but contracts also became much more complex, with the development of policies to govern the Free Agency market and the implementation of incentives to perform. With the increasing intricacy of a player's compensation, team management spent more time and money on the creation of contracts and the exploration of the relationship between a player's performance and his contract.

Over the past two to three decades, the economic literature has reflected an increasing interest in the relationship between the compensation of professional athletes, and their performance. Some of these papers look at how previous performance will affect the contract length and salary that a player will receive (Meltzer, 2005; Dinerstein, 2007; Tarman, 2005). In 2005, Josh Meltzer examined how contract length and salary are determined by performance and if their relationship is significant. Meltzer hypothesized that performance is a major determinant of salary. He then performed an OLS (Ordinary Least Squares) regression on a large statistical sample and confirmed the hypothesis that there exists a significant positive effect of performance on a player's salary. In 2002, Anthony Krautmann and Margaret Oppenheimer conducted a study attempting to link contract length to the annual salary of a player. An OLS regression determined that contract length is positively related to wages; people with long-term contracts tend to be making large amounts of money per year. Since more skilled players receive higher salaries (Meltzer, 2005), this transitively implies that high-performance players also attain long-term contracts. These studies provide sound statistical evidence linking player performance to player salary, and to the length of contracts.

More recent statistical studies began to pry at the issue of the effect of a player's contract on their future performance. With so much money involved in Major League Baseball, it is vital for General Managers to balance vigilance and wit when they sign players to contracts. A team will never win a World Series if its management is unwilling to shell out large amounts of money to acquire the talent necessary for success. On the other hand, if a manager is too bold with his acquisitions and spends excessive amounts of money on risky players, the success of the team and the manager's job become at risk if the franchise and players do not meet expectations. However, discussed in papers by David Berri and Krautmann (2006) and Krautmann and Thomas Donley (2007), studies thus far have yielded conflicting results due to varying methodologies. One problem is that the evidence of specific effects is varied. Some investigations found evidence to suggest that slacking off is a significant ploy that coincides with long-term contracts (Lehn, 1982; Scoggins, 1992; Stiroh, 2007), while other analyses concluded that this relationship is not statistically evident (Krautmann, 1990; Maxcy, 1997; Maxcy, 2002).

For the dependent variable in these studies, most past investigations have used OBP (on-base-percentage) and OPS (OBP + slugging percentage). OBP describes a player's ability to get on base, which is a primary step towards scoring a run. OPS has gained recent popularity as a statistic to evaluate a hitter (Krautmann,1990; Dinerstein, 2007; Maxcy, 2004; Krautmann and Oppenheimer, 2002; Tarman, 2005). OPS takes into account the regularity that a player is able to reach base as well as a hitter's power, creating an evaluative offensive measure of ability.

A player's age is another important factor to consider in this analysis. The production of a player throughout his career tends to take on an upside down quadratic shape, with performance peaking around the years 28 to 31. Experience can also be a substitute for age as a measure; the more years of experience a player has, the more productive he tends to be (Maxcy, 2005). Players learn techniques to help them keep in shape and retain high levels of production throughout long seasons (Dinerstein, 2007). Older players tend to receive longer contracts because they have accumulated this experience and these techniques (Krautmann and Oppenheimer, 2002). However, typically once a player reaches their mid-30's the effect of age undermines experience. This is due to increased probability of injury, as well as deteriorating physique and skill. For this reason, players in the latter stages of their career tend to receive shorter and smaller contracts (Maxcy, 2005; Berri and Krautmann, 2006; Maxcy, 2004).

Research has also investigated the relationship between injuries and contracts. In 1990, Anthony Krautmann concluded that as the number of years in a contract increases, the number of days spent on the disabled list increases by 25%. More generally, players with long-term contracts tend to be on the disabled list with more frequency than players on single-year contracts (Berri and Krautmann, 2006).

The manager of a baseball team is another variable that can affect an individual's performance. Managers with a strong ability to lead, motivate, and teach their teams, cause players to become more productive on the field than players under mediocre coaches (Berri and Krautmann, 2006). However, other studies have concluded that players' coaches have insignificant effects on their performance (Stankiewicz, 2009).

There are other variables that can be added to the discussion to help examine the relationship between contracts and performance. However, many of these are hard to quantify. Sometimes personalities complement each other and two athletes play more effectively when they are together because they feed off of one another. Performance can also be affected by players' history with one another as well as team chemistry. Factors such as a player's attitude, his hustle, and also his intelligence are difficult to quantify and have not been given much exploration (Maxcy, 2004).

In this paper, the relationship of a baseball player's contract and his future performance is investigated. This study expects to find a negative relationship between the number of years remaining on a player's contract and his performance for each respective season relative to what is expected.[1] With these results, there will ideally emerge a statistical approach to the design of a player's contract that will provide significant contribution to player performance, and therefore team success. The inclusion of variables that have not been previously examined as well as the implementation of the cause and effect that contracts have on injuries are elements incorporated in this study that past literature has yet to explore.

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[1] The expected performance is estimated using regression results from variables including age, past years performance, injury history, position of the player, and offensive rank of the team the player competes on.

CHAPTER 1

ECONOMIC THEORY

In competitive input markets, managers hire workers to provide additional assistance to more efficiently and successfully complete a job. Traditional economic theory states that the maximization of profits is the major goal of enterprise. Theory also tells us that the most efficient use of labor is found at the wage and employment level where the marginal cost of labor is equal to its marginal revenue. It is the optimal goal of the manager to allocate the least amount of money on employee salaries and equipment necessary to attain a certain level of desired output. Businesses can therefore maximize profits by allotting expenses in specific ways to capitalize most resourcefully on their inputs. Throughout history and more intensely in the past half century, researchers have investigated how to achieve these ideal levels of input and production so as to maximize profits.

In making decisions on employment for a company, many variables must be taken into account by the hiring team. These include the number of employees to hire, how long to hire each of them, and how much they should be compensated. Another significant issue regarding employment is how workers react to situations in which one's specific contribution or output is difficult to interpret or quantify. If the effort put forth cannot be inferred from outcome, the result is moral hazard. In this case, incentives arise for workers to deliver sub-optimal levels of effort in their specific functions (Alchian and Demsetz, 1972). Not working to one's full potential or putting off work for later is called "shirking". A large amount of research has been invested into uncovering strategies that provide incentives to work hard in order to offset prior existing incentives to shirk (Holmstrom, 1979; Prendergast, 1999).

Although the idea of 'efficiency wages' had been previously explored, in 1984 Carl Shapiro and Joseph Stiglitz published their very influential model of efficiency wages in an attempt to combat shirking. Under conventional competitive paradigm, all workers receive the market wage rate and there is virtually no unemployment. Under these conditions, the worst that can happen to a shirker is termination. Since there is virtually no unemployment, a fired worker can immediately become rehired, and there is practically no punishment to the worker for shirking. Therefore, workers in this environment will choose to shirk. So, to provide incentive not to slack off, firms will raise their wage rate above the market wage to create punishment for a shirker who is caught. If all firms begin to adopt this idea and raise their wages, then the incentive to shirk reappears. However, an increase in all wage rates will lead to a decrease in the demand for labor, creating unemployment. This will again provide incentive to not shirk because if the worker shirks and is fired, then it might take time before a new job is found. This equilibrium unemployment rate must be large enough where it pays workers to work rather than shirk and risk getting fired. Unemployment benefits increase the equilibrium unemployment rate because they reduce the penalty of being fired. Therefore, employers are driven to increase the wage rate even further in the presence of unemployment benefits (Shapiro and Stiglitz, 1984).

When a worker is hired, labor agreements are constructed between management and the employee in the form of contracts that describe wages, benefits and working conditions. Economic theory describes how the behavior of a decision-maker follows a utility maximization algorithm. Each utility function is a representation of a set of preferences over a set of goods and services. Therefore, the information asymmetry involved in Contract Theory[1] increases the attraction for decision-makers to engage in activities characterized by moral hazard. In theory, moral hazard is a situation following an agreement where one party alters its actions or performance to benefit itself to the detriment of another, creating a contract violation. A contract violation is when the expectations of either the employer or employee are not met. The magnitude of contract violations is an increasing function of the cost to monitor shirking. As it becomes more expensive to monitor a worker's effort and productivity, less supervision takes place and therefore a larger degree of shirking occurs. Economic theory explains that monitoring will only take place if the marginal gains from a decrease in shirking (from the monitoring) equals or exceeds the cost of the monitoring (Alchian and Demsetz, 1972).

One of the primary incentives to underperform in a workplace is when an employee has guaranteed payment over a lengthened period of time. Not working to one's potential due to high job security is one form of shirking. An example of this includes when professors receive tenure and are ensured lifetime employment. This can lead to decreased time spent on research or less commitment allocated towards educating their students. This study will examine the theory that Major League Baseball players who are involved in contracts guaranteeing long-term compensation will shirk.

[1] Contract Theory is the study of how people and businesses construct legal agreements, especially under uncertain conditions and the existence of asymmetric information.

Just as in any firm, the primary goal of a baseball franchise is to maximize the amount of profit. To do this, administrations must correctly balance and allocate their expenses so as to generate the revenue that leads to the largest attainable profit. In Major League Baseball, there are many contributing factors to the revenue column in a franchise's Statement of Income. While the financial bonuses are immense from participating in the playoffs and even more from winning a World Series, ticket sales are the source of the majority of revenue for franchises. For example, in 2008, the Tampa Bay Rays generated over $39 million in ticket sales revenue, equal to 24.2% of their overall revenue and the most of any other source. In 2009, the Los Angeles Angels of Anaheim drew in $100.1 million in ticket sales, which was 42% of their total revenue. Therefore, it is the objective of the administration to maximize ticket sales revenue.

There are many factors that go into determining the revenue from ticket sales. Some of these could be the attraction of the home stadium, the demographics of the city population, and the geographical location of the home city. However, undoubtedly the most prominent determinant in how much revenue that comes in from ticket sales is the performance of the team, as well as the performance of specific players. In a 2009 study, Michael Davis examined the relationship between a team's winning percentage and its attendance for home games. His extensive examination concluded that a team's winning percentage has a strong positive and statistically significant causation effect on attendance. Since a strong winning percentage also leads to large bonuses from participation in playoff baseball, this further describes the importance of team success on the financial status of a franchise.[2] It is for this reason that it is a pivotal question of

[2] Following the 2012 postseason, a total of over $65 million was distributed to the teams that participated in the playoffs as a bonus. By winning the World Series, the San Francisco Giants were awarded $23.5

whether a contract has an effect on a player's performance, as well as the success of the team as a whole. The decision to offer a player a one-year versus a four-year contract could be the difference between a ball club reaching and not reaching the playoffs.

The application of shirking theory to Major League Baseball suggests that when a player receives a contract that guarantees him payment over a long period of time, he will not perform to his full potential. Performance is a measure of a player's output that takes into account a combination of the statistics that he produces while competing as well as the injuries that prevent a player from participating. Although it is unrealistic to directly quantify a player's effort, purposeful choices an athlete makes such as a decrease in time spent training and studying the game, indirectly affect a player's performance (Fort, 2003). During long-term contracts, players may spend less time taking batting practice, less time in the weight room, or less time watching game video in order to help improve their abilities. An athlete may also not eat on the healthy diet that helped him earn that huge contract in the first place, which could drive him out of shape and to become less productive (Berri and Krautmann, 2006). The diminished focus that a player applies to his preparation and practice can lead to increased vulnerability to injury. Once injured, players are exempt from practice and working hard on a daily basis. High job security provides incentive for players to rehab at a phlegmatic tempo so they can remain out of the strenuous pace of playing in the MLB. Therefore, theory implies that when a player is on the final year of his contract, he will put forth maximum effort and produce to his full potential. For each additional year remaining in a contract, the degree of shirking becomes more significant.

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million in bonuses, and the World Series-losing Detroit Tigers received $15.7 million. The rest of the purse was divided up between the remaining 8 playoff teams and was allocated based on the playoff round reached.

Following a very impressive season for a player whose contract is coming to an end, it seems logical for a manager to offer this player more money and lock him up with this large salary for a long period of time. However, this may lead to the player naturally returning to a more average level of production (Krautmann, 1990). For the nine years leading up to the year 2011, outfielder Carl Crawford, who played for the Tampa Bay Rays during this period, emerged as one of the most potent offensive threats in the MLB. He consistently held a batting average over .300, he scored around 100 runs each year, and he averaged exactly 50 stolen bases per season. Before the 2011 season, Crawford signed a 7-year, $142 million contract with the Boston Red Sox, making him the second highest paid outfielder in all of baseball. With this new fortune, during the following two seasons Crawford's batting average dropped to a dismal .260, he averaged 44 runs per season, and he only stole 23 bases total. The management of MLB teams, most especially the General Manager, must be able to decipher which players deserve long-term contracts, and which players are more likely to shirk. Proven shirkers will develop a bad reputation, thereby decreasing their future chances of receiving another long-term contract (Berri and Krautmann, 2006).

Just as in all industries, MLB administrations have explored various ways to counter the incentives for players to shirk. One common incentive to perform that is included in major league contracts is bonuses based on performance. These contract clauses are not as straightforward or obvious as one would expect, however. One would think that offering a player an extra $50,000 if they hit 20 home runs during a season could urge this player to take additional steps to meet this mark. However, MLB's collective bargaining contract limits the ability of owners to offer such incentives. Major

League Rule 3(b)(5) says: *"No Major League Uniform Player's Contract or Minor League Uniform Player Contract shall be approved if it contains a bonus for playing, pitching or batting skill or if it provides for the payment of a bonus contingent on the standing of the signing Club at the end of the championship season"*(Newberg, 2006). This policy is in place to prevent players from attending to their personal statistical achievements at the expense of the success of the team. Therefore, the only performance bonuses based on a statistical accomplishment are measures of playing time. Hitters often receive additional compensation for accumulating 500 plate appearances in a season and pitchers for amassing a predetermined quota for innings pitched. This not only urges players to remain healthy and avoid injury by eating correctly and taking care of their bodies, but it also forces players to continually impress their coaches with their performance so they do not become benched for an alternate player. These performance bonuses are generally offered to low performance players, so that they provide strong incentive for them to work hard to achieve their quotas.

Similar to performance bonuses, award bonuses are an incentive that are more commonly used in the contracts of star players. Awards such as MVP, Gold Glove (most superior fielder at his position), and Silver Slugger (best offensive player at his position) are all awards that commend achievement in one's overall play, versus a specific statistic. Additional monetary bonuses are often incorporated into contracts to reward the receiving of these accolades and provide further incentive to perform.

In the past two decades, contracts have also included quirky incentive clauses. Prior to the 2008 baseball season, aging pitcher Curt Schilling signed a one-year, $8 million contract with the Boston Red Sox. Also included in the contract was an additional

$2 million that would be awarded to Schilling if he met six random monthly weigh-ins throughout the season. Along with the bonuses from pitching a predetermined number of innings, this clause provided further incentive to take care of his body (Schultz, 2008).

Another technique employed in the formation of player contracts is the use of the ‘club option’. This incentive tool is often employed when negotiating with players who are in the middle of or past the prime of their career. Franchises will often attach a one-year club option to the end of a contract. This gives the franchise the option of renewing the player’s contract at a predetermined salary for one supplementary year. The prearranged salaries of these extra years are generously fixed, so as to provide incentive for the player to continue to perform at high levels as he ages.

CHAPTER 2

METHODOLOGY AND VARIABLES

The goal of this investigation is to examine all aspects of a Major League contract, most notably length, and study how each feature may play a part in influencing an athlete's future performance. Lengthy research is conducted in scrutinizing the contract history of a pool of currently and recently employed MLB players. Players are included if their contract history contains at least a three-year-long contract at any point in their career. Since the data is comprised of observations on the same variables from the same cross-sectional sample over the past ten to twenty years, this analysis is best modeled through the use of panel data.

The dependent variables chosen for this study are the measures of performance. Since both hitters and pitchers are being examined in this study, various dependent variables will be employed. Conveniently, in 2010, Sean Smith of BaseballProjection.com introduced a new statistic called WAR (Wins Above Replacement) that has gained tremendous popularity. WAR is a metric tool that will allow pitchers and hitters to be examined together. WAR stands for how many additional wins a player contributes to his team over an average replacement (bench) player. Along with major offensive and pitching criterion, this statistic takes into account a player's speed, his fielding ability, the position being played, and other aspects of the game that general statistics do not evaluate. WAR is also a summed total that is accumulated throughout a season, making this quantity a lot less complicated to analyze than a statistic that measures an average. A player's WAR can range from -3 up to Hall of Fame levels of performance around 8.

A second dependent variable to be used is OPS+ (adjusted OPS), and is only befitting for offensive players. OPS+ is a very strong indicator of the quality of a hitter. OPS+ improves on the standard OPS by adjusting to the ballpark and the league in which a player competes.[1] In addition, the number is normalized, meaning that the median of every player is 100. OPS+ can range from meager levels around 50 to very impressive ranks that can surpass 150.

A supplementary dependent variable to measure a pitcher's performance is WHIP (Walks + Hits per Inning Pitched). WHIP is a highly notable pitching statistic because it describes the effectiveness that a pitcher has against each individual hitter. This statistic is a much more precise measure of dominance than Earned Run Average (earned runs given up per nine innings) because ERA numbers can be tainted due to effects from luck and the defensive play behind a pitcher. A WHIP below 1.00 is considered outstanding, as it implies that a pitcher gives up less than one base runner per inning. A level of 1.75 is considered poor, and is a level that will often get a pitcher demoted to the minor leagues.[2]

In determining how a contract affects a player's performance, independent variables other than those related to a contract must first be introduced. These factors will

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[1] Ballparks can affect offensive statistics because of varying dimensions of the fields, different heights of home run walls, whether the field is turf or grass, and even the elevation of the stadium. At 5227 feet in altitude, Coors Field in Denver, Colorado, home of the Colorado Rockies, is considered a "hitter's park" because the thin air allows balls to travel slightly further than an identical hit in lower elevation stadiums.

[2] Professional baseball is made up of a hierarchy of leagues below Major League Baseball called the minor leagues that provide opportunities for player development.

model a player's expected performance throughout his career. To account for the relationship between performance and age throughout a career, the variables AGE and AGE2 are incorporated. The AGE2 variable is equal to AGE raised to the second power and is included to model the upside-down parabolic shape that a baseball player's performance tends to follow throughout his career. Therefore, the expected sign in front of the AGE2 coefficient is negative.

The differences in talent between specific players must be accounted for. To do so, two lagged variables are generated and are given the tentative names PERF1 and PERF2. These variables are set equal to the PERF value that each player finished with the past season and two years prior. PERF will be replaced by WAR, OPS+, and WHIP when running the regression analysis. Each of these variables is expected to have a positive coefficient, since it is logical to assume that the past two years of a player's career will be indicative of how he will perform in the current year. This is incorporated so a superstar like Miguel Cabrera will not be expected to produce numbers equivalent to a mediocre player like JJ Hardy when their age is set equal.

Adjusting for a player's position is another important step in estimating an expected performance level. Dummy variables are created to take into account if a player is a catcher (C), a first baseman (1B), a designated hitter (DH), and an infielder (INF) excluding first base. If a player is an outfielder, each of these dummy variables are set to zero. Making these adjustments is important since more talented players often play specific positions. In 2012, the average WAR of a centerfielder was 1.46, while for first basemen the average was 0.55. For pitchers, a dummy variable (SP) will be exercised to differentiate between a Starting Pitcher and a Relief Pitcher. Starting pitchers generally pitch about once a week and will throw sometimes over 100 pitches in one outing. Relievers generally make one to four appearances per week and will not throw more than 20 to 30 pitches. These distinctive roles will likely generate contrasting statistical results.

It is very important to adjust for injuries as well. If a player misses a portion of the season due to injury, it is logical that his WAR will suffer from the lost playing time. It is also arguable that if a player has been hurt then the injury will cause a drop in performance levels during games following the recovery of the injury. For this reason, a variable is created titled GAMESDL that measures the games missed due to injury. GAMESDL should have a large negative coefficient with respect to its effect on WAR and should have a smaller yet still negative coefficient as it determines OPS+. A variable titled DAYSDL is also included, which measures the total days a player spends injured, including days during the offseason. This variable is used for two reasons: to investigate if a player's injury history has an effect on future contracts, and to test whether contracts have an effect on how often a player is injured. To assist in quantifying a player's injury proneness, a variable labeled INJHISTORY is created that is the sum of the days spent injured during a player's last three years.

The final variable employed specifically for hitters to assist in the estimation of expected performance is the offensive rank of the team that a player competes on (TEAMOFFRANK). Adjusting for the talent of the team is very important. If a hitter is in a batting lineup with skilled players hitting before and after him, his statistics will often be more impressive than if he was on a low-performance team. He will have more chances to score runs and accumulate Runs Batted In (RBI).[3] Also, if a player has a

[3] RBI is a statistic used to credit a batter (except in certain situations) for enabling a runner to score as a result from his at bat.

skilled hitter batting behind him, the pitcher is forced to throw his pitches in the strike zone so as not to walk him to face this other talented hitter. In this situation, a batter will often see a larger amount of hittable pitches in the strike zone. This leads to more opportunities for the player to get a hit, resulting in a higher OPS+ and WAR.

One last determinant variable for the expected performance of pitchers is called RA9OPP, which describes the average runs scored per nine innings that the opposing team of the pitcher scores throughout the season. This number is a weighted average of every team that a pitcher competed against throughout one season. Oftentimes a manager will tailor his team's starting pitching rotation, so that a team's most talented pitcher will throw against better hitting teams on average, or so a weak pitcher receives the benefit of starting against a poor offensive team. This variable will take this effect into account.

Expected Performance for hitters:

$$E(PERF_t) = \alpha + \beta_1(AGE_t) + \beta_2(AGE2_t) + \beta_3(PERF1_t) + \beta_4(PERF2_t) + \beta_5(INF_t) + \beta_6(1B_t) + \beta_7(C_t) + \beta_8(DH_t) + \beta_9(GAMESDL_t) + \beta_{10}(TEAMOFFRANK_t) + \varepsilon_\tau \quad (2.1)$$

Expected Performance for pitchers:

$$E(PERF_t) = \alpha + \beta_1(AGE_t) + \beta_2(AGE2_t) + \beta_3(PERF1_t) + \beta_4(PERF2_t) + \beta_5(SP_t) + \beta_6(GAMESDL_t) + \beta_7(RA9OPP_t) + \varepsilon_\tau \quad (2.2)$$

Expected Performance for hitters and pitchers:

$$E(WAR_t) = \alpha + \beta_1(AGE_t) + \beta_2(AGE2_t) + \beta_3(WAR1_t) + \beta_4(WAR2_t) + \varepsilon_\tau \quad (2.3)$$

Now that a specific individual has an expected level of production, the independent variables representing a player's contract are introduced. To measure instances of shirking, three different variables will be interchangeably employed to test for this scheme. One variable will represent the total remaining years on a player's contract, titled REMAIN. Since it is expected that a player with multiple years remaining on his contract will shirk, a negative coefficient is anticipated on REMAIN. CONTRACTYEAR is a second variable to test for shirking, and is a dummy variable that represents the situation of when a player is on the final year of his contract. Shirking theory suggests that players will perform at their utmost potential on the final year of their contract so as to maximize the compensation offerings during contract negotiations following the season. Therefore, it is hypothesized that there is a positive relationship between CONTRACTYEAR and performance. Lastly, a variable titled 1STYEAR will be utilized as a final detection device for shirking. 1STYEAR is a dummy variable that represents the first year on a long-term contract. Following the signing of a long-term deal, shirking theory suggests that players decrease the intensity of training and practice due to the comfort brought upon from their recent increase in job security. Therefore, a negative relationship between 1STYEAR and performance is anticipated.

Each player's total guaranteed salary from every year is compiled into a dataset that is used to generate the next independent variable regarding contracts. To construct a more linear relationship between yearly salaries and WAR and hopefully improve the models as well, the natural log of the salary dataset is taken (LNSALARY) to generate the independent variable. It is expected for there to be a positive coefficient on LNSALARY, as higher paid players are expected to perform at higher levels than players with smaller salaries. A variable embodying a percent change in salary from the past year (SPERCENT) is another determinant variable. The coefficient on SPERCENT is a little trickier to predict. One would anticipate that if a player is getting paid more in a current year than in a previous year that he would also increase his production. However, there is also an argument that once a player receives a massive pay increase, the tendency might inevitably be to tone down the intensity of effort.

Along with the variables defining the magnitude of compensation as well as the duration of a player's guaranteed earnings, various incentives are commonly included in player contracts. Customarily, when an over-average contract of length and size is signed, a signing bonus (SIBON) is granted to the player as a lump sum gift at the beginning of the first year. A negative coefficient is anticipated to be on the dummy variable, SIBON, as it may contribute to the shirk factor because the player will now be receiving even more money than his long-term contract originally guaranteed. Two additional bonus incentives that are also in the study are performance bonuses (PERFBON) and award bonuses (AWARDBON). The final variable involved in a contract is another incentive that is called a club option (CLUBOP). It would be rational to imagine that the coefficients on these dummy variables will all be positive.[4]

Adding in all these contract determinant variables, the expected performance models in their current state appear as follows:[5]

[4] A 'Mutual Option' will be treated the same as a club option. A mutual option gives the player the option of declining or accepting the additional year as well. Ultimately, the decision comes down to the franchise to renew the contract, so the effect of a mutual option on performance is believed to be very similar to the club option.

[5] In these tentative models, 'SHIRK' will represent each of the three shirk-measuring variables that will be used interchangeably throughout the regressions.

Expected Performance for hitters:

$$E(PERF_t) = \alpha + \beta_1(AGE_t) + \beta_2(AGE2_t) + \beta_3(PERF1_t) + \beta_4(PERF2_t) + \beta_5(INF_t) + \beta_6(1B_t) + \beta_7(C_t) + \beta_8(DH_t) + \beta_9(GAMESDL_t) + \beta_{10}(TEAMOFFRANK_t) + \beta_{11}(SHIRK_t) + \beta_{12}(LnSALARY_t) + \beta_{13}(SPERCENT_t) + \beta_{14}(SBON_t) + \beta_{15}(PB_t) + \beta_{16}(AWARDBON_t) + \beta_{17}(CLUBOP_t) + \varepsilon_\tau \quad (2.4)$$

Expected Performance for pitchers:

$$E(PERF_t) = \alpha + \beta_1(AGE_t) + \beta_2(AGE2_t) + \beta_3(PERF1_t) + \beta_4(PERF2_t) + \beta_5(SP_t) + \beta_6(GAMESDL_t) + \beta_7(RA9OPP_t) + \beta_8(SHIRK_t) + \beta_9(LnSALARY_t) + \beta_{10}(SPERCENT_t) + \beta_{11}(SBON_t) + \beta_{12}(PB_t) + \beta_{13}(AWARDBON_t) + \beta_{14}(CLUBOP_t) + \varepsilon_\tau \quad (2.5)$$

Expected Performance for hitters and pitchers:

$$E(WAR_t) = \alpha + \beta_1(AGE_t) + \beta_2(AGE2_t) + \beta_3(WAR1_t) + \beta_4(WAR2_t) + \beta_5(SHIRK_t) + \beta_6(LnSALARY_t) + \beta_7(SPERCENT_t) + \beta_8(SBON_t) + \beta_9(PB_t) + \beta_{10}(AWARDBON_t) + \beta_{11}(CLUBOP_t) \ \ \varepsilon_\tau \quad (2.6)$$

In addition to investigating how contracts affect specific performance statistics, examining the relationship between contracts and injuries is worthy of exploration. To examine how contracts affect the time a player spends injured, an additional regression model is created with DAYSDL as the dependent variable, representing the number of days in a year that a player is unable to play due to injury. All of the same previous contract variables will be employed as dependent variables. AGE and the positional variables will also be included among the original determinant variables. As people grow older, athletes' bodies become more susceptible to injury, generating a strong positive coefficient on AGE. Different positions are likely to have various implications for time spent injured. Some positions attract a style of play or require physical behavior that is more taxing on one's body, thus inducing a higher frequency of injury. Lastly, INJHISTORY will be an independent variable. It seems logical that some players are more fragile or have worse luck with injuries than other players. INJHISTORY will take this into consideration.

Expected days injured:

$$E(DAYSDL_t) = \alpha + \beta_1(AGE_t) + \beta_2(INF_t) + \beta_3(1B_t) + \beta_4(C_t) + \beta_5(DH_t) + \beta_6(INJHISTORY_t) + \beta_7(SHIRK_t) + \beta_8(LNSALARY_t) + \beta_9(SPERCENT_t) + \beta_{10}(SIBON_t) + \beta_{11}(PERFBON_t) + \beta_{12}(AWARDBON_t) + \beta_{13}(CLUBOP_t) + \varepsilon_\tau \quad (2.7)$$

CHAPTER 3

DATA ANALYSIS

Descriptive Statistics

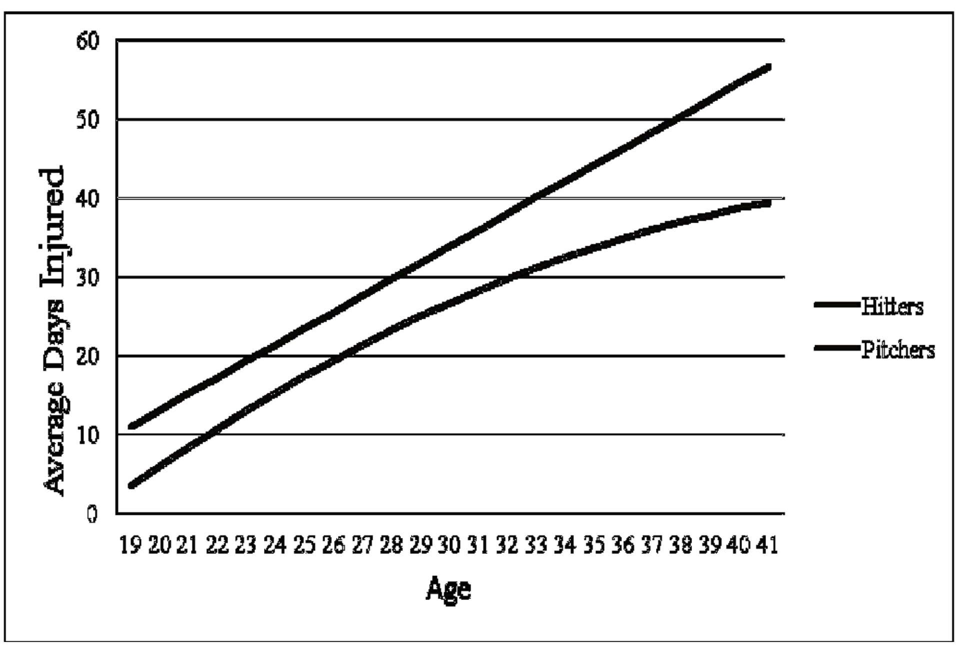
In this study, 236 MLB players, which includes 2186 data points, had their contract figures, performance statistics, and injury history collected for involvement in this analysis. All performance statistics were compiled from Baseball-Reference.com. Contract figures and injury numbers were compiled through BaseballProspectus.com. 153 of the players are hitters and 83 are pitchers. The years involved range from 1989 to 2012, with about 84% of data points occurring during or after the year 2003. With players' ages ranging from 19 to 45 years of age, the average age is 28.1 years. For the performance variable WAR, the average value is 2.4 and ranges from -3.1 to Alex Rodriguez's 10.1 score in the year 2000. As illustrated in Figure 3.1, a hitter's WAR peaks around the age 28 while pitchers generally reach the height of their performance around age 30. The average number of days spent injured during a year is approximately 24 days. For the 137 hitters, the average number of games missed per year due to injury is 17.3. A pitcher on average spends 11.4 more days injured than a hitter, and this margin also increases as players grow older. As age increases, the average player spends two more days injured than a player that is one year younger. A comparison of average injury numbers by age between a hitter and pitcher is illustrated in Figure 3.2.

FIGURE 3.1

AVERAGE WINS ABOVE REPLACEMENT BY AGE: A COMPARISON OF HITTERS TO PITCHERS

FIGURE 3.2

AVERAGE NUMBER OF DAYS SPENT INJURED BY AGE: A COMPARISON OF HITTERS TO PITCHERS



OPS+ displays a range from -30 to 199 with a mean of 108.5. 36% of the data points are from outfielders, 37% from infielders, 14% from first basemen, 9% from catchers, and 4% from designated hitters.

Results/Discussion/Diagnostics

For the analysis with a performance statistic as the dependent variable, age restrictions on the data points used in the regressions will be implemented. Due to alterations in contract policies and incentives, data from the very beginning of a player's career as well as from the final stages is likely to contain error within the current model. Contracts for newcomers into the major leagues are essentially fixed at a one-year, minimum wage deal with no perks for their first three years. On top of that, other teams are not permitted to negotiate with a player until he has six years of experience and becomes a Free Agent. Due to these contract policies, observations from players of ages twenty-four and under are omitted from the analysis that is conducted with a performance statistic as the dependent variable. Additionally, the performance of veterans who are in their thirties begin to deviate away from any consistency. This is because some players acquire incentives to retire earlier than others and inevitably diminish their training efforts at a younger age. On the other hand, some players have the mental and physical stamina to extend their career into their early forties. Consequently, all observations from players of ages thirty-five and older are omitted from these analyses as well.

To examine if and how baseball contracts influence a player's performance, various regressions will be run to gain multiple perspectives on the issue. Firstly, the most general model will be employed that utilizes the entire field of 236 players to conduct a regression with WAR as the dependent variable. As specified previously by equation 2.6, this model in its original form is presented as follows:

$$E(WAR_t) = \alpha + \beta_1(AGE_t) + \beta_2(AGE2_t) + \beta_3(WAR1_t) + \beta_4(WAR2_t) + \beta_5(SHIRK_t) + \beta_6(LnSALARY_t) + \beta_7(SPERCENT_t) + \beta_8(SBON_t) + \beta_9(PB_t) + \beta_{10}(AWARDBON_t) + \beta_{11}(CLUBOP_t) + \varepsilon_\tau$$

Now that an initial model is fully specified, it must be decided whether the panel data has a better estimate using a fixed effects model or a random effects model. Although it is likely that the fixed effects model is more suitable because it helps avoid omitted variable bias due to unobservable heterogeneity, it is necessary to run a Hausman test[1] to confirm this choice of model. As displayed in Table 3.1, this test produces a P-value of 717.7. Since this value is significant, it is now evident that the fixed effects modeling of the panel data is the most appropriate estimate.

[1] Named after Jerry A. Hausman, the Hausman test is used to evaluate one estimator versus another, and is often used to decipher between a fixed-effects model and a random-effects model in panel data.

TABLE 3.1

	Coefficients (b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
age	1.425956	.0389492	1.387007	.1703802
age2	-.026765	-.0032496	-.0235154	.0024497
yrsremain	-.0326894	.0547653	-.0874546	.0181034
salarychange	-.0031702	-.0824634	.0792932	.0043434
sibon	-.020232	-.1740814	.1538494	.0533917
perfbon	.039586	-.0466656	.0862517	.0724932
awardbon	-.0037498	.304601	-.3083509	.0916422
clubop	-.0193879	-.1640381	.1446502	.0939207
gamesdl	-.0229639	-.0213662	-.0015977	.0005578
war1	.1067718	.4053294	-.2985576	.0121792
lnsalary	.0468374	.1465707	-.0997332	.0545485

```
                    b = consistent under Ho and Ha; obtained from xtreg
     B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test:  Ho:  difference in coefficients not systematic

              chi2(11) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                       =      717.71
             Prob>chi2 =      0.0000
             (V_b-V_B is not positive definite)
```

The initial regression results display close to a nonexistent significance of each of the incentive variables. A RESET test[2] on this initial regression generates an f-statistic of 8.51, implying that this model possibly contains error in functional form. Dropping all of the incentive variables slightly improves the R-squared value and delivers a regression with more precise results. Additionally, eliminating the Wins Above Replacement 2 variable contributes to the precision of the regression. Since a player's Wins Above Replacement values generally display year to year consistency, the inclusion of WAR2 is likely detrimental to the regression, as it is too parallel to Wins Above Replacement 1. Lastly, removing the Percent Change of Salary variable, which conveys insignificance with a miniscule t-statistic, improves the model. Consequently, the regression model to

[2] The Ramsey Regression Equation Specification Error Test is a general specification test for linear regression models and specifically tests for error in a model's functional form.

represent WAR as the dependent variable while incorporating both pitchers and hitters is displayed in Table 3.2.

TABLE 3.2

```
Fixed-effects (within) regression               Number of obs      =      1528
Group variable: ID                              Number of groups   =       229

R-sq:  within  = 0.1829                         Obs per group: min =         1
       between = 0.2876                                        avg =       6.7
       overall = 0.2088                                        max =        10

                                                F(6,1293)          =     48.24
corr(u_i, Xb)  = 0.1477                         Prob > F           =    0.0000
```

war	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
age	1.735423	.4402536	3.94	0.000	.8717336	2.599113
age2	-.0316962	.0073853	-4.29	0.000	-.0461847	-.0172078
war1	.1104207	.0269515	4.10	0.000	.0575472	.1632941
yrsremain	-.0394898	.0347569	-1.14	0.256	-.107676	.0286964
gamesdl	-.0224077	.0016926	-13.24	0.000	-.0257283	-.0190871
lnsalary	.0696983	.0714301	0.98	0.329	-.0704333	.2098299
_cons	-21.72942	6.104865	-3.56	0.000	-33.70595	-9.752897
sigma_u	1.3068437					
sigma_e	1.7174324					
rho	.3666928	(fraction of variance due to u_i)				

```
F test that all u_i=0:     F(228, 1293) =     2.31           Prob > F = 0.0000
```

The results of the non-contract related variables show significant links to performance parallel with the hypothesized effects. Age clearly has a significant impact with its rainbow-shaped effect on performance. A player’s past performance also is significant, which again was the logical hypothesis. Additionally, the data displays a very significant relationship with games injured and WAR, conveying that for every 45 games spent injured, a player’s WAR will fall by one point on average. These results are expected. From examining this model, little detail about the effects of contracts is apparent. The Years Remaining variable displays the largest t-statistic compared to the

Contract Year and 1st Year shirking variables. Although there is a negative correlation with the years remaining on a contract and expected performance, this result is not statistically significant. The t-statistic of a player's salary also does not convey much significance. Although in this initial regression, there appears to be only little relationship with a player's contract and performance, more specific regression analyses will provide a deeper examination.

The first step to taking a finer look at the question at hand is to solely examine hitters. This will permit the introduction of supplementary independent variables into the discussion which should provide more accurate results. As was specified in equation 2.4, the first model utilizes WAR as the dependent variable:

$$E(WAR_t) = \alpha + \beta_1(AGE_t) + \beta_2(AGE2_t) + \beta_3(WAR1_t) + \beta_4(WAR2_t) + \beta_5(INF_t) + \beta_6(1B_t) + \beta_7(C_t) + \beta_8(DH_t) + \beta_9(GAMESDL_t) + \beta_{10}(TEAMOFFRANK_t) + \beta_{11}(SHIRK_t) + \beta_{12}(LnSALARY_t) + \beta_{13}(SPERCENT_t) + \beta_{14}(SBON_t) + \beta_{15}(PB_t) + \beta_{16}(AWARDBON_t) + \beta_{17}(CLUBOP_t) + \varepsilon_\tau$$

After running an initial regression, the first step is to once again eliminate the WAR2 variable as it conveys insignificant results. This appears to be a reoccurring issue in the regressions and from this point on, the WAR2 variable will be excluded due to its initiation of multicollinearity with WAR1. After further improvements in the specification of variables, the regression appears in Table 3.3.

TABLE 3.3

Fixed-effects (within) regression		Number of obs	= 1036
Group variable: ID		Number of groups	= 151
R-sq:	within = 0.2446	Obs per group: min	= 1
	between = 0.2108	avg	= 6.9
	overall = 0.2439	max	= 10
		F(14,871)	= 20.15
corr(u_i, Xb)	= 0.0440	Prob > F	= 0.0000

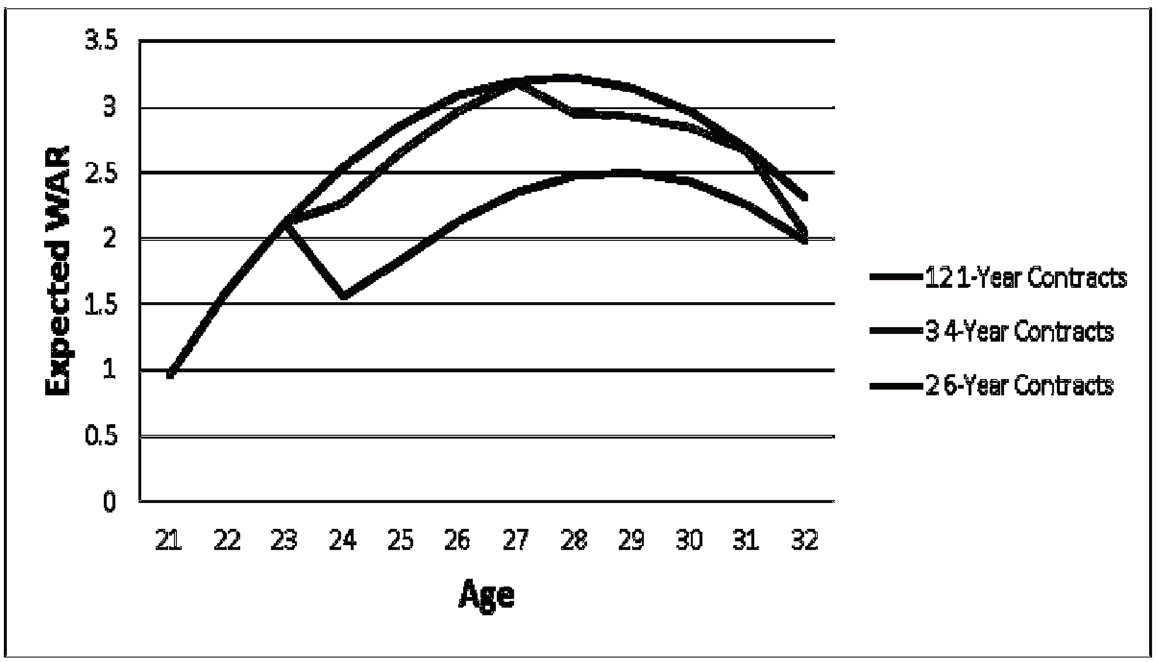
war	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
age	1.695614	.5213905	3.25	0.001	.6722851	2.718943
age2	-.0320245	.008698	-3.68	0.000	-.049096	-.014953
war1	.0885089	.0323685	2.73	0.006	.0249796	.1520382
lnsalary	.1432087	.0866245	1.65	0.099	-.0268084	.3132258
inf	-.419237	.3395936	-1.23	0.217	-1.085754	.2472805
b	-.3439774	.3899783	-0.88	0.378	-1.109384	.4214297
c	-1.485077	.764048	-1.94	0.052	-2.984668	.0145129
dh	-.6488803	.4693271	-1.38	0.167	-1.570024	.2722639
yrsremain	-.0903599	.0436754	-2.07	0.039	-.1760812	-.0046385
salarychange	-.0249684	.0328335	-0.76	0.447	-.0894104	.0394735
sibon	.2601748	.1981574	1.31	0.190	-.128747	.6490966
perfbon	.1955122	.1826981	1.07	0.285	-.1630678	.5540923
gamesdl	-.0234978	.0021737	-10.81	0.000	-.0277641	-.0192314
teamoffrank	-.0304606	.0081225	-3.75	0.000	-.0464027	-.0145186
_cons	-20.31983	7.250852	-2.80	0.005	-34.55101	-6.088646
sigma_u	1.3489762					
sigma_e	1.6193278					
rho	.40966984	(fraction of variance due to u_i)				

F test that all u_i=0: F(150, 871) = 2.44 Prob > F = 0.0000

Although some of the variables still display very low significance, their inclusion in the model aids the regression as a whole. For hitters, 43 games missed due to injury decrease WAR by a full point on average. The offensive rank of the team that a player competes on has a strong significance on an individual's WAR as well. When examining positions, the effect that being a catcher has is significant at the 10% level. A catcher will on average have a WAR of 1.49 less than a player of all other positions. Since REMAIN has a t-statistic of -2.07, there is statistical significance at the 5% level explaining that the more years remaining on a player's contract, the larger the average variance between expected and actual performance. For every extra year remaining on a contract, a player's WAR will decrease by 0.09. Although this value seems low, if the scale of WAR is kept in mind, this margin can mean significantly less production over time. Figure 3.3 illustrates these effects by displaying three players who exhibit equal performance levels from the ages 21 through 23 before their career becomes defined by three different contract schemes beginning at age 24.

FIGURE 3.3

FORECASTED CAREER WAR FOR THREE PLAYERS OF EQUAL TALENT WITH DIFFERING CONTRACT SCHEMES



When 1STYEAR is substituted for REMAIN to test for shirking in an alternative manner, the results show that on a player's first year following a long-term contract signing, his WAR will fall by 0.25 below his expected level. However, this result falls just short of the 10% level of significance. These results are the first evidence of shirking to be identified. The Natural Log of Salary also displays a positive significance at the 10%

level; this is expected as higher paid players theoretically should produce more impressive results. Other variables like Infield, Designated Hitter and SPERCENT are not statistically significant.

To investigate further the relationship between a hitter's WAR and his contract, breaking up the regressions by a player's position may deliver interesting results. The equivalent variables utilized in the regression for all hitters along with all of the incentive variables are applied to separate regressions broken up by each position. For outfielders, the only result worth noting is that LNSALARY is significant at the 10% level with a positive coefficient; this is expected. The results for a designated hitter display significance at the 5% level with REMAIN. The coefficient is -1.4, implying that for every additional year remaining on a contract, a designated hitter's WAR will fall by 1.4 on average. This is an alarming amount of shirking evidence. A designated hitter's primary role on his team is to hit. Therefore, this strong negative relationship with REMAIN implies that the shirking factor is solely determined by offensive production that falls well below expectation. The only result worth noting for catchers is that the effects of performance bonuses are significant very close to the 10% level and display an average increase in WAR of 0.71 when these bonuses are in effect. Since catchers take more days off than players of any other position besides a pitcher, there exists constant competition from backup catchers to win the starting job. Therefore, it is logical that performance bonuses awarded by the number of plate appearances would incentivize a catcher to play as much as he possibly can, thereby increasing his WAR by a significant amount throughout a full season. The first basemen regression delivers evidence of shirking. While REMAIN is very close to a 10% level of significance, 1STYEAR is significant at the 10% level. During the year following the signing of a multi-year contract, a first baseman's WAR will dip by 0.88 below its expected value. This is interesting because first basemen and designated hitters are two positions that generally produce more proficient hitters, again implying the possibly negative effect that shirking has solely on hitting production. At a 10% level, infielders are the only positions for which the implementation of award bonuses displays a significant effect. When award bonuses are implemented, an infielder's WAR increases by an average of 0.69. Infielders also respond to performance bonuses, as the regression estimates at a 10% level of significance that when performance bonuses are in effect, an infielder's WAR increases by 0.55 on average.

To examine the effects of contracts on a hitter's performance in an alternative manner, regressions will be run with Adjusted OPS as the dependent variable. This model in its original form is identical to the hitter's WAR model in its original state except that OPS+ is now the dependent variable. After alterations are made to produce accurate model specification, the regression is observed in Table 3.4.

TABLE 3.4

```
Fixed-effects (within) regression               Number of obs      =      1063
Group variable: ID                              Number of groups   =       151

R-sq:  within  = 0.1413                         Obs per group: min =         1
       between = 0.0857                                        avg =       7.0
       overall = 0.1284                                        max =        10

                                                F(11,901)          =     13.48
corr(u_i, Xb)  = 0.0277                         Prob > F           =    0.0000
```

adjops	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
age	20.9622	6.231952	3.36	0.001	8.731371	33.19304
age2	-.3733805	.1044039	-3.58	0.000	-.5782836	-.1684774
ops1	.0233563	.0330281	0.71	0.480	-.0414646	.0881772
lnsalary	1.352091	1.031205	1.31	0.190	-.6717524	3.375934
inf	-10.46862	3.932066	-2.66	0.008	-18.1857	-2.75155
b	-5.643994	4.787701	-1.18	0.239	-15.04034	3.752351
dh	-4.014951	5.812925	-0.69	0.490	-15.4234	7.393497
contractyear	2.762113	1.531473	1.80	0.072	-.2435569	5.767783
perfbon	3.607582	2.251609	1.60	0.109	-.8114253	8.02659
gamesdl	-.2331727	.0274804	-8.49	0.000	-.2871059	-.1792396
teamoffrank	-.3239292	.0989088	-3.28	0.001	-.5180477	-.1298107
_cons	-192.4255	86.56738	-2.22	0.026	-362.3227	-22.52833
sigma_u	19.649101					
sigma_e	20.18297					
rho	.48659942	(fraction of variance due to u_i)				

```
F test that all u_i=0:     F(150, 901) =     2.75            Prob > F = 0.0000
```

When examining the non-contract variables, a few observations are worth noting. In the WAR hitter regression, WAR1 is significant at the 1% level. In this OPS+ regression, the lagged performance variable does not display statistical significance. This could be due to how OPS+ numbers are much more volatile, especially in years that a player does not play a full season. Also, OPS+ only takes into account hitting statistics, while WAR factors in many more facets of performance, thus diversifying the sources that comprise the value, which would likely create a more consistent score. The result of the Games Disabled variable is very intriguing. In the WAR regression, it made sense that games missed due to injury would have a strong negative effect on a WAR value.

This is because WAR is a total that is accumulated throughout a season. However, OPS+ is a value based on the average of a hitter's plate appearances throughout a season. While it is significant at the 1% level, GAMESDL holds a coefficient of -0.23. The numbers from the regression estimate that for an average of every four games missed due to injury, a hitter's OPS+ will suffer by almost a full point value. These results convey that the more a player is injured throughout a season, the weaker his performance will be during the games that he does play. This is likely because of two reasons. One is that players will often compete through an injury, whether it is a strained muscle or a bone that is still healing following a fracture. This discomfort could lead to a player competing at a substandard level. Also, if a player misses many games from an injury, it may take a few weeks for the player to regain his utmost form upon returning to action. This could be because it can take time to regain a rhythm of high performance or because the player returns to action before he is fully healed.

The only contract variable worth noting is CONTRACTYEAR which attains a 10% level of significance. The regression suggests that the final year of a player's contract has a positive effect on his performance. These results suggest that when a player is on his contract year, his OPS+ will elevate an average of 2.76 points above his expected performance. The REMAIN and 1STYEAR variables each have coefficients that suggest shirking, but both fall short of a 10% level of significance.

Just as with the WAR regression for hitters, regression analysis differentiating the effects by position is executed. Upon examining the results specifically for outfielders, the Performance Bonus variable is shown to have significance at the 10% level with a coefficient of -7.5. This signifies that if an outfielder has performance bonuses implemented into his contract, his OPS+ will drop by 7.5 points on average. Since performance bonuses are often given to players who are on the cusp of manning a starting role, outfielders who receive these bonuses are generally risky players. This could be the explanation for this negative significance. For designated hitters, REMAIN has a 1% level of significance. The regression estimates with confidence that for each additional year remaining on a DH's contract, their OPS+ will fall by about 29 points. Again, this a very alarming degree of shirking evidence for designated hitters. DH's are also shown to respond positively to award bonuses, signing bonuses, and club options. An interesting aspect of the designated hitter regression is that the age variables show little to no significance. This could be due to how designated hitters only have to focus on offensive aspects of the game, while most players must allocate their practice and preparation to balance hitting and defense. This may cause a DH's production to deteriorate at a much slower pace and with a different pattern than most other players. The catcher position is the most responsive to CONTRACTYEAR. However these results still do not provide sound statistical evidence. Catchers exhibit evidence of shirking when examining the 1STYEAR variable. Significant at the 10% level, 1STYEAR has a coefficient of -13.1, suggesting that during a catcher's first year of a long-term contract, his OPS+ will fall by 13.1 points. At a 10% level of significance, catchers are shown to negatively respond to salary increases. As a result of a 100% increase in salary, a catcher's OPS+ will on average drop almost 3 points below his expected production. This is also intriguing because the catcher is the only position where salary has a significant positive effect on OPS+. 1STYEAR is significant at the 5% level for first basemen and regressions estimate that during post-contract-signing years, a first basemen's OPS+ will suffer by almost 15 points. Since 1STYEAR was also negatively significant at the 5% level for its effect upon WAR, it is very evident that first basemen shirk during the first year following a large contract signing. It is noteworthy that first basemen and designated hitters exhibit the highest degree of shirking when considering how these positions are both held by athletes whose primary attributes revolve around offensive and power statistics. Infielders exhibit no significant variables worthy of discussion.

Returning to the topic of how injuries affect a player's OPS+, a comparison of these relationships by position is in order. The catcher is the only position for which the effect of injuries on OPS+ is insignificant. This is interesting because their position often entails a lot of physical abuse. However, the frequency of days off for catchers could explain this situation. In all other positions there exists at least a 5% level of significance for the GAMESDL variable. The designated hitter had by far the highest correlation between games missed from injury and their OPS+. For every game that a DH spends injured, their OPS+ diminishes by 0.63. This seems extremely high, but since DH's do not play defense, they also probably get injured much less than players of other positions. However, this result also implies an element of shirking. DH's may exhibit laziness when injured by not adequately preparing for their return to action. Outfielders, infielders, and first basemen all had coefficients between .21 and .26, which is about equivalent to the correlation when the positions are all pooled together.

To continue the investigation on the effects that contracts have on performance, a more in-depth look into how this relationship pertains specifically to pitchers is required. The first performance statistic to play the part of the dependent variable is Walks + Hits

Per Inning Pitched. Beginning with every variable that could be involved, the original model as specified earlier by equation 2.5 is:

$$E(WHIP_t) = \alpha + \beta_1(AGE_t) + \beta_2(AGE2_t) + \beta_3(WAR1_t) + \beta_4(WAR2_t) + \beta_5(SP_t) + \beta_6(GAMESDL_t) + \beta_7(RA9OPP_t) + \beta_8(SHIRK_t) + \beta_9(LnSALARY_t) + \beta_{10}(SPERCENT_t) + \beta_{11}(SBON_t) + \beta_{12}(PB_t) + \beta_{13}(AWARDBON_t) + \beta_{14}(CLUBOP_t) + \varepsilon_\tau$$

Necessary adjustments are made to generate a model with the most precise specification of variables. This regression is displayed in Table 3.5.

TABLE 3.5

```
Fixed-effects (within) regression               Number of obs      =       437
Group variable: ID                              Number of groups   =        79

R-sq:  within  = 0.1015                         Obs per group: min =         1
       between = 0.0249                                        avg =       5.5
       overall = 0.0587                                        max =        10

                                                F(8,350)           =      4.94
corr(u_i, Xb)  = -0.1824                        Prob > F           =    0.0000
```

whip	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
age	-.0012488	.0790857	-0.02	0.987	-.1567918	.1542941
age2	-.0001128	.0013119	-0.09	0.932	-.0026929	.0024673
whip1	-.0317346	.0418898	-0.76	0.449	-.1141219	.0506528
sp	.1039708	.0534948	1.94	0.053	-.0012409	.2091826
gamesdl	.0012335	.0002685	4.59	0.000	.0007054	.0017615
ra9opp	.130952	.0471694	2.78	0.006	.0381809	.2237232
salarychg	-.0058784	.005259	-1.12	0.264	-.0162217	.0044648
lnsalary	.0257553	.0148955	1.73	0.085	-.0035406	.0550513
_cons	.343754	1.112583	0.31	0.758	-1.844436	2.531944
sigma_u	.13563023					
sigma_e	.1539573					
rho	.43696567	(fraction of variance due to u_i)				

F test that all u_i=0:   F(78, 350) =   2.80   Prob > F = 0.0000

Significant at the 10% level, the Starting Pitcher variable explains that relief pitchers have more success keeping runners off base than starting pitchers. This is because relief pitchers often come into the game to pitch a single inning and focus on a small number of batters, while starting pitchers pitch an average of about 6 innings in one appearance. The Walks + Hits Per Inning 1 variable displays an insignificant effect, suggesting that a pitcher's WHIP from a previous year is not indicative of how he will perform in the following year. While surprising, this inconsistency of year to year performance has a few possible explanations. Relief pitchers tend to display erratic performance numbers from year to year mainly due to a much smaller sample size of innings pitched than a starting pitcher. Also, excluding the most dominant pitchers in the MLB, a pitcher's performance tends to be volatile throughout his career. When a pitcher is frequently traded, he constantly faces foreign styles of offense. A pitcher could be demoralized by a team that emphasizes home runs and power, and then seem untouchable versus a team that prioritizes getting on base via walks and singles. Teams in different leagues and divisions have schedules characterized by differing forms of offense, so a pitcher's performance tends to follow a pattern of vacillation. LNSALARY is positively significant at the 10% level conveying that higher paid pitchers produce higher levels of WHIP. Whether this is due to characteristics of the pitcher position that promote erratic performances year-to-year, or a shirking element of higher-pay precipitating weaker performance, a relationship is certainly apparent. No evidence of influences from contract incentives is displayed in this regression.

Running the regressions with WAR as the dependent variable is useful to provide an alternative perspective on the contract-performance relationship for pitchers. After improvements in the specification of variables are made, the regression appears in Table 3.6.

TABLE 3.6

```
Fixed-effects (within) regression               Number of obs      =       442
Group variable: ID                              Number of groups   =        79

R-sq:  within  = 0.1663                         Obs per group: min =         1
       between = 0.1981                                        avg =       5.6
       overall = 0.1524                                        max =        10

                                                F(10,353)          =      7.04
corr(u_i, Xb)  = 0.0384                         Prob > F           =    0.0000
```

war	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
age	.6406641	.9361213	0.68	0.494	-1.200412	2.48174
age2	-.0115291	.0155472	-0.74	0.459	-.0421059	.0190477
war1	.0986426	.0535394	1.84	0.066	-.0066537	.203939
gamesdl	-.0224121	.0031864	-7.03	0.000	-.0286788	-.0161455
ra9opp	-.1955786	.564265	-0.35	0.729	-1.305323	.9141653
yrsremain	.086571	.0985853	0.88	0.380	-.1073175	.2804595
salarychg	.0432557	.0630672	0.69	0.493	-.080779	.1672905
sibon	-.4599091	.3370849	-1.36	0.173	-1.122856	.2030381
perfbon	-.2035697	.2812157	-0.72	0.470	-.7566387	.3494992
lnsalary	-.2389228	.1733809	-1.38	0.169	-.5799124	.1020667
_cons	-1.852419	13.15855	-0.14	0.888	-27.73143	24.02659
sigma_u	1.3037717					
sigma_e	1.8484853					
rho	.33220913	(fraction of variance due to u_i)				

F test that all u_i=0:   F(78, 353) =   1.66   Prob > F = 0.0011

When first analyzing the results from the non-contract variables, a few observations arise. The effect that a pitcher's age has on his WAR appears to be of little significance. The response of a pitcher's WAR to his age reacts much stronger than that of a hitter.[2] When observing the negative correlation between LNSALARY and WAR, it is suggested that pitchers who make large salaries based on productive prior seasons

[2] If a pitcher utilizes power as his weapon for success, then it is logical to hypothesize that his success will relate more significantly to age. However, there are many pitchers who use more crafty techniques in getting batters out. Some pitchers rely on specialty pitches like a curveball or slider for their success. Others utilize tremendous precision with their pitch placement for their success.

frequently falter in follow-up years. Since LNSALARY also has noteworthy effects upon WHIP, it is clearly apparent that higher-paid pitchers produce less impressive results.

Inspecting the GAMESDL variable also shows a strong significant effect on WAR. For every 45 games missed due to injury, a pitcher's WAR decreases by one point value; this is very similar to that of a hitter. A final observation regarding this regression concerns the Signing Bonus variable. Although not technically statistically significant, the data estimates that a pitcher's WAR during a year that has included a signing bonus will dip by almost 0.5. Since signing bonuses occur immediately after a large contract signing, this could be potential evidence that a pitcher shirks at the beginning of a long-term contract.

By rerunning the regressions and segmenting the pitchers into starting pitchers and relief pitchers, another perspective on the matter appears. A relief pitcher's WAR1 statistic has a negative coefficient at the 5% significance level, indicating extreme vacillation of a reliever's WAR. This is explained by the small sample size of hitters that relief pitchers face from year to year, which leads to inconsistent production numbers. This is the complete opposite result for starting pitchers. The WAR1 variable for starting pitchers is positively significant at the 10% level. This is because starters pitch 3 to 4 times as many innings as a reliever as well as the fact that stronger and more consistent pitchers are generally placed in the starting pitching role. The results from the SIBON and LNSALARY variables are consistent with the initial regression with all pitchers pooled together. From inspecting the variables of REMAIN, CONTRACTYEAR, and 1STYEAR, no evidence of shirking is uncovered from the results.

While using performance statistics as the dependent variable to examine the relationship between contracts and future performance is enlightening, the effects that contracts have on injuries is often neglected. When a player is injured, he is unable to perform at all. Sitting injured on a bench is often worse than playing at any level of performance. Examining the relationship between contracts and injuries is another approach to determine if shirking is a significant tactic used by baseball players. To begin, the entire pool of players is employed for regressions to be run with Days Disabled as the dependent variable. This model was specified earlier by equation 3.7.

$$E(DAYSDL_t) = \alpha + \beta_1(AGE_t) + \beta_2(INJHISTORY_t) + \beta_3(REMAIN_t) + \beta_4(LnSALARY_t) + \beta_5(SPERCENT_t) + \beta_6(SBON_t) + \beta_7(PB_t) + \beta_8(AWARDBON_t) + \beta_9(CLUBOP_t) + \varepsilon_\tau$$

After removing insignificant variables and utilizing the shirking variable that generates the most precise results, the resulting regression is depicted in Table 3.7.

TABLE 3.7

```
Fixed-effects (within) regression               Number of obs      =      1948
Group variable: ID                              Number of groups   =       236

R-sq:  within  = 0.0722                         Obs per group: min =         2
       between = 0.1503                                        avg =       8.3
       overall = 0.0041                                        max =        23

                                                F(5,1707)          =     26.58
corr(u_i, Xb)  = -0.4190                        Prob > F           =    0.0000
```

daysdl	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
age	2.515699	.2893386	8.69	0.000	1.948204	3.083195
injhistory	-.0668966	.0145436	-4.60	0.000	-.0954217	-.0383716
contractyear	-3.028328	2.003319	-1.51	0.131	-6.957547	.9008902
salarychange	-1.208769	.5235471	-2.31	0.021	-2.235631	-.1819079
clubop	4.083272	2.59435	1.57	0.116	-1.00517	9.171713
_cons	-40.79942	8.508341	-4.80	0.000	-57.48729	-24.11154
sigma_u	25.348857					
sigma_e	36.801009					
rho	.32178446	(fraction of variance due to u_i)				

F test that all u_i=0:   F(235, 1707) =   2.17   Prob > F = 0.0000

Examining the results, it is evident that a player's age is the most significant determinant of how much time he spends injured. This regression estimates that a player is expected to spend two more days injured than the previous year. Injury History is significant at the 1% level and holds a coefficient of -0.07. Since the t-statistic implies strong significance and the coefficient is very close to zero, this outcome explains that baseball players tend to have injury patterns that are consistent with their recent years. Significant at the 5% level, SPERCENT contains a coefficient of -1.21. This estimates that for a 100% increase in salary from a previous year, a player tends to spend a little more than one less day injured than his expected amount. The Club Option variable holds significance just short of the 10% level and suggests that when a club option is in place, a player will spend about four more days injured per year. This result is the opposite effect from what the club option is designed to induce. It is notable that club options also coincide with long-term contracts. Therefore, a possible explanation of this unintended result is that players are spending more time injured because they have job security. This could be evidence of shirking. Lastly, the CONTRACTYEAR variable is also very close to being significant at the 10% level and the regression estimates that when players are on their contract year, they will be injured for about four days less than expected. Consider a situation when a player would generally miss a game due to a minor injury, or take a month or two off to get surgery on a body part that may not be urgent or completely necessary. The results suggest that if he is on his contract year then he will take the necessary steps so that he can still perform; he will fight through the discomfort of a minor injury, or delay a non-urgent surgery for another time. If a player is on a long-term contract and he does not take steps to stimulate the healing process of an injury, this implies shirking.

To investigate the relationship between contracts and injuries on a deeper level, rerunning the analysis with solely hitters is appropriate. This regression can be referred to in Table 3.8.

TABLE 3.8

```
Fixed-effects (within) regression               Number of obs      =      1353
Group variable: ID                              Number of groups   =       154

R-sq:  within  = 0.0858                         Obs per group: min =         2
       between = 0.0115                                        avg =       8.8
       overall = 0.0148                                        max =        23

                                                F(7,1192)          =     15.97
corr(u_i, Xb)  = -0.5106                        Prob > F           =    0.0000
```

daysdl	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
age	1.95406	.40337	4.84	0.000	1.162666	2.745454
c	-32.23663	12.9504	-2.49	0.013	-57.64474	-6.828511
contractyear	-3.698157	2.208286	-1.67	0.094	-8.030716	.6344027
salarychange	-1.02073	.5450415	-1.87	0.061	-2.090077	.0486178
clubop	3.412855	2.750373	1.24	0.215	-1.983257	8.808966
lnsalary	1.18878	1.15743	1.03	0.305	-1.082047	3.459607
injhistory	-.0195377	.0173623	-1.13	0.261	-.0536017	.0145263
_cons	-44.23374	12.85125	-3.44	0.001	-69.44733	-19.02016
sigma_u	20.784107					
sigma_e	31.830719					
rho	.29891153	(fraction of variance due to u_i)				

```
F test that all u_i=0:     F(153, 1192) =     1.92          Prob > F = 0.0000
```

The results reflect similar effects to the regression of the entire pool of players. However, the most interesting observation comes from the Catcher variable. A t-statistic of -2.49 conveys significance at the 5% level and the coefficient is -32.2. This data estimates that a player of the catcher position spends 32 fewer days injured than hitters of other positions. Even knowledgeable followers of the MLB would likely find this result puzzling. However, a recent ESPN study derived this same incomprehensible result (Stark, 2012). Since catchers take significantly more days off than hitters of any other position, catchers likely use these customary days of rest to nurse minor injuries. That being said, with the physical demand on a catcher's knees and frequent collisions at home plate, it is difficult to accept that this is truly the consequence of a player in the catcher position.

Other than C, the only other noteworthy difference in the hitter's injury regression model is a more confident correlation in a hitter's final year on a contract and spending fewer days out due to injury. While the CONTRACTYEAR variable fell just short of statistical significance in the regression of the entire pool of players, it attained a 10% level of significance for hitters. When hitters are competing on the final year of their contract, they will miss almost four fewer games on average. By revisiting the discussion about how injuries negatively affect a hitter's OPS+, it is uncovered here that not only does the final year of a contract affect OPS+, but hitters will also play more games from less time spent injured on their contract year. It is also known from before that the less time spent injured positively influences OPS+. More games played combined with a higher OPS+ generates a significantly higher contribution from a hitter on his contract year. These links between the final year of a contract with OPS+ as well as days injured provide strong evidence of hitters engaging in shirking activity.

A brief discussion of how the contract-injury relationship varies by hitters of different positions may provide notable results. For the purpose of solely investigating for evidence of shirking, a unique regression for each individual position is run with only the AGE, SPERCENT, LNSALARY, INJHISTORY and each of the shirk-testing variables. The injury histories of infielders and first basemen have a statistically significant association with the CONTRACTYEAR variable. While playing during the final year of a contract, the data estimates at the 1% level of significance that first basemen are injured for sixteen less days than their average, and at the 10% significance level infielders are reportedly hurt for about seven days below their expected.

A final regression model to test the shirking theory by the effect that contracts have upon days injured is conducted by substituting pitching data in for hitting data, shown in Table 3.9.

TABLE 3.9

```
Group variable: ID                               Number of groups   =        82

R-sq:  within  = 0.0757                          Obs per group: min =         2
       between = 0.1452                                         avg =       7.2
       overall = 0.0017                                         max =        17

                                                 F(8,503)           =      5.15
corr(u_i, Xb)  = -0.4963                         Prob > F           =    0.0000
```

daysdl	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
age	3.000711	.7592537	3.95	0.000	1.509012	4.49241
sp	-12.9218	11.50992	-1.12	0.262	-35.53524	9.69165
salarychg	-1.894031	1.283698	-1.48	0.141	-4.416101	.6280395
sibon	-3.680945	6.824287	-0.54	0.590	-17.08856	9.726673
clubop	7.801201	6.017874	1.30	0.195	-4.022064	19.62447
perfbon	-6.761678	6.090676	-1.11	0.267	-18.72798	5.204621
injhistory	-.100972	.0285221	-3.54	0.000	-.1570092	-.0449348
contractyear	-1.130156	5.048178	-0.22	0.823	-11.04827	8.787955
_cons	-35.13089	24.66362	-1.42	0.155	-83.5873	13.32551
sigma_u	35.605766					
sigma_e	46.352307					
rho	.37109386	(fraction of variance due to u_i)				

```
F test that all u_i=0:     F(81, 503) =     2.09             Prob > F = 0.0000
```

When comparing the age to injury effect between pitchers and hitters, it is apparent that pitchers damage their bodies over the years more quickly than hitters. The effect of age on pitchers is 50% greater than its effect on hitters. The motion of throwing a baseball 90 miles per hour at the frequency that a pitcher does is one of the most abusive actions in all of sports. (Sarris, 2012) This result is very understandable given the arm injuries with which pitchers have to deal. The only other statistically significant variable to determine days injured is INJHISTORY. At the 1% level of significance and with a very minute coefficient, the regression estimates convey an extreme consistency of a pitcher's injury numbers from year to year. There is large uniformity with some pitchers very rarely injuring themselves, while other pitchers find themselves getting hurt year after year. From this, it is apparent that pitchers have little control over whether or not they get injured. This is a possible explanation of the very low significance that each of the shirk-measuring variables have with injuries. A pitcher's work ethic towards preventing injury has a very small effect thereby making it difficult for pitchers to shirk through the amount of time they spend injured.

CHAPTER 4

IMPLICATIONS AND CONCLUSIONS

From all these results, it is very evident that specifically hitters demonstrate tendencies to shirk. On the other hand, no evidence of shirking is displayed by pitchers. Besides the data describing how higher-paid pitchers have a tendency to produce lower Walks + Hits Per Inning Pitched and Wins Above Replacement values, there is no other connection between pitchers' contracts and their performance and injuries. This seems to be the result of both a high volatility in pitching performances and consistent year to year injury numbers by individual pitchers. For hitters, it is intriguing that there seems to emerge a theme that demonstrates how the Years Remaining variable has no significance to injuries, while the Contract Year variable consistently does. It is quite the contrary when discussing these shirking variables as they relate to the performance statistics. One interpretation is that hitters with high job security display lackadaisical or conservative habits regarding the treatment and prevention of injuries. It is only until the year that is the primary factor in a player's future salary that he puts forth exceptional effort to disallow injuries to affect his playing time. On the other hand, while there is no evidence to suggest that players accelerate their performance specifically in their contract year, performance statistics seem to be negatively affected by multiple years remaining on a contract. Seeing as the 1st Year variable also displays a probable negative relationship with WAR and OPS+, this could be a reflection on an initial dip in performance in the primary years following a large contract signing. Performance is then able to realign with expected levels following this post-signing slump. More specifically, designated hitters and first basemen display the most significant responses, as their performance statistics and injury numbers both follow a shirking pattern based on their degree of job security. The sporadic and inconsistent signs of significant effects from contract incentives do not amount to any conclusive claims. The only confident claim regarding incentives is the positive effect that performance bonuses have on catchers.

The implications behind all the results can derive various strategies to the construction of a contract depending on the situation. Some franchises like the New York Yankees, Los Angeles Dodgers, Philadelphia Phillies, and Boston Red Sox have the financial capabilities of maintaining yearly payrolls well over $150 million. Affluent teams like these have the ability to shell out ludicrous amounts of money on high-performance players to ensure their yearly status as a playoff contender. However, over half of the ball clubs in Major League Baseball have a budget that must accommodate a payroll less than $100 million. Teams such as the Houston Astros, Miami Marlins, Pittsburgh Pirates, and Oakland Athletics all have payrolls under $60 million. Since the 1994 baseball strike that cancelled the entire season, a team with a payroll in the bottom half of all Major League teams has only won the World Series one time; the Florida Marlins completed this feat in 2003. The Kansas City Royals and Pittsburgh Pirates, two teams consistently ranking in the bottom half of team payrolls, each have not made the playoffs in over twenty years. These facts highlight the detriment that a small budget has on team success. If these low-budget franchises desire successful seasons, their limited amount of money must be allocated efficiently and strategically in order to maximize their winning potential.

Regarding pitchers, while there is virtually no evidence of multiple-year contracts having an effect on their performance and injuries, franchises still must be careful with how they make their contract decisions. GM's must be very keen on a pitcher's injury proneness. Offering a long-term contract to a high-performance pitcher who is also injury-prone could result in a catastrophic waste of money. In 2006, Florida Marlins starting pitcher Josh Johnson broke into the Major Leagues with an impressive 3.14 ERA and finished fourth in the Rookie of the Year (ROY) voting. The following two seasons, Johnson missed 146 games in 2007 and 91 games in 2008 due to injury. In 2009 while on a one-year contract, Johnson seemed to get back on track, remaining healthy and gaining election to the All-Star game. As a Free Agent following his impressive 2009 campaign, the Marlins signed Johnson to a 4-year, $39 million deal that would last through 2013. In 2010, Johnson battled through various minor ailments and missed 28 games and his 2011 season was almost a total wash, as he was unable to compete in 122 games. Although he remained healthy in 2012, he posted a record of 8 wins and 14 losses and held a disappointing WHIP of 1.28. Prior to the 2013 season, the Marlins had paid Johnson almost $30 million to sit injured on the bench for almost one half of his time and to pitch only mediocre baseball during the other half. Following the 2012 World Series, it is to no surprise that the Marlins had had enough and shipped Johnson to Toronto in a trade with the Blue Jays. Pitchers like Josh Johnson, who require a large amount of money due to their All-Star potential, but also carry the burden of injury-proneness, should be strongly avoided. The Marlins' 2013 financial crisis can be partly attributed to the repercussions from the poor contract signing of Josh Johnson. Therefore, narrowing one's focus onto pitchers without an extensive injury history is very important.

Since it has been shown that higher-paid pitchers display evidence of weaker performance compared to those with smaller salaries, GM's must be very hesitant in signing pitchers who require higher salaries. There are few pitchers in the MLB who year after year produce results that rank among the top in the league. There are a few recommendations for how franchises should build their pitching staff. Long-term contracts are advisable for pitchers who have exhibited relatively consistent performance numbers and are unconnected to injuries. Long-term contracts for pitchers who recently exhibited all-star numbers and require a large amount of money should be avoided. Chances are that these all-star numbers will be a thing of the past in another year. This is especially true for pitchers who have shown a tendency to become injured. However, if a franchise sets its goals on winning a championship in a specific year, it is advisable for GMs to take a risk where the payoffs, positive or negative, would only last one year. For example, say the Baltimore Orioles hypothetically reasoned that the 2014 season was going to be their year to win it all. During the offseason prior to the year, taking a risk on an expensive high-performance but erratic and possibly injury-prone pitcher on a one-year contract could be the right idea. If he gets injured or does not perform as well as the franchise desired, then the negative effects only last one year and maybe the Orioles, along with 30 other teams, do not win the championship. On the other hand, if he stays healthy and lives up to his potential, his effectiveness could play a huge part in the Orioles' 2014 World Series campaign. Given these guidelines, it must be remembered that the signing of pitchers can be compared to an auction, as a player often accepts the offer that is most generous to him. Therefore, strictly following these rules is unrealistic, as a pitcher will generally select a long-term deal over a one-year contract, and will choose a $5 million salary over a team that only offers him $3 million. Finding an equilibrium that allows GMs to build a pitching staff while keeping these recommendations in mind but still staying competitive in the market is the objective.

For hitters, the implications primarily describe how a GM can tailor a contract to incentivize a player to be most productive in specific seasons. Since there is significant evidence supporting the existence of negative effects from long-term contracts on performance for hitters, it is possible to mold contracts to create statistically higher performance numbers during a targeted year. Evidence suggests that each additional remaining year on a player's contract contributes to decreased performance. This holds particularly true for first basemen and designated hitters. Given the competitive nature of the baseball business, it is unrealistic to only sign single-year contracts, as no player will ever want to play for a team with this characteristic. Therefore, just as with pitchers, reasonable equilibriums must be targeted that are attractive enough to sign a productive hitter, yet steer clear of the 8-year engagement with no bail-out plan.

The history of Red Sox legend, David Ortiz, illustrates a great example of the repercussions of a hitter's contract. Prior to 2007 when Ortiz signed his 4-year, $52 million contract, he had never attained job security larger than two years. During the four seasons leading up to 2007, Ortiz averaged only two games missed due to injury. Ortiz's average WAR during this stretch was 4.4 and his OPS+ was 152. After his large 2007 contract signing, Ortiz averaged almost 20 games injured per year from 2007 through 2009. His average WAR fell to 2.7 and his OPS+ dropped to 134. While on one-year contracts during 2010 and 2011, Ortiz was injured for a total of 11 games, and his OPS+ jumped back up to 149. This sequence of contract signings and resulting performances, although not representative of every player, is a great demonstration of how multiple year contracts can effect a hitter's production.

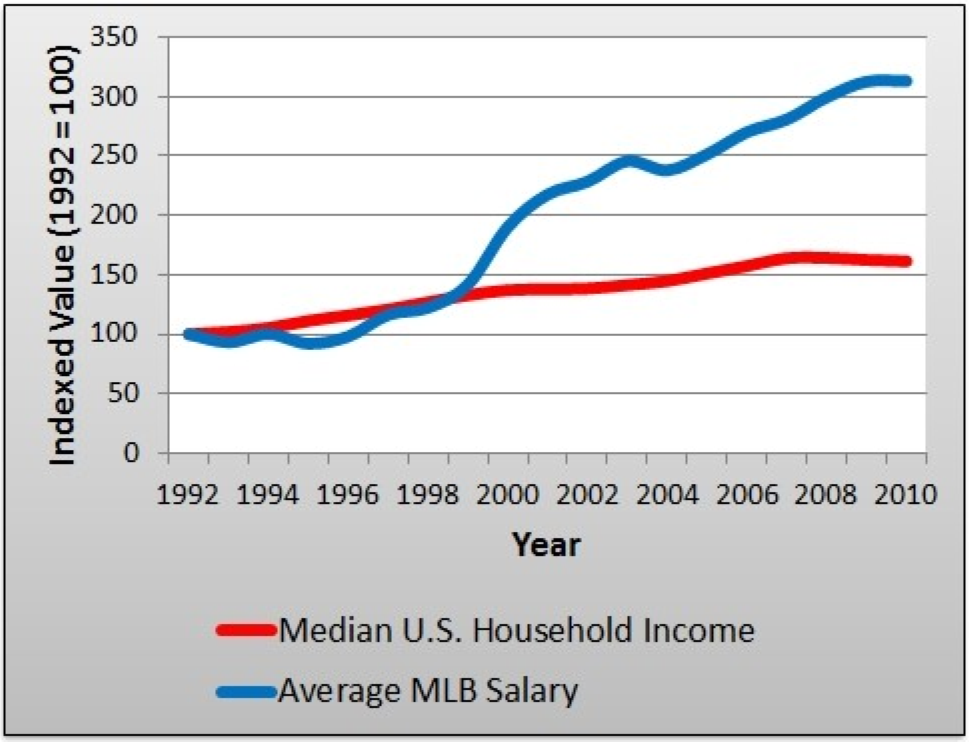
To maximize a batting lineup's potential for a specific season, a franchise must attempt to minimize the number of years remaining on players' contracts during this targeted season. For example, imagine that the Cincinnati Reds currently have a lot of young and growing talent, but realistically in the upcoming 2013 season they do not believe they will be probable playoff contenders. However, management estimates that in 2015 their young players will develop and by then they will have the tools to hold a very competitive offensive lineup. It is in the preceding years that the Cincinnati GM should make moves so that the majority of their players will have only one or two years left on their contract when the 2015 season comes around. Signing a couple high-performance hitters to three or four year contracts prior to the 2013 season will put the Reds in an advantageous state to vie for the World Series when 2015 arrives. This will allow for these hitters to move past their post-contract signing drought in 2013 and possibly 2014. In 2015, these high-performance hitters will produce significantly higher offensive numbers, and minimize their time spent injured. Another strategy is to trade for an All-Star caliber hitter who will be on the final year of his contract prior to the 2015 season. Lastly, it is recommended for the Reds to offer performance bonuses to their catcher, as this does not pose a significant financial burden, and evidence suggests that this incentive increases production. Since a team like the Cincinnati Reds does not have the budget to be spending copious amounts of money on players every single year, utilizing these strategies will efficiently allocate their spending to escalate their chances of success in a specific season.

Although a strong significant relationship between contracts and performance is often exhibited, the regressions also reflect variation. The tedious process of researching and evaluating every individual's contract and performance history resulted with the inclusion of 236 players. To adequately quantify relationships between contract variables and performances over time, a considerably larger sample size must be attained. Secondly, there are a variety of additional variables that can be explored to aid in the forecasting of expected performance over a player's career. A more effective and accurate approach to the handling of the years leading up to a player's Free Agency would bring more consistency to the results. Also, developing an algorithm that can predict when a player is likely to retire based on a subset of other variables will permit the model to accurately sort through and include the older generation of ball players in the analysis.

As the net worth of professional athletes continues to grow, the amount of money invested in sports industries today expands faster than the majority of all other industries nationwide. As illustrated in Figure 4.1, the inflation of MLB salaries over the past 15 years has doubled the median household income in the United States.

FIGURE 4.1

AVERAGE MLB SALARY VERSUS MEDIAN U.S. HOUSEHOLD INCOME FROM 1992 TO 2010



Source: FanGraphs (Wolfersberger, 2012)

As baseball players continue to ask for more money each progressive year, increasing amounts of pressure is placed on General Managers to manipulate their budgets to attain the most beneficial effect. It is the GM's job to decide who deserves the big bucks and who does not, and the margin for error is millions of dollars lost. On December 29, 2006, starting pitcher Barry Zito signed a contract with the San Francisco Giants to a 7-year, $126 million deal, allegedly crowning Zito the highest paid pitcher in baseball history at 28 years old. Zito's record up until this signing was 201-63 (.618) and he collected 1096 strikeouts in his six years. During the six years following Zito's record breaking contract, he compiled a record of 58-69 (.457) and accumulated just 701 strikeouts. Barry Zito is the epitome of an MLB shirker. Giants General Manager, Brian Sabean, made the miscalculation of his career and displayed to the rest of the sports world the potential dangers the large mass of capital can cause in professional sports.

CHAPTER 5

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