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Abstract

This paper examines the principal-agent problem within professional sports. Imperfect information between managers and players, as well as the guaranteed income a long-term contract provides, are predicted to provide players with the incentive to alter effort over the length of a contract – especially during the first year of a long-term contract. Regression analysis indicates that players' performance levels decline during the first year of a long-term contract, suggesting that the effects of the principal-agent problem may outweigh competing effects. The study does not, however, suggest that players increase performance in the final year of a contract.

Keywords

principal-agent problem, sports contracts, professional sports

LONG-TERM CONTRACTS AND THE PRINCIPAL AGENT PROBLEM

Elizabeth Purcell

ABSTRACT

This paper examines the principal-agent problem within professional sports. Imperfect information between managers and players, as well as the guaranteed income a long-term contract provides, are predicted to provide players with the incentive to alter effort over the length of a contract – especially during the first year of a long-term contract. Regression analysis indicates that players' performance levels decline during the first year of a long-term contract, suggesting that the effects of the principal-agent problem may outweigh competing effects. The study does not, however, suggest that players increase performance in the final year of a contract.

1. Introduction

The benefits of long-term contracts to firms have been under debate for some time. On the one hand, employees may focus better on their work if they are not concerned about losing their jobs. On the other hand, a long-term contract guarantees income for a certain time period, regardless of the effort put forth. As employers are not able to monitor every action employees make, employees are able to reduce effort once a long-term contract is signed. This opportunistic behavior is most likely to occur when employers are unable to distinguish between shirking, or not trying, and poor performance due to the stochastic nature of the environment.

Behavior patterns arising from long-term contracts exemplify the principal-agent problem. The principal-agent relationship exists when a principal (the employer) needs to hire an agent (the employee) with specialized skills to perform a task. The principal must motivate the agent to perform like the principal would prefer, while facing difficulties in monitoring the agent's every action (Sappington 1991). The principal-agent problem occurs when principals and agents have conflicting goals.

The principal-agent relationship can be seen in various situations in the real world. In academia, for example, professors are expected to teach classes and conduct research that will eventually be published. However, once professors have tenure, they may care less about teaching or may start publishing fewer papers. With internships, there is an incentive to work hard and perform well because there is the opportunity for a full-time offer at the end of the internship. However, once a full-time job has been obtained, there is less urgency for the former-interns to impress their superiors, as there is no immediate room for advancement.

The motivation behind this study is to examine the principal-agent problem in the realm of professional sports. Sports is used as a venue for this study because it is an industry in which labor productivity is easily quantifiable and the data is openly reported. The existence of imperfect information between

managers and players, along with the guaranteed income a multi-year contract provides, may lead players to alter effort over the term of their contracts. In the contract year, the last year of players' contracts, players may exert more effort, hoping to receive long-term contracts with higher salaries the next year. Once they have signed long-term contracts, however, players may reduce effort, as they have guaranteed income for the remainder of their contracts, regardless of performance.

Whereas previous studies have examined long-term contracts in a specific sport, this paper looks to examine the impact of long-term contracts across Major League Baseball (MLB), the National Football League (NFL), the National Hockey League (NHL), and the National Basketball Association (NBA). The paper proceeds as follows: the next section analyzes the principal-agent problem and the incentive to shirk given the structure of contracts in the various sports, the third section provides a literature review, the fourth section describes the data, the fifth section provides the methodology behind the study, the sixth section presents and analyzes the results, and the final section draws conclusions and implications from the study.

2. The Principal-Agent Problem and Collective Bargaining Agreements

Employers are willing to offer secured income contracts because they can act as incentive mechanisms that motivate employees to put forth as much effort as they can so they can obtain the contract. Long-term contracts can be beneficial for both employers and employees. Employers benefit from being able to secure productive employees and prevent them from moving to the competition (Maxcy 1997), while employees, once they obtain a long-term contract, are promised a salary for a specific period of time.

Principal-agent theory suggests that when parties of a contract have different objectives, shirking can occur. When compensation or job security is dependent on performance, workers are likely to exert as much effort as they can. However, when compensation is no longer dependent on performance, workers have less incentive to put forth the same amount of effort. Once agents have secured income through a contract, effort put into work lowers utility.

Shirking will not necessarily occur, however, because workers may gain utility from contributing to the success of the firm. For example, professional athletes derive utility in helping their team win a championship (Maxcy 1997). Athletes are unlikely to see shirking as beneficial from this standpoint because if they are not performing at their best, they will contribute to the team losing. On the other hand, there is less need for workers to be concerned about employer perceptions of them and their productivity once a long-term contract is signed (Stiroh 2007). Therefore, there may be less incentive to exert effort once a contract is signed.

Monitoring shirking is sometimes difficult because individual contribution is not always easily identified. The free-rider problem can exist, as the team can

still perform well if one player is not exerting all his effort (Prendergast 1999). If players can enjoy wins without putting forth all their effort, there is incentive for them to shirk.

Shirking can occur during games and in other ways as well. Once a long-term contract is obtained, athletes may not train as diligently during the off-season. Players that are at the end of their contracts want to show that they are willing work hard to improve their skills and do their best for the team. If players know they have another five years left on the contract, however, they may spend the off-season relaxing rather than training every day. In addition, whereas athletes who are at the end of a contract may be more likely to play with an injury in an attempt to show they are still valuable to the team, athletes who still have time left on their contracts may avoid playing while injured to avoid the risk of further injury and shortening their careers.

In order to examine the impact long-term contracts have on performance, performance needs to be considered at various stages over the length of a contract. Ideally, effort would be used as the measure of whether players shirk once they have secured a long-term contract; however, changes in effort are difficult to observe. Therefore, performance will be used as the dependent variable, assuming that if players put forth more effort they will perform better.

The year directly preceding contract negotiation is when players are likely to put forth the most effort. While there is more information in players' performance history as a whole, salaries are based more on the most recent year of performance rather than past performance. Healy finds that teams put about twice as much weight on performance from the past season than on performance from two or three years ago (Healy 2008). This suggests that shirking is more likely to occur early in the contract and diminish as players get closer to the contract year.

While principal-agent theory suggests that players have the incentive to shirk, there are other factors that may impact players' behavior. Players are paid not only by salary, but also by endorsements. Players receive endorsements because they are large contributors to their teams' success and are popular with fans. Therefore, endorsements are a disincentive for players to shirk because if their performance starts declining, they risk losing their endorsements as well as popularity. As some endorsements rival players' salaries, the cost of losing the additional income may be greater than the benefit received from lowering effort. In addition, if players enjoy having fame, the disutility they may face from losing fans due to a drop in performance may outweigh the utility players get from shirking. Many athletes want to leave behind a legacy and be remembered for being great. Shirking has the potential to taint this legacy, which may prevent some athletes from shirking. Therefore, endorsement incentive effects, as well as utility derived from popularity, may offset the shirking that is predicted by the principal-agent problem.

The principal-agent problem predicts that long-term contracts can create inefficient pay and performance, unless mechanisms exist within the contract to

prevent these (Maxcy et al. 2002). When implementing mechanisms in contracts, incentives should be used carefully. Certain mechanisms, such as tying rewards to performance, can lead to dysfunctional responses, where agents focus solely on the specific performance measures listed in the contract (Prendergast 1999). This can end up damaging firm performance overall, as agents begin to ignore other aspects of their jobs that do not bring rewards. For example, Ken O'Brian, a quarterback, was given a contract in which he was penalized any time he threw the ball to the opposing team. While he threw fewer interceptions, his solution was to hold the ball rather than throw, instead of working to improve his accuracy (Prendergast 1999). This in the long run hurt the team because its quarterback would not throw the ball, even in cases when he should have. When used improperly, contract incentives may be more detrimental than beneficial.

Contracts and other labor issues in professional sports are governed by collective bargaining agreements (CBA). The CBA, which determines many parameters that teams and players face when negotiating contracts, is agreed upon between the league and the league's respective player's union. As this study focuses on the impact of long-term contracts, only the key factors relating to the contracting framework of each sport will be discussed. The information is summarized in Table 1. This study focuses on the regular season; therefore, post-season incentives and regulations are not addressed.

Minimum salary levels are a commonality across the four CBAs examined, however the minimum salary implemented varies between sports. The existence of a minimum salary predicts that players will be more likely to reduce effort in the first year of a long-term contract because they know they will at least get a certain level of income even if they shirk.

The ways in which salary maxima are handled in the different sports show more variation than salary minima. In MLB, for example, there is no maximum mandated by the CBA. However, there are limits on how much players' salaries can be reduced (MLB CBA 2007), which provides players with the incentive to shirk after signing a long-term contract because even if performance declines, their salary can only be reduced by a certain amount. In a sense this is a security blanket because players are guaranteed a certain salary level in a new contract, which in many cases is probably higher than the minimum salary requirement. As such, it is less likely that MLB players will increase effort in the final year of a contract compared to other

Table 1: CBA Summary (Source: CBAs)

Organization	Performance Incentives	Maximum Salary	Minimum Salary	Free Agency
MLB	Only post-season incentives	None. Can't reduce player's salary by more than 20% previous year's salary or more than 30% of 2 years previous salary	\$380,000 (2007) to \$400,000 + cost of living adjustment (2011)	Players with 6 or more years of service and have not signed a contract for the next season are eligible. As a free agent, can sign with any team. Must file within 15 days of end of World Series; former club retains exclusive negotiating rights during those 15 days.
NFL	Performance-based pool Pro Bowl	None. Salary cap goes into effect if player costs are more than 56.074% of total revenue (salary cap is \$102 million in 2006 to 58% of total revenue/number of teams in 2011)	0 credited seasons: \$275,000 (2006) to \$355,000 (2012) 10+ credited seasons: \$810,000 (2006) to \$890,000 (2012)	Players with four or more years of service whose contract has expired are qualified for unrestricted free agency and are free to sign with any team. Players with three seasons of service whose contract has expired are eligible for restricted free agency. The former team has the right to match any offer made by another team until April 21 and retain the player. Players with 0-2 years of service whose contracts have expired are considered exclusive-rights free agents. If tendered, they must sign with former team.
NBA	Structured to provide incentive for positive achievement, pre-agreed benchmarks	< 7 yrs. Experience: > 25% salary cap, 105% salary of final season of prior contract, or \$9 million ≥ 7 and < 10 yrs. Experience: > 30% salary cap, 105% salary of final season of prior contract, or \$11 million > 10 yrs. Experience: > 35% salary cap, 105% salary of final season of prior contract, or \$14 million	\$301,875 (1 st year player)-\$1,000,000 (more than 9 years experience)	Players become restricted free agent after 3 years of service if fourth year option not carried out or after 4 years if team offers fourth year option. Unrestricted free agents can sign with any team, restricted free agents can sign with any team but former team is able to match contract and keep the player.
NHL	Only for entry level players, 35+ players with 1 year contracts, "400+ game players" and in last year spent 100+ days on injured reserve and have 1 year contract in upcoming year (incentives vary between positions)	Can't be in excess of 20% of upper limit for any league year Entry level compensation: \$850,000 (2005) to \$925,000 (2011)	\$450,000 (2008) - \$525,000 (2011)	Players who have at least 7 years of service or are 27 years old can declare himself an unrestricted free agent if his contract has expired. Players who are not entry level but do not qualify for unrestricted free agency can declare themselves a restricted free agent. Current team must extend qualifying offer to retain negotiating rights to player, if qualifying offer not made player becomes unrestricted free agent. Unrestricted free agent can sign with any team

leagues. Similarly, the NFL places no limit on maximum salary unless the salary cap goes into effect (NFL CBA 2006).

Salary maxima in the NHL and NBA depend on player experience (NHL CBA 2005 and NBA CBA 2005). The differences in maximum salary levels that exist between players of varying experience levels in the NBA and NHL may provide incentive for players not to shirk as they approach the next experience bracket. In the NHL for example, if players are nearing the end of their entry level status, they may avoid shirking in hopes of boosting their salary in the next contract, which has the potential to increase more than it was able to as an entry level contract. However, overall, the existence of a salary maximum in the NHL and NBA diminishes the likelihood of players increasing effort during the contract year compared with MLB or the NFL because once players reach the maximum salary, there is no incentive to continue putting in increasing effort because they will not be rewarded with a higher salary if performance improves.

The four leagues vary in how they handle performance incentives. While individual contracts may have performance incentives, these contracts are not made public, and therefore it is not possible to analyze these differences. However, the CBAs of the different sports have varying league-wide performance incentive mechanisms that can be examined. The MLB CBA mentions post-season incentives for players, but these are not relevant to this study. However, as the reward for MLB players depends on the performance of the team as a whole and whether the team makes it into the post-season, the lack of performance incentives in the regular season potentially provides the incentive to shirk, as there are no individual performance benefits. Because of the lack of individual performance benefits, it is more likely MLB players will decrease effort in the first year of a long-term contract. In the NFL, players are part of a performance-based pool (PBP). The pool starts off at \$3 million per club in 2006 and increases each subsequent capped year by 5%. Players are allocated their share of the fund by dividing their PBP index¹² by the sum of the PBP indices for each player on the team and multiplying that percentage by the club's total PBP allocation (NFL CBA 2006). As players' allocation of the PBP depends on their playing time, players are provided with an incentive not to shirk because they will have more playing time and more opportunities to make plays if they are performing at full potential. The presence of the PBP reduces the likelihood that players will shirk after signing a long-term contract because if performance declines, players' shares of the PBP drop. In the NBA, performance incentives are required to be structured so that they provide incentive for positive achievement by players (NBA CBA 2005). While there are opportunities for players to get performance-based incentives worked into their contracts, these incentives may lead players to focus on improving certain skills that are in the contract, and ignore other skills. While developing the other skills may help the team as a whole, if there is no monetary incentive attached to them,

12 **PBP index** = play time percentage/PBP compensation , **Play time percentage** = player's total plays on offense or defense / team's total plays on offense or defense, **PBP compensation** = full regular season salary + prorated signing bonus for current league year + earned incentives + other compensation for current league year

the opportunity cost of improving those skills over those that are in the contract rises. However, the existence of performance incentives diminishes the likelihood that NBA players will show a decline in effort after signing a long-term contract. Finally, the NHL only allows for performance incentives for certain players (NHL CBA 2005). As such, there is the potential for players to shirk because there is no reward for them to make additional effort.

Similarly to how the MLB limits the amount salaries can be reduced, the NBA CBA mandates that contracts only be extended upward (NBA CBA 2005). Because the length of a contract cannot be reduced during renegotiation, there may be more incentive for players to shirk early in their contracts because current contracts cannot be shortened. This increases the likelihood that players lower effort in the first year of a long-term contract. As players reach the end of a contract, they can boost performance and still receive a new long-term contract, based on the idea that teams focus on recent performance more than historical performance (Healy 2008). In this regard, players' performance is expected to increase during the contract year.

Free agency is present in all of the sports included in this study, but there are differences between leagues. Players are only eligible for free agency if they have not signed a contract for the next season. The NFL, NBA, and NHL differentiate between restricted and unrestricted free agents. Unrestricted free agents are able to sign with any team they choose. Restricted free agents, however, are eligible to negotiate with any team, but their former team has the ability to make an offer in order to retain the players. MLB free agency operates differently, as there is no distinction between free agents. The existence of free agency increases the likelihood that players will put forth more effort in the contract year because players will want to be desirable to team owners in hopes of getting a higher salary.

The presence of guaranteed contracts in sports increases the likelihood that players will lower effort in the early portion of a long-term contract. If players sign a long-term contract for five years and the contract is guaranteed, they are more likely to shirk, as they know that they have a guaranteed salary, regardless of their performance. MLB, the NBA, and NHL guarantee player contracts, while the NFL does not make this a league-wide policy (MLB CBA 2007, NFL CBA 2006, NHL CBA 2005, NBA CBA 2005). Because of this, it is less likely that NFL players will lower effort after signing a long-term contract. There are however, some contracts in the NFL that are guaranteed. Depending on how many contracts are guaranteed, the impact of the presence of guaranteed contracts in the NFL compared with other sports may be ambiguous.

3. Literature Review

There is contradictory evidence regarding how player performance changes as a result of contract length and where players are in their contracts. Maxcy examines how long-term contracts influence performance in MLB. If

effort changes with contract status, performance is assumed to be highest during the last year of a contract. The author uses first differences to examine the change in performance as contract status changed. As expected, the author finds that age and experience are significant factors in performance variation. However, he finds no evidence that long-term contracts influence performance on average (Maxcy 1997). Maxcy concludes that players and firms have similar goals, and therefore shirking does not occur.

Another study completed by Maxcy, Fort, and Krautmann examines *ex ante* strategic behavior and *ex post* shirking in terms of the principal-agent problem. *Ex ante* strategic behavior is defined as increasing performance just before contract negotiations. *Ex post* shirking is defined as reducing effort after a contract is signed. The authors believe that in order to properly test for shirking, a comparison between players who are expected to behave strategically and players who are not at a point in their contracts where they would behave this way is needed. The way in which performance of a player is affected by proximity to contract negotiations is tested in this model to examine strategic behavior. To control for players' expected performance, the authors use average performance over the three prior years. Skill is measured by SA for hitters and strikeout-to-walk ratio for pitchers. Playing time and time spent on the disabled list are also variables included in the model. The authors find that time spent on the disabled list declines in the period immediately preceding contract negotiations. Playing time in this period is also higher. The authors find no evidence, however, that performance declines after a long-term contract is signed (Maxcy et al. 2002). This study indicates that players may avoid the disabled list more as contract renegotiations approach because they want to appear strong in hopes of getting a longer contract; however, long-term contracts do not promote shirking.

Krautmann uses a model of stochastic productivity to test if long-term contracts diminish work effort in MLB. Rather than simply seeing a drop in performance as a sign of shirking, Krautmann believes that the model should test whether a drop in performance lies outside a forecast interval. Performance varies over a players' careers, so a drop in performance does not necessarily signal shirking. Performance is partially dependent on chance, and therefore low productivity could be due to the stochastic nature of productivity in sports. However, if performance lies significantly above or below players' forecast intervals, which takes performance variations into consideration, players may be behaving strategically. The author concludes that there is no evidence of shirking, and that decreased performance is due to the stochastic nature of productivity rather than asymmetric information (Krautmann 1990).

Sommers studies the influence of salary arbitration on player performance using MLB. Evidence suggests that lower performance after arbitration may be due more to aging than shirking (Sommers 1993). Therefore, this could suggest that arbitration may be an effective mechanism in MLB collective bargaining.

In contrast to the previous studies mentioned, Woolway finds statistically significant evidence that multi-year contracts have worker disincentives. Using a Cobb-Douglas production function, the author examines the marginal products of players who signed multi-year contracts to test for performance disincentives associated with long-term contracts. From the production function, Woolway derives players' marginal products. A one-tailed significance test is then run to test the null hypothesis that shirking does not exist. Woolway finds that the null hypothesis can be rejected. While individual reductions in productivity obtained by Woolway are not large, if several players have long-term contracts and shirk, the individual reductions are aggregated and team productivity can significantly be affected (Woolway 1997).

A study conducted by Stiroh on pay and performance in the NBA finds that performance improves significantly in the year before a multi-year contract is signed, and declines after the contract is signed. Stiroh excludes players with one-year contracts from his analysis to avoid competing incentive effects because players with one-year contracts are typically marginal players or players near the end of the career. Using weighted-least squares, the study finds that players with better performance receive longer contracts with higher salaries. When examining individual performance and contract status, Stiroh finds that there is improvement in the contract year, however there is no evidence of a post-contract decline in performance. Age is negatively related to performance, implying that skills erode as players get older (Stiroh 2007).

Asch conducts a study of the impact of contract incentives on worker productivity using Navy recruiters. Recruiters are rewarded for good performance as a part of an incentive program and also face quotas each month. Higher-quality recruits provide more points to recruiters, and points are accumulated over a 12-month period. Asch finds that recruiters vary effort in an attempt to win rewards. Output is greatest when recruiters are getting close to being eligible to winning a prize. Also, once recruiters are in a good position to win a reward, they seem to reduce effort (Asch 1990). This is similar to the idea that players put forth more effort as they are getting close to contract negotiation, in an attempt to receive a "prize" of a longer contract and higher pay. Once they have obtained the contract, however, they relax and reduce effort.

A study similar to Asch's conducted by Oyer examines the effect of nonlinear contracts on employee performance. Nonlinear contracts refer to the nonlinear relationship between compensation and sales or compensation and profits. In an attempt to reach the annual quota, salespeople may alter effort level or manipulate the timing of sales. Oyer finds that the nonlinear contracts may provide incentives for sales employees to bunch sales at the end of the fiscal year and vary effort throughout the year. There is more incentive for salespeople to work harder at the end of the fiscal year than during any other time. As the incentive payment gets closer, employees are willing to exert more effort (Oyer 1998). Put into the context of sports, as players get closer to the possibility of

higher pay in a new contract, they may be more willing to put forth more effort to improve performance.

Healy conducts a study on whether firms place too much importance on most recent performance rather than focusing on past performance. He analyzes this using MLB. To estimate his equations, a Prais-Winsten regression is used because there is significant first-order serial correlation in the salary data. The data shows that teams do not generally use players' past performance to determine salary offers. More successful teams, as measured by achieving more wins than predicted by their payrolls, base salary offers on historical performance. Unsuccessful teams, however, tend to focus too much on most recent performance alone (Healy 2008).

4. Data

The data used in this paper include historical performance statistics from players in MLB, the NFL, the NHL, and the NBA from the years 1992 until 2008. The data include 2,656 player/year observations, with 149 players from baseball, 103 players from football, 48 players from hockey, and 74 players from basketball. Summary statistics, divided by sport, are available upon request. The data on baseball players include pitchers, shortstops (SS), third basemen (3B), and right fielders (RF). Wide receivers (WR), running backs (RB), and quarterbacks (QB) are used in the NFL sample. Data for hockey players include only goalies. Basketball player data include centers, forwards, guards, center-forwards (CF), and guard-forwards (GF). Players are randomly selected from a list of the current players holding the previously mentioned positions. Some players are excluded from the study because historical contract data could not be found.

Because players are randomly selected from players currently in the leagues, the sample suffers from truncation bias. The study uses point in time contract information and follows players' careers backwards. Therefore, the database does not include players who left the league prior to 2008, excluding players who only lasted in the league for a couple years. This may affect the study's results because these players may behave differently from those who are able to have long-term careers. Marginal players are less likely to increase effort in the final year of a contract if they are not expecting to receive a long-term contract the following year. Therefore, performance in the last year of a contract would be lower, thus making the coefficient of the variable measuring effort in the final year of a contract smaller if these players with subpar performance were included. To avoid this selection bias, future studies could pick a year as a base-point and follow players' careers forward, thus encompassing players who only play for a couple years as well as those with long-term careers.

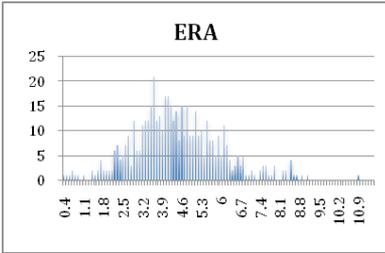
There are many statistics used to measure player performance, but they vary in relevance by position. For MLB pitchers, earned run average (ERA), as used by Maxcy, is used as the performance measure. ERA measures the average number of runs a pitcher would have given up if he were to pitch a full nine

innings. Performance of shortstops, third basemen, and right fielders is measured by slugging average (SA), as used by Maxcy. SA, used to measure batting power, is calculated by dividing a player's total number of bases reached on hits divided by the number of times at bat. For NFL wide receivers, yards per reception (YPR) is used. YPR is calculated by dividing the number of receiving yards by the number of receptions. Leeds and Kowalewski use receptions in their study, however yards per reception is deemed to be a better measure, as it measures whether players are able to do something with the ball once a reception is made. Similarly, based on the performance measures used by Leeds and Kowalewski, running backs' performance is measured by receiving yards per reception (YPRRB). This is calculated in the same manner as YPR. Quarterback performance is measured by yards per attempt (YPA), as used by Einolf. YPA is calculated by dividing passing yards by passing attempts. For NBA players, free throw percentage (FTP), as used by Bodvarsson and Brastow, measures player performance. FTP calculates the number of free throws made out of the number of free throws attempted. Finally, for NHL players, save percentage (saveper), as used by Richardson, is used to measure performance. This statistic measures the percentage of goals a goalie saves.

For sports that span across two years, namely the NFL and NBA, year is classified by the year in which the season started. For each player used in the study, performance, contract information, team, position, and age for every year the player has been in the league is included. Age is normalized, by subtracting the mean age for that sport from the player's age. This is done to control for age related variation between sports and in contracts due to seniority. For example, once players in the NFL reach thirty they are seen as old, whereas in the MLB, thirty year olds are likely to still be able to play for another ten years.

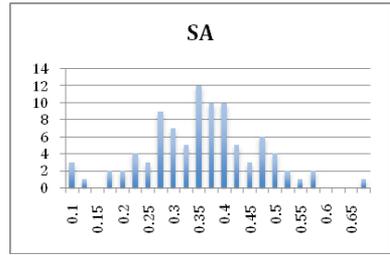
As each sport has different rules and measures of performance, directly comparing performance statistics across sports is not possible. For example, one cannot look at ERA and YPR and determine which is the better player. However, by assigning z-scores to each performance statistic, comparisons between sports can be made, as the performance statistics are translated into relative performance in comparison to one's peers. The frequencies of performance statistics for each sport are plotted to determine whether they are normally distributed. The distributions can be seen in Figures 1-7 below. These graphs indicate that the performance statistics chosen are approximately normally distributed. For MLB pitchers, a lower ERA is better than a higher one. A better ERA would have a negative z-score, while in other sports, better performance measures have positive z-scores; therefore, the signs of the z-scores for pitchers are reversed.

Figure 1: ERA Normal Distribution



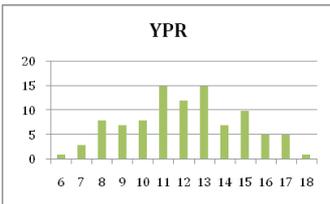
n = 492

Figure 2: SA Normal Distribution



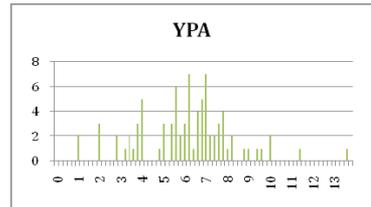
n = 93

Figure 3: YPR Normal Distribution



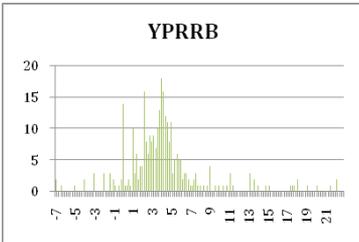
n = 100

Figure 4: YPA Distribution



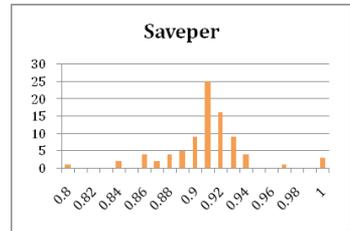
n = 103

Figure 5: YPRRB Normal Distribution



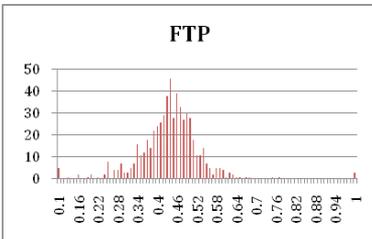
n = 308

Figure 6: Saveper Normal Distribution



n = 85

Figure 7: FTP Normal Distribution



n = 593

5. Methodology

The hypothesis of this study is that the principal-agent problem is a large enough effect to overcome competing effects, such as the utility players receive from winning, the endorsement effect, and fame. While effort cannot be easily measured, performance is assumed to depend on the amount of effort athletes put forth. Assuming that players change effort based on contract status, the following regression is estimated:

$$P_{i,t} = \beta_{PRE} PRE_{i,t} + \beta_{POST} POST_{i,t} + \beta_{AGE} AGE_{i,t} + \beta_{AGE^2} AGE_{i,t}^2 + \alpha_s + \alpha_t + \varepsilon_{i,t},$$

where $P_{i,t}$ is the performance measure, $PRE_{i,t}$ is equal to 1 in the final year of a contract and 0 otherwise, $POST_{i,t}$ is equal to 1 in the year after the contract year and 0 otherwise, and AGE is a player's normalized age¹³. Controls for sport (α_s) and year (α_t) are also used. PRE and $POST$ are thought to matter differently from one sport to another. As such, the sport variables are interacted with the PRE and $POST$ variables and the following regression is estimated:

$$P_{i,t} = \beta_{PRE} PRE_{i,t} + \beta_{POST} POST_{i,t} + \beta_{AGE} AGE_{i,t} + \beta_{AGE^2} AGE_{i,t}^2 + \alpha_s + \alpha_t + PRE_{i,t} * \alpha_s + POST_{i,t} * \alpha_s + \varepsilon_{i,t}.$$

Whereas plain dummy variables shift the intercept of a regression line for various groups, the interacted dummy variables shift the slope of a regression line (Greene 1993).

A fixed effects model is used because it controls for the average differences across year and sport in any observable or unobservable predictors. When using ordinary least squares (OLS), the error terms are assumed to be normally distributed with constant variance. However, this is not typically true for panel data. In addition, OLS does not account for unobservable factors that may be correlated with the variables included in the regression. By using fixed effects, omitted variable bias is eliminated. When using a fixed effects model, the differences between units are viewed as parametric shifts of the regression function (Greene 1993).

The variables of most interest are PRE and $POST$, as they measure the impact of contract status on players' performance. It is expected that β_{PRE} will be greater than 0, as players increase effort in the contract year, and β_{POST} will be less than zero, as players shirk once they obtain a long-term contract. AGE and AGE^2 control for the possibility that performance declines as players mature and act as a proxy for athletic ability, as this changes with over players' lifetimes.

Regressions for individual sports are also estimated. While performance measures vary from sport to sport, the basic regression estimated is:

$$P_{i,t} = \beta_{PRE} PRE_{i,t} + \beta_{POST} POST_{i,t} + \beta_{AGE} AGE_{i,t} + \beta_{AGE^2} AGE_{i,t}^2 + \alpha_t + \alpha_p + \varepsilon_{i,t},$$

where α_p is a variable controlling for position. For each sport, several measures of performance are estimated. Including all players in the sample, regressions are

13 To normalize age, the mean age for the sport was subtracted from a player's age.

estimated using players' performance z-score as well as absolute performance statistics. As with the regression including all sports, these regressions are estimated using fixed effects.

6. Results and Discussion

The results of the regression analysis are mixed. These results are presented in Table 2. Analysis is primarily focused on PRE, POST, AGE, and AGE², however year is controlled for in all of the regressions. In the regressions including all sports, the only years that are statistically significant are 2007 and 2008. In the regressions of the individual sports, none of the year variables are significant.

When interaction terms are not included in the regression of all sports, PRE and POST are both negative and significant, indicating that players decrease effort in both the final year of a contract as well as in the first year of a long-term contract. While the result of POST is expected, the finding that PRE is negative is contrary to predictions. Theoretical findings do not provide an explanation of why players would decrease effort in the final year of a contract. As the sport variables are also significant, indicating that MLB, the NFL, and the NHL are statistically significantly different from the NBA, PRE and POST are interacted with the sport variables. This is intended to capture differences of PRE and POST in the varying sports.

The only interaction term that is significant is *mlbpre*, which is negative. The negative sign indicates that baseball players do not perform as well in the final year of a contract compared to the NBA. This implies that baseball players may not be able to change effort to improve performance as much as athletes in the NBA can during the final year of a contract. After including the interaction terms, POST remains significantly negative, while PRE becomes positive and insignificant. While it is not significant, having a positive PRE is in agreement with the hypothesis. As including the interaction terms changes the sign of PRE, it appears as though some sports have more incentive to increase effort in the final year of a contract than others and that the moral hazard problem is worse in some sport than others.

In all of the leagues, there is incentive for players to shirk early in their contracts and increase effort in the final year of a contract. Teams tend to focus mostly on most recent performance, rather than historical performance (Healy 2008). As such, if players sign ten-year contracts and do poorly in the first year, but do well in the final year, they are still in good position to receive a long-term contract when they are up for renegotiation. The results of regression analysis are mixed in this hypothesis. While POST is negative in the instances where it is significant, indicating that players do take advantage of their ability to shirk, there is no evidence that players increase effort in the final year of a contract.

Table 2: Summary of Regression Results

- +/- indicates sign
- shaded boxes are significant

	All Sports		MLB		NFL			NHL		NBA			
	No interaction	Interaction	z-score	ERA	SA	z-score	YPR	YPA	YPRRB	z-score	Save %	z-score	FTP
pre	-	+	-	+	-	-	-	-	+	+	-	+	+
post	-	-	-	+	-	-	-	-	+	+	-	-	-
age	+	+	+	-	+	-	-	+	-	-	+	+	+
age ²	-	-	+	-	-	-	-	-	+	-	+	-	-
MLB	-	-											
NFL	-	-											
NHL	-	-											
NBA													
mlbpre		-											
mlbpost		-											
nflpre		-											
nflpost		+											
nhlpre		+											
nhlpost		+											
R-squared	0.6010	0.6039	0.2248	0.0927	0.2743	0.0921	0.0383	0.2469	0.0692	0.2786	0.0571	0.236	0.236

Players are expected to reduce effort during the first year of a long-term contract with the existence of minimum salary because if players shirk, they are still guaranteed the league-wide minimum salary. POST is negative in most of the regressions, indicating that performance does decline in the first year of a long-term contract. POST is significantly positive in the regression using ERA as the dependent variable, however as a lower ERA is better than a higher one, the signs for this regression need to be reversed to account for this. Therefore, the regression indicates that MLB pitchers reduce effort following the signing of a long-term contract.

In MLB, players' salary can only be reduced by a limited amount, providing players with the incentive to shirk. It appears that MLB players are

more likely to decrease effort in the first year of a long-term contract than NHL and NBA players. POST is not significant for the NHL or NBA, indicating that it is not significant in explaining changes in performance level. This supports the hypothesis that MLB players are more likely to shirk than NHL and NBA players.

In MLB and the NFL, there is no salary maximum, which is expected to increase the likelihood that players will increase effort in the final year of a contract. In the NHL and NBA, players face salary maximums so once a player reaches the maximum salary, there is little incentive to continue putting forth more effort, as there is no reward of a higher salary if performance improves. Regression analysis, however, does not seem to support this prediction. In the cases where PRE is significant, the regressions suggest that players decrease effort in the final year of a contract. This does not agree with theory, as reducing effort and therefore lowering performance is not beneficial for players trying to obtain as big a contract as possible.

As MLB does not offer performance incentives for players during the regular season, it is predicted that MLB players are more likely to reduce effort after signing a long-term contract because post-season incentives are dependent on how the team as a whole performs and not individual performance. Regression analysis suggests that MLB players do in fact reduce effort after signing a long-term contract. In all three MLB regressions, POST is significant, indicating that performance declines in the first year following the signing of a long-term contract.

The performance incentives offered by the NFL and NBA are expected to reduce the likelihood of POST being negative and significant. Regression analysis shows mixed results. In the NFL regressions, POST is negative and significant in the regressions using z-score and YPR as the dependent variable. However, the regressions using YPA and YPRRB are insignificant. This suggests that certain positions in the NFL may lend themselves to shirking more than others, or the PBP may provide different incentives for different positions. The NBA regressions indicate that POST is negative, however this is not significant. Players may be apt to reduce effort in the first year of a long-term contract, but the desire to shirk appears to be overcome by other factors since POST is not significant.

The NBA CBA mandates that players' contracts can only be renegotiated upward. This provides incentive for players to shirk early in their contracts because they know their current contracts will not be reduced. While it is expected that POST will be negative and significant, regression analysis shows that POST is negative and insignificant. While players may indeed reduce effort after signing a long-term contract, it does not appear to be significant, suggesting that other factors may outweigh the incentive to shirk.

Free agency is expected to increase the likelihood that players will increase effort in the final year of a contract. Players want to obtain the most lucrative contract they can, and therefore want to appear to be valuable members

of a team. As such, they will not want to reduce effort in the final year of a contract because team owners prefer top performers to mediocre players. Regression analysis does not support this prediction, however, as PRE tends to be negative.

The presence of guaranteed contracts is expected to increase the likelihood that players will lower effort in the first year of a long-term contract. A guaranteed contract ensures that players will receive their salary, regardless of whether they have poor performance. The only CBA in this study that does not provide guaranteed contracts is that of the NFL. As such, the likelihood of POST being negative and significant is expected to be lower compared to other leagues. Regression analysis does not support this hypothesis, however, as there are instances where POST is negative and significant in the NFL, while it is not in the NHL or NBA. As some NFL players are given guaranteed contracts while others are not, this result does not hold strong significance. Information regarding whether a contract is guaranteed is not generally made public, so the number of players in the NFL sample with guaranteed contracts is unknown. If this data were available, it would be possible to examine whether NFL players with guaranteed contracts behave differently from those without.

While the signs of AGE and AGE² vary between the regressions, there appears to be a common trend. Where AGE and AGE² are significant, AGE is positive and AGE² is negative. AGE captures the experience players gain as they get older, which will tend to improve performance, and AGE² captures the deteriorating effects of age on performance. As players age, even if they are putting forth the same amount of effort, their performance will eventually start to decline. Skills begin to deteriorate with age, which leads to lower performance levels.

Looking at the individual sport regressions, it is apparent that both significance and sign change as the equations are estimated using the z-score version of performance statistics and various performance statistics, depending on sport and position. This indicates that certain positions or performance measures may be more sensitive to changing effort than others.

The models analyzed in this study use both z-scores, which measure relative performance, as the dependent variable and raw performance statistics, which measure absolute performance. Relative performance examines the change in performance over a contract in comparison with other players in the league. Therefore, if other players are performing poorly, a decrease in effort resulting in a decline in performance may not be seen as readily. However, absolute performance solely examines a player's performance relative to his past performance.

A common pattern across all the regressions is that POST is mostly negative, especially when it is significant. While there are some deviations from this, the results generally imply that players reduce effort after signing a long-term contract. While none of the coefficients are particularly large, this result is still significant. One player reducing effort after signing a long-term contract may not have a sizeable impact on team performance overall, however if many players are lowering effort, team performance as a whole may begin to fall.

An issue that the model may be facing is a small sample size. When all the sports are included, the model has a fairly large sample size, however when broken up by sport and position, the number of observations is significantly decreased. Also, using only one position for hockey may not allow the model to capture all the effects of a change in contract status.

A potential reason for the lack of consistency in the sign and significance of PRE is that the variable may not be measured correctly. In this study, players are assumed to increase performance in the final year of a contract. However, players may operate in a different time frame and may increase performance before this point in hopes of securing a long-term contract.

As the models in this study are slightly different from Stiroh’s model, Stiroh’s model is replicated as closely as possible to determine if his results are repeatable. The model used is:

$$P_{i,t} = \beta_{PRE}PRE_{i,t} + \beta_{POST}POST_{i,t} + \beta_{AGE}Age_{i,t} + \alpha_a + \alpha_p + \alpha_l + \alpha_t + \epsilon_{i,t},$$

where α_a controls for player and α_l is controls for team. Weighted least squares is used to estimate the regression, using the percentage of games played for the season as weights. The results of this regression are shown in Table 3. The significance of the control variables is mixed; some are significant while others are not. While Stiroh finds PRE to be positive and significant, POST to be positive and insignificant, and age to be negative and significant, this study finds PRE to be positive and insignificant, POST to be negative and insignificant, and Age to be positive and significant.

Table 3: Replication of Stiroh’s Study (FTP is dependent variable, t-stats in parentheses)

	FTP
PRE	0.0079 (1.04)
POST	-0.0033 (-0.45)
Age	0.0055 (2.12)
R-squared	0.7590 (9.58)
Observations	486

Whereas Stiroh concludes that there is improvement in performance in the contract year, this study cannot do so. A smaller sample size may be part of the reason for

variations in the results, as Stiroh has a sample size of 2,646 while this study only has 486 observations. In addition, the weights used in the study may differ from Stiroh's weights, as he does not clearly define how he calculates his weights.

7. Conclusion

The mixed results that are obtained in this study align with the contradictory evidence regarding player performance over the course of a contract seen in past studies. Various reasons for the contradictory evidence exist. Certain positions or performance measures may allow players to alter effort more than others. Therefore, using different performance statistics from the ones used in this study may change the significance of PRE and POST. In addition, players may reduce effort in the off-season rather than during games, which may not be reflected directly in the performance statistics chosen. If, for example, a basketball player does not practice his free throw during the off-season, his FTP may not be affected significantly in the subsequent season, as it is a skill that he has perfected over time and may be able to pick up again without much practice. Increasing the sample size may also improve significance.

This study's key finding is that players' performance levels decline during the first year after signing a long-term contract, suggesting that the effects of the principal-agent problem may outweigh competing effects. This is of importance because if managers expect that players will shirk after signing long-term contracts, they can implement incentive mechanisms in the contracts in order to prevent shirking. The study also has conclusive evidence that as players gain experience, performance increases, however as players age, skills begin to erode and performance eventually declines.

The finding that players reduce effort after signing a long-term contract should be of interest to other types of firms as well. In sports, it is relatively easy to measure individual performance through performance statistics. However, in other professions, such as teaching, it is much harder to measure individual performance. Employers are not able to monitor effort as effectively, and therefore face a moral hazard problem. Employees are paid to do a certain job, but since employers are not always able to monitor effort, they are often able to shirk. While this may not be able to be measured empirically, this study suggests that this is what occurs.

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