MULTIDIMENSIONAL SEPARATING EQUILIBRIA AND MORAL HAZARD: AN EMPIRICAL STUDY OF NATIONAL FOOTBALL LEAGUE CONTRACT NEGOTIATIONS

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Abstract—This paper empirically tests for a multidimensional separating equilibrium in contract negotiations and tests for evidence of the moral hazard inherent in many contracts. Using contract and performance data on players drafted into the National Football League from 1986 through 1991, we find evidence that players use delay to agreement and incentive clauses to reveal their private information during contract negotiations. In addition, our empirical tests of the moral hazard issue indicate that a player's effort level is influenced by the structure of his contract.

I. Introduction

This note considers whether players drafted into the National Football League (NFL) reveal private information about their ability during contract negotiations and whether contract structure affects a player's effort level. The dimensions considered by which players can reveal their private information include delay to agreement, incentive clauses, and contract length.[1] The idea that private information can be revealed through delay to agreement as well as contract structure applies to many types of negotiations. For example, private information can be revealed as a buyer and seller negotiate over price, delivery date, and quality, or in franchise negotiations over the initial fee, the percentage of gross revenue, the termination penalty, and the length of the contract. There is also extensive theoretical and empirical research concerning how strikes reveal private information during union contract negotiations.[2] However, this research does not consider other ways in which private information can be revealed, such as straight-time versus overtime compensation, performance-based compensation, the wage-experience gradient, and the length of the contract.[3] This paper is the first to test empirically for a multidimensional separating equilibrium, but there are numerous papers testing signaling and screening along a single dimension.[4]

Three major concerns when empirically testing private-information models are: the ability to control for public information, the accuracy of ex post performance measures, and the comparability of outcomes. NFL data on drafted players allow us to address these concerns. Specifically, we are able to control for the public information available on a player at the time of contract negotiations, because we have information on when a player is selected in the draft. When a team selects a player depends not only on the player's expected ability level but also on the team's need for a player with that set of skills. Therefore, draft selection is an excellent measure for a team's valuation of a player. In addition, we have good measures of a football player's ex post performance that are likely to be affected by a player's private information at the time of contract negotiations: whether a player has an active contract, and the number of games the player starts during the first three years after being drafted.[5] Finally, the outcome of contract negotiations can be compared, because players drafted into the NFL agree to what is termed a *standard form contract*.[6]

The structure of a player's contract may affect the incentives of the team and player. Because our data are from a time where there was very limited player mobility and no salary cap,[7] we do not expect

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[1] The theoretical research on multidimensional separating equilibria is extensive. Multidimensional signaling has been applied to the pricing and "wasteful" advertising decisions of firms (Milgrom & Roberts, 1986), franchising (Gallini & Lutz, 1992), and the retained earnings and dividend levels of firms (Bernheim, 1991).

[2] See Tracy (1987), Kennan and Wilson (1989), Card (1990), and Cramton and Tracy (1992).

[3] A review of recent *Daily Labor Reports,* published by the Bureau of National Affairs, suggests that union contract negotiations involve many issues and that strikes often occur as the result of an inability to agree on issues other than wages.

[4] Private-information models have been empirically tested in the context of pricing a new product (Bagwell & Riordan, 1991) and the dividend puzzle (Bernheim & Wantz, 1995).

[5] Throughout this paper, the terms "active contract" and "making the NFL team" will be used interchangeably for simplicity. A player without an active contract will be referred to as a player who is cut from the team. See footnote 14 for exactly what qualifies as an active contract.

[6] These advantages of using NFL contract data enable Conlin (1999) to provide strong evidence that players reveal their private information by delaying contractual agreement. However, the paper does not consider other dimensions by which players may reveal their private information, nor the moral hazard issue inherent in NFL contracts.

[7] See Shapiro (1993) for a detailed description of the history of the NFL's collective bargaining agreements.

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contract structure to significantly affect the team's decision of whom to keep on the team and whom to play. As for the player's incentives, because the terms of a player's subsequent contract are likely to be strongly influenced by the player's most recent performance, this paper focuses on whether players exert more effort in the last year of their initial contract.

The empirical results indicate that players drafted into the NFL reveal their private information by delaying contractual agreement and possibly by agreeing to contracts that include incentive clauses. In regard to the moral hazard issue, we find evidence that a player's effort level increases when the player is in the last year of his current contract.

II. Multidimensional Separating Equilibrium and Moral Hazard in the NFL

When a player wishes to play in the NFL, he is allocated to a team through a draft and, after being drafted, negotiates the terms of a contract.[8] Before discussing the ways in which a player can reveal private information during contract negotiations, it is useful to consider the nature of private information in this setting. By the time of the NFL draft in late April, almost all players drafted have had a college career, undergone a complete physical examination, and participated in the NFL draft combine (a two-day event where players' physical and mental abilities are tested). Therefore, a large amount of public information is available on each player at the time of the draft. However, there is scope for a great deal of private information as well. For example, a player may know that his college coach's methods or philosophy has underutilized his talents, that a nagging injury, now gone, hampered his college performance, or that his motivation and willingness to play hard are particularly high. The inability of a player to credibly claim greater ability, higher motivation, or better health prior to the draft, along with the inability of teams to obtain this private information at a reasonable cost prior to the draft, can result in players using contract negotiations to reveal this private information.[9]

Due to antitrust concerns, NFL teams require all draft choices to sign a standard form contract (SFC). Though SFCs do differ in the monetary payments and duration, their fringe benefits and job scope are identical. These SFCs specify a signing bonus, a base salary for the different years of the contract, and, in some cases, incentive clauses. The player receives a signing bonus after agreeing to a contract, and it is not contingent on the player making the team. However, because these contracts are rarely guaranteed, a player only receives the base salary from the team in a given year if he makes the team. The duration of these contracts ranges from one to six years. Incentive clauses are payments that are made to the player only if the player reaches certain specified performance levels.

This paper tests whether players reveal private information during negotiations through delay, contract duration, and/or incentive clauses.[10] We expect that the single-crossing conditions are such that players with positive private information agree to contracts after the start of training camp,[11] with a short duration and/or with an incentive clause.[12] The expected cost of delaying contractual agreement is likely to be less for a player with positive private information, because the decrease in the probabilities of making the team in subsequent years resulting from this delay is greater for a player with negative private information. As for contract duration, the benefit of agreeing to a contract with a shorter duration is likely to be greater for the player with positive private information. A player with positive private information is more likely to negotiate a subsequent contract that is much more lucrative than his initial contract. Finally, the expected benefit of a particular incentive clause for a player depends on the probability of performing well enough to achieve the requirements of the incentive clause. We expect this probability to be greater for a player with positive than with negative private information. Even if all of the single-crossing conditions hold, a player will not necessarily reveal his positive private information along all three dimensions. Instead, he will reveal the information in the least costly manner possible. The least costly manner could be in one, two, or all three dimensions.

The player's decision on effort level is likely to be affected by the contract structure. Perhaps the most important aspect of the contract, in terms of the effect on this decision, is whether the player is in the last year of his contract. The benefit the player receives from increasing his effort level is twofold: A higher effort level decreases the player's probability of getting cut in subsequent years and increases the expected wage the player can negotiate in his second contract. We expect the second effect to be much more important for players in the last year of their contract. Therefore, we expect those players to exert more effort. The team may also have increased incentive to cut a player in the last year of a contract due to the expected pay raise, but we expect this effect to be minimal when no salary cap exists.

III. Data and Empirical Results

The data used in this study consist of information from the NFLPA and the 1986 through 1995 *NFL Record and Fact Books.* The NFLPA provided rookie contract data on 1,873 players selected in the 1986 through 1991 drafts, the date each contract was signed, the player's position, and the team that selected the player.[13] The starting dates of training camp for the different teams, team won-lost records, whether the player had an active contract the first, second, and third year after being drafted, and the number of regular season games the player started in the first, second, and third year after being drafted were obtained from the 1986 through 1995 *NFL Record and Fact Books.*[14] Table 1 presents summary statistics of the data by round.

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[8] From 1986 to 1991, the NFL assigned its teams one draft pick in each of twelve rounds in inverse order of the teams' relative standing at the end of the previous season. The team and the drafted player almost always reached contractual agreement.

[9] The empirical implications do not change if the team also has private information.

[10] Another manner in which a player can reveal positive private information is by agreeing to a contract where a large fraction of the contract's compensation is nonguaranteed rather than guaranteed (that is base salary plus incentive clauses rather than signing bonus). However, contracts do not appear to vary significantly in the ratio of nonguaranteed to guaranteed compensation after controlling for draft position and contract duration.

[11] Training camps begin in July, at which time players learn the offensive and defensive systems of their team, work on conditioning, and play exhibition games. A player cannot attend training camp unless he has agreed to a contract.

[12] The contract data provided by the NFL Player's Association (NFLPA) does not include explicit information on these incentive clauses, but does identify some of the contracts that contain incentive clauses. Our discussions with the NFLPA suggest that the incentive-clause identifiers are not complete (that is, certain contracts with incentive clauses are not identified).

[13] The NFLPA collected rookie contract data for 1,873 of the 2,016 players drafted from 1986 through 1991. The remaining 143 draft choices either did not sign a contract, were selected in the supplemental draft, or did not report their contract to the NFLPA.

[14] A player's contract is considered active if it is active for at least three games. A contract is active if the player plays on the team that drafted him,

TABLE 1.—SUMMARY STATISTICS BY ROUND

Round	Proportion Who Sign before Training Camp	Mean Signing Bonus ($1000s)	Mean Annual Base Salary ($1000s)	Mean Contract Duration (years)	Proportion of Contracts with Incentive Clauses	Proportion of Contracts Active	Mean Number of Regular Season Games Started
1	.19	981	345	4.07	.087	.95	8.2
2	.32	272	207	3.46	.065	.89	6.2
3	.35	131	158	3.15	.068	.77	4.2
4	.37	76	110	2.92	.055	.61	3
5	.49	42	92.4	2.59	.025	.50	1.9
6	.52	26	86.3	2.52	.019	.45	1.9
7	.57	21	80.8	2.42	.013	.31	1.2
8	.59	17	78	2.39	.013	.33	1.2
9	.59	14	75.7	2.32	.019	.21	0.47
10	.68	11	74.1	2.25	.000	.21	0.67
11	.65	9.4	73	2.24	.007	.17	0.33
12	.73	8.5	72.5	2.23	.017	.16	0.47

A. *Separating Equilibrium*

A player's contract being active and the number of regular season games the player starts depend on whether the player has positive or negative private information. These variables, for the first, second, and third years after the player is drafted, are the set of dependent variables used to test whether players reveal private information through delay to agreement, the duration of a contract, and the inclusion of incentive clauses. We control for the public information by including the player's draft position. We also control for other factors that are likely to influence the player's ex post performance measures, such as the team's record in the previous season, the player's position, the team that drafted the player, and the year in which the player was drafted.

After controlling for the public information at the time of negotiations, we expect the probability of having an active contract and the number of games started to be greater for the player with positive than with negative private information. If players do reveal their positive private information along all three dimensions, then players who sign a contract after the start of training camp, with a short duration, and with an incentive clause should be more likely to have an active contract and start a larger number of games.[15]

To test for a separating equilibrium, we first estimate a probit model where the dependent variable equals 1 if the contract is active and 0 if the contract is inactive. Separate models are estimated for when the dependent variable is an active contract in the first, second, and third years. The three independent variables that concern how a player reveals private information are interacted with two dummy variables: one which indicates whether a player was drafted in the first three rounds, and another which indicates whether a player was drafted in the last nine rounds.[16] The player prefers to reveal private information at the minimum cost. Because costs are likely to differ for early and late draft choices, along which dimension(s) a player reveals information may depend on when the player is drafted. The results of these probit regressions are presented in columns (1), (3), and (5) of table 2.

In table 2, the training-camp coefficient for players drafted in the last nine rounds is positive and statistically significant in all years. With regard to the marginal effects for late-round draft choices, signing a contract after the start of training camp increases the probability of having an active contract by 0.096 the first year, 0.072 the second year, and 0.067 the third year (evaluated at the mean of the independent variables). This suggests that late-round draft choices with positive private information reveal this information by delaying contract agreement. Although the results in table 2 suggest that players do not reveal private information through contract duration, they do provide some evidence that early-round draft choices use incentive clauses. The positive incentive-clause coefficients suggest relatively large marginal effects, for early-round draft choices, of having a contract with an incentive clause on the probability of an active contract. Although the incentive-clause coefficients for early-round selections are not statistically significant at conventional levels, the t-statistics are well over 1 in all three years.[17] Although it is possible that this result is due solely to the fact that players with an incentive clause exert more effort, the results from the test of moral hazard (see table 3) suggest that the positive incentive-clause coefficients in table 2 are attributable, at least in part, to players revealing private information during contract negotiations.

The number of regular season games the player starts is another measure of a player's performance, which in turn is affected by whether the player has positive or negative private information. Therefore, we can test for a multidimensional separating equilibrium by using the number of regular season games started as the dependent variable and including the same set of independent variables as in the probit models. Because starts range from 0 to 16 and most players either start very few or close to all sixteen regular season games, we use a count-data model proposed by Allison (1984) to estimate the coefficients.[18]

is on injured reserve, is traded, is selected off waivers, or signs with another team under Plan B.

[15] A training-camp indicator variable is used as the measure for time, rather than a continuous variable, because most players sign their contracts within five days of the start of training camp. As training camp is where the true cost of delay occurs, this indicator variable captures the essential attribute of the role of time in this setting.

[16] The empirical results are not sensitive to how rounds are classified as either early or late: the results are qualitatively the same when late rounds are defined as those after the second, third, fourth, or fifth round.

[17] The lack of statistical significance could be due to our inability to identify all contracts with incentive clauses as well as our inability to determine the payments associated with the incentive clauses, the probability of obtaining the payments, and what years the incentive clauses are in effect.

[18] Allison employs a nonparametric estimation of the hazard function (that is, the probability of starting at least $s + 1$ games conditional on starting at least s games) which constrains the coefficient associated with each independent variable to be the same for all number of starts, but allows the probability of starting at least $s + 1$ games conditional on starting at least s games to vary with s. Allison's model is a discrete-time version of the model in Cox (1972), which estimates a logit model for each number of starts. We also estimated the coefficients using a tobit, a Poisson and a negative-binomial model, and the qualitative results did not change appreciably.

TABLE 2.—SEPARATING EQUILIBRIUM: PROBIT REGRESSION ON ACTIVE CONTRACT AND COUNT MODEL ON NUMBER OF STARTS

Independent Variable	(1) Contract Active 1st Year	(2) Games Started 1st Year	(3) Contract Active 2nd Year	(4) Games Started 2nd Year	(5) Contract Active 3rd Year	(6) Games Started 3rd Year
Selected in first 3 rounds:						
Rookie training-camp dummy	0.202	−0.210	0.094	0.152	0.012	0.076
	(0.189)	(0.131)	(0.179)	(0.126)	(0.155)	(0.126)
	[0.078]	[−0.048]	[0.038]	[0.028]	[0.004]	[0.013]
Duration of contract	0.002	−0.040	−0.012	−0.118	0.064	−0.056
	(0.141)	(0.089)	(0.137)	(0.088)	(0.114)	(0.084)
	[0.001]	[−0.009]	[−0.005]	[−0.022]	[0.025]	[−0.010]
Incentive clause	0.610	0.478**	0.698	0.009	0.340	−0.048
	(0.487)	(0.202)	(0.463)	(0.203)	(0.301)	(0.218)
	[0.214]	[0.109]	[0.255]	[0.002]	[0.134]	[−0.009]
Selected in last 9 rounds:						
Rookie training-camp dummy	0.247**	0.141	0.180**	0.111	0.173**	0.410**
	(0.077)	(0.097)	(0.078)	(0.084)	(0.081)	(0.082)
	[0.096]	[0.032]	[0.072]	[0.020]	[0.067]	[0.072]
Duration of contract	0.034	−0.116	0.016	0.135	0.048	0.191**
	(0.081)	(0.095)	(0.081)	(0.084)	(0.082)	(0.084)
	[0.013]	[−0.027]	[0.006]	[0.025]	[0.018]	[0.034]
Incentive clause	−0.028	0.299	0.095	0.124	0.045	−0.150
	(0.280)	(0.278)	(0.276)	(0.267)	(0.276)	(0.271)
	[−0.011]	[0.068]	[0.038]	[0.023]	[0.018]	[−0.026]
No. of team wins prior to draft	Yes	Yes	Yes	Yes	Yes	Yes
Selection number in the draft	Yes	Yes	Yes	Yes	Yes	Yes
Indicator variables:						
Round of draft, player's position, team, year of draft	Yes	Yes	Yes	Yes	Yes	Yes
Chi-squared	727	1478	749	1560	684	1428
Number of contracts	1873	1873	1873	1873	1873	1873

Standard error is in parentheses. Marginal effects are in brackets.
** Statistically significant at 5% level.

If players reveal private information along a particular dimension, the expected signs of the training camp, contract duration, and incentive-clause coefficients are similar to those expected in the probit regressions above.[19] The coefficient estimates from Allison's count data model are given in columns (2), (4), and (6) of table 2.[20] The average marginal effects in table 2 represent the probability that a player starts $s + 1$ games conditional on starting s games (evaluated at the mean of the independent variables).[21] The training-camp coefficients for late-round draft choices are positive, and the coefficient is economically and statistically significant in the third year. Whereas the estimated coefficients associated with contract duration and incentive clause vary in sign, the incentive-clause coefficient for early-round selections is positive and both economically and statistically significant for first-year starts. Therefore, the results from the count-data model provide further evidence that late-round draft choices reveal positive private information by delaying contract agreement, and limited evidence that early-round draft choices reveal positive private information through incentive clauses.

B. *Moral Hazard*

To test for moral hazard, we use whether a contract is active conditional on being active in the prior year (*conditional activity*) and the number of starts conditional on having an active contract in the prior year (*conditional starts*) as the dependent variables. Therefore, both the probit model and Allison's count-data model are estimated using only those observations where the contract was active the prior year. Because the public information in this case includes not only the information on the player at the time of the draft, but also the information revealed during contract negotiations and during prior NFL seasons, we use the numbers of games the player started in prior years, in addition to the set of independent variables used in the prior models testing for a separating equilibrium, to control for the public information at the start of a given year. After controlling for this public information, we are interested in how the conditional activity and conditional starts variables are affected by whether the player is in the last year of his contract.[22] If players' effort levels increase in the last

[19] The only difference in the expected signs involves the coefficients on the training-camp dummy variables. The adverse effect of missing the start of training camp is more likely to be revealed in games started than in whether the player makes the team, because a team is less concerned about a player's future potential when deciding who starts than when deciding who is cut from the team.

[20] Kickers and punters were coded as starting zero games. Therefore, the forty-five observations where the player was either a kicker or a punter were dropped from these regressions.

[21] The average probability of starting $s + 1$ games conditional on starting s games is approximately 0.20 for each of the three years.

[22] Whether the player has an active contract the first year and the number of first-year starts are not included as dependent variables, because there are only two contracts with one-year duration and the results would be almost identical to those testing for a separating equilibrium [columns (1) and (2) of table 2].

TABLE 3.—MORAL HAZARD: PROBIT REGRESSION ON ACTIVE CONTRACT AND COUNT MODEL ON NUMBER OF STARTS CONDITIONAL ON ACTIVE CONTRACT IN PRIOR YEAR

Independent Variable	(1) Cond. Active the 2nd Year	(2) Cond. Starts the 2nd Year	(3) Cond. Active the 3rd Year	(4) Cond. Starts the 3rd Year
Last year of initial contract and drafted in first three rounds	1.124*	0.063	0.506**	0.103
	(0.656)	(0.314)	(0.252)	(0.182)
	[0.078]	[0.008]	[0.067]	[0.010]
Last year of initial contract and drafted in last nine rounds	−0.333	−0.011	0.107	0.450**
	(0.380)	(0.309)	(0.245)	(0.180)
	[−0.055]	[−0.001]	[0.017]	[0.044]
Starts in first year	0.148**	0.119**	0.016	0.037**
	(0.025)	(0.010)	(0.017)	(0.011)
	[0.022]	[0.015]	[0.003]	[0.004]
Starts in second year			0.102**	0.145**
			(0.015)	(0.009)
			[0.017]	[0.014]
Selected in first 3 rounds:				
Rookie training-camp dummy	0.025	0.144	−0.091	−0.090
	(0.272)	(0.137)	(0.234)	(0.153)
	[0.004]	[0.018]	[−0.015]	[−0.009]
Duration of contract	0.368	−0.062	0.549**	0.080
	(0.254)	(0.106)	(0.195)	(0.133)
	[0.055]	[−0.008]	[0.089]	[0.008]
Incentive clause		−0.144	0.074	−0.329
		(0.216)	(0.406)	(0.237)
		[−0.018]	[0.012]	[−0.033]
Selected in last 9 rounds:				
Rookie training-camp dummy	0.075	−0.015	0.076	0.221
	(0.140)	(0.116)	(0.173)	(0.139)
	[0.011]	[−0.002]	[0.012]	[0.022]
Duration of contract	−0.323	0.192	0.123	−0.214
	(0.335)	(0.265)	(0.237)	(0.165)
	[−0.048]	[0.024]	[0.020]	[−0.021]
Incentive clause	0.132	0.295	0.167	−0.280
	(0.433)	(0.330)	(0.554)	(0.385)
	[0.018]	[0.036]	[0.024]	[−0.028]
No. of team wins in season prior to draft	Yes	Yes	Yes	Yes
Selection number in the draft	Yes	Yes	Yes	Yes
Indicator variables:				
First three rounds of draft, player's position, team, year of draft	Yes	Yes	Yes	Yes
Chi-squared	221	564	203	553
Number of contracts	959	980	798	818

Standard error is in parentheses. Marginal effects are in brackets.
* Statistically significant at 10% level.
** Statistically significant at 5% level.

year of the contract, one would expect positive coefficients associated with the last year's contract variables.

The results of these specifications are presented in table 3.[23,24] The coefficients associated with the last-year-of-the-contract variable provide evidence that contract structure affects a player's effort level.[25] The three statistically significant coefficients associated with the last year of the contract variables indicate that, conditional on having an active contract in the prior year, the probability that a player drafted in an early round has an active contract in the second or third year and the number of games a player drafted in a late round starts in his third year are much greater if the player is in the last year of his contract. The large

[23] The incentive-clause indicator variable for early-round draft choices is not included in the specification when the dependent variable is conditional activity the second year, because it is a perfect predictor of having an active contract. In addition, observations where the player is drafted by the Buffalo Bills and where the player's position is a kicker are not included in the estimation when the dependent variable is conditional activity the third year, because they are perfect predictors.

[24] The varying signs of the incentive-clause coefficients suggest that incentive clauses do not significantly affect players' effort levels.

[25] Of all players drafted in the first three (last nine) rounds, 28 (836) contracts were two years in duration, 206 (476) contracts were three years in duration, and 257 (68) contracts were more than three years in duration.

marginal effects implied by these coefficients suggest that players exert more effort in the last year of their contracts.[26]

IV. Conclusion

This paper empirically tests for a multidimensional separating equilibrium in NFL contract negotiations and the moral hazard associated with these contracts. Our empirical results suggest that a separating equilibrium does exist in NFL contract negotiations. This paper finds empirical support for the premise that late-round draft choices reveal positive private information by delaying agreement and early-round draft choices reveal positive private information by agreeing to contracts with incentive clauses. The empirical tests of moral hazard support the contention that contract structure affects a player's effort level. The evidence presented here suggests that multidimensional separating equilibria and moral hazard may be important in other types of contract negotiations, and that further empirical work in this area may be profitable.

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[26] Because of the relationship between contract duration and whether the player is in the last year of his contract, we estimate specifications similar to those in table 3 but exclude the independent variables involving contract duration. Excluding these variables does not appreciably change the coefficient estimates associated with the player being in the last year of his contract.