A Bilateral Labor Market: Salary Determinants of National Football League Quarterbacks

by

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ABSTRACT

In general, an individual commands a salary in return for their contribution to the production process at their place of employment. In the case of a quarterback for a National Football League team, the salary he commands depends on how much the team's owner expects him to contribute to the team and how unique his talents and services are. The salary of the quarterback is negotiated between the quarterback and the team and will vary greatly depending on the relative strengths of each side's bargaining position. The bilateral oligopoly provides a useful way to view how salaries are determined. This thesis uses an econometric model to explore the bilateral oligopoly framework for determining quarterback salaries. Within this framework, there are a set of on-field performance variables (related to the quarterback and the team) and off-field financial variables (related to the team) that are used to negotiate a quarterback's salary. This paper characterizes the quarterback-team relationship by identifying those variables that effect quarterback salaries.

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Section I:
INTRODUCTION

The market for quarterback services in the National Football League (NFL) is imperfect. The current framework for salary negotiations between a quarterback and the owner of an NFL team suggests a bilateral oligopoly market situation. There exists an upstream oligopolist (the quarterback) that is selling its output to a single downstream oligopsonist buyer (the team owner) that may also be an oligopolist in its output market.[1] As a result of this framework, some quarterbacks are paid extremely high salaries while others are paid far less. Is it simply a difference in their perceived talent or is there something else? By developing an econometric model to explore these negotiations, this study seeks to identify what factors impact a quarterback's salary.

The following paragraphs provide a summary of the work done previously on this topic and how those early efforts influenced this study. Next, the approach taken by this study is outlined and how it differs from earlier work is discussed. Finally, a theoretical look at the model is provided and accompanied by a discussion on several key issues considered during the development of the model.

The "Pay for Performance" Area of Study

The identification and analysis of salary determinants in professional team sports is a relatively young field of study with most of the work coming in the last two decades. Early work focused on identifying the performance variables that impact average team salaries while more recent studies have attempted to identify salary determinants for an individual player position in a team sport (i.e., a pitcher in baseball or a quarterback in football). Some of the seminal studies in this area, referred to by many as "pay for performance", were conducted by Gerald Scully (1974), Gary Neil Ross (1975), Marshall

[1] Ferguson and Gould, page 288

Medoff (1976), and James Hill and William Spellman (1983). These early studies concentrated primarily on professional baseball since, by its nature, baseball provides distinct and measurable performance variables for the individual player. These include batting average, home runs and runs batted in for measuring a hitter's performance, and strike-outs and earned run average for measuring the performance of a pitcher.

"Pay for performance" studies did expand to encompass other professional team sports such as football and hockey. However, the structure of these sports does not allow for the easy identification of performance variables for an individual player position. Under this constraint, much of the early work in football "pay for performance" by economists such as Mogull (1975) and Scahill (1985) focused on linking salaries to non-performance variables including a player's draft round, the number of games played (as a proxy for experience) and their race. Other studies aimed to link team and average salaries to the overall success of the team, as measured by wins and championships.

Much of the work completed to date focuses solely on player-side variables with econometric models being developed to regress salaries against certain on-field player performance variables. In only a few instances have team-oriented variables such as revenue, monopoly power, etc. been included in the analysis. Studies that have incorporated team-owner variables have been limited primarily to baseball and hockey. No football-related studies using this approach were identified.

Approach to this Study

In contrast to the work summarized above, this study takes the more traditional approach of regressing salaries against player performance variables one step further by introducing a bilateral labor market framework to the salary negotiations of NFL quarterbacks. In this context, a set of team owner-related variables has been identified and incorporated into the salary determination model. The assumption here is that a

quarterback's salary is not determined solely by his on-field performance. Instead, those on-field variables are used in conjunction with team-related variables to negotiate a quarterback's salary.

Unlike a competitive labor market, a bilateral labor market yields no precise solution. Each party (the quarterback and the team owner) uses the results of certain individual and team performance and financial variables to establish a price range within which they will negotiate. Depending on the relative strength of each side's bargaining power, the final salary will fall somewhere within the established price range.

In this study, the average annual salary for an NFL quarterback is regressed against a combination of player and team variables in an attempt to identify which variables impact quarterback salaries. The variables selected have largely been drawn from existing studies, mostly for the quarterback variables. As noted, football-related studies that provide insights into team variables were not available. However, team-related variables such as team revenue, payroll costs and winning percentage were identified in several non-football studies and applied to this effort. Hopefully, the approach taken in this study will contribute to the overall body of "pay for performance" literature and, in particular, to the study of salary determination in the NFL.

The Theoretical Model

In examining this issue, the inherent challenge became "How to identify the variables that impact an individual player's salary in a team sport"? In football, it is quite possible that this could only be accomplished for the quarterback position. For certain positions, it would be virtually impossible to measure individual performance. For example, offensive linemen are paid to create openings for running backs to run through and to provide time for the quarterback to complete passes to receivers. However, one could not separate out the impact one lineman has on team performance without

considering his teammates on the offensive line since their every step is so closely coordinated. In contract negotiations for a lineman, an emphasis would be placed on subjective evaluations of the player's productivity and not on quantifiable performance measures. This would likely hold true for other positions on the team including defensive lineman and linebackers. Although some quantifiable performance variables may exist (e.g., tackles and quarterback sacks), individual productivity would not be easily measured. For instance, a defensive lineman who is consistently double-teamed, may have fewer tackles than one of his teammates. However, because of the double-teaming, he has freed up his teammates to make more tackles. As a result, his total contribution to the team's success may not come from tackles and sacks, but through his ability to disrupt the opponent's offense. Measuring that contribution would then take on a more qualitative or subjective approach.

With this in mind, this study attempts to explore the performance of the quarterback and, in conjunction with certain team performance and financial variables, analyze their relative impact on the price of a quarterback. As the study progresses, the reader should be prepared to accept two key tenets. First, as a leader in a team sport, the quarterback frequently gets more than his share of the blame for an unproductive offense. Conversely, he most certainly receives more than his share of credit for a productive offense. This is likely due to the perception that he has a certain level of control over each play and, subsequently, over the outcome of each play. Although the modern-day quarterback rarely calls his own plays, he does have the option of changing the play at the line of scrimmage if he sees a defensive scheme that he does not like. Further, each play starts in his hand and his decisions largely affect the play's outcome.

Secondly, it must be remembered that while this study attempts to isolate individual impacts, it is still a team game. Regardless of how good the quarterback is, his production will suffer if he is surrounded by inferior talent. Conversely, the performance of a mediocre quarterback may be elevated by superior production from his teammates.

As such, what might appear to be a potentially important performance variable on the surface may not be as closely correlated as one might suspect. A quarterback is not going to win games by himself, regardless of how talented he is.

From a team perspective, certain financial and on-field performance variables must be considered when deciding to sign a contract with a quarterback. Player payroll, team revenue, and franchise value would certainly present themselves as potentially important elements that would impact a team's salary decisions. For example, a team that has a traditionally low payroll may be willing to bypass a certain quarterback in favor of one that might fit into a price range they are comfortable with. In doing so, they will have foregone a certain increment of talent in exchange for retaining some of their labor funds.

Based on these interactions, the following theoretical model has been developed using a reduced form equation approach. The equation is characterized by several on-field quarterback performance variables and by several team-related on-field performance variables and off-field financial variables. The equation is as follows:

$S_{sal} = (Q_{1,} Q_{2,}.....Q_{n,} T_{1,} T_{2,} .....T_{n})$, where

S_{sal} = the average annual salary of the quarterback
$Q_1..Q_n$ = some combination of on-field quarterback performance variables
$T_1..T_n$ = some combination of on-field football performance variables and off-field financial variables

To move this analysis forward, empirical salary data from 32 NFL quarterback signings have been applied to the theoretical model described above. The remaining sections introduce some of the literature that influenced this study, provide a detailed look at each of the model's equations, variables and expected signs, and examine the model's empirical results and accompanying conclusions.

Section II
MOTIVATING THE MODEL

This section introduces several of the more influential studies and identifies methodologies, approaches, and performance variables that were applied to this study. A summation of the contributions from those studies is provided along with a discussion on the key differences between those prior efforts and this study. Finally, the empirical model will be introduced and its equations and variables specified.

Influential Studies

While there is a growing body of work in the area of "pay for performance" in team sports, a large majority focuses on team performance results and average salaries. Less has been done on an individual position basis. In Scoville (1974), average NFL team salaries for 1970 were regressed on team winning percentage for the previous three years. To level the field, dummy variables were used for expansion franchises (which were far weaker than the other teams in the league) and the Green Bay Packers (by far the most dominant team in the league at that time). After running the model, Scoville determined that the most important factor impacting team salaries was their winning percentage. This implied that team owners rewarded their players for successful team performance. In response to this study, Scahill (1985) attempted to determine the marginal revenue product of individual players in a team sport. Faced with the difficulty of quantifying a player's contribution to team success (especially those players on the offensive and defensive lines), Scahill developed a number of proxies for individual performance and inserted them into two regression models. These included the number of games played as a proxy for the player's experience; the position the player was drafted as a proxy for their potential; and, the number of all-pro teams selected to as a measure of the player's stature among his peers.

Average team salaries were then regressed on the average number of games

played by the team's players, the average round in which they were drafted, the average number of all-pro teams they had been selected to, and on team winning percentage (for the last five years and the last ten years). Although the results of the two runs indicated the correlation between average salary and winning percentage was positive, in neither regression was the winning percentage statistically significant when included with the other independent variables. Of the variables included, only the number of all-pro teams was statistically significant. As a result, Scahill suggested that team performance plays a lesser role in determining player salaries.

While Scahill's study focuses on average team salaries, it is possible that the quarterback may be viewed as having the most direct impact and, therefore, the largest responsibility for winning and losing games than any other single position. In this sense, the quarterback assumes the role of a manager and must be willing to accept a larger share of the blame when the offense (and subsequently, the team) is unproductive while garnering a larger share of the credit when the offense is productive.

Perhaps the most influential study was Jones and Walsh (1988). In this study, the authors set up a regression model relating individual player salaries to skill attributes, a measure of discrimination, and the monopoly and monopsony characteristics of National Hockey League (NHL) franchises. Their major conclusions were that skills (on-ice performance) are the principal salary determinant for players at all positions, monopoly characteristics of franchises have a positive impact on the forward position, and the only position that may incur some salary discrimination is the defensemen. These results support the standard view of neoclassical price theory, which puts forth that in the absence of discrimination, skill differences are the prime determinant of salary differentials.

Of particular interest from this study was the methodology used by the authors in developing a position-specific model and testing it against empirical salary data. Jones

and Walsh included a number of on-ice performance variables and off-ice variables in their model and ran it against salary data from over 300 players. Particularly interesting was that a number of variables looked at the player's career performance (e.g., number of points scored per game, number of goals allowed per game, etc.), the round in which they were drafted and the number of NHL games they had played. These last two variables provide insights into the team's expectation of a player's future performance and some measure of how "intelligently" he plays the game.

A second, very influential study was Ahlburg and Dworkin (1991). They sought to identify which factors determined salaries in the NFL. At the time, there was much disagreement over which variables actually determined player salaries. Players contended that salaries where determined by a player's years of experience, their position and draft round. They did not believe that performance impacted their salaries as much as it should. Team owners, on the other hand, insisted that on-field performance was the principal factor in determining player compensation.

To study the situation, the authors developed a model focusing on salary determinants and ran it using salary data from 1982, 1986 and 1987. Since player positions in football are filled by "specialists", the authors developed a set of position-specific performance measures to use in the model. Using principal factor analysis, a set of 21 performance measures were developed for the quarterback position. This set included both career and previous-year measures. After completing the model runs, it became apparent that both sides were at least partially right. Draft round and seniority continued to be a factor (as contended by the players) while at the same time, performance differences clearly and significantly impacted salaries across all positions. Two elements of Ahlburg/Dworkin were applied directly to this study. First, salary determinants were identified as being both on-field performance variables and off-field non-performance variables such as draft round and years of experience. Second, a quarterback's on-field performance was looked at using both career and previous-year

statistics.

Additional works that were used in developing this study's methodological approach include Kahn (1991) and Scully (1974). Kahn's methodology called for developing a number of performance variables including whether the player was named to the Pro Bowl, how many games he had played (as a proxy for experience), demographic characteristics of the city he played in and his race. He then regressed the player's average annual compensation against those variables.

Scully's model posits: 1) a team's winning percentage in baseball is determined by batting and pitching performance; and, 2) that overall team revenues are determined by team winning percentage. His model may then be used to estimate indirectly how an individual player's performance effects the team's winning percentage, the team's revenue, and subsequently, the player's value as measured by his marginal revenue product.

Contributions to this Study

As indicated, a number of the studies reviewed contributed in various ways to the development of this study. Jones and Walsh (1983) provided an overall methodology to identifying salary determinants of individual players in a team sport. The authors regressed player salaries against a number of player performance variables and franchise characteristics. In essence, this was the approach that was used in developing the bilateral model that is the subject of this study.

Ahlburg and Dworkin (1991) identified a number of quarterback variables that were also used in this study. In addition, the authors introduced two key considerations behind the selection of the variables. First, salary determinants in the NFL are largely a combination of on-field variables (performance) and off-field variables (non-

performance). In their study, however, off-field variables included only player-related variables. It does not address any team-related variables. Secondly, quarterback variables were used that focused on their performance during the most recent season and their performance over the course of their career.

It should be noted that several non-football studies including Scully (1974), Medoff (1976), and Sommers and Quinton (1982) incorporated team-related variables such as team winning percentage and team revenue. While these variables were also applied to this study, the intent of these authors was to look back to prior seasons and determine the marginal revenue product of an individual player. The approach used in this study differed slightly in that team revenue and wins were identified as factors that impact salary negotiations from the team's perspective. That is, their success in these two areas will help dictate the amount of money they are willing to spend to acquire a quarterback. What has been emphasized in this approach is that a quarterback's salary will reflect his expected contribution towards winning games and championships. Empirical results from the three studies listed above, as well as Scott, et al (1983), indicate a strong correlation between a team's winning percentage and their total revenue. This would lead a team owner to sign a quarterback that the owner believes can help his team win games and, subsequently, increase team revenues.

While this study has drawn from the approaches of earlier studies, it has expanded beyond those mentioned by applying a bilateral market framework to the NFL. That is, individual player variables and team-related variables have been included in the model. This has been done primarily to capture performance and non-performance factors that may impact negotiations from both the quarterback's side as well as the team's side. Although this has been attempted in other team sports, notably hockey and baseball, this study appears to be breaking new ground in the analysis of NFL quarterback salaries.

At this point, it will be useful to introduce the model developed for this study and

define its equations and variables. Hopefully, it is clear to the reader how the model makes use of some of the approaches and variables identified above and how it differs from previous studies.

Specification of the Bilateral Model

The focus of this study has been on the interdependence between the quarterback variables and the team variables, and whether the quarterback and the team can come to an agreement on salary as their situations vary. This has led to the development of a simultaneous equation model consisting of three equations that encompass the joint determination of several variables. Once the first two equations are estimated, the resulting fitted values are entered into the third equation, which is then estimated. The third equation is the principal equation in this model.

Using the fitted values from Equations 1 and 2 as variables in Equation 3 captures the quarterback's *expected* rather than actual level of performance. Holding the other variables constant, these expectations may be used to project future levels of performance as input to the salary negotiation process.

A simultaneous equation system has been used since the nonstochastic nature of the relationship between explanatory variables and the error term would otherwise violate an assumption necessary for using ordinary least squares. That is, explanatory variables must be independent of the error term for consistent estimation. Since the model is in reduced form, only predetermined exogenous and lagged endogenous variables appear on the right side of the equation and are assumed to be independent of the error term. This method allows the use of ordinary least squares for each separate equation.

The equations of the model are as follows:

Equation 1: Provides insight into the expected success (number of completions) and experience (years in NFL) that a quarterback would bring to a team.

$C_j=f_c(A_j, B_j) + e_j$, where

C= number of passes completed during previous season
A= number of passes attempted during previous season
B= number of years quarterback has been in the NFL
e_j= the error term

The expected signs for both variables are positive. That is, as the number of attempts and the number of years experience increases, the number of passes completed will increase. The fitted value for completions is used as an explanatory variable in the principal equation (#3).

Equation 2: Provides further information on the successes (yards, touchdowns and completion percentage) and failures (interceptions) that a quarterback would be expected to bring to the team that signs him.

$R_k=f_R(D_k, T_k, I_k, O_k) +e_k$, where

R= the quarterback's rating for the previous year (a quarterback rating is a performance measure derived from the number of passes completed, yards gained, touchdowns thrown and inceptions thrown per pass attempt)
D= the quarterback's yards per completion from the previous year
T= the number of touchdowns the quarterback threw the previous year
I= the number of interceptions the quarterback threw the previous year
O= the completion percentage of the quarterback for the previous year
e_k= the error term

The expected sign for each of the variables, except for interceptions (I), is positive. That is, the higher a quarterback's yards per completion, touchdown passes and completion rate is, the higher his rating will be. Conversely, the more interceptions a quarterback throws, the lower his rating will be. The fitted value for quarterback rating is used as an explanatory variable in Equation 3.

Equation 3: Establishes a correlation between a quarterback's salary and his performance on the field (completions, career won-loss, rating, pro bowl selection, and championships) and some measures (total team revenue, player costs and team wins) of the team that signs him.

$S_l=f_S(X_l, Y_l, Z_l, C_{l,}, L_l, R_l, F_l, G_l) + e_l$, where

S= average annual salary of the quarterback
X= total team revenue
Y= annual player costs of the signing team (captures talent level of team)
Z= the number of wins the signing team had the previous year
C= an expectation of the quarterback's pass completions as a result of his completions during the previous season (fitted value from Equation 1)
L= the career win-loss percentage of the quarterback
R= an expectation of the quarterback's rating as a result of his rating from the previous season (fitted value from Equation 2)
F= whether the quarterback was selected to the Pro Bowl following the previous season (peer recognition)
G= whether the quarterback's previous team won the NFL championship (measure of success)
e_l= the error term

The expected signs for all of the variables, except the number of wins (Z) the signing team had the previous year, are positive. As the value of each variable increases, the expected salary increases. With respect to team revenue and player costs, it appears as though a team with higher revenues and a history of higher player costs is more willing to pay a higher salary to attract the quarterback they covet. For number of wins by signing team, it is possible a team with fewer wins may be more likely to pay a higher salary to attract a quarterback that may help them to increase their number of wins and, ultimately, their on-field success. However, the sign of this variable is ambiguous.

The number of pass completions the quarterback had the previous season has been included in the model as a measure of his effectiveness, his decisionmaking, his experience and his ability to move the team via the pass. More pass completions generally lead to more yardage gained, points scored and team victories. His career win-loss percentage provides a past history of his ability to lead and/or contribute to team victories. This captures the notion that a quarterback is a proven "winner" and carries with it additional information about the quarterback's leadership abilities. The quarterback's rating from the previous year captures additional on-field performance measures including touchdowns, interceptions and yards per completion. Each of these helps establish the quarterback's ability to protect and advance the football, which is the

primary objective of the offensive unit. While completions alone may shed light on the quarterback's throwing abilities and decisionmaking, the yards per completion indicates an ability to advance the ball.

Additionally, from a quarterback's perspective, the championship and pro bowl selection variables provide insight into the end result (success) of his season. In a team game, the objective is to win games and, ultimately, the championship. As such, winning games is the output of the team's production function. Based on a review of average salaries, starting quarterbacks have the highest average salary of any position. This suggests that owners, in general, view quarterbacks as the most instrumental piece of the team's production function. By virtue of winning a championship, the quarterback has shown that he is capable of leading and/or contributing to accomplishing a team's ultimate goal. In being named to the pro bowl, he has been selected by his peers (and coaching staffs) as one of the best in the game for that season. This is particularly important since no one knows the game and the factors that influence games like the players and coaches.

With respect to player costs, this variable serves as a constraint to the team's production function. Team's that have high payrolls may have higher willingness to pay for talent than team's with lower player costs, thus attracting more talented players on average. However, high costs may also prevent them from paying premium salaries in some cases. The number of wins that the signing team had the previous year is used to define the potential that the team has with respect to winning games. A team with few wins may not be willing to pay a premium quarterback salary until they acquire/develop talent in other areas. Conversely, a team with potential for a successful season or that is interested in signing a certain quarterback to use as a foundation in the building process, may agree to a premium salary for the quarterback they want.

Section III:
BILATERAL LABOR MARKETS

At this point, it may prove useful to step back and take a look at some of the characteristics of a bilateral oligopoly market. This section provides an overview of the bilateral market and contrasts it with a competitive labor market. The bilateral framework is then applied to the market for NFL quarterbacks. Finally, several underlying market assumptions that were included in this study are discussed.

A Bilateral Oligopoly Market

In a competitive labor market, there are many buyers and many sellers, none of whom are large enough to have any appreciable influence on wages. Each of the sellers in this market produces the same product and prices it to maximize profits. The primary difference between a competitive market and a bilateral is that the competitive market generates substantial amounts of price and quantity-demanded information to its buyers and sellers. The market is able to achieve equilibrium, thus enabling market participants to develop supply and demand curves. However, due to an insufficient level of information rising from the inability to develop supply schedules, the market structure in a bilateral oligopoly does not yield a single equilibrium price or quantity.[2]

In further exploring a bilateral oligopoly market's inability to generate supply schedules, a supply schedule may be defined as a set of prices and the quantities that would be supplied at each price. For the oligopolist seller in this market, any number of prices may be associated with a given level of output depending upon the position of demand at the output level.[3] That is, an infinite number of prices can be associated with one level of output. Under these circumstances, market participants will establish a theoretical bounds within which price and quantity will range instead of looking for a

[2] Maurice and Phillips, page 524
[3] Baumol and Blinder, 472-3

precise market solution. The final result will then depend on the bargaining positions, skill and preparation of the negotiating parties.[4]

Economic theory provides a basis for analyzing the market for a commodity. It articulates a possible equilibrium in demand, supply, production, derived demand, profits and costs. Consumers maximizing their utility subject to budget constraints choose to purchase quantities of goods at prevailing prices. Producers use their production processes, wholesale, and retail and marketing activities to produce and supply quantities of goods by combining inputs in such a fashion to optimize an objective function. Professional football is essentially an entertainment product. Team owners supply the market with a team franchise that in a limited sense, may satisfy the consumers demand for entertainment and team performance. Football players are an essential input to the "production" or supply of the product. The team owner has a "derived demand" for all team members, including the quarterback. Owners hire quarterbacks and other players and combine their talents with that of the coach to supply consumers a "team." At the time the salaries are negotiated, the quarterbacks and the owners may have an "expectation" that the team will perform sufficiently well to "supply the fans" with a good team, hopefully one that will win enough games, qualify for the play-offs and, ultimately, win the NFL championship. The demand for a quarterback then is a "derived demand" - it is derived with a production function and an objective function clearly in mind. However, this industry is not perfectly competitive. At best it is oligopolistic and, as such, the "existence" of upward sloping supply curves and downward sloping derived demand curves come into question.

As Applied to the NFL Quarterback Market

As opposed to a truly competitive market, the labor market for NFL quarterbacks more closely resembles a bilateral oligopoly. That is, we see the quarterback operating

[4] Maurice and Phillips, page 524

under oligopolistic competition principles as a oligopoly seller of his services while the team owner acts as a oligopsonist buyer. By definition, oligopolistic competition exists when there are relatively few sellers in a market, each of whom sell a slightly different product. This is the case with the market for NFL quarterbacks where, at any given time, there are three to four dozens individuals who have the requisite college or NFL experience to be considered. Each of these individuals is selling a product, himself, that is slightly different from the product sold by others in the market. Some of the differences might include size of the player, arm strength, years of experience, etc.

The compelling condition of oligopolistic competition is the concept that competing products, namely quarterbacks, are not identical. As such, it is reasonable to expect that prices will differ. In selling his services, each quarterback deals with a market that is slightly distinct from his competitors. Each quarterback sets a price range that is also distinct from his competitors. For instance, Quarterback A may be approaching the prime years of his career and has led his teams into post-season play the last couple of years. Along the way, he has garnered a number of individual awards and proven himself to be an upper echelon quarterback. In setting a price range for his services, his target customers may be a select few teams that can offer him the right combination of a high salary, talented teammates, and championship possibilities. Conversely, Quarterback B is past his prime and, although he is still a competent performer, his skills are beginning to deteriorate. His target customers may be a different group of teams that are looking for an experienced player to serve as a back-up to a younger player. In any case, his market is different from Quarterback A's as his price range is lower. In both cases, as each quarterback's price gets higher, fewer teams are in the market for his services. In this situation, it is possible for the quarterback to price himself too high and find out there are no buyers at that price.

While the negotiations that take place are between a single seller and a single buyer, the actions of other sellers and buyers are likely given some weight during

negotiations. Prices that have been set by earlier agreements between other quarterbacks and teams are often used to place bounds on a price range. This information provides both parties with sort of a reality test on the quarterback's price demands and the potential for a team to meet or come close enough to the price to initiate talks. While a "hot" quarterback may concurrently entertain offers from several teams, each offer is a distinctly separate transaction and the particulars of one offer are not common knowledge to the other teams. The concept of establishing a price range in the market for quarterback services, rather than a specific price, is a defining characteristic of a bilateral oligopoly.

Underlying Assumptions

As variables were identified and considered for inclusion in the model, several key assumptions were made regarding both the quarterback and the team owner. The most important being that each wants to win football games and, ultimately, the NFL championship. This is the nature of athletic competition. As such, the function a football team, in which the quarterback is a factor of production in that function, is to win football games. If they win enough, they will be the champions of the NFL. If an owner does not believe a player will contribute towards this goal, that player will likely be waived or traded. Similarly, if players are not convinced that the owner has the same goal, they will find ways to leave (via trade or not re-signing). In addition to winning games, the quarterback is attempting to maximize his salary while the team owner is attempting to sign the quarterback he covets at the lowest possible salary. Whether winning games or salary is the most critical factor will differ in each situation. Some players are more interested in maximizing their salary while others might be more interested in winning championships. The same likely holds true for owners.

In signing a quarterback, the team owner's principal objective is to develop a situation that fosters a synergy between the quarterback and the rest of his teammates that

leads to wins and championships. The quarterback's past performance, combined with how well he fits into their offense (i.e., passing teams need a passing quarterback) are all part of the expectations an owner has when signing a quarterback. Again, it is a team game and the quarterback cannot win games by himself.

Additionally, reality says that not all teams can expect to compete for a championship each year. Some teams are young and inexperienced while others are rebuilding, etc. This gives rise to the notion that teams are in unique situations within which they must decide how much they are willing to spend in signing a quarterback (or any player for that matter). Logically, if a team is not likely to go to the play-off, then the owner will be less inclined to pay top dollar for a premium quarterback unless the owner plans to make the him a cornerstone to building or rebuilding a contending team. Conversely, the quarterback must also be convinced that the team he is considering fits into his objective whether it is to play for a contending team or if the team has plenty of money to spend.

In his 1962 book "The Economics of Labor", Phelps Brown asked "Why rates of pay are different for different types of labor?"[5] The answer is that labor is a factor of production and will vary from production process to production process. From a theoretical standpoint, wages are high in markets where demand is high and supply is low, while lower wages are associated with markets where demand is relatively low and supply is high. Higher wages are sometimes the result of a scarcity of workers, high demand for a product, or the expectation by an employer of high productivity. In situations were the opposite is true, lower relative wages will prevail.

In the market for NFL quarterbacks, some factors that might affect a party's bargaining position (and, subsequently, the negotiated price) include the number of currently available quarterbacks, the specific needs of a team, the attractiveness of the

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[5] Phelps-Brown, page 3

team to the quarterback, and others. With these factors influencing price ranges, it is useful to distinguish between skills that can be duplicated through training and education and skills that cannot. If one individual possesses an ability that a second individual cannot duplicate regardless of the amount of training and/or education consumed, than the wages earned by the first individual have an element of economic rent that is not available to the second individual.[6] The high salaries that NFL quarterbacks command are an example of how economic rents can create large wage differences. It is conceivable that there are individuals who can throw a football farther and run faster than some NFL quarterbacks because there are weight lifters who are likely stronger and track and field sprinters that are likely faster. However, it is unlikely that they also possess the ability to "read" opponents defenses and make instantaneous and correct decisions.

[6] Baumol and Blinder, page 622

Section IV:
PARAMETERS OF THE STUDY

In the early stages of this study, it was necessary to define the time period over which the analysis would be conducted, set parameters around which quarterback contract signings should be included in the study, and take steps to ensure the data collected was consistent.

Time Period of Study

After careful consideration, it was determined that it would be inappropriate to compare the average salaries of today's NFL quarterbacks to their counterparts in past eras. In some eras, quarterbacks played football to supplement their regular income from other sources, while the modern day quarterback is often paid in the millions and trains year-round. Further, a number of on- and off-field changes have evolved creating greater disparity between the game of football in the 1980s and 1990s versus the game that was played in the 1950s and 1960s. Several of these changes include free agency, greater exposure through television, increased fan support leading to higher team revenues, and changes to the game's rules.

Additionally, statistical information from past generations is often incomplete. There does not appear to be any reliable sources for obtaining the necessary salary information on players from the 1960s and 1970s. And, given the advances that have occurred in the gathering and managing statistical information, the amount of data available on today's game far exceeds the data that was tracked in past generations. As a result of these constraints, it was decided that the study should focus on quarterback signings during the 1980s and 1990s.

The chosen time period (1987-1993) was selected as a result of several key events relating to the NFL and its labor negotiations. In 1987, the football players in the NFL

staged a strike that lasted through training camp and the first three games of the regular season. At stake was the free agent system under which players could sign with new teams either at the end of their current contract or during option years. The collective bargaining agreement that ended the player's strike established new guidelines for the system. Under the old system, if a free agent player decided to change teams, the team signing the player must compensate the other team with a draft choice. This, combined with a guaranteed minimum increase of 10% over their previous salary, discouraged much free agent movement. In fact, when Wilbur Marshall of the Chicago Bears signed as a free agent in 1988 with the Washington Redskins, he was only the second player to do so in the 11-year history of free agency.[7]

Under the new agreement, players were designated as either restricted or unrestricted free agents depending on their years in the league. If a restricted free agent received an offer from another team, his current team could choose to match the offer or receive compensation in the form of draft choices. An unrestricted free agent was free to move to another team without compensating the team he left. This provided players with an opportunity to test the market in an attempt to determine their true value and maximize their salaries. Free agent signings exploded, driving up the salaries of all players. For example, the average quarterback's base salary in 1982 was $161,380; in 1987 it was $340,438 with seven quarterbacks making over $1 million and 19 making over $600,000 per year.[8] By 1992, the average salary for all quarterbacks was $969,990, a six-fold increase in 10 years.[9] Interestingly enough, if football follows the standard set by Major League Baseball and the National Hockey League, player salaries will correlate more closely with performance under free agency than with no free agency agreement (See Hill and Spellman, 1983).

In an attempt to slow down rapidly escalating salaries, team owners and players

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[7] St. Petersburg Times, June 15, 1992
[8] Atlanta Journal and Constitution, December 22, 1994
[9] Atlanta Journal and Constitution, December 22, 1994

negotiated a new labor agreement in 1993 that included a salary cap that was put into effect prior to the 1994 season. For that season, the cap was set at $34.6 million in salary expenses per team; in 1995, the cap was raised to $36.5 million.[10] The cap limits spending by teams on salaries and benefits to 64% of the NFL's defined gross revenues, that is, the revenues from ticket sales and broadcasting.[11]

Also included in the same labor agreement is another element that affects the purity of the labor market for quarterbacks. This is the option that teams have to protect certain players by designating them as a "franchise" player. By rule, these players are offered the average of the top five salaries league-wide in their position while allowing the team the right of first refusal if a second team makes an offer to the player. If the first team decides not to match the offer, it will be compensated in draft choices with the number of choices and draft round dependent upon the current salary of the player in question.

On a related note, this period also coincides with the end of a boom in the growth of television revenues for the NFL. In 1982, the three networks - CBS, NBC, and ABC - signed a 5-year, $2.1 billion dollar contract with the NFL. This averages out to $15 million per team per year. In 1987, a fourth network -ESPN - entered the picture with a 3-year, $1.43 billion contract. By 1990, each team received approximately $33.8 million in television revenues, a 225% increase over eight years.[12]

Characteristics of Selected Quarterbacks

In selecting quarterback signings to be included in this study, the contract had to have been signed during the 1987 to 1993 time period. Second, it was decided that only quarterbacks who attempted at least 100 passes the season prior to their signing and had

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[10] Atlanta Journal and Constitution, February 8, 1995
[11] USA Today, February 16, 1994
[12] Orange County Register, March 16, 1987

NFL experience would be included in the study. This means that no quarterbacks who played only a few plays (we'll call them "back-ups") nor rookies (See Jones and Walsh, 1988) were considered. Back-up quarterbacks presented two problems. First, they normally don't get enough playing time to produce the statistics needed to credible analyze the data. For example, it would be inappropriate to compare the statistics of a quarterback that threw 35 passes all year to a quarterback that threw 350 passes primarily because the back-up quarterback is often faced with game situations that the starting quarterback does not face. This could mean the game's outcome has already been decided, the game is meaningless in terms of post-season play, or an injury to the starting quarterback necessitates the use of the back-up even though he has not practiced as regularly as the starting quarterback.

Second, teams have varying reasons for signing a quarterback to a back-up role that are outside the scope of this study. For instance, a team with a young starting quarterback may pay what appears to be a high salary for a veteran back-up quarterback whose principal contribution will be to serve as a tutor to the younger quarterback. Teams whose starting quarterbacks have difficulty in staying healthy are also willing to pay higher than expected salaries to have a capable back-up in case the starter gets injured. This is especially the case if the team believes that it is good enough to advance into post-season play and wants the security of a veteran back-up quarterback on the bench.

In the case of a rookie quarterback, he has not played against defenses at the NFL level and, thus, the statistics he produced in college are not comparable to the statistics produced by a starting NFL quarterback. In college, the level of competition varies so widely between conferences and divisions that there exists a certain degree of unintentional "statistics padding". Additionally, a rookie's salary is largely determined by the salaries of players drafted directly ahead of and behind him, and by the salary of the player drafted in the same position in the previous year's draft. For example, the eighth

player selected in the draft will likely have an annual salary somewhere between the annual salaries of the seventh and the ninth draft picks. This practice is known as slotting.[13]

In summary, the freedom resulting from the 1987 free agency agreement and the restrictive salary cap implemented in 1994 created a natural time frame in which to analyze this issue. Once the cap was implemented, teams attempted to maneuver around the cap in order to sign higher-priced players. One approach was to offer exorbitant "signing" bonuses up front that could be spread out over the length of the contract. This enabled teams that had little room under the salary cap to compete with teams having more cap room for marquee players.

Data Collection and Handling

To develop this model, several types of data were needed: specifics of salary packages, on-field performance statistics and off-field financial results related to the team. While the on-field quarterback statistics and off-field team financial data were easily obtainable, salary information was less readily available and it was necessary to rely on newspaper articles and periodicals for this information. (It should be noted that two quarterbacks sat out the season prior to signing a contract as a result of contract disputes. In each case, on-field statistics for the last season they played were used.) A complete data set is attached as an appendix.

To maximize the search for player contract signings, two databases that were part of the Washington Research Library Consortium were accessed. The first database was a multi-subject periodical list that spanned the years 1983 to 1993. The second information source was a newspaper abstract database covering 1989 to 1993. Multiple searches were conducted in both databases using keywords such as "athletes", "salaries", "wages", and

[13] USA Today, February 28, 1990

"income", just to name a few. In addition, a list of all quarterbacks that played in the NFL between 1987 and 1993 was compiled and last-name searches were conducted. This list consisted of approximately 75 quarterbacks.

Since renegotiating contracts is a fairly common practice, especially after a player has an exceptional year, the model uses player statistics from the season prior to the signing of the contract. This builds a one-year lag period into the analysis. In all cases, salary packages were converted to an average annual amount over the course of the contract. This enables salary packages of differing lengths to be compared with one another. The salary packages included base salaries as well as any signing, reporting or roster bonuses. However, incentive bonuses were not included since the data was not consistently available. Once an average annual salary had been calculated, it was adjusted for inflation using the Consumer Price Index (CPI). For this model, annual salaries have been adjusted to 1993 dollars.

Section V:
EMPIRICAL RESULTS

As noted previously, a key difference between a bilateral oligopoly market and a competitive market is that price and quantity are indeterminate in a bilateral market. Of course this does not mean that the market collapses or that participants are unable to reach agreement on price and quantity.[14] It means only that there is insufficient information to reach a precise market solution. Price and quantity are determined not only by cost and demand factors, but also by other factors such as the uniqueness of the quarterback, the team's distinct needs, bargaining positions, skill of the negotiators, etc. Regardless of how good a quarterback is, there is a limit to how much a team will pay. Conversely, there is a minimum amount that a quarterback would be willing to settle for and will not sign for anything below that.

As a result, this model is not necessarily a predictive model. Its function is to provide some insights into which variables weigh more heavily in determining quarterback salaries. As appropriate to a bilateral situation, an absolute market solution is not available because each negotiation is unique. Some of the variables may apply to certain situations while other situations may call for a different set of variables.

Model Results

Results from Equation 1:

Variable	X Coefficient	Standard Error	t-statistic
Pass Attempts	0.628	0.020	30.762
Years in NFL	2.173	0.929	2.338

This equation was applied to 32 observations. The R^2 is .971 with the t-statistics for both variables being significant at the 5% level. The sign for each variable is as expected. Additionally, the Durbin-Watson statistic was 1.81 indicating no significant serial correlation.

[14] Ferguson and Gould, page 288

Results from Equation 2:

Variable	X Coefficient	Standard Error	t-statistic
Yards/Completion	2.009	0.406	4.952
Touchdowns	0.867	0.088	9.901
Interceptions	-1.261	0.117	-10.819
Percentage Completed	144.271	12.016	12.007

Applied to 32 observations, this equation resulted in an R^2 of .963 with the t-statistic for each of the four variables being significant at the 5% level. The sign for each variable is as expected and the Durbin-Watson statistic was 2.01 indicating no significant serial correlation.

Results from Equation 3:

Variable	X Coefficient	Standard Error	t-statistic
Team Revenue	0.076	0.029	2.572
Player Costs	0.027	0.022	1.213
Team Wins	-0.135	0.099	-1.361
Completions	0.010	0.003	3.636
Career Win-Loss	5.186	1.90	2.733
Rating Previous Year	0.016	0.020	0.787
Pro Bowl Selection	0.749	0.678	1.104
NFL Champions	-0.031	0.806	-0.039

Equation 3 was run against 32 observations. The resulting R^2 is .731 with the t-statistics for team revenue, completions and career win-loss record being significant at the 5% level. The t-statistics for the remaining variables were not significant. The sign for each variable is as expected with the exception of the sign for NFL champions. This sign was negative instead of positive, though the estimate is not statistically significant. In addition, the Durbin-Watson statistic was 2.09 indicating no significant serial correlation.

Section VI:
CONCLUSIONS

The foregoing analysis suggests a number of conclusions, primarily that a bilateral labor framework exists in the labor market for NFL quarterbacks. A quarterback's salary is impacted by his on-field performance and by certain variables associated with the team that signs him. From the player's perspective, the variables that most significantly impact salaries were the quarterback's career win-loss record and the number of passes they completed the previous year. Interestingly enough, the statistical significance of these two variables indicate that the quarterback is rewarded for his performance during his most reason season (completions) and for his performance over the course of his career (win-loss record).

The conclusions based on the player variables are consistent with the findings surrounding the one team-related variable that proved statistically significant in the model's principal equation: team revenue. As reported in several studies (Scully, 1974; Medoff, 1976; and Scott, et al., 1983), a team's revenue is closely correlated with their winning percentage. As the team's winning percentage increases, so does its revenue. The results of this model support those findings and indicate that team owners recognize the importance of having a quarterback who is a proven winner in the NFL lead the team.

It should be noted that while this study is designed to cover as completely as possible the on-field quantitative contributions to salary determination, it is not within its scope to address certain qualitative contributions. For instance, while variables such as courage and intelligence may be embedded in the on-field performance of the quarterback, his marquee value may not be measurable. One can infer certain hypotheses through a team's ticket revenue performance after signing a particular quarterback. However, the causal relationships embedded within these circumstances would be very difficult to define.

Finally, it would be difficult to determine the impact other components of the football team have on the quarterback's salary level. There is a definite joint-production relationship between a team's offense (of which the quarterback leads), the defense and the special teams, and their ability to generate victories. This further assumes that increases in victories, all things being equal, will lead to increases in the salaries of key individual players, of which the quarterback is often considered one. This model has attempted to capture the talent level of the players supporting the quarterback by including a "player costs" variable. The implication is that teams with higher player costs will, in general, attract the more talented players. However, this variable was not considered statistically significant in the model's principal equation.

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APPENDIX:

Data Set and Sources

DATA SET

#	Player	Year Signed	Signing Team	Adjusted Salary ($93M)	Pass Attempts	Years in NFL
1	Everett, Jim	1990	LA Rams	2.58	518	4
2	Fourcade, John	1990	New Orleans	0.50	107	3
3	Kelly, Jim	1990	Buffalo	3.16	391	4
4	Kramer, Tommy	1990	New Orleans	0.55	136	13
5	Majkowski, Don	1990	Green Bay	1.66	599	3
6	Montana, Joe	1990	San Francisco	4.42	386	11
7	Schroeder, Jay	1990	LA Raiders	1.22	194	6
8	Tomczak, Mike	1990	Chicago	0.88	306	5
9	Hebert, Bobby	1991	New Orleans	1.45	353	6
10	Harbaugh, Jim	1991	Chicago	1.33	312	4
11	Majkowski, Don	1991	Green Bay	1.80	264	4
12	Rypien, Mark	1991	Washington	1.49	304	4
13	Kosar, Bernie	1992	Cleveland	3.97	494	7
14	Marino, Dan	1992	Miami	5.15	549	9
15	Millen, Hugh	1992	New England	1.42	409	5
16	Moon, Warren	1992	Houston	4.12	655	8
17	Rypien, Mark	1992	Washington	3.09	421	5
18	Walsh, Steve	1993	New Orleans	0.91	255	3
19	Aikman, Troy	1993	Dallas	6.25	473	4
20	Carlson, Cody	1993	Houston	2.93	227	6
21	Elway, John	1993	Denver	4.80	316	10
22	Esiason, Boomer	1993	NY Jets	3.00	278	9
23	Harbaugh, Jim	1993	Chicago	3.25	358	6
24	Hebert, Bobby	1993	Atlanta	3.47	422	8
25	Hostetler, Jeff	1993	LA Raiders	2.60	192	8
26	Kosar, Bernie	1993	Cleveland	0.83	155	8
27	Nagle, Browning	1993	NY Jets	0.75	387	2
28	O'Donnell, Neil	1993	Pittsburgh	2.73	313	3
29	Simms, Phil	1993	NY Giants	2.50	137	13
30	Testaverde, Vinny	1993	Cleveland	1.40	358	6
31	Wilson, Wade	1993	New Orleans	1.00	163	12
32	Young, Steve	1993	San Francisco	5.30	402	8

DATA SET (cont)

#	Yards/ Completion	Touchdown Passes	Inter-ceptions	Completion %	Adj. Total Team Revenue ($93M)	Adj. Player Costs ($93M)
1	14.18	29	17	0.59	54.62	20.34
2	15.25	7	4	0.57	52.74	16.69
3	13.73	25	18	0.58	53.40	22.22
4	11.77	7	7	0.57	52.74	16.69
5	12.23	27	20	0.59	46.66	24.21
6	12.99	28	8	0.70	57.16	32.84
7	17.03	8	13	0.47	51.08	24.88
8	13.18	16	16	0.51	55.72	22.55
9	12.10	15	15	0.63	53.58	24.08
10	12.10	10	6	0.58	60.05	23.77
11	12.83	10	12	0.57	47.74	25.36
12	12.47	16	11	0.55	55.38	29.60
13	11.36	18	9	0.62	53.35	21.73
14	12.48	25	13	0.58	54.59	41.82
15	12.49	9	18	0.60	48.92	27.40
16	11.61	23	21	0.62	57.06	32.96
17	14.31	28	11	0.59	57.37	39.24
18	11.62	11	6	0.55	62.50	43.50
19	11.41	23	14	0.64	92.90	41.80
20	11.48	9	11	0.66	62.00	45.50
21	12.89	10	17	0.55	59.60	38.00
22	9.77	11	15	0.52	59.20	43.20
23	12.31	13	12	0.56	65.40	35.30
24	13.20	19	16	0.59	59.80	40.30
25	11.89	8	3	0.54	58.80	43.30
26	11.26	8	7	0.66	65.10	37.00
27	11.88	7	17	0.50	59.20	43.20
28	12.34	13	9	0.59	57.80	28.10
29	10.99	5	3	0.61	65.30	45.00
30	12.40	14	16	0.58	65.10	37.00
31	12.31	13	4	0.68	62.50	43.50
32	12.93	25	7	0.67	70.40	55.70

DATA SET (cont)

#	# Wins Previous Year - Signing Team	Completions (fitted)	Career Win - Loss %	Previous Year Rating (fitted)	Pro Bowl (Yes=1, No=0)	Super Bowl Champ (Yes=1, No=0)
1	11	307	0.60	90.4	0	0
2	9	49	0.64	87.4	0	0
3	9	227	0.49	84.2	0	0
4	9	67	0.48	76.1	0	0
5	10	358	0.52	81.3	1	0
6	14	224	0.69	115.1	1	1
7	8	104	0.67	66.0	0	0
8	6	174	0.69	67.3	0	0
9	8	204	0.58	82.7	0	0
10	11	178	0.57	82.2	0	0
11	6	148	0.51	74.8	0	0
12	10	173	0.63	77.4	0	0
13	6	292	0.53	90.3	0	0
14	8	327	0.62	87.5	1	0
15	6	239	0.44	70.5	0	0
16	11	393	0.47	79.3	1	0
17	14	246	0.72	98.0	1	1
18	12	142	0.44	78.6	0	0
19	13	279	0.50	90.9	1	1
20	10	124	0.67	85.2	0	0
21	8	180	0.63	66.1	0	0
22	4	156	0.49	58.5	0	0
23	5	207	0.56	75.8	0	0
24	6	247	0.65	81.5	0	0
25	7	102	0.64	78.0	0	0
26	7	79	0.51	90.1	0	0
27	4	225	0.23	53.6	0	0
28	11	178	0.55	83.5	1	0
29	6	68	0.59	83.6	0	0
30	7	207	0.33	73.4	0	0
31	12	84	0.55	102.7	0	0
32	14	234	0.53	108.5	1	0

Data Sources

Contract signings of individual quarterbacks (average annual salary) were identified from various newspapers, primarily the USA Today.

Equation 1:

Variable	Data Source
Pass Attempts	"The NFL Record and Fact Book", National Football League (1987-1993)
Years in NFL	"The Football Encyclopedia", St. Martin's Press 1994

Equation 2:

Variable	Data Source
Yards/Completion	"The NFL Record and Fact Book", National Football League (1987-1993)
Touchdowns	"The NFL Record and Fact Book", National Football League (1987-1993)
Interceptions	"The NFL Record and Fact Book", National Football League (1987-1993)
Percentage Completed	"The NFL Record and Fact Book", National Football League (1987-1993)

Equation 3:

Variable	Data Source
Team Revenue	Financial World Magazine's Annual Franchise Valuation Issue (1991-1994)
Player Costs	Financial World Magazine's Annual Franchise Valuation Issue (1991-1994)
Team Wins	"The NFL Record and Fact Book", National Football League (1987-1993)
Completions	Fitted from Equation #1
Career Win-Loss	"The Football Encyclopedia", St. Martin's Press 1994
Rating Previous Year	Fitted from Equation #2
Pro Bowl Selection	"The Football Encyclopedia", St. Martin's Press 1994
NFL Champions	"The Football Encyclopedia", St. Martin's Press 1994

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