THE INTRODUCTION OF THE RESERVE CLAUSE AND ITS IMPACT ON BASEBALL SALARIES DURING THE 1880s: A PANEL ESTIMATION

by

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ABSTRACT

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One of the most frequently studied areas in professional baseball is the Reserve Clause. Originally introduced in 1879 by the National League, the Reserve Clause indefinitely tied a player's services to his current team and was implemented in an attempt to prevent baseball salaries from increasing and reduce team expenses. However, it was also used to control player mobility as well. While the majority of economic research on the Reserve Clause focuses on the post-Reserve Clause era, this paper analyzes the Reserve Clause during its infancy in the 1880s, a period when professional baseball was just beginning, and its impact on baseball salaries. This study illustrates that the Reserve Clause did not have a significant impact on baseball salaries during the beginning of professional baseball, despite team owners' intentions.

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CHAPTER 1

INTRODUCTION

Known as America's national pastime, the game of baseball has become one of the most popularized sports in history. From the little leagues to the big leagues, baseball has encompassed athletes of all ages with the same love of the game. Unlike basketball, for example, baseball's roots did not originate in the United States. Rather, baseball evolved primarily from the game of town ball, described next, which evolved from the English sport called Rounders. Dating back several centuries, Rounders was a game similar to baseball. The game, as described by the National Rounders Association website, is a "striking and fielding team game, which involves hitting a small hard leather cased ball with a round wooden or metal bat and then running around 4 bases or posts in order to score a rounder".

Before the formation of baseball, town ball evolved from Rounders during the 1800s in Cooperstown, NY (Baseball Almanac Website, 2005). A wide variety of names describing this bat and ball game came into effect including: "old cat", "one old cat", "two old cat", "three old cat", "goal ball", "town ball", "barn ball", "sting ball", "soak ball", "stick ball", "round ball", “base”, and finally “Base Ball” (Burns and Ward 2001, 3). During the 1830s, town ball did not have a solid set of rules and regulations from which to play. Thus, Abner Doubleday, labeled by some as the Father of Baseball, created rules for the game he identified as baseball (Burns and Ward 2001).

In 1845, the game of baseball started emerging as a more sophisticated sport played by society’s elite. Baseball’s first organized team was the New York Knickerbockers Base Ball Club led by Alexander Cartwright. This team represented more of a social club type atmosphere rather than the aggressive atmosphere future teams would eventually display. According to Seymour, the Knickerbockers were more “genteel” in the way they handled the game…“Their rules and regulations emphasized proper conduct” (Seymour 1960, 15). Soon after, the amateur era of baseball began to take off. The first baseball game ever recorded was in 1846 between the Knickerbockers and the New York Baseball Club.

Many clubs started to form throughout the United States as well. Along with the Knickerbockers, there were approximately twenty-three additional baseball clubs formed by 1857 (Spalding 1991, 45). In fact, the National Association of Base Ball Players, or NABBP, united the Knickerbockers with other club teams. It began in 1871 and remained until the end of the 1875 season (Gillette and Palmer 2004). Its main purpose was keeping the sport at the zero-wage amateur level while maintaining a gentlemen's sport kind of atmosphere. While the goals of the Knickerbockers as well as the NABBP were certainly to preserve the game of baseball with their ideals, many prospective players wanted a chance to play baseball. Consequently, the popularized sport began to move from the amateur era to the professional era.

Despite pro-amateur objections, the professional era began to take off between the late 1860s and early 1870s. Just as the Knickerbockers were the first club to represent the amateur era, the Cincinnati Red Stockings were the first club to represent the professional era beginning in 1869 (Spalding 1991, 83). Likewise, from 1871 to 1875, the National Association represented the first league in professional baseball history (Gillette and Palmer 2004).

After the end of the National Association, one of the two leagues still represented today was born in 1876, which was the National League. Pre-National League, there were no real restrictions on players' rights. However, beginning with the National League, this would all change. According to Sean Lahman, "players had owned the teams and run the games, but the National League was to be run by businessmen. They established standards and policies for ticket prices, schedules, and player contracts" (Baseball One Website, 2005). Baseball was no longer the game the Knickerbockers or any other amateur club intended for it to be. From strict restrictions on team locations to players' rights being taken away, baseball was becoming more of a business and less of a leisurely sport.

Now that baseball was coming into its own as a business, labor issues soon followed. Baseball players had no influence on which team they would play. Players were seen as more of a commodity than anything else. Unlike present day baseball players, the first generation professional baseball players did not have the luxury of being compensated as full-time, year round professional athletes. In fact, management believed players should be employed elsewhere during the "off-season" months (Seymour 1960, 106). As teams began competing for players, in lieu of trades, team expenses began to escalate. According to Seymour, "The owners soon realized what was causing high salaries. It was competition among themselves for players. Scrambling for men jacked up payrolls and boosted costs. The owners believed the existence of even the wealthy clubs was threatened…" (Seymour 1960,106).

As a result, the reserve clause was initiated in 1879. Intended to decrease expenses by placing limits on player salaries, the reserve clause was designed to "reserve" a certain number of players, starting with a just a handful of players to eventually the entire roster, from moving to other teams. Given that the number of reserved players on a club's roster increased from five players to all players, it is unclear which players were reserved each year. Therefore, due to the lack of data detailing which players were reserved each year, for the purpose of this study, it is assumed that all players included in the sample were reserved players. Hence, the player was obligated to one specific team for life unless the team's owner decided otherwise. Along with reducing salaries, another purpose of the reserve clause was to discourage the more affluent teams from obtaining all of the talented players, thereby creating an asymmetric distribution of player talent. In other words, the reserve clause was believed to improve competitive balance among teams. However, Burk described the reserve clause as "the most significant step [up to that time] in a progression of moves to limit player independence and control" (Burk 1994, 63).

Beginning in 1882, the second professional league in baseball emerged, the American Association. Though this new league increased competition for players, in 1883, one season after the establishment of the American Association, both the American Association and the National League jointly agreed to adhere to the reserve clause. Even after the 1883 agreement between the National League and the American

Association, reserving players was “included by reference only” (Spalding 1960, 109). Even though the reserve clause was active in baseball beginning in 1879, it was not until 1887 that it was formally included in a player’s contract (p. 109).

Baseball was coming into its own as a professional sport during the 1880s. Leagues were being established and rules and regulations were being created. Interestingly enough, one league called the Union Association was established and terminated in the same season of 1884. Thus, the only two leagues, as mentioned earlier, remaining strong in the 1880s were the National League and the American Association.

The introduction of the reserve clause was the first labor issue baseball’s management and players dealt with. The concern over player salaries is a timeless issue that has been battled since the beginning of professional baseball. In the late 1870s, the introduction of the reserve clause enabled management to prevent player salaries from increasing. Moreover, it also transferred the rights of the players’ services to the owners. As early as 1914, William H. Dunbar wrote that salaries were a major concern among the players primarily because of the reserve clause. He studied the most-valued players of the 1880s and gave a list of their respective salaries each year of the decade.

Although the reserve clause was intended to decrease player salaries, the purpose of this paper is to analyze whether or not the reserve clause influenced player salaries when professional baseball was just beginning. The data used to analyze this topic comes from the salary figures provided in Dunbar's article. To determine the impact the reserve clause had on player's salaries, two econometric models will be studied. The first model estimated is a wins production function. Throughout the remainder of this paper, wins production function and team production function will be used interchangeably. This model will be used to estimate how many wins a player contributed to his respective team depending on his on-field performance statistics. Once this is measured, the second model estimated is a wage equation, which will be used to determine the impact of various factors on player salaries, including on-field performance, experience, and tenure. Effectively, the first model is used to obtain an aggregated measure of on-field performance to be estimated as a factor influencing players' salaries. Based on the analysis, the evidence suggests that the reserve clause did not have as dramatic an impact on baseball salaries as was intended.

The remainder of this paper is structured as follows. Chapter two studies the economic literature on the issues facing baseball economics and salaries. Chapter three gives an analysis of the data, including hypotheses testing, to determine the statistical significance of various factors possibly having an influence on baseball salaries during this era. Finally, the conclusion in chapter four gives an evaluation based on the results of the hypotheses testing and ends with concluding remarks.

CHAPTER 2

LITERATURE REVIEW

As discussed in the introduction, the main purpose of the reserve clause was to decrease the competition for players, thereby reducing the upward pressure on player salaries. This, in turn, was expected to lower team expenses. The reserve clause did not only affect player salaries, but it had additional effects as well. To understand the effects of the reserve clause, several economic theories can be used. Here, the theory of monopsony and the Coasian invariance principle will be discussed. The unique aspect of this study is using data from the 1880s, whereas the majority of the empirical literature relating to these economic theories uses post-reserve clause data, i.e. after final offer arbitration and free agency were established in 1973 and 1976, respectively. Therefore, a background of the theories will be presented first, followed by a discussion of the existing empirical literature, which investigates the efficacy of various theories.

The smaller salaries of baseball players during the reserve clause period can be explained by the monopsonistic market the reserve clause created. The difference between what the player was worth, or their marginal revenue product, and what they were paid was economic rents retained by team owners.

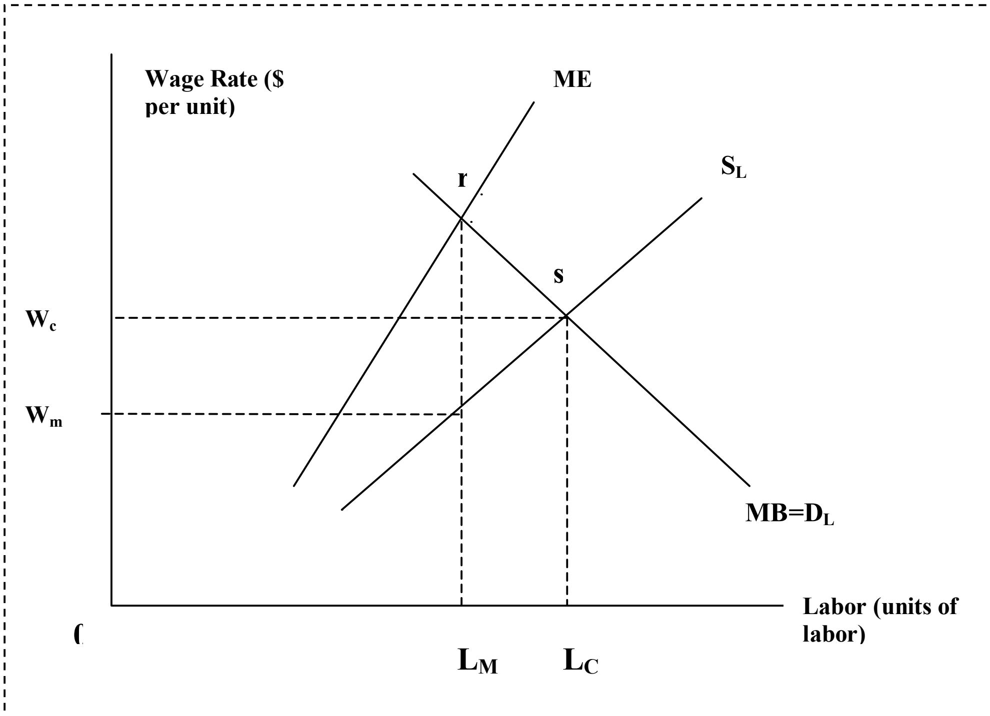

Figure 1 Illustration of monopsony

To help explain this offset of the reserve clause, consider Figure 1 taken from Leeds and von Allmen's "The Economics of Sports" (2002). Figure 1 depicts a monopsonistic market in which fewer workers are hired and lower wages are paid compared to a purely competitive market. A monopsonist represents the only buyer in the labor market compared to the many buyers represented in a purely competitive market. As a result, the supply curve, S_L, is the supply curve for the entire market. In a purely competitive market, the supply curve would represent the supply for one particular buyer, and the market supply curve would encompass all of the buyer's supply curves. However, when there is only one market buyer, there is only one supply curve representative of the entire market. Because of no competition, a monopsonist is able to dominate the demand side of the market. Therefore, fewer workers are hired with lower wages, represented by L_M and W_M respectively, compared to that of the purely competitive market, represented by L_C and W_C respectively.

Whether in a purely competitive market or in a monopsonistic market, profit maximization is the goal both markets want to achieve. Profit maximization occurs when marginal benefit equals marginal cost. In a purely competitive market, for example, the marginal cost of hiring an additional worker is the wage rate. Workers will be hired until the marginal benefit of hiring the last worker equals the marginal cost. In this case, it is at the point where the demand curve, D_L, and the supply curve, S_L, intersect. Profit maximization is achieved.

On the other hand, in a monopsonistic market, the marginal cost of hiring an additional worker is the wage rate plus the cost of matching current workers' wage rates to the wage rate of the last hired worker. Therefore, the "ME" on the curve, or marginal expenditure, lies above the supply curve representing the marginal cost of hiring the additional worker. Profit maximization is achieved when marginal cost, ME, and marginal benefit, D_L intersect. Thus, because the cost of hiring additional labor is higher in a monopsony than in a purely competitive market, the amount of labor hired decreases as is shown in Figure 1. Triangle r-s-t represents the deadweight loss on society.

In 1960 economist Ronald Coase developed what is now known as the Coase Theorem in his article "The Problem of Social Cost". He argues that regardless of externalities and the wealth effects of businesses, whether dealing with the cattle industry or the pollutants of factories, the end result is the same: resources will flow where they are valued the most regardless of who owns the resources. Therefore, Coase argued that in the absence of transaction costs, externalities do not impose deadweight loss on society.

While not specifically aimed at the sports labor market, the Coasian invariance principle is a common departure point when analyzing the impact of the reserve clause. Rottenberg (1956) analyzed baseball's labor organization. He discussed the structure of the minor leagues and the major leagues based on various baseball constitutions and rules formed up to the 1950s. He examined the foundation and effects of the reserve clause and how it indirectly related to the Coasian invariance principle through the impact of competitive balance, which will be discussed further in the next section. Rottenberg questioned the rationale behind the reserve clause, in that the reserve clause is believed to prevent higher-revenue teams from dominating the market thereby improving competitive balance. Therefore, Rottenberg argued that the higher-revenue teams at some point would experience diseconomies of scale. That is, ticket sales will increase at a decreasing rate per “star” player added to the roster. Effectively, it is more logical to add a player where he is valued the most. He adds that it is not in a team’s best interest to dominate other teams, since “no team can be successful unless its competitors also survive and prosper sufficiently so that differences in the quality of play among teams are not “too great”” (p. 254). Therefore, he concludes that without the reserve clause in place, players would go to where there are valued the most but not necessarily to the richest, or largest market, teams. This conclusion is consistent with the Coasian invariance principle.

The Coase Theorem aids in identifying the effects or impacts the reserve clause had on the baseball community. Because this theorem states that wherever the resources are valued the most, there the resource will be, the reserve clause would not be expected to change to which team a player is assigned. In support of the invariance principle is an analysis of competitive balance in Major League Baseball. Competitive balance focuses on the distribution of wins across all teams in the league. Lower competitive balance indicates that one or a few teams have a disproportionate number of wins. Improved competitive balance centers on the idea that one team does not dominate in terms of winning percentage during a regular season of play.

Competitive balance was a major concern among baseball's management before free agency because they believed that baseball players would gravitate to the large market teams. The reserve clause, it was argued, helped competitive balance by creating an even distribution of player talent among the teams.

In "The New Bill James Historical Baseball Abstract", James (2001) computed competitive balance using two mathematical techniques. The first was computing the "standard deviation of winning percentages for teams in a single season during the decade, averaged", and the second was computing the "standard deviation of winning percentages among franchises for the decade as a whole" (p. 19). After all summations and divisions were made the final number was divided by 100 to get a percentage. If there was perfect competitive balance, the index of Competitive Balance according to Bill James was 100%. Therefore, the lower the percentage, the less competitive balance would be; indicating more dominant teams in the leagues.

Furthermore, Bill James' calculations regarding competitive balance before and after the reserve clause illustrate that competitive balance actually improved after the reserve clause was abolished in 1976 as shown in Table 1 below.

Table 1 Standard Deviations of Competitive Balance from 1870-1990

Year	Competitive Balance Index
1870	21%
1880	24%
1890	27%
1900	30%
1910	36%
1920	34%
1930	31%
1940	34%
1950	34%
1960	40%
1970	45%
1980	56%
1990	57%

As Table 1 shows, not only did competitive balance improve each decade after the 1870s, but the decade after the reserve clause was no longer in effect, i.e. 1980, actually had the greatest percentage increase over this 120 year span of baseball.

Sanderson and Siegfried (2003) theoretically analyzed the impact competitive balance had on baseball as well as the impact it had in other sports. Many outside the field of economics have complained regarding the perceived imbalance of baseball competition. The coauthors reacted by clarifying, “in a society that confronts substantial inequality in its daily activities, the current level of imbalance in baseball may not be intolerable" (p. 261). Listing fan loyalty, population size of team cities, and revenue sharing, as a few factors contributing to the issues of competitive balance, Sanderson and Siegfried gave insight as to how competitive balance may increase or decrease depending upon the nature of the factors listed . Concluding that competitive balance would remain a topic of concern not only in the sports field, but also in the economics field, Sanderson and Siegfried argued that competitive imbalance existed in other sports, such as collegiate sports and other competitive sports such as swimming and tennis, but of all sports, baseball seemed to be the main area of concern.

Zimbalist (2002) evaluated the various methods used to calculate competitive balance. He suggested using a technique aimed at baseball fans. More specifically, he recommended using a method "which the consumers show greatest sensitivity" (p. 112). In evaluating the baseball market regarding competitive balance, Zimbalist used regression analysis to evaluate the attendance of baseball games. Two models were created: one for the baseball seasons covering 1950-1965 and the other for the baseball seasons covering 1985-2000. Based on his results, attendance had become increasingly dependant on "team performance". As a result, attendance and revenue coincided with wins. Zimbalist's research clarified that fan attendance impacted revenue through the reliance on team wins, thereby concluding that competitive balance measures should focus more on fan feedback.

Maxcy (2002) examined the outcome of competitive balance through the impact of "player mobility" and its relation to the invariance principle. His study challenged the ideas presented by Coase and Rottenberg by studying player movement under baseball's evolving rules and limitations, i.e. pre/post free agency, basic agreement, etc., that created unavoidable transaction costs which could alter player reassignments. He developed a logit model to analyze player mobility during the sample period 1951-1999. His results indicated that the smaller the transaction costs, the more likely the transfer of players would occur. Although Maxcy illustrated that transaction costs do impact player mobility, he also explained that competitive balance has improved post player draft era.

In dealing with the subject of competitive balance, there are three areas that target this issue: player mobility, the relationship between winning and market size, and the distribution of championships among the teams[1]. Since the reserve clause mandated that only team owners had the right to sign, trade, or remove players, it was argued that the reserve clause maintained fairness among the teams to the benefit of the league

[1] Player mobility, market size and winning, and the distribution of championships were ideas used from Rodney D. Fort's 2003 *Sports Economics* to illustrate competitive balance.

as a whole. The reserve clause precluded the all-stars during the time from gravitating toward one particular team or a small group of teams on their own. Thus, balanced player skill was thought to have been maintained through the reserve clause.

First of all, the consensus that player mobility would greatly change post-reserve clause is to say that as players gain freedom to decide where they will play and for whom, the chance of player mobility is greater than it would have been during the time of the reserve clause. The research on this topic alone has different conclusions. Authors Hylan, Lage, and Treglia (1996) define labor mobility as either involuntary or voluntary. They define involuntary labor mobility as “workers being forced to leave their current employment” (p. 3). Studying the effects of the reserve clause on the labor market in baseball, or what the authors called the pre-free agency period, Hylan, Lage, and Treglia identified “player mobility” in Major League Baseball as involuntary mobility. The reason for this classification stems back to the fact that if a player wanted to play for another team, he would not be able to since the team controlled where and when he played. Therefore, team’s management could release the player on its own terms or decide to trade him to another team, making this an involuntary move by the player.

Hylan, Lage, and Treglia (1996) studied the effects of player mobility from 1961 through 1992. The study was performed solely on pitchers and the authors researched the effect of removing the reserve clause in the context of the invariance principle. The authors' study concluded that pitchers with over seven years experience did not move as often as they did under the reserve clause. They concluded that the invariance principle did not have its predicted output on the labor market for pitchers.

Alternatively, more research adheres to the concept of the invariance principle and how it impacts player mobility. Depken (2002) analyzed player talent concentration post reserve clause through the Herfindahl-Hirschman Index (HHI)[2]. Three measures of the concentration of player talent in both pitchers and hitters were analyzed: runs scored, home runs, and strikeouts. His empirical results concluded that free agency improved the level of concentration for home runs in Major League Baseball. Overall, results from this study revealed that the dispersion of player talent did not have an asymmetric distribution.

Cymrot, Dunlevy, and Even (2001) also studied the affects of player mobility and how it related to and supported the invariance principle. They

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[2] The Herfinahl-Hirshman Index (HHI) is calculated as the sum of squared market shares, i.e., $HHI = \sum_{i=1}^{N} S_i^2$, where $S_i = q_i / \sum_{i=1}^{N} q_i$ is the firm's market share in the variable of interest.

studied the players who were free agents and non-free agents by analyzing their earnings from moving to another team or residing with their current team, based on their individual current wages and potential wages during the 1979 and 1980 seasons. A two-step Heckman procedure was used to adjust for selection bias. Their results concluded that whether a player was a free agent or not, player movement was not affected since a player would move to where he was valued the most, regardless of who acquired the economic rents.

Another issue centered on competitive balance is the association between market size and winning. The theme of this issue deals with the idea that without the reserve clause, team revenues will increase. The increase in revenues is then believed, a priori, to create team dominance in major league baseball among the larger revenue teams over the smaller revenue teams.

Levin, Mitchell, Volcker, and Will (2000) argued that competitive balance declined as a result of higher revenue teams attracting better skilled players, which their research indicated led to more wins. However, Eckard (2001b) questioned the results of Levin et al. (2000) because they only analyzed the years from 1995-1999. Eckard compared 1995-1999 with the previous five years post reserve clause time frames for a more accurate assessment. His results suggested that competitive balance narrowly decreased in the American League but improved in the National League. Using the Herfindahl-Hirschman Index, or HHI, to analyze the relationship between market size and winning, Eckard's results illustrated that market size did not determine winning. In fact, he stated that "the bulk of year-to-year variation is explained by factors unrelated to market size" (p. 222).

Scully (1995) supported the idea that competitive balance has not improved in baseball based on previous research from Scully as well as from Fort and Quirk. However, he examined this topic further by integrating market size and winning into his analysis. Understanding that larger market sized teams were better able to attract the league's top players through better salary offers, ceteris paribus, Scully observed the large "variance in the win percent of clubs" in baseball and used this as a basis for further investigating competitive balance by analyzing market size and winning (p. 84). His study investigated competitive balance as the effect rather than the cause of the "non random" imbalance of team wins. Scully used time series analysis techniques, i.e. autoregression models through the Box Jenkins approach. His results suggested that teams move through various up and down cycles due to the level of skill the players attain as a whole. Players' skills and abilities increase up to a certain point, level off, and then decrease. Consequently, the aggregated level of skill the players possess helps to determine team wins. Thus, team wins depend upon where in their cycle the team is.

Burger and Walters (2003) measured total revenue based on individual baseball market size, fan loyalty with respect to population, and anticipated wins generated by a team to determine the impact market size had on wins, or specifically team performance. In their model, fan loyalty is categorized into two groups: “purists” and “bandwagoners”. They also incorporate coefficients representing a new stadium dummy variable as well an age variable for each stadium. Their results indicated that total revenue increased based on attendance, especially for teams with large market size. New stadiums did have a positive affect on total revenue, but each additional year the stadium accumulated annual depreciation creating a negative impact on total revenue. Even though stadiums did affect total revenue, Burger and Walters noted that they did not affect team performance. Based on their analysis, Burger and Walters claimed a strong relationship between market size and team performance.

The last issue dealing with competitive balance is that of the distribution of championships among baseball teams. This hypothesis states that the reserve clause enhances competitive balance, which precludes any team consistently winning championships.

Butler (1995) studied competitive balance in a unique way. He first analyzed the results concerning competitive balance from various economists. Each of the economists' literature Butler researched came to an agreement that competitive balance had improved in Major League Baseball. However, all of the previous research he studied came to varying conclusions as to what led to an increase in competitive balance, whether it was based on "the elimination of the reserve clause, a narrowing of market sizes among major league teams, or the compression of baseball talent" (p. 46). Butler estimated two regression models: one based on the standard deviation of wins per season and the other based on seasonal correlation of team wins. His results suggested that on a per season basis, the "improvement" of competitive balance can not be supported. However, Butler's results also suggested that aggregated seasonal estimates support the theory of "improved" competitive balance.

Eckard (2001a) supported the invariance principle in regards to the improvement of competitive balance post free agency. In relation to the distribution of championships, he calculated the Herfindahl-Hirschmann Index to study the impact "league champions" had on competitive balance. In this context, "champion" was defined as, "the team with the highest league win percent in each year, in effect ignoring the divisional playoffs that began in 1969" (p. 435). Eckard's results indicated that the distribution of championships among teams improved, which indicated an improvement in competitive balance. He also found that the more championship wins a team accumulated, the less willing fans were to attend future games. That is, marginal returns decrease with each win since the excitement of the game increases but at a decreasing rate per marginal win.

Whether researchers look at competitive balance as an invariance principle issue or as a problem solved by invoking salary caps or revenue sharing, O'Roark (2001) investigated the concept of competitive balance by studying the organizational ownership of baseball stadiums. From a different point of view, this unique and interesting approach aids in recognizing how it is that some teams win more championships than others, hence the distribution of championships. To begin with, O'Roark used a "two-stage" regression analysis. The first regression model measured the degree to which ownership of the stadium is private or public. The second regression was based on the individual team's performance during the years of play in the existing stadium prior to when another one was built.

Contrary to previous studies supporting the invariance principle, O'Roark's results indicated that teams with publicly owned stadiums did not perform as well as teams with privately owned stadiums. He argued that owners of teams with privately owned stadiums have to deal with more risk and are therefore more conscientious to player and team performances. He claimed that, “If the players fail to perform up to standards, the residual claimant owner will feel the monumental cost of building a stadium more acutely” (p. 177). He also used the performance of the Yankees as an example by illustrating that the team won more World Series Championships, based on a per years basis, when the stadium was privately owned compared to the number of championships they won after the stadium became publicly owned. Therefore, the distribution of championships, as O’Roark explained, may be related more to stadium ownership than to salary issues.

Fort and Quirk (1995) found similar results in favor of the invariance principle through competitive balance. They studied the affects of winning and the distribution of championships. Calculating a “win-percent” model by analyzing the standard deviation of wins, their results indicated that there were no statistically significant changes in the percentage of wins before or after free agency. The Gini-coefficient was used as well to determine the distribution of league championships. The results showed not only the lack of concentration of league championships, but “the Gini coefficients offer no evidence at all for the argument of owners that free agency would lead to a domination of the sport by strong-drawing teams or rich owners" (p. 1276). Therefore, the research performed by Fort and Quirk reiterate the validity of the invariance principle and illustrate that post reserve clause, the distribution of championships and the percentage change in team wins are not affected.

Historically, maintaining competitive balance was a popular reason for maintaining the reserve clause in baseball. However, research has proven that the invariance principle does not affect competitive balance. Although some studies cast doubt on the Coase Theorem in baseball, the majority of the research maintains the argument that competitive balance did not dramatically change after removing the reserve clause. Furthermore, According to Fort's "Sports Economics",

"Under a reserve clause, the owner sells (or trades) the contract and gets the value of the move. If the talent market is competitive, the player runs out his current contract, moves to that location, and collects the higher value for himself. The player moves to the larger-revenue market team with or without the reserve clause" (pp. 246-7).

Prior to the 1970s, each decade saw either a slight percentage increase or decrease in competitive balance. However, the decade after the reserve clause was abolished in 1976, competitive balance improved by 11%, the greatest increase in the 20th century[3]. While James's study is not an econometric analysis, there are factors such as increased player

[3] See Table 1

skill, etc. that help to explain the increase in competitive balance. Nonetheless, the econometric studies performed on competitive balance support the notion of Coase's invariance principle. Furthermore, Bill James' competitive index study helps to support the theory that competitive balance did not decrease post reserve clause, as was strongly believed by team owners.

The purpose of the current study is to determine if the reserve clause, in its infancy, had a dramatic impact on the salaries of baseball players. The analysis entails estimating a wage equation for a sample of baseball players, in which wages are related to player specific characteristics, including overall baseball ability. The empirical approach taken herein follows the existing literature, which is here briefly reviewed.

In order to determine how much a player contributes to each team win, the production function of baseball wins is examined first. Generally, marginal product is defined as the change in output with respect to a one unit change in an input. Usually, a measure of marginal product is used to help quantitatively determine the revenue generated by an additional worker hired. Specifically, the marginal product is multiplied by marginal revenue, or price if the firm operates in a purely competitive market, to determine the marginal revenue product of labor, denoted MRP_L. The marginal revenue product of labor is the estimated revenue generated from each additional worker hired.

Studies analyzing the marginal revenue product of baseball players rely heavily on Scully (1974), who analyzed what a player was worth compared to his actual salary. Scully calculated the value of a player's on-field performance in terms of wins and then calculated the value of the player's contributions to overall team revenue. He evaluated hitters based on slugging percentage and evaluated pitchers based on strike-to-walk ratios. His main focus centered on the fact that baseball players were not overpaid athletes. In analyzing the concern of overpaid baseball players, Scully compared yearly percentage changes of player salaries to yearly percentage changes of team total revenues from 1951-1988.

By calculating a "two-equation model" using a production function based on team wins and the other model based on a player's contribution to total revenue, Scully calculated the marginal revenue product of baseball players, which identified the salary a player was valued at based on his individual player performance. Scully's econometric results concluded that players were not overpaid, but in many cases, were paid less than what they contributed to total revenue. In fact, he concluded that the theory of owner collusion during the 1980s had more truth in it than owners wanted to admit.

In addition, Depken and Wilson (2004) calculate the marginal revenue product of baseball using two regressions. The first regression is a team production function, based on aggregated player statistics; the second regression is a team revenue function. A player's MRP relies on the two regressions because player statistics directly contribute to or reduce wins, but only indirectly impact a team's total revenue. Therefore, the regression model from Depken and Wilson (2004) for the team production function is:

$$WINS_{it}=f(HIT_{it},HR_{it},BB_{it},K_{it},KP_{it},HRA_{it}) + u_{it}.$$

Wins represent the absolute number of games won in a particular season. Contributing to the number of wins are the total number of hits (HIT), the total number of homeruns (HR), the total number of walks (BB), and the total number of strikeouts (K). The number of hits, homeruns, walks, and strikeouts represent the offensive side statistics of a team. The total amount of strikeouts pitched (KP) and the number of homeruns allowed (HRA) represent the defensive side statistics of a team. These variables are calculated at the team level by aggregating each player's analogous season total statistics. The subscripts "i" and "t" represent the team and year respectively.

Next, the Depken and Wilson (2004) team revenue function is:

$$\text{Total Revenue}_{it}=f(\text{Wins}_{it}, \text{Team HR}_{it}) + v_{it}.$$

Wins and team homeruns (HR) both impact total revenue. It is interesting to note however, that homeruns have the largest marginal impact on the wins production function, which impacts total revenue directly as well. While using the total revenue function is useful in calculating marginal revenue product, it is not possible in the current analysis. Data for team revenues during the 1880s are not available so marginal revenue products cannot be calculated; therefore, another econometric approach is required. The next section undertakes an econometric analysis of how the reserve clause influenced baseball salaries in the 1880s.

CHAPTER 3

ANALYSIS

3.1 Data Description and Models

In William H. Dunbar's "Baseball Salaries Thirty Years Ago", the salaries of select players are given from 1881 through 1889. Written in 1914, the article gives an insight into the salary issues during the 1880s. Certainly, the complexities of player salaries have been a characteristic of baseball since the beginning of the sport. The players listed in this article, as described by Dunbar, "were stars of their day and their salaries no doubt were much superior to those paid the average player of the time" (Dunbar 1914, 292). The main issue analyzed in this study is whether the reserve clause influenced these player salaries when professional baseball and the reserve clause were both in their infancy. To determine this, an overview of the model specification will be given, the data obtained will be further explained, and econometric models will be specified and estimated. Afterwards, hypothesis testing followed by econometric results and interpretations will be given.

Due to the fact that team revenues are not available, the assumption will be made that the player's quality is reflected in his salary. Player quality is calculated as the number of wins a player accounts for in a given season, per the wins production function. This model is estimated as:

$$Wins_{it} = \beta_0+\beta_1 HIT_{it}+\beta_2 HR_{it}-\beta_3 K_{it}+\beta_4 KP_{it}-\beta_5 HRA_{it}+u_{it,} \qquad (1)$$

Where u_{it} is a zero-mean stochastic error, and the β's are parameters to be estimated. The dependent variable is wins, while the independent variables are hits (HIT), homeruns (HR), strikeouts (K), strikeouts pitched (KP), and homeruns allowed (HRA). The model is estimated using all existing baseball teams from 1881 through 1889. Although the data comprise a panel, pooled OLS estimation was statistically superior to alternative panel estimators.

Once $Wins_{it}$ is estimated, the fitted equation will be used to generate an estimate of the number of wins each player in the sample contributed to his respective team. This estimated number of games contributed is used as a generated regressor in the player wage equation. The wage equation estimated is:

$$Log(Wage)_{jt} = \alpha_j+\delta_1 WINS_{jt}+\delta_2 EXP_{jt}+\delta_3 EXPSQ_{jt}+\delta_4 TEN_{jt}+\delta_5 NEWTEAM_{jt}$$

$$+\delta_6 NUM_{jt}+ v_{jt,} \qquad (2)$$

where 'j' indexes players, 't' indexes time, v_{jt} is a zero-mean error term, and the α's and δ's are parameters to be estimated.

The log of the player's salary is hypothesized to depend on the number of wins (WINS) a player contributes. The α_j are player specific, and therefore measure unobserved characteristics of the players that are not captured by the explanatory variables in the model. The explanatory variables include the marginal product of the player, as reflected in WINS, the player's experience (and experience squared), the player's tenure with his current team, a dummy variable that takes a value of one if the player has moved to a new team, and the number of leagues that competed for players. The error term, v_{jt}, captures any randomness in the model not explained by the explanatory variables.

Experience in this wage equation captures the number of years a player has played professional baseball, excluding any experience past 1889 since the years 1881-1889 are the only years being studied. Tenure (Ten), on the other hand, represents the number of years a player has played for his current team during the sample periods. For example, if a player played two years on Team A then switched to Team B for another three years, then that player has a two year tenure for Team A and a three year tenure for Team B. The variable New Team is a dummy variable that takes a value of one if the player switched teams in the current year. Finally, "Num" represents the baseball leagues in professional baseball during the 1880s. Historically, there were three representative leagues in baseball during this decade: the National League, the American Association, and the Union Association. However, the Union Association existed for only one year, which was 1884. Given the sample of players and their respective teams being analyzed for this study, only one player, Fred Dunlap of the St. Louis Maroons, in 1884 played for the Union Association. There is also no salary figure given for Dunlap in Dunbar (1914). Therefore, with only one person representing the Union Association without a salary given, the variable Num will only be inclusive of the National League and the American Association.

While the theory of the reserve clause regarding the Coasian invariance principle was explained at a more general level earlier given the wage equation specified, more description of how the Coase theorem applies to the labor market of professional baseball is appropriate. At the same time, descriptions of the data will be explained in order to give a more complete understanding of how the theorem applies in the current context.

The data in this study are very unique. It not only gives a list of the well-known players of that time, but it also gives a list of each of the player salaries over a 10 year time frame. Any data given for this period are rare since baseball was a young sport at this time. The 1880s, in particular, represented a unique time since baseball was coming into its own with many rules and regulations forming and changing. Given these salaries and what was known about the reserve clause, these data help to uncover effects of the reserve clause not heretofore investigated. The tables of players and their respective teams from Dunbar's article are given in the appendix.

In regards to the individual player statistics, data were obtained from the "2004 Baseball Encyclopedia" as well as from the Baseball Reference website. J.W. Ward and Con. Daly, both of which were included in the table, are not included in the econometric portion of the study because their individual player statistics were not available. All other players listed in the table are included in the final sample.

The descriptive statistics of the sample data are listed in Table 2.

Table 2 Descriptive Statistics of the Data

	Variable	Description	Mean	Std. Deviation	Minimum	Maximum
Team Data	HIT	Hits	999.125	188.125	535	1404
	HR	Homeruns	26.729	21.300	2	142
	K	Strikeouts	416.354	126.054	169	713
	KP	Strikeouts Pitched	412.479	138.283	113	805
	HRA	Homeruns Allowed	27.573	16.705	4	83
Player Data	WINS	Wins	7.472	3.940	-3.963	23.176
	EXP	Experience	5.300	3.843	0	18

Table 2-continued

	EXPSQ	Experience Squared	42.789	57.605	0	324
	TEN	Tenure	2.300	2.035	0	10
	NEW-TEAM	New Team	0.276	0.448	0	1
	NUM	Number of Leagues	2	0.472	1	3

The upper panel of Table 2 reports descriptive statistics for the team-based variables used in the estimation of the team production function. Over the sample period, the teams averaged approximately 1000 hits, 27 homeruns, 415 strikeouts, 412 strikeouts pitched, and 27 homeruns allowed per season.

The lower panel of Table 2 reports the descriptive statistics of the variables used to estimate the player wage equation. Accumulating 5.3 years of major league experience in his career and 2.3 years of tenure with his current team, the average player in the sample contributed 7.5 wins per season to his team during the 1880s. Approximately 28 percent of the sample observations were players who had moved from one team to another during the previous off-season and there was an average of 2 leagues in competition for players during the sample period.

Based on general knowledge of baseball, it is expected that the team production function will indicate that hits, homeruns, and strikeouts pitched are positively related to team wins and that strikeouts and homeruns allowed will be negatively correlated with team wins. In the case of the player wage equation, the general consensus is that wages should respond to human capital and marginal product. If the baseball labor market emulated a free market, for example, player salaries would have a positive correlation with marginal product (reflected in WINS contributed), major league experience, and tenure with the player's current team. In a free market, the laws of supply and demand should hold. As quantity demanded for baseball talent increases, baseball salaries should increase, ceteris paribus. Likewise, players should receive a premium to move to a new team and obtain a higher salary as more competing leagues enter the market.

However, the implementation of the reserve clause implies that the market for baseball talent might not have been as free as the above implications require. Therefore, the wage equation provides a unique opportunity to test the impact of the reserve clause against the prevailing consensus on what influences wages in a free labor market.

3.2 Empirical Models Estimation

This next section deals with the estimation of the models presented earlier. The initial empirical analysis focuses on team-level production, estimating the team production function model in equation (1) Pooled OLS estimation results are presented in Table 3:

Table 3 Pooled OLS Results for Team Production Function

Variables	Parameter Estimates
Intercept	-15.675* (5.291)
Hits	0.065* (0.007)
Homeruns	0.237* (0.075)
Strikeouts	-0.031* (0.011)
Strikeouts Pitched	0.057* (0.013)
Homeruns Allowed	-0.440* (0.104)

Standard errors are presented in parentheses[4]. (*) Indicates statistical significance at the 5% level.

Unlike the team production function estimated by Depken and Wilson (2004), the production function estimated here does not include a measure of walks. This is because the rules of baseball went through many transformations during the 1880s. For example, the "New Bill James Historical Baseball Abstract", describes the changes in what

[4] Standard errors represent the range of confidence around the estimated parameters.

constituted a walk during the time period analyzed herein: “The number of balls required for a walk, which was nine before, was changed to eight in 1880, to seven in 1882, to six in 1884, back to seven in 1886, to five in 1887, and to four in 1889” (p. 35). Moreover, a measure of “stolen bases” was not included as part of an on-field performance measure until 1886, “although the modern definition of stolen bases came a decade later” (Schwarz 2004, 19). Pitchers also experienced changes in the rules of baseball. For instance, pitchers went from throwing “overhand” to “underhand” (James 2001, 35). The number of strikes making a strikeout changed also during the 1880s, which directly effected walks as well (Burk 1994, 245). Because of the many rule changes during the 1880s regarding walks, this player statistic was excluded from the regression model.

Each independent variable is statistically significant in this production function. To begin with, an extra hit contributes approximately 0.065 wins, as shown in Table 2. Likewise, an extra homerun contributes approximately 0.237 wins. On the other hand, an extra strikeout decreases wins by 0.031. Similarly, an extra strikeout pitched contributes approximately 0.057 wins, while an extra homerun-allowed decreases wins by 0.440. From the results in Table 2, it can be seen that homeruns, whether homeruns hit or homeruns allowed, had the greatest impact on wins during this time period.

The team production function is only a vehicle to generate a measure of marginal product for the players included in the sample. In this study, a player's marginal product is measured as the number of wins the player's offensive and defensive statistics were expected to contribute to the player's team. To illustrate the calculation Table 4 lists three players during the 1889 season, their salary, their offensive and defensive statistics, and their estimated contribution to total team wins.

Table 4 Win Contributions by Representative Players

Player	Team	Salary	H	HR	K	KP	HRA	Extra Wins
M.J. Kelly	Boston Beaneaters	$4,000	149	9	40	-	-	10.58
James Galvin	Pittsburgh Alleghenys	$3,000	-	-	-	77	19	-3.97
C.G. Buffington	Philadelphia Quakers	$2,800	32	0	5	153	10	6.25

The three players in Table 4 are purposely chosen to represent a hitter, pitcher, and a hitter/pitcher. To calculate the number of wins a player contributed to his team, each player statistic is multiplied by its respective parameter estimate from Table 2. For example, Kelly's extra wins estimation was 0.065(149) + 0.237(9) -0.031(40) = 10.58. According to the output, both Kelly and Buffington contributed 10.58 and 6.25 extra wins to their individual teams during the 1889 season respectively. Buffington, on the other hand, did not contribute to any of his team's 1889 season wins. His -3.97 extra win calculation probably resulted in team losses throughout the season due to his poor pitching statistics. Because the calculation of a player's marginal revenue product is not possible in this current analysis, for reasons mentioned in the previous section, the expected number of wins a player contributes to his team is used as a measure of marginal product in the wage model given in equation (2) above.

Because the data comprise a time-series and cross-section, or an unbalanced panel, three possible estimators can be employed. First, Pooled OLS is estimated in such a way that a distinction does not exist between the potential intercepts present in the model, i.e., $\alpha_1=\alpha_2......=\alpha_N$. Thus, a separate "fixed effect" for each player is not estimated. Even though degrees of freedom are saved as a result, the unobserved "fixed effects" create an omitted variables bias within the model by ignoring unmeasured player heterogeneity. To aid in avoiding such bias, two panel estimators can be utilized as alternatives to the Pooled OLS model: the fixed effects estimator and the random effects estimator. Treating each player's unmeasured heterogeneity as a time-invariant parameter to be estimated, the fixed effects estimator observes the intercept term as being player-specific. It differs from the Pooled OLS model in that α_i are assumed to change with each observation. An F-test was used to verify whether the fixed effects model is more appropriate than the pooled OLS model[5].

However, it is not always apparent that α_i are correlated or uncorrelated with the explanatory variables. If correlation between α_i and the explanatory variables exist, the fixed effects model is appropriate. However, the disadvantage of using the fixed effects model is due to the fact that it sacrifices significant degrees of freedom by estimating a separate parameter for each group in the panel.

The other alternative to Pooled OLS is the random effects estimator. Because it is a parsimonious estimator, given that it has "as few parameters as possible for capturing any desired features", the random effects estimator is perhaps the more efficient estimator to use (Wooldridge 2003, 842). Instead of observing the intercept term as being player specific, as the fixed effects estimator does, the random effects estimator treats the individual player heterogeneities as a portion of a composite error term consisting of a white-noise error term and the player-specific heterogeneity. The random effects model is often used when there are time-invariant variables in the model or when the sample under

[5] The F-test supports the fixed effects model over the pooled OLS model because $F(28,175)= 16.85$, $Prob>5 =0.00$

investigation is a small subset of the overall population. In this case, the sample is clearly a subset of the general population of baseball players and therefore the random effects is likely the more appropriate.

In order to determine whether the fixed effects or random effects model is appropriate, a variant of the Hausman (1978) test is used. The hypothesis tests whether the random effects estimator is biased or inconsistent. The Hausman test is structured as follows:

H_o: The random effects estimator is consistent and efficient
The fixed effects estimator is consistent but inefficient.

H_α: The random effects estimator is inconsistent
The fixed effects estimator is consistent.

Because panel estimators rely upon large samples, it is generally conceded that consistency is preferred to efficiency. Therefore, if the null hypothesis is rejected, the fixed effects estimator is consistent and is preferred to the random effects estimator. On the other hand, if the null hypothesis cannot be rejected, the random effects model is preferred to the fixed effects estimator because it conserves degrees of freedom and therefore provides more efficient estimates, which reiterates why it is a parsimonious estimator. The Hausman test is distributed Chi-square with p degrees of freedom, where p is the number of parameters estimated in the fixed effects model. Here, there are six parameters estimated in the fixed-effects specification, and therefore the critical value at the 5% significance level is 12.5916.

The estimation results are presented in Table 5, although the interpretation of the estimation results will be presented in the next section. Before proceeding any further though, it is useful to note that despite the differences in the properties of the three panel estimators, their results are very similar. In regards to the model testing indicating which estimator should be used, the results are as followed: the test of fixed effects versus Pooled OLS supports the Fixed Effects estimation, whereas the Hausman test statistic supports the random effects estimator over the fixed effects estimator. Therefore, the random effects estimator is supported by the Hausman test and will be used as the regression estimator.

As shown in Table 5, marginal product (measured as wins contributed), experience, experience squared, and league all displayed similar results among the three models. However, the parameter estimates used in the hypothesis testing section will be those from the random effects model. Interpreting the parameter estimates and constant term presented in Table 5 will be completed in the hypothesis section.

Table 5 Panel Estimation Results: Dependant Variable is Salary

Variable	Pooled OLS Model	Fixed Effects Model	Random Effects Model
Constant	6.823* (0.135)	6.580* (0.080)	6.684* (0.098)
Games	0.012* (0.006)	0.019* (0.004)	0.016* (0.004)
Experience	0.177* (0.021)	0.192* (0.013)	0.189* (0.014)
$Experience^2$	-0.007* (0.001)	-0.004* (0.001)	-0.005* (0.001)
Tenure	-0.028* (0.012)	-0.018** (0.009)	-0.018** (0.010)
New Team	-0.008 (0.068)	0.067** (0.038)	0.054 (0.043)
League	0.100** (0.060)	0.053** (0.032)	0.067** (0.036)
R^2	0.479	0.4152	0.4350
N	210	210	210
F-Test (Pooled OLS vs F.E.)		16.85*	
Hausman Test (H_o: R.E. vs F.E.)			0.00

Standard errors are presented in parentheses. (*)** Indicates statistical significance of the coefficient at the (5%) 10% level. The variable *League* in the fixed effects model is weakly statistically significant at the 10% level.

3.3 Hypotheses Testing

The hypothesis testing performed in this section will deal with the wage function only. The team production function only serves as an aid to the player wage equation; therefore, the main hypothesis being studied deals with how the reserve clause affected baseball salaries in the beginning of baseball as an organized professional sport, i.e. the decade of the1880s.

The null hypothesis, H_0, is that the reserve clause did not matter to player salaries when baseball was just beginning. The null, H_α, is that the reserve clause negated the negotiating power of players on one or more margins, such as marginal product, experience, or tenure on the team, when baseball was just beginning. In order to test these general claims, the variables in the wage equation are analyzed individually to test the various implications of the reserve clause. Afterwards, a joint test is applied to determine whether the reserve clause had a noticeable impact on player salaries. Therefore, each variable being analyzed will represent a separate hypothesis. There will be six hypotheses analyzed. To reiterate, the five “variables” are analyzed: wins, experience and experience squared, tenure, new team, and number of leagues.

The six separate hypotheses being analyzed are listed below:

H1). Marginal Product

H_0: Better players should not be paid more because of the reserve clause.

H_α: Better players should be paid more, especially if household labor supply is upward sloping.

H2). Experience

H_0: Players with more experience should not be paid more because of the reserve clause.

H_α: Players with more experience should be paid more because of unmeasured human capital

H3.) Tenure with Team

H_0: Players playing longer for the same team should not be paid more Because of the reserve clause.

H_α: Playing longer with the same team provides more information to team owners, and players might be paid more.

H4). Premium for moving to a New Team

H_0: Players who move to a new team should not be paid more. under the reserve clause all rents involved in the trade of a player should be distributed amongst the team owners alone.

H_α: Players who move to a new team are rewarded a premium for moving, either because moving incurs costs or because the team values the player more.

H5). Number of Leagues Competing for Players

H_0: Under the reserve clause, it should not matter how many leagues there are.

H_α: Having more leagues in existence should bid up player salaries, ceteris paribus.

H6). Overall Impact of the Reserve Clause

H_0: Overall, the explanatory variables do not matter under the reserve clause

H_α: The explanatory variables do matter under the reserve clause

The econometric results for each of these hypotheses will be given first, followed by the results of the main hypothesis. Once the interpretations of the econometrics behind this study are analyzed, interpretations of the hypotheses will then be given to determine how baseball salaries were affected during this period of the reserve clause.

The main purpose of the reserve clause was to restrict player salaries from increasing. On one hand, player performance/statistics should not predict a player's salary structure. On the other hand, however, as the supply of household labor increases salaries should increase as well, ceteris paribus. Therefore, the testable hypothesis is:

H_0: Better players should not be paid more because of the reserve clause.

H_α: Better players should be paid more, especially if household labor supply is upward sloping.

In order to test this hypothesis, the results of the players' wins production function is analyzed since the production function, as mentioned earlier, measures how much an individual player is worth in terms of team wins. To determine if a player is more skilled than another, the player wins production function is analyzed since it calculates the number of wins each player contributes to his respective team. Thus, the higher a player's marginal product, as represented in wins contributed to their team, the better the player, ceteris paribus.

The average player in the sample contributed seven wins per season, and the coefficient for wins is statistically significant at the 5% level (see Table 5). Therefore, the null is rejected and it is concluded that a player's on-field performance did impact his salary despite the reserve clause. On average, each additional win a player contributes to his team increased salary by 1.6%. Therefore, on average 11% of a player's salary was determined by their marginal product. The second hypothesis deals with the overall experience of a player. In general, the more experience a worker has on the job, the higher salary should be, ceteris paribus. For example, experience on the job may lead to promotions, salary raises, and even bonuses. As an athlete gains more experience with his or her respective sport, athletic skills improve and are worth more to teams. The greater demand for an athlete's talents and abilities should lead to higher salaries. Thus, the hypothesis tested is:

H2). Experience

H_0: Players with more experience should not be paid more because of the reserve clause.

H_α: Players with more experience should be paid more because of unmeasured human capital

The two coefficients of the variables, experience and experience^2, are both statistically significant at the 5% level; therefore, the null is rejected and experience did effect a player's salary under the reserve clause. The results show that each year of experience contributes approximately 19% to a player's salary. The negative 0.5% of experience squared implies that the salary structure based on experience squared is concave. Marburger (1996) and Gius and Hylan (1996) revealed similar results concerning experience and experience squared, post reserve clause.

To examine if experience and experience squared are jointly equal to zero, an F-Test was performed in order to test the significance of these coefficients. Thus, the following hypothesis represents the validity of the restricted parameters:

H_0: $\beta_2=\beta_3=0$

H_α: At least one of the parameters is nonzero

After estimating a restricted random effects model, the resultant F-statistic indicates that the null hypothesis can be rejected; thereby indicating that experience, experience squared, or both, are nonzero. Therefore, experience seems to have had an influence on player salaries in contradiction what the reserve clause intended.

The third hypothesis deals with a player's tenure. This differs from a player's experience in that tenure is team specific whereas experience is career specific. In other words, a particular player may have been in baseball for seven years while playing five years on one team and two years on another. The hypothesis is:

H3). Tenure with Current Team

H_0: Players playing longer for the same team should not be paid more because of the reserve clause.

H_α: Playing longer with the same team provides more information to team owners, and players might be paid more.

The coefficient for tenure is statistically significant at the 10% level; therefore, the null is weakly rejected and a player's tenure did negatively affect his salary because of the reserve clause. Each year of tenure decreases a player's salary by approximately 1.7%.

The fourth hypothesis deals with the new team variable in the wage equation. This hypothesis addresses the issue of whether a premium existed when a player was traded to a new team. The hypothesis is:

H4). Premium for moving to a New Team

H_0: Players who move to a new team should not be paid more. under the reserve clause all rents involved in the trade of a player should be distributed amongst the team owners alone.

H_α: Players who move to a new team are rewarded a premium for moving, either because moving incurs costs or because the team values the player more.

The coefficient for new team is statistically insignificant; therefore, the null is not rejected. Thus, player mobility did not affect a player's salary. This actually supports the Coase Theorem, which predicts that with the reserve clause all rents involved in a player trade would be distributed between the team owners alone, thereby not affecting the player's salary. The finding here supports this claim.

The fifth hypothesis deals with the leagues impact of overall competition for players in baseball. Theoretically, as the number of leagues increases, the overall demand for players would increase, which would bid up player salaries as well, ceteris paribus. The hypothesis is:

H5). Number of Leagues Competing for Players

H_0: Under the reserve clause, it should not matter how many leagues there are.

H_α: Having more leagues in existence should bid up player salaries, ceteris paribus.

The coefficient for league is statistically significant at the 10% level; therefore, an increase in the number of leagues did bid up player salaries under the reserve clause. The results show that an additional league increased salaries by approximately 6.7%.

While the five previous hypotheses tested the impact of the explanatory variables individually, this last hypothesis tests the impact of the explanatory variables together in order to test the overall significance of the wage equation. Therefore, a Wald test was used to examine this model[6]. The hypothesis is:

H6). Overall Impact of the Reserve Clause

H_0: Overall, the explanatory variables do not matter under the reserve clause

H_α: The explanatory variables do matter under the reserve clause

This hypothesis tests whether the variables included in the player wage model had a jointly statistically significant impact on wages. On one hand, the null hypothesis helps to determine if the reserve clause was strictly adhered to, meaning there would not be any player specific characteristics

[6] An F-test is often used to test the overall significance of a model, but the Wald statistic is a large-sample analogue to the F-test. Random effects estimation assumes large samples and therefore the test of overall significance is based on a Wald statistic rather than an F-statistic.

impacting a player's salary. In other words, salaries would be statistically "explained" by the constant term in the estimation. On the other hand, the alternative hypothesis helps to determine that baseball salaries from the 1880s are influenced by the explanatory variables. This suggests that the reserve clause did not have a significant impact on the salaries of the players included in the sample. The Wald statistic is distributed chi-square with six degrees of freedom, with a critical value of 12.5916. The Wald statistic of 541.63 is greater than the critical value, and the null is therefore rejected. This also confirms that the wage equation has overall significance since the parameters are jointly statistically different from zero.

3.4 Interpretation of Hypotheses

Each variable, except for New Team, in the wage equation exhibited statistical significance at the 10% level. The purpose of the reserve clause was to decrease player salaries as well as to keep all other salary influences constant, i.e. experience, tenure, etc. Though this was the claim from baseball management, the variables tested in the earlier section indicate that other factors helped determine baseball salaries.

To begin with, the first hypothesis dealt with the on-field performance factor. The results indicate that approximately 11% of the average player's salary was explained by their marginal product, or on-field performance. However, if the reserve clause was strictly binding this should not have been true. Salaries did increase during this time period as the game of baseball evolved into a profitable business; however players exhibiting mediocre playing skills were paid less (Seymour 1960, p.117). In fact, when the Limit Agreement was reached in 1885, all baseball clubs agreed to a salary cap of $2,000. However, in 1885 alone, many players received salaries beyond $2,000 (Dunbar 1914). In 1887, Boston paid Mike Kelly $3,000 for his picture alone (Seymour 1960, 120). Since the rules of the Reserve Clause, as well as the Limit Agreement, were ignored, it is evident that on-field performance did affect a player's salary despite regulations.

The next hypothesis dealt with a player's experience and how it affected his salary. If the reserve clause were strictly binding, experience should not have had an impact on salary, but the results suggest that experience contributed approximately 19% to a player's salary. However, player salaries were concave in experience. The baseball labor market at the time was similar to other labor markets in that salaries improve with experience up to a certain level. In "League Operating Rules and the Level of Team Performance", Scully explained that a player's skills are improved by gaining experience, but indicated that a player's batting average over the years replicates a concave pattern. In other words, while a player is young, his level of skill improves up to a certain point, “levels off”, and then decreases (Scully 1989, 46). Thus, the results of this study do mimic Scully’s analysis in that the value of a player’s experience reflected in his wages decreases overtime, but again, this should not have been a factor to consider under the reserve clause.

The third hypothesis dealt with a player’s tenure on a team. Surprisingly, results show that tenure had a negative impact on player salaries. While it is not evident that this would be the case, especially from the results of the experience hypothesis, one possible explanation to consider is that of the constant changes given to the rules of baseball. As discussed in the background section, the rules of baseball went through many changes making it difficult to adapt to any hitting and pitching techniques. For example, Scully (1974) explained that the many changes in the definition of the strike zone impacted both hitters and pitchers alike. When the strike zone was narrowed (widened), batting averages increased (decreased). Thus, as batting averages increased (decreased), pitchers’ ERAs decreased (increased). Changing the strike zone was certainly one of many rules of baseball as it evolved into the sport it is today.

However, since the 1880s went through a period of many changes, another explanation to consider lies with management’s view toward their senior players. Perhaps tenure on a team did not matter since players did not have the opportunity to work with the same techniques and skills since they had to be altered every time a rule changed. Therefore, management may have not valued a senior player on the team as they could have without the rule changes. If senior players were not valued as much as rookie players, management may have reduced compensation as a player's tenure increased. As the results show from the hypothesis section, it can be inferred that tenure was viewed as a negative rather than a positive.

The fourth hypothesis dealt with the issue of whether players who move to a new team are rewarded a premium for moving. Results show that moving to a new team did not affect a player's salary; thus, the null hypothesis is supported. New Team is the only variable analyzed in the study not having an impact on player salaries. It is interesting to note that New Team was the only statistically insignificant variable in the pooled OLS results for the wage equation also, as shown in Table 3. This result supports the purpose of the reserve clause because team owners could not compete against one another for players, so as to not increase the bid on a player's salary, ceteris paribus. Therefore, results indicate that a premium did not exist for a player moving to a new team.

The fifth hypothesis analyzed dealt with the issue of whether the existence of more leagues would bid up player salaries, ceteris paribus. Contrary to the statistical insignificance of the previous hypothesis, the results for num, or league, suggest that the existence of additional leagues did increase a player's salary by approximately 5.3%. This hypothesis supports the Coase theorem in that an increase in the number of leagues increased competition for players' skills leading to salary increases. The leagues in existence during the 1880s were the National League, the American Association, and the Union Association. To reiterate, the Union Association was not analyzed in this study for reasons mentioned earlier in this paper. Additional leagues did create premiums since, for example, in the 1882 post-season, the American Association offered various National League players higher salaries to guarantee their names on the 1883 American Association club rosters versus the National League club rosters in 1883 (Burk 1994, 71).

Hence, additional leagues led to an increase in the bidding of players' salaries for their athletic talents and abilities despite the reserve clause. However, it was not until 1883 that the American Association adopted the reserve clause. So, the bidding of player salaries by the American Association was not affected by the reserve clause at that time.

The last hypothesis tested the overall significance of the wage equation. Because the null was rejected, the explanatory variables did have an impact on player salaries. Thus, this hypothesis indirectly rejects the notion that the reserve clause removed player power to negotiate salaries. Based on the results and interpretations of the previous hypotheses, it is assumed that player power was more apparent than some might realize. The random effects constant term in Table 5 reiterates this concept. Based on the sample studied in this analysis, the average salary in 1881 was approximately $1,243, while the average salary in 1889 was approximately $3,293. Similar salary increases for 1881 and 1889 are discussed in Seymour (1960).

The constant term plays a unique role in this salary increase. Since the constant term is 6.68, this is interpreted as approximately $796[7]. This amount represents the portion of a player's salary unexplained by the explanatory variables. Based on the average salary for 1881, $796 was approximately 64% of the average salary included in the sample, whereas by 1889, it accounted for approximately 24%. Because the percentage of this unexplained portion of a player's salary decreased, this implies that the explanatory variables' impact on salaries increased during the 1880s

[7] This value is calculated as $e^{6.68} \approx 796.3191$

when the reserve clause was just beginning. The interpretation of these figures supports the fact that players did have power to negotiate salaries.

Now that the various implications about the reserve clause through the various hypotheses have been examined, the main hypothesis can be analyzed. The general hypothesis being studied is whether the reserve clause was relevant to player salaries when baseball was just beginning. Post-reserve clause, i.e., after 1976, results show that player salaries increased dramatically because rents moved from the owners to the players. In the early evolution of baseball, the reserve clause did not prevent other factors from being considered when determining the level of player salaries. Thus, while it may have seemed management adhered to the reserve clause, the econometric results obtained from this unique sample of player salaries suggest that salaries were indeed affected by outside factors creating an environment suitable for players to be involved in the salary negotiation process.

CHAPTER 4

CONCLUSION

The late 1870s and the 1880s introduced the first generation of professional baseball players. The main objective of the reserve clause was to decrease team expenses by reducing player salaries, while at the same time eliminated the rights of the players. Dunbar (1914) lists the salaries of the best players in the leagues during the 1880s. The purpose of this paper was to analyze whether or not the reserve clause had an influence on player salaries or not.

To determine this, two econometric models were estimated. The first model was a team production function, which gave an aggregated measure of a player's on-field performance. This variable as well as other variables, i.e. tenure, experience, etc., was then used as a regressor in the second model, a wage equation, to determine if players' salaries were influenced by the reserve clause. Before the hypotheses were studied, economic theory and empirical literature were examined. In reviewing the literature, two primary economic theories have been used to analyze the impact of the reserve clause in professional baseball: the Coase Theorem, the invariance principle, which is an extension of the Coase

Theorem, and the theory of monopsony. In the context of the reserve clause, the economic theories claim that regardless of whether the reserve clause prevailed in baseball, players will go to the team where they are valued the most. While some empirical literature questions this intuition, the majority of the literature supports the Coase Theorem and the invariance principle.

To test the validity of the main hypothesis, there were five supporting hypotheses examined first. Testing the factors possibly influencing player salaries under the reserve clause were: on-field performance, experience and experience squared, tenure, new team, and league. Although switching to a new team did not affect player salaries, the other variables had statistical significance, and the results showed that the reserve clause did in fact not matter in controlling salaries when baseball was just beginning. In fact, it appears the impact of the unexplained portion of baseball salaries decreased, while the impact of the explained portion, i.e. explanatory variables, of baseball salaries increased during the 1880s.

The updated version of Scully (1974), pre-free agency, claimed that "Four factors are crucial to the determination of player salaries: the overall quality of player performance; the weight or fraction of the player's contribution to team performance; the experience factor; and, and the popularity or recognizability of the player to the fans - “star” or “superstar” status, if you like” (Scully 1989, 156). Although this statement comes almost a century after the beginning of the reserve clause, Scully’s quote emulates the results of this paper’s analysis and aids in recognizing that the reserve clause did not have such an impact on the first generation of baseball players’ salaries as was originally intended.

APPENDIX A

PLAYERS AND THEIR TEAMS FROM 1881-1889

Table A.1 Players and Their Teams: Years 1881-1884

Player	1881	1882	1883	1884
Micheal Joseph Kelly	Chicago White Stockings	Chicago White Stockings	Chicago White Stockings	Chicago White Stockings
Hardy Richardson	Buffalo Bisons	Buffalo Bisons	Buffalo Bisons	Buffalo Bisons
Ed Williamson	Chicago White Stockings	Chicago White Stockings	Chicago White Stockings	Chicago White Stockings
George Gore	Chicago White Stockings	Chicago White Stockings	Chicago White Stockings	Chicago White Stockings
Dan Brouthers	Buffalo Bisons	Buffalo Bisons	Buffalo Bisons	Buffalo Bisons
James Henry O'Rourke	Buffalo Bisons	Buffalo Bisons	Buffalo Bisons	Buffalo Bisons
James Laurie White	Buffalo Bisons	Buffalo Bisons	Buffalo Bisons	Buffalo Bisons
John Charles Rowe	Buffalo Bisons	Buffalo Bisons	Buffalo Bisons	Buffalo Bisons
Edward Hanlon	Detroit Wolverines	Detroit Wolverines	Detroit Wolverines	Detroit Wolverines
George A. Wood	Detroit Wolverines	Detroit Wolverines	Detroit Wolverines	Detroit Wolverines
James Galvin	Buffalo Bisons	Buffalo Bisons	Buffalo Bisons	Buffalo Bisons
Fred Pfeffer	-	Troy Trojans	Chicago White Stockings	Chicago White Stockings
William Ewing	Troy Trojans	Troy Trojans	New York Gothams	New York Gothams
J.W. Ward	No Data Available			
Timothy John Keefe	Troy Trojans	Troy Trojans	New York Metropolitans	New York Metropolitans
Roger Connor	Troy Trojans	Troy Trojans	New York Gothams	New York Gothams
Arthur Albert Irwin	Worcester Ruby Legs	Worcester Ruby Legs	Providence Grays	Providence Grays
Charles Radbourne	Providence Grays	Providence Grays	Providence Grays	Providence Grays
Sydney Farrar	-	-	Philadelphia Quakers	Philadelphia Quakers
Charles G. Buffington	-	Boston Red Caps	Boston Beaneaters	Boston Beaneaters
George Edward Andrews	-	-	-	Philadelphia Quakers
Fred Dunlap	Cleveland Blues	Cleveland Blues	Cleveland Blues	St. Louis Maroons
James Fogarty	-	-	-	Philadelphia Quakers
Daniel Richardson	-	-	-	New York Gothams

Table A.1-continued

Player	1881	1882	1883	1884
Con. Daly	No Data Available			
Frederick Herbert Carroll	-	-	-	Columbus Buckeyes
Edward Morris	-	-	-	Columbus Buckeyes
Cornelius Mack	-	-	-	-
Charles Getzien	-	-	-	Detroit Wolverines
James Ryan	-	-	-	-
William Nash	-	-	-	Richmond Virginians

Table A.2 Players and Their Teams: Years 1885-1889

Player	1885	1886	1887	1888	1889
Micheal Joseph Kelly	Chicago White Stockings	Chicago White Stockings	Boston Beaneaters	Boston Beaneaters	Boston Beaneaters
Hardy Richardson	Buffalo Bisons	Detroit Wolverines	Detroit Wolverines	Detroit Wolverines	Boston Beaneaters
Ed Williamson	Chicago White Stockings	Chicago White Stockings	Chicago White Stockings	Chicago White Stockings	Chicago White Stockings
George Gore	Chicago White Stockings	Chicago White Stockings	New York Giants	New York Giants	New York Giants
Dan Brouthers	Buffalo Bisons	Detroit Wolverines	Detroit Wolverines	Detroit Wolverines	Boston Beaneaters
James Henry O'Rourke	New York Giants	New York Giants	New York Giants	New York Giants	New York Giants
James Laurie White	Buffalo Bisons	Detroit Wolverines	Detroit Wolverines	Detroit Wolverines	Pittsburgh Alleghenys
John Charles Rowe	Buffalo Bisons	Detroit Wolverines	Detroit Wolverines	Detroit Wolverines	Pittsburgh Alleghenys
Edward Hanlon	Detroit Wolverines	Detroit Wolverines	Detroit Wolverines	Detroit Wolverines	Pittsburgh Alleghenys
George A. Wood	Detroit Wolverines	Philadelphia Quakers	Philadelphia Quakers	Philadelphia Quakers	Philadelphia Quakers & Baltimore Orioles
James Galvin	Buffalo Bisons & Pittsburgh Alleghenys	Pittsburgh Alleghenys	Pittsburgh Alleghenys	Pittsburgh Alleghenys	Pittsburgh Alleghenys
Fred Pfeffer	Chicago White Stockings	Chicago White Stockings	Chicago White Stockings	Chicago White Stockings	Chicago White Stockings
William Ewing	New York Giants	New York Giants	New York Giants	New York Giants	New York Giants
J.W. Ward	No Data Available				
Timothy John Keefe	New York Giants	New York Giants	New York Giants	New York Giants	New York Giants
Roger Connor	New York Giants	New York Giants	New York Giants	New York Giants	New York Giants
Arthur Albert Irwin	Providence Grays	Philadelphia Quakers	Philadelphia Quakers	Philadelphia Quakers	Philadelphia Quakers & Washington Nationals
Charles Radbourne	Providence Grays	Boston Beaneaters	Boston Beaneaters	Boston Beaneaters	Boston Beaneaters
Sydney Farrar	Philadelphia Quakers	Philadelphia Quakers	Philadelphia Quakers	Philadelphia Quakers	Philadelphia Quakers
Charles G. Buffington	Boston Beaneaters	Boston Beaneaters	Philadelphia Quakers	Philadelphia Quakers	Philadelphia Quakers
George Edward Andrews	Philadelphia Quakers	Philadelphia Quakers	Philadelphia Quakers	Philadelphia Quakers	Philadelphia Quakers & Indianapolis Hoosiers

Table A.2-continued

Player	1885	1886	1887	1888	1889
Fred Dunlap	St. Louis Maroons	St. Louis Maroons & Detroit Wolverines	Detroit Wolverines	Pittsburgh Alleghenys	Pittsburgh Alleghenys
James Fogarty	Philadelphia Quakers	Philadelphia Quakers	Philadelphia Quakers	Philadelphia Quakers	Philadelphia Quakers
Daniel Richardson	New York Giants	New York Giants	New York Giants	New York Giants	New York Giants
Con. Daly	No Data Available				
Frederick Herbert Carroll	Pittsburgh Alleghenys	Pittsburgh Alleghenys	Pittsburgh Alleghenys	Pittsburgh Alleghenys	Pittsburgh Alleghenys
Edward Morris	Pittsburgh Alleghenys	Pittsburgh Alleghenys	Pittsburgh Alleghenys	Pittsburgh Alleghenys	Pittsburgh Alleghenys
Cornelius Mack	-	Washington Nationals	Washington Nationals	Washington Nationals	Washington Nationals
Charles Getzien	Detroit Wolverines	Detroit Wolverines	Detroit Wolverines	Detroit Wolverines	Indianapolis Hoosiers
James Ryan	Chicago White Stockings	Chicago White Stockings	Chicago White Stockings	Chicago White Stockings	Chicago White Stockings
William Nash	Boston Beaneaters	Boston Beaneaters	Boston Beaneaters	Boston Beaneaters	Boston Beaneaters

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