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Empirical test of a separating equilibrium in National Football League contract negotiations

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I empirically test for a separating equilibrium in the bargaining context of National Football League (NFL) contract negotiations. The separating equilibrium predicts that a player who delays contractual agreement signs a more lucrative contract and has positive private information on his ability level at the time of contract negotiations. These predictions are tested using data on 1,873 players selected in the 1986 through 1991 NFL drafts. The empirical results support the implications of the separating equilibrium.

1. Introduction

■ The December 1991 edition of the National Football League Players Association's (NFLPA's) publication, *On the Sidelines: An Annual Economic Analysis of the National Football League Prepared for Members of the NFL Players Association,* states the following: "[W]hen a contract is signed has a major impact on what gets signed. For draftees especially, early deals as a rule produce numbers not only below the final averages in a round, but in many cases also under averages from the previous season." The fact that contracts agreed upon later are more lucrative (conditional on when the player was drafted) prompts a number of questions. Why would a drafted player agree to a less lucrative contract early rather than a more lucrative contract later? Is there a difference between players who sign early and those who sign late? Why do teams, in general, agree to a more lucrative contract if the drafted player endures a longer negotiation period?

My explanation for these phenomena relies on the idea that players prefer agreeing to a contract early rather than agreeing to that same contract later. Players prefer to sign early because contracts are nonguaranteed, and the later a player signs a contract, the lower its probability of being active.[1] Consider a player who signs a contract after

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[1] The signing bonus is the only payment specified in a player's contract that is guaranteed. The player receives the other payments (base salary, roster bonus, and reporting bonus for each year of the contract) conditional on his contract being active, which is at the team's discretion (i.e., the team holds the option). An active contract is defined in footnotes 13 and 14.

the start of training camp. Late to report to training camp, this player misses the opportunity to learn the team's offensive or defensive system and fails to achieve proper conditioning, decreasing his probability of making the team.[2] The reason some players sign less lucrative contracts early and others sign more lucrative contracts later is that players have different ability levels (conditional on, among other things, when they were drafted). The cost of delaying an agreement is less for a high-ability player (i.e., a player with positive private information) than for a low-ability player (i.e., a player with negative private information) because the delay-caused decrease in the probability of his contract's being active is less. Therefore, the benefit from the more lucrative contract may be greater than the cost of delay for the high-ability player but not the low-ability player. This results in the high-ability player delaying agreement and achieving a more lucrative contract than the low-ability player does.

This article is most similar to the empirical articles that test private information bargaining models using union contract data (Tracy, 1987; Kennan and Wilson, 1989; Card, 1990; Cramton and Tracy, 1992). The advantage of using NFL contract data of those players drafted is threefold. First, there exist accurate *ex post* measures of player performance from which to infer *ex ante* private information. In union contract negotiations, it is very difficult to obtain reasonable measures of union or firm performance from which to determine *ex ante* private information. Part of the difficulty is the inability to adequately control for the public information available at the time of the negotiations. For those players drafted into the NFL, draft selection is a very good measure of the public information at the time of contract negotiation. Second, several measures of a player's *ex post* performance can be obtained, and the player's private information and delay of agreement have different effects on these measures. The *ex post* performance measures I use are whether the player makes the team and the number of games the player starts in his first, second, and third years after being drafted. The player's private information on his ability level is likely to persist across years, while the adverse effect of delaying agreement and missing the start of training camp is likely to diminish across years. When deciding whether to start a player, a team is mainly interested in his expected performance in that game, whereas the decision about whether to keep a player on the team is based more on the player's future potential. Therefore, the adverse effect of missing the start of training camp is likely to have a larger effect on the number of games started the first year than on the other performance measures. Third, all drafted players sign a standard contract that differs among individuals only in the monetary payments and the duration. This standardization facilitates the comparison of different contracts.

This article is organized in the following manner. Section 2 provides an overview of a bargaining model and proves that in all separating equilibria, high-ability players agree to more lucrative contracts after longer negotiation periods than do low-ability players. Section 3 discusses the empirical predictions arising from the separating equilibria, and Section 4 considers alternative explanations as to why some players agree to a contract later than do others. I test the predictions of the separating equilibria in Section 5 using a confidential database obtained from the NFLPA augmented with roster information published by the NFL. The database contains information on 1,873 players drafted by NFL teams in 1986 through 1991. Sections 4 and 5 also provide

[2] Throughout the article, "active contract" and "making the team" are used interchangeably. As footnote 13 indicates, a player who is traded or selected off waivers has an active contract but did not actually make the roster of the team he was drafted by. However, in the large majority of cases, an active contract does correspond to the player making the roster of the team that drafted him.

details of the contract negotiation process. Section 6 presents conclusions of the analysis.

2. Separating equilibrium

■ The team bargains with a player over a wage that the player receives only if he makes the team. There is substantial public information on players available for the NFL draft, which influences when and if a player is selected.[3] In addition, there exists private information that the player knows and the team is unable to obtain. The fact that the player has private information implies that he has some information that the NFL team does not. It does not imply that he has more information than the team does about his ability level or his expected performance in the NFL. For instance, the player may know that he performed below his true ability level at predraft workouts or that he is exceptionally motivated. These are examples of a player's private information being positive, which I refer to as a "high-ability" type. A "low-ability" type is a player whose private information is negative. An example of a low-ability type is a player who has a knee injury unknown to the NFL team. The cost to a player of delaying agreement is a decrease in the probability of making the team. The high-ability player's cost to delay is less than the low-ability player's cost.[4]

The type of player is denoted by i, where $i = h$ if the player is of high ability and $i = \ell$ if the player is of low ability.[5] Player i's expected utility from agreeing to a wage w at time t is $u_i(w, t) = [1 - F_i(t)]w + F_i(t)U$, where $F_i(t)$ is the probability that a player of type i who agrees to a contract at time t does not make the team and U is the player's utility if he does not make the team. The wage, w, is paid by the team conditional on the player making the team (i.e., the contract is nonguaranteed). I assume that $F_i(t)$ is continuous, $\partial F_i(t)/\partial t > 0$ for $i \in \{h, \ell\}$ and $F_\ell(0) \geq F_h(0)$. A player's probability of making the team decreases the later he agrees to a contract, and the probability that the low-ability player makes the team is less than that for the high-ability player if both agree to a contract without delay. I also assume for simplicity that $U = 0$. The team's expected surplus of agreeing with player i to a wage w at time t is $V_i(w, t) = [1 - F_i(t)][P_i(t) - w]$, where $P_i(t)$ is the team's expected valuation of player i who agrees to a contract at time t, conditional on his making the team.[6]

To ensure that the low-ability player's cost of signing later is greater than the high-ability player's cost, I assume that the hazard rate of the low-ability player is greater than that of the high-ability player (i.e., $[f_\ell(t)]/[1 - F_\ell(t)] > [f_h(t)]/[1 - F_h(t)]$, where $f_i(t)$ is the probability density function). This condition says that the percentage increase

[3] When a player was selected in the NFL draft may be the best measure of the public information available at the time he was drafted. This public information, which is often obtained by the teams in predraft workouts, includes the player's size, strength, speed, and intelligence. Teams also obtain game films of the player from which to measure collegiate performance and conduct background checks to collect information on the player's character.

[4] It is possible that a player's wage may influence his probability of making the team due to the double moral hazard issue. If the ability levels of two players are equal, then the team should retain the player with the lower wage. In addition, a lower nonguaranteed wage reduces a player's incentive to exert effort. If these contract incentives are important, the team's moral hazard issue is likely to weaken and the player's moral hazard issue likely to strengthen my empirical results.

[5] For simplicity, I consider only two different types of players: a high-ability type and a low-ability type. A continuum of types could have been specified and a separating equilibrium obtained in which different player types sign at different times and higher-ability types sign later than lower-ability types.

[6] The representation of player i's utility and the team's expected surplus abstracts from the actual contract negotiations in a number of ways. I assume that the players and team are risk neutral, I do not account for the signing bonus, and I do not account for the fact that contracts are almost always several years in duration and the team can cut the player at any time.

in the probability of not making the team due to delaying an agreement is greater for the low-ability player. This assumption ensures that the single-crossing property holds where[7]

$$\frac{\partial u_\ell(w, t)/\partial t}{\partial u_\ell(w, t)/\partial w} < \frac{\partial u_h(w, t)/\partial t}{\partial u_h(w, t)/\partial w}.$$

The graphical representation of this single-crossing property is given in Figure 1, where $u_h(w, t)$ and $u_\ell(w, t)$ are indifference curves for the high- and low-ability players, respectively.

Let w_ℓ denote the wage the low-ability player obtains at time t_ℓ and w_h denote the wage the high-ability player obtains at time t_h. A separating equilibrium exists when $w_\ell \neq w_h$ or $t_\ell \neq t_h$. Lemma 1 states that the high-ability player must obtain a higher wage at a later time than the low-ability player in any separating equilibrium.

Lemma 1. For all separating equilibria, $w_h > w_\ell$ and $t_h > t_\ell$.

Proof. See the Appendix.

Conlin (1997a) considers a signalling model of these NFL contract negotiations. The model is similar to Admati and Perry (1987) except that (1) the private information resides with the seller (player), not the buyer (team), (2) the private information involves ability levels, not reservation values, and (3) the cost of delay is not discounting. Instead, the player's cost of delay is the decrease in the probability of making the team, and the team's cost is the decrease in the player's probability of making the team as well as the decrease in the player's expected performance conditional on making the team. Conlin (1997a) identifies a separating equilibrium that satisfies Lemma 1. A separating equilibrium satisfying Lemma 1 could also be obtained if the extensive form of the bargaining game was that of a screening model in which the team makes the offers that the player either accepts or rejects.

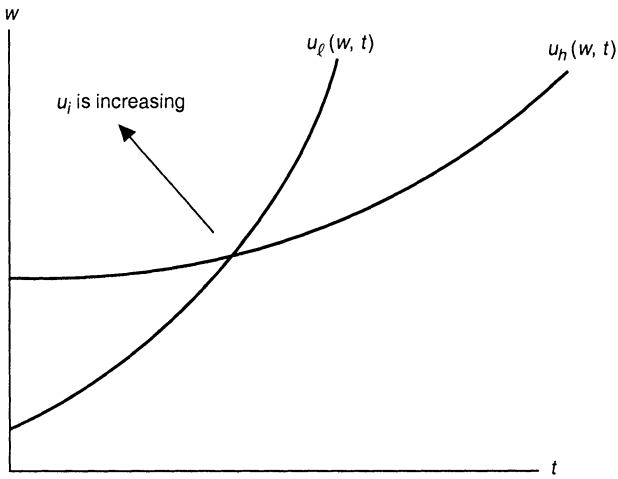
3. Testable implications

■ Lemma 1 predicts that a player who delays agreement signs a more lucrative contract and the player who delays is of higher ability. Consider the implications of high-ability players delaying agreement until after the start of training camp on whether a contract is active and the number of regular season games started in the first, second, and third years of the contract. The adverse effect of delaying agreement would cause players who sign after the start of training camp to have a lower probability of an active contract and to start fewer games than players who sign before training camp (conditional on draft selection, position, team, number of team wins the prior season, and year of the draft).[8] However, the higher ability level of players who sign after the start of training camp would cause them to have a higher probability of an active contract and to start more games than players who sign before training camp. Whether

[7] The single-crossing property could also be obtained by assuming that players have different reservation utilities instead of different hazard rates. Player i's expected utility from agreeing to a wage w at time t would then be $u_i(w, t) = [1 - F_i(t)]w + F_i(t)U_i$, where $U_h > U_\ell$. With minimal restrictions on $F_h(t)$ and $F_\ell(t)$, the model's results and empirical implications would not change.

[8] The opinion that missing the start of training camp adversely affects a player's performance is expressed by popular media and shared by representatives of the NFL Player's Association and the NFL. Section 2 incorporates this adverse effect by having the player's probability of making the team decrease with respect to time.

FIGURE 1



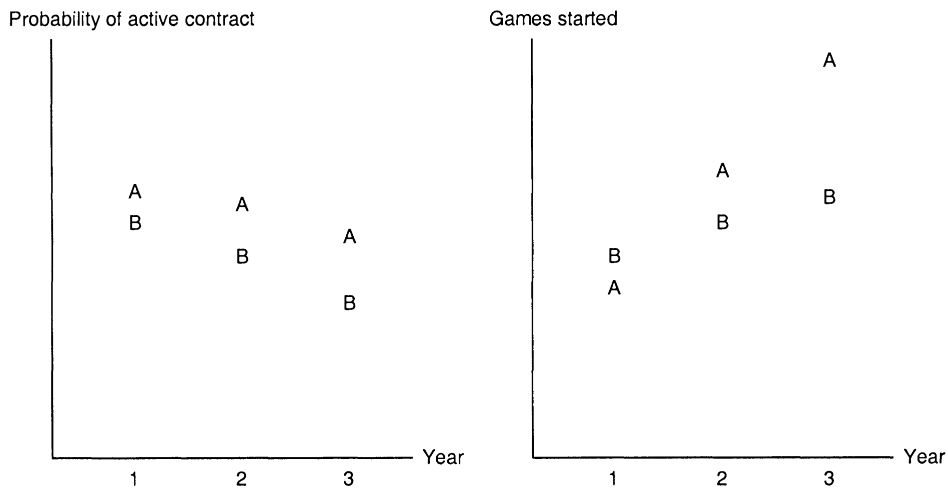
players who sign before or after the start of training camp have a higher probability of an active contract and start more games depends on how the difference in ability levels compares to the adverse effect of missing the start of training camp.

While the difference in ability levels is likely to persist across years, the adverse effect of missing the start of training camp is likely to diminish across years. In fact, opinions differ on whether this adverse effect persists after the player's first year.[9] If a player misses the start of training camp after being drafted, he falls behind in learning the team's offensive or defensive system and achieving proper conditioning. This would have the greatest impact the first year of the contract. By the second year, a player who made the team the first year has a season of experience and can participate in the entire training camp prior to his second year. There may still be an adverse effect in the second year because the player may have obtained minimal game time experience the first year. A similar argument can be used to explain why, if there is an adverse effect in the second year of missing the start of training camp, it diminishes in the third year.

Consider the case where the difference in ability levels does not completely compensate for the adverse effect of missing the start of training camp the first year but more than compensates for the adverse effect by the second and third years. If this is indeed the case, one would expect that players who sign after the start of training camp would start fewer games the first year and more games the second and third years than would those who sign before training camp. However, players who sign after the start of training camp would likely have a higher probability of an active contract in all three years. This is because a team, when deciding who to start, is much more interested in the player's expected performance today than in his future potential; when deciding whether to cut a player, a team is more concerned about the player's future potential. Figure 2 depicts this case.

[9] Donnell Woolford was selected in the first round of the 1989 draft by the Chicago Bears and missed the start of training camp owing to an inability to reach a contractual agreement. Woolford stated in the *Chicago Sun-Times,* July 28, 1995, that "[The holdout] made my first year kind of rough. When I got into camp it took a while to get adjusted . . . ." The *Wisconsin State Journal,* August 11, 1994, noted that "Buckley, whose development was hurt by a holdout as a rookie, has struggled mightily at times . . . ."

FIGURE 2



B: Player signs before the start of training camp
A: Player signs after the start of training camp

4. Alternative explanations and their implications

■ Alternative explanations for why some players agree to contracts later than others include the following: (1) players are indifferent between signing early and signing late because there is no adverse effect of delay; (2) players have different preferences in terms of when a contract is signed; (3) agents representing the players have different preferences in terms of when a contract is signed; and (4) teams choose to negotiate with players sequentially. I argue that these explanations have different empirical implications from, or are just different interpretations of, my argument.

Suppose that delaying agreement does not adversely affect players' performances and, therefore, players are indifferent as to the time of the contractual agreement. If there is no adverse effect from delay and ability level is not correlated with when a player signs, one would expect players who sign before and after the start of training camp to have the same probability of an active contract and start the same number of games all three years (conditional on draft selection, position, team, number of team wins the prior season, and year of the draft). If there is no adverse effect from delay and high-ability players are more (less) likely to sign before training camp, players who sign before training camp would have a higher (lower) probability of an active contract and start more (fewer) games all three years.

Consider the explanation that players have different preferences for when a contract is signed. That is, the "cost" of delaying agreement is different across players. If these preferences are public information (i.e., known by the team), than the less patient players would likely get a worse contract than the more patient ones, but this would not explain why the players would agree to contracts at different times.[10] Now suppose that players' costs of delaying agreement are private information (i.e., not known by the team). The empirical implications would be the same as those depicted in Figure 2

[10] Consider the Rubinstein complete information alternating offers bargaining game when players have different discount factors. The subgame-perfect equilibrium outcome has an agreement being reached without delay. The agreement is more favorable to the player the greater his patience.

if and only if these costs were negatively correlated with ability level (causing the high-ability player to possibly sign later than the low-ability player), and the adverse effect of delay on performance decreases across years. The assumption that these costs are negatively correlated with ability level is analogous to my model, where the cost of delay is characterized as a decrease in the probability of an active contract and this decrease is greater for the low-ability type.

The majority of players who are drafted hire agents before the draft to negotiate their contracts with the team. Draft choices primarily select agents who make their living by representing professional athletes, although lower-round draft choices sometimes select family or friends to represent them. Suppose that certain agents perceive the cost of delaying contractual agreement to be less than other agents do. As in the case of players with different costs, if the agents' costs are public information, then the less patient agents would likely get a worse contract than would the more patient agents, but this does not explain why agents agree to contracts at different times. Now consider the case where the agents' costs are private information. One would expect the empirical implications depicted in Figure 2 if agents with lower costs of delay were positively correlated with high-ability types, players represented by low-cost agents signed later than those represented by high-cost agents, and the adverse effect of delaying agreement decreased across years. Because the player's ability level is conditional on draft selection, this implies that agents provide information on players' ability levels, NFL teams are not aware of this information when drafting players, and players do not control when their agents agree to a contract. While this is rather unrealistic, the explanation that agents have different costs of delay is just a different interpretation of my model, where delaying agreement signals that the agent has a low cost of delay, which in turn signals that the player is of high ability (if there is this correlation).

The final alternative explanation I consider is that teams choose which players to negotiate with first, thereby delaying negotiations with other players. To obtain the results depicted in Figure 2, it must be the case that the adverse effect of delay diminishes across years and teams choose to negotiate with low-ability players before high-ability players. This is a team's optimal sequence of negotiations if the team's cost associated with delaying agreement is greater for a low-ability player than for a high-ability player. While this assumption is arguable, the primary problem with this explanation is that except for first-round draft choices, contracts usually take at most a couple of hours to negotiate. The negotiations usually occur in person for players drafted in the first and second rounds and in a series of phone calls for players drafted in the middle and late rounds. Thus, if there is a cost to the team of players signing later and teams negotiate sequentially, all players drafted would be signed well before the start of training camp.

5. Empirical evidence

■ The NFL teams draft players primarily from the collegiate level. From 1986 through 1991, the 28 NFL teams were given one draft pick in each of 12 rounds to select a player or trade. The team that drafts a player has the rights to that player, which prevents other NFL teams from signing him unless they acquire the rights to his services through a trade. The NFL draft occurs in late April. Each team conducts a training camp beginning in July, during which the players learn the team's offensive and defensive systems, work on conditioning, and play exhibition games against other NFL teams. A player cannot participate in training camp unless he has signed a contract. Each NFL team has a representative directly responsible for negotiating with the player and/or his agent. Almost all players sign a contract before the regular season with the team that drafted them. Rookies (first-year players) are scheduled to report to training camp up to two weeks before veterans, depending on the NFL team. The regular season begins in late August or early September.[11]

I obtained information from the NFL Player's Association (NFLPA), the NFL, and the 1986 through 1994 *NFL Record and Fact Books.* The NFLPA provided contract data and player information for 1,873 of the 2,016 players selected in the 1986 through 1991 drafts.[12] The NFL provided the starting dates of training camp for the different teams. Team win-loss records, whether players' contracts were active, and the number of regular-season games players started were obtained from the 1986 through 1994 *NFL Record and Fact Books.*[13,14] In the subsections below, I use these data to determine if high-ability players sign more lucrative contracts later than low-ability players.

The first two subsections test whether players of high ability sign after longer negotiations, using information on whether a contract is active and the number of regular-season games started the first, second, and third years. Table 1 shows that the proportion of contracts signed before the scheduled start of training camp for rookies increases across rounds.[15] A number of players agree to contracts immediately before and immediately after the start of training camp for rookies. Table 1 also indicates that the proportion of contracts active and the mean number of regular-season games started the first year, in general, decreases across draft rounds. The same holds true for the second and third years of the contract.[16]

The final subsection tests whether longer negotiations result in more lucrative contracts. NFL teams sign draft choices to what is termed a Standard Form Contract. Contracts are standard because of the NFL teams' concern with the antitrust issues associated with the draft and their desire to ensure the legality of the contracts.[17] Fringe benefits in terms of insurance coverage and pension plans are identical for all players. Therefore, the only differences among players' contracts are in monetary payments and duration. The duration of a contract is from one to six years. The fact that all players

[11] See Conlin (1997b) for more details on the NFL draft, training camp, and contract negotiations.

[12] The contract information obtained from the NFLPA is not public information and was obtained after strict confidentiality was ensured. Of the 143 draft choices for which contract information was not collected and which are not included in my sample, 15 were selected in the supplemental draft and almost all the rest signed a contract but did not report the terms of the contract to the NFLPA.

[13] I define an active contract as one that is active for at least three games. Players on injured reserved are classified as active, since they receive the payments specified in their contract for that year. If a player is traded, his contract is also still active. If a player is cut from a team, he goes on "waivers" for 24 hours, where he can be selected by any of the 27 other NFL teams. If a team selects a player from waivers, it is required to honor his existing contract. Therefore, a player's contract is still active if he is claimed off of waivers.

[14] Starting in 1989, the NFL established development/practice squads. Each NFL team is allowed six players on these squads, and these players cannot participate in games. The contract of a player on a development/practice squad is not considered active. If that player is on the active roster the following year, I consider the contract active for that year. In reality, the player signs a new contract but the terms are usually similar to his original contract. The NFL also began Plan B in 1989. Under Plan B, each NFL team protected 37 players. If an unprotected player signed with another team under Plan B, I considered his contract active.

[15] The cost of delaying agreement (in terms of not having an active contract) is likely to be less for early-round compared to late-round draft choices. In terms of the model, this would cause the delay required by a high-ability player, in support of a separating equilibrium, to be greater for players drafted in earlier rounds. This is a possible explanation for why players drafted in the earlier rounds are less likely to sign before the start of training camp.

[16] Players who participate on special teams and do not start on either offense or defense are not considered starters. This includes punters and kickers.

[17] The NFL has received a nonstatutory labor exemption from the courts that insulates it from antitrust violations. These violations include restricting which team a player signs with through the draft. See Shapiro (1993) for a history of the NFL's exemption.

TABLE 1 Proportion Who Sign Before Training Camp
Proportion of Contracts Active and Mean Number of Starts by Round and by When Player Signs Contract

Round	Proportion Who Sign Before Training Camp	(1) Proportion of Contracts Active in 1st Year		(2) Proportion of Contracts Active in 2nd Year		(3) Proportion of Contracts Active in 3rd Year		(4) Mean Number of Games Started in 1st Year		(5) Mean Number of Games Started in 2nd Year		(6) Mean Number of Games Started in 3rd Year	
		Before Camp	After Camp	Before Camp	After Camp	Before Camp	After Camp	Before Camp	After Camp	Before Camp	After Camp	Before Camp	After Camp
1	.19 (161)	1 (31)	.95 (130)	.97	.97	.94	.92	6.1	6.1	9.9	9.5	9.1	9.0
2	.32 (168)	.92 (53)	.96 (115)	.92	.90	.81	.82	4.4	4.4	6.0	7.4	7.0	7.5
3	.35 (162)	.79 (56)	.86 (106)	.77	.82	.66	.69	3.1	2.8	4.7	4.7	4.6	5.1
4	.37 (164)	.64 (61)	.71 (103)	.56	.68	.46	.57	2.0	1.8	2.3	3.9	3.0	4.3
5	.49 (162)	.59 (80)	.58 (82)	.55	.56	.41	.33	1.3	1.0	2.3	2.4	2.2	2.1
6	.52 (162)	.43 (84)	.59 (78)	.43	.51	.36	.41	1.2	1.2	1.9	2.0	2.3	2.5
7	.57 (154)	.30 (88)	.47 (66)	.24	.38	.19	.35	.4	1.1	1.4	1.4	.9	2.2
8	.59 (157)	.36 (92)	.42 (65)	.35	.37	.25	.25	.4	1.5	1.5	1.2	1.2	1.6
9	.59 (158)	.23 (94)	.23 (64)	.24	.23	.12	.20	.5	.2	.5	.3	.7	.8
10	.68 (153)	.25 (105)	.29 (48)	.18	.21	.17	.19	.6	.2	.7	.5	.9	1.0
11	.65 (152)	.23 (99)	.25 (53)	.15	.15	.09	.15	.1	.1	.5	.5	.4	.6
12	.73 (120)	.21 (87)	.30 (33)	.14	.24	.10	.09	.2	.2	.5	.8	.5	1.0
Total	.50 (1,873)	.42 (930)	.64 (943)	.38	.60	.31	.50	1.2	2.3	2.0	3.8	2.0	4.0

Note: The number of observations is in parentheses.

sign Standard Form Contracts allows the value of different contracts to be more easily compared.

□ **Probability that a contract is active.** Columns 1, 2, and 3 of Table 1 show, by round, the proportion of contracts, signed before and after the scheduled start of training camp, that are active the first, second, and third years. In 9 of the 12 rounds, the proportion of active contracts the first year is greater for those players who sign after compared to before the start of training camp for rookies. Similar results are obtained for the proportion of contracts active the second and third years.

Although the descriptive statistics in Table 1 support a separating equilibrium, many other characteristics other than round affect a player's probability of having an active contract. Therefore, I estimate the following model:

$$a = \begin{cases} 1 & \text{if } \alpha + \beta X + \psi TC + \epsilon > 0 \\ 0 & \text{otherwise.} \end{cases}$$

The dependent variable, *a*, equals one if the contract is active and zero if the contract is not active. Separate models are estimated for when the dependent variable is whether a player's contract is active the first year, second year, and third year. The independent variables, *X*, include dummy variables for the round the player was drafted, the player's selection number in the draft, dummy variables for the team that drafted the player, dummy variables for the player's position, the number of wins the prior season for the team that drafted the player, and dummy variables for the year the player was drafted. I include dummy variables for the team that drafted the player because certain teams have a reputation for maintaining and developing draft choices while other teams have a reputation for preferring veterans. For example, the data indicate that a player drafted by the San Diego Chargers has a higher probability of having an active contract than a player drafted by the Los Angeles Rams. Because a player's position influences the probability that his contract is active, I also include position as an independent variable. For instance, the probability a quarterback's contract is active is less than the probability a tight end's contract is active. The number of team wins in the prior season is included because I expect the probability a player's contract is active to be greater if he is drafted by a weak team that won few games the previous year compared to a strong team that won many games the previous year.[18] I include the year of the draft because there have been some minor changes to teams' allowable roster size across years, and roster size influences the probability a contract is active. *TC* is a dummy variable indicating whether the player signed before ($TC = 0$) or after ($TC = 1$) the scheduled start of training camp. The unobserved factors are assumed to be standard normally distributed and independent of *X* and *TC*. I use maximum-likelihood estimation to consistently estimate the parameters.

If delaying agreement does not adversely affect a player's performance and high-ability players do not sign later than low-ability players, one would expect the training camp coefficient to be zero. The training camp coefficient would also equal zero if delaying agreement adversely affects a player's performance, high-ability players sign after the start of training camp, and the difference in ability level exactly offsets the adverse effect of missing the start of training camp. The training camp coefficient would be negative if delaying agreement adversely affects a player's performance and high-ability players do not sign later than low-ability players. It would also be consistent with the argument that delaying agreement adversely affects a player's performance, high-ability players sign after the start of training camp, and the difference in ability level does not completely compensate for the adverse effect of missing the start of training camp. If delaying agreement adversely affects a player's performance, high-ability players sign after the start of training camp, and the difference in ability level more than compensates for the adverse effect of missing the start of training camp, the training camp coefficient would be positive.

[18] The order in which teams draft in each round depends on their performance the prior season, with the weaker teams drafting before the stronger teams. Therefore, the strength of the team that drafted the player is also captured by including as an independent variable the player's selection number within a round. Number of team wins the prior season is included because teams often trade draft choices before the draft.

Columns 1, 2, and 3 of Table 2 show the results of the probit regression when the dependent variable indicates whether a contract is active the first year, second year, and third year, respectively. In all three regressions the training camp coefficient is positive and statistically significant.[19] Because of the nonlinearity of probit estimation and the large number of dummy variables in the specification, the training camp coefficient is not easily interpretable. To understand the marginal effect, a specific example is helpful. Consider a running back selected tenth in the fourth round of the 1988 draft by the San Diego Chargers, who won eight regular-season games the previous season. His probability of having an active contract the first year is 3.7 percentage points greater if he signs after rather than before the start of training camp.

□ **Regular-season games started.** Columns 4, 5, and 6 of Table 1 identify, by round, the mean number of regular-season games started the first, second, and third years of the contract, for players who sign before and after the scheduled start of training camp for rookies. Conditional only on round, the mean number of starts the first year for players who sign after the start of training camp is greater in 2 of the 12 rounds than for those who sign before training camp and is greater in 5 of the 12 rounds the second year. In the third year, the mean number of starts is greater in 10 of the 12 rounds for players who sign after compared to before the scheduled start of training camp. The descriptive statistics in Table 1 condition only on the round the player is drafted. A multivariate analysis is required to account for the other factors that influence the number of games a player starts.

I estimate two different types of models in which the dependent variable, ST, is the number of regular-season games the player starts. Separate models are estimated for when the dependent variable is the number of starts the first year, second year, and third year. The independent variables in both types of models, X and TC, are the same as those in the preceding probit regressions because the factors that influence whether a player's contract is active also influence the number of games he starts.

The first model type is a tobit regression model with double censoring. The number of games started is left-censored at 0 and right-censored at 16. Of the 1,873 players, the number of players who start zero games is relatively large, at 1,369 the first year, 1,239 the second year, and 1,307 the third year. The number of players who start all 16 games the first year is only 34 but increases to 110 the second year and to 154 the third year. Therefore, I estimate the following model to determine the effect of signing late on the number of games started.

$$\begin{aligned} ST &= 0 && \text{if } ST \leq 0 \\ ST &= \alpha + \beta X + \psi TC + \epsilon && \text{if } 0 < ST < 16 \\ ST &= 16 && \text{if } ST \geq 16. \end{aligned}$$

I assume that ϵ is normally distributed and independent of X and TC. Maximum-likelihood estimation is used to consistently estimate the parameters.

[19] I performed numerous sensitivity tests. First, to determine whether the number of days before or after the start of training camp influences the probability of an active contract, I interacted the variable TC with the days after the start of training camp the player signs and the variable $1 - TC$ with the days before the start of training camp the player signs. The coefficients on the interactive terms were statistically and economically insignificant. The second sensitivity test had TC indicate whether the player signs before or after the scheduled start of training camp for veterans. The results were consistent with my initial specification.

TABLE 2 Probit Regression Results of Probability That Contract Is Active

Independent Variable	(1) Contract Active the First Year	(2) Contract Active the Second Year	(3) Contract Active the Third Year
Number of team wins in season prior to draft	−.005 (.019)	.005 (.019)	.007 (.019)
Selection number in the round	−.015** (.006)	−.018** (.006)	−.018** (.006)
Rookie training camp dummy (=1 if sign after the start of training camp)	.239** (.072)	.168** (.072)	.136* (.071)
χ^2	725	746	678
Number of contracts	1,873	1,873	1,873

Notes: Dummy variables for the rounds, the teams, the positions, and the years of the draft are included as independent variables in the regressions but not presented in the table. Standard errors are in parentheses. * represents statistically significant at the 10% level. ** represents statistically significant at the 5% level.

It can be argued that because the dependent variable is not continuous, the assumption that ϵ is normally distributed is unsatisfactory. Therefore, I also estimate a count data model proposed by Allison (1984). A standard Poisson regression is inappropriate because of the characteristics of the hazard function. In fact, it is difficult to fit any parametric hazard function to the data. The hazard rate in each year decreases until approximately 3 games, is relatively constant from 4 to 11 games, and then begins to increase after 11 games. The count data model proposed by Allison employs nonparametric estimation of the hazard function. The model is a discrete time version of Cox (1972) and estimates a logit model for each "period" while constraining the coefficient to be the same each "period."[20]

The training camp coefficient being equal to zero when the dependent variable is the number of starts the first year, second year, and third year would be consistent with the premise that delaying agreement does not adversely affect a player's performance and high-ability players do not sign later than low-ability players. If delaying agreement adversely affects a player's performance and high-ability players do not sign later than low-ability players, one would expect the training camp coefficient to be negative when the dependent variable is the number of starts the first year. Whether the training camp coefficient is negative or zero when the dependent variable is the number of second- and third-year starts depends on how persistent this adverse effect is across years. If delaying agreement adversely affects a player's performance and high-ability players sign after the start of training camp, the expected sign of the training camp coefficient depends on whether the difference in ability level offsets the adverse effect of delaying agreement. The training camp coefficient would be negative if the difference in ability level does not completely compensate for the adverse effect of delaying agreement. This is more likely to be the case the first year of the contract if one believes that the adverse effect of missing the start of training camp diminishes across years. If in the second and third years the difference in ability level more than compensates for the

[20] In terms of my data, it estimates a logit model for whether a player starts at least $g + 1$ games conditional on starting g games. The coefficients are constrained to be the same for all values of g. The probability a player starts g games is $f(g, X, TC, \beta) = h(g, X, TC, \beta)[1 - F(g, X, TC, \beta)]$, where $h(g, X, TC, \beta)$ is the hazard rate associated with game g and $[1 - F(g, X, TC, \beta)]$ is the probability the player starts at least g games. Like Cox (1972), I assume the density function has a logistic distribution.

TABLE 3 **Tobit Regression and Count Data Model Results on Number of Starts**

Independent Variable	Number of Starts 1st Year (1) Tobit Regression	(2) Count Data	Number of Starts 2nd Year (3) Tobit Regression	(4) Count Data	Number of Starts 3rd Year (5) Tobit Regression	(6) Count Data
Number of team wins in season prior to draft	−.452** (.146)	−.054** (.019)	−.128 (.173)	−.010 (.017)	.128 (.247)	.011 (.017)
Selection number in the round	−.117** (.046)	−.024** (.006)	−.120** (.054)	−.020** (.005)	−.246** (.078)	−.023** (.005)
Rookie training camp dummy (=1 if sign after the start of training camp)	−.119 (.600)	.015 (.077)	1.177* (.710)	.113 (.070)	2.152** (1.006)	.303** (.068)
χ^2	635	1,473	760	1,568	584	1,413
Number of contracts	1,828	1,828	1,828	1,828	1,828	1,828

Notes: Dummy variables for the rounds, the teams, the positions, and the years of the draft are included as independent variables in the regressions but not presented in the table. Standard errors are in parentheses. * represents statistically significant at the 10% level. ** represents statistically significant at the 5% level.

adverse effect of delaying agreement, the training camp coefficient would be positive when the dependent variable is the number of starts the second and third years.

Columns 1, 3, and 5 of Table 3 show the results of the tobit regressions when the dependent variable is the number of games started the first, second, and third years of the contract, respectively. The training camp coefficient is slightly negative in the first year and positive in the second and third years. The coefficient is statistically significant at the 10% level the second year and statistically significant at the 5% level the third year.[21] As for the marginal effect in the third year, the expected number of starts for a running back selected tenth in the fourth round of the 1988 draft who signs with the San Diego Chargers after the start of training camp for rookies is .5 games more than if he signs before training camp. This difference is based on the number of wins the prior season being eight. Columns 2, 4, and 6 of Table 3 show the results of the count data model when the dependent variable is the number of games started the first, second, and third years of the contract, respectively. The results are similar to those in the tobit regressions.

□ **Contract valuation.** Table 4 is representative of the contract data obtained from the NFLPA. (All figures are in thousand-dollar terms.) The terms are indicative of a typical contract, but the information has been altered to ensure confidentiality. Fred Smith was the 47th overall selection in the 1991 draft. He is an offensive lineman (OL) selected in the second round by the Seattle Seahawks (SS). He was represented by agent John Doe and signed a two-year contract on July 22, 1991. Smith's contract specifies a $225,000 signing bonus; a base salary of $160,000 in 1991 and $185,000 in 1992; a reporting bonus of $20,000 in 1992; and a roster bonus of $10,000 in 1991 and 1992. The signing bonus is guaranteed money that Fred Smith receives on July 22, 1991. He is paid one-sixteenth of each year's base salary after each regular season game if his contract is active for that game. Fred Smith receives his reporting bonus if he makes the roster in 1991 and arrives at the 1992 training camp on time. Each

[21] Sensitivity tests like those described in footnote 19 were performed. The results were similar to those of the prior section and consistent with Table 3.

TABLE 4 Round 2

Selection	Name	Team	Position	Sign Date	Year	Base Salary	Signing Bonus	Reporting Bonus	Roster Bonus	Agent
47	F. Smith	SS	OL	7/22/91	91	160	225		10	John Doe
47	F. Smith	SS	OL	7/22/91	92	185		20	10	John Doe

year's roster bonus is obtained if Fred Smith is on the active roster that year for at least three games. Fred Smith has no incentive clauses. Occasionally, primarily for first-round and sometimes for second-round draft choices, there are incentive clauses in the contracts.

To obtain a single value representing a contract's value, comparisons of a dollar in signing bonus, base salary, roster bonus, and reporting bonus must be made. Since the probability of making the team depends on when the player is drafted, these comparisons are different for players drafted in different rounds. Taking the present discounted value of the flow of payments over the duration of the contract is not appropriate because the base salary, roster bonus, and reporting bonus are conditional on the player making the team that year or the prior year. Instead, the value of a contract will be based on the expected present discounted value (EPDV) in 1986 dollars of the flow of payments the player is expected to receive over the duration of the contract. The EPDV is the present value of each payment the player may receive multiplied by the probability of receiving the payment.[22] The expected probability a player receives a given payment is based on the average probability a player drafted in that particular round receives the payment.[23]

To test whether delaying agreement results in a more "lucrative" contract, I first drop the contracts of all first-round draft choices because I do not have comprehensive information on incentive clauses, which these contracts often contain. I then regress, using ordinary least squares and White's (1980) method of calculating heteroskedasticity-consistent standard errors, EPDV on selection number, number of wins the prior season, and dummy variables for the round, team, player position, year of draft, and length of contract.[24] These are all important factors when determining whether a contract is lucrative. A dummy variable indicating whether the player signed after the start of training camp is also included as an independent variable to test whether a player who delays agreement receives a more lucrative contract. The results of this regression are given in Table 5. Note that the coefficient on the training camp dummy variable is positive and statistically significant at the 5% level. This suggests that a player who signs after training camp receives a more lucrative contract. The coefficients on the selection number and the dummy variables indicating contract duration are the expected signs and statistically significant as well.[25]

[22] The payments are in thousand-dollar terms, and the present value of the payments is calculated using the returns of three-year treasury bills, r_t, for the appropriate years.

[23] Estimates of the expected probabilities in the fourth, fifth, and sixth years were calculated using the decrease in the probabilities from the first to the second and the second to the third years.

[24] The length of contract is arguably endogenous. If contract length is not included as an independent variable, contracts of longer duration are much more likely to appear as lucrative contracts. The reverse holds if a contract's valuation is measured as EPDV divided by the duration of the contract. To directly compare contracts of different lengths, I would require information on what players drafted in different rounds obtain in their subsequent contracts.

[25] Results similar to those in Table 5 are obtained when interactive terms between year of draft and round, selection number and round, and position and round are included as independent variables.

TABLE 5 OLS Regression Results on EPDV

Independent Variable	Coefficient Estimates (White Standard Errors in Parentheses)
Number of team wins in season prior to draft	−.134
	(.674)
Selection number in the round	−.875**
	(.223)
Rookie training camp dummy (=1 if sign after start of training camp)	4.52**
	(2.21)
Dummy for contracts 1 year in duration	−97.66**
	(9.97)
Dummy for contracts 2 years in duration	−45.52**
	(3.23)
Dummy for contracts 4 years in duration	63.60**
	(6.95)
Dummy for contracts 5 years in duration	225.9**
	(79.7)
R^2	.96
Number of contracts	1,712

Notes: Dummy variables for the rounds, the teams, the positions, and the years of the draft are included as independent variables in the regressions but not presented in the table. * represents statistically significant at the 10% level. ** represents statistically significant at the 5% level.

6. Conclusion

■ This article finds empirical evidence of a separating equilibrium in the bargaining context of NFL contract negotiations where players with positive private information delay contractual agreement. The separating equilibrium predicts that (1) players who sign after longer negotiations are of higher ability levels and (2) longer negotiations result in more lucrative contracts. The first prediction is empirically tested using whether a player's contract is active and the number of regular-season games he starts as proxies for his ability level. The second prediction is supported by the quote in the Introduction from the NFLPA's December 1991 edition of *On the Sidelines: An Annual Economic Analysis of the National Football League Prepared for Members of the NFL Players Association.* It is also empirically tested using information on the terms of the players' contracts.

Using whether a player's contract is active the first, second, and third years of the contract as the dependent variables, probit regressions indicate that after controlling for draft selection, position, team, and draft year, the probability of an active contract is greater for players who sign after rather than before the start of training camp. Tobit regressions and a count data model, using the number of regular-season games started as the dependent variable, indicate that players who sign after the start of training camp are likely to start about the same number of games the first year, more games the second year, and substantially more games the third year than those who sign before training camp. These results are consistent with the assumption that delaying agreement adversely affects a player's performance and the implications of the separating equilibrium where high-ability players delay agreement. These results are also consistent with the premise that the adverse effect of missing the start of training camp diminishes across years. They suggest that the difference in ability level compensates for the adverse effect of delaying agreement the first year and more than compensates for this adverse effect in the second and third years. The expected present discounted value of the flow of payments associated with a player's contract is used to test whether a contract signed after the start of training camp is more lucrative. The empirical results support this premise.

Appendix

■ Proof of Lemma 1 follows.

Proof of Lemma 1. For a separating equilibrium to exist, the following incentive-compatibility constraints for the low- and high-ability players must be satisfied.

$$[1 - F_\ell(t_\ell)]w_\ell \geq [1 - F_\ell(t_h)]w_h$$

$$[1 - F_h(t_h)]w_h \geq [1 - F_h(t_\ell)]w_\ell.$$

If $w_h < w_\ell$ and $t_h > t_\ell$, the high-ability player's incentive-compatibility constraint is not satisfied and his expected utility would be greater by following the low-ability player's strategy and obtaining a higher wage at an earlier time. If $t_h < t_\ell$, the single-crossing condition implies that

$$[F_\ell(t_\ell) - F_\ell(t_h)]/[1 - F_\ell(t_h)] > [F_h(t_\ell) - F_h(t_h)]/[1 - F_h(t_h)],$$

which ensures that $F_\ell(t_\ell) - F_\ell(t_h) - F_\ell(t_\ell)F_h(t_h) > F_h(t_\ell) - F_h(t_h) - F_h(t_\ell)F_\ell(t_h)$. The incentive compatibility constraints are satisfied if $w_\ell \geq [1 - F_\ell(t_h)]/[1 - F_\ell(t_\ell)]w_h$ and $w_\ell \leq [1 - F_h(t_h)]/[1 - F_h(t_\ell)]w_h$, which is equivalent to $F_\ell(t_\ell) - F_\ell(t_h) - F_\ell(t_\ell)F_h(t_h) \leq F_h(t_\ell) - F_h(t_h) - F_h(t_\ell)F_\ell(t_h)$ and contradicts the single-crossing condition. Therefore, a separating equilibrium cannot exist where $w_h < w_\ell$ and $t_h > t_\ell$, $w_h > w_\ell$ and $t_h < t_\ell$, or $w_h < w_\ell$ and $t_h < t_\ell$. *Q.E.D.*

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