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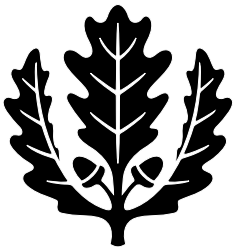

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Abstract

The first professional base ball clubs came in two varieties: stock clubs, which paid their players fixed wages, and player cooperatives, in which players shared the proceeds after expenses. We argue that stock clubs were formed with players of known ability, while co-ops were formed with players of unknown ability. Although residual claimancy served to screen out players of inferior ability in co-ops, the process was imperfect due to the team production problem. Based on this argument, we suggest that co-ops functioned as an early minor league system where untried players could seek to prove themselves and eventually move up to wage teams. Empirical analysis of data on player performance and experience in early professional base ball provides support for the theory.

Journal of Economic Literature Classification: L14, L23

The Old Ball Game:
Organization of Nineteenth Century Professional Base Ball Clubs[1]

INTRODUCTION

Most baseball fans with even a casual interest in the history of the sport know that the first openly professional team was the Cincinnati Red Stockings in 1869.[2] What far fewer know is that the first professional baseball league, called the National Association of Professional Base Ball Players (or National Association for short), formed in 1871 and lasted through the 1875 season, after which it folded due to financial and other difficulties.[3] A year later, the present-day National League arose out of the National Association's ashes.

Baseball is unique among professional sports in the reverence that it holds for its history, yet the National Association has received relatively little attention from most baseball historians (Ryczek, 1999: p. xi). And economists, who in recent decades have extensively studied the business of professional baseball,[4] have neglected it altogether. This is unfortunate, because much can be learned from the sort of experimentation that ordinarily characterizes new ventures. Such experimentation occurred in the new league, both on the field in terms of playing techniques and rules, but also in organizational forms. The latter issue is the subject of the current paper. The analysis employs modern economic theories of organization with historical evidence on team and player performance to develop a theory of team production and organization in early professional base ball.

The specific question we examine is why some teams in the National Association paid their players fixed salaries while others were organized as cooperatives with players

sharing in the gate receipts after expenses. From an economic perspective, one might suppose that cooperative clubs, by making players the residual claimants, should have provided greater incentives for effort and/or attracted players of higher ability (Lazear, 1986, 2000). In fact, this does not appear to have been the case; as Table 1 shows, at the close of the 1872 season, the cooperative clubs were at the bottom of the league standings (their performance in other years was similar—see Ryczek (1999)).

To explain this seemingly anomalous result, we argue that fixed wage clubs (also known as stock clubs) were comprised largely of players known to have high ability based on their earlier performance for amateur and semi-pro clubs, while cooperatives were formed primarily with players of unknown ability. In this sense, we argue that cooperatives did represent a response to uncertainty in the market for players, once the players of known ability were all taken. We further argue, however, that the ability of co-ops to screen players was imperfect due to the inherent team production problem (Alchian and Demsetz, 1972), which explains the inferior performance of cooperatives relative to fixed wage clubs. Nevertheless, we suggest that cooperatives served an important screening function in early professional baseball by acting as a sort of nascent minor league for untried players. Thus, many players who began on co-ops eventually moved on to stock teams and became stars, while others had short-lived professional careers.

The remainder of the paper is organized as follows. The next section develops the theoretical framework, and the following section presents some empirical evidence in support of the theory using data on player performance and experience. The final section summarizes our conclusions.

THEORETICAL ANALYSIS

As noted, teams in the National Association were of two types: stock (wage) clubs and cooperative clubs (or co-ops). The stock clubs raised capital through the issuance of common stock and the contributions of club members. This capital plus revenue from gate receipts were used to cover operating expenses, including player salaries (Ryczek, 1999: p. 35). Stock owners were therefore the residual claimants to any profits left over after expenses and salaries were paid. The co-op clubs, in contrast, relied entirely on gate receipts, and rather than a salary, players received a share of the receipts after expenses were paid (Rader, 1992: pp. 30-31). Under this arrangement, the players (workers) were the residual claimants. In what follows, we draw insights from the economics of organization literature to suggest an explanation for the co-existence of stock and co-op clubs in early professional base ball.

Risk-sharing?

We begin with risk-sharing. In his classic analysis of agricultural contracts, Cheung (1969) argued that an important explanation for the prevalence of sharecropping contracts in agriculture is that they share the risks of uncertain output between the landlord and the tenant. This assumes that both parties are risk averse and therefore value some protection against output variation.[5] By this logic, fixed wage contracts would be preferred if the landlord is the superior risk bearer, while fixed rental contracts would be preferred if the tenant can better bear the risk.

If risk aversion similarly explains the different contracts in baseball, we would have to conclude that players on stock teams were more risk-averse than those on co-op teams. This may or may not be true, but it would be difficult to test absent evidence about

individual players' risk preferences. Further, the evidence we do have is that stock teams performed better on the field, and there is no reason to suppose that better players were systematically more risk averse. We therefore seek an alternative explanation (based on imperfect information) from which we can derive testable predictions.[6]

The Team Production Problem

For purposes of our analysis, we assume that the owners (residual claimants) of a professional base ball club were interested in maximizing profits. The revenues consisted of gate receipts, and the costs were capital costs (e.g., building an enclosed park), operating expenses, and, in the case of stock clubs, player salaries.

An important determinant of revenue was the performance of the team, which depended largely on the abilities of the players. However, because sports teams represent a prototypical example of "team production," the contributions (abilities) of individual members of the team may be difficult to discern simply by observing the output (performance) of the team (Alchian and Demsetz, 1972). As a result, the team faced the standard problem associated with team production: how to monitor the workers so that compensation would correspond as closely as possible to individual contributions to output (the metering problem).[7] At this point, we should note that our discussion of team production will differ slightly from that in Alchian and Demsetz in that we will focus primarily on unobservable player "abilities" rather than "efforts." For purposes of the current discussion, this distinction is unimportant since much of what we will say in this section applies equally to effort and ability. However, the focus on ability paves the way for the analysis of ability differences across players in the next section.

In the context of ability differences, the metering problem amounts to paying workers according to their individual marginal products as well as screening out inferior workers. Alchian and Demsetz argue that the capitalist firm solves this problem by appointing a specialized monitor who becomes the residual claimant after the inputs have been paid. As the sole residual claimant, the monitor's incentive to shirk in that role is minimized. In contrast, Alchian and Demsetz argue that in a profit-sharing (or cooperative) firm that relies on mutual or self-monitoring, each member will have a greater incentive to shirk because the losses resulting from any one member's failure to work hard will be partially passed on to the other members. As a result, mutual monitoring with profit sharing should be inferior to centralized monitoring by a residual claimant.

The Alchian-Demsetz story emphasizes the importance of residual claimancy to maximize the *incentive* to monitor, but Putterman (1984) notes that the *technology* of monitoring is also important. For some kinds of tasks, he argues, it may be that mutual, or peer-monitoring is at least as effective as centralized monitoring by a single individual. For example, Putterman (1984: p. 173-174) observes that

> Some activities allow individuals to work and to observe one another's performance simultaneously, … so that output and monitoring are joint products. While … monitoring is made difficult by technologically nonseparable activities, the implication that a third party can better assess the effort level of team members cannot be asserted to hold universally…

Early baseball may have been an activity for which third party monitoring was not effective. In its infancy, the ballplayers themselves were likely the best judges of talent. Most teams did not have specialized managers but rather had the modern-day equivalent of "player-managers" (Burk, 1994, p. 43). Further, players were more versatile, often

playing multiple positions,[8] which would have enhanced their ability to evaluate one another's performance and ability (Cosgel and Miceli, 1999). In the early years, even umpires were generally drawn from the ranks of players (Ryczek, 1999: p. 103). For these reasons, the problem of team production in base ball (whether dependent on abilities or efforts) may not have automatically favored a single-monitor/ residual claimancy type of organization over a mutual-monitoring/ profit-sharing arrangement.[9]

While the team production/monitoring story provides a partial explanation for the co-existence of stock clubs and co-ops, it does not explain certain stylized facts; in particular, the marked inferiority of co-op clubs on the field compared to stock clubs. If co-ops were at least as good at solving the team production problem in terms of motivating players and weeding out those of inferior ability, then why didn't they perform as well on the field? We seek to answer this and related questions in the next section.

Contracting Between Players and Owners

In this section, we consider the impact of uncertainty on the part of owners about players' abilities. According to Ryczek (1999: p. 35), when professional teams began to form, the stock entries in the National Association filled their rosters first with the best players, leaving the co-op entries to "pick up the pieces." This suggests that there in fact existed a group of players in the pool whose abilities were *known* to prospective owners as a result of their past performance on amateur or semi-pro teams.[10] Clearly, the owners would have selected the best players from this group, and because there was no uncertainty about their abilities, these owners would have been willing to offer them

wages consistent with their abilities. In this case, the market for players functioned efficiently.

Players known to be of high ability were in short supply, however, so once they were all signed, if further profits could be earned, new teams would have had to draw from among players of unknown ability. In the early days of base ball, scouting of untried players was virtually unknown due to the difficulty of travel and communication (Burk, 1994, p. 44). Players often simply wrote to an owner requesting a position on the team. Faced with this sort of uncertainty about the ability of an unknown player, a rational owner would only have been willing to offer a wage based on the *average* ability in the pool of potential players. Under this arrangement, above-average players would either have been underpaid, or would have chosen not to play at all, depending on their next best option.[11] In response to this adverse selection problem, good players may have found it advantageous to form "player-owned," or cooperative, teams where they would share in the profits after expenses. Such an arrangement would have allowed them to capture the full returns on their abilities after paying expenses.

The situation is analogous to Barzel's description of the problem facing immigrant workers in agriculture:

> Landowners are reluctant to commit themselves to paying new workers the prevailing wage. Given the lack of knowledge regarding workers' abilities and attitudes, both demand for the services of such workers and, consequently, the wage offered are likely to be low. A new worker who believes that she or he is more productive than the wage she or he is offered indicates can "guarantee" her or his output by offering to operate as a fixed-rent tenant. The worker then bears the onus of the information problem (Barzel, 1989: p. 40).

Players on co-ops were likewise guaranteeing their ability by taking on the role of residual claimant and thereby bearing the burden of failure.[12] Lazear (1986) similarly

showed that when workers have superior knowledge of their productivities, higher ability workers will self-select piece-rate contracts over fixed wage contracts.[13]

The preceding examples show the advantage of profit sharing over fixed wages in attracting higher ability players (screening), but they ignore the team production problem. Because co-op players shared the returns, those of inferior ability could have attempted to free-ride on the high ability players. In response to this, we have suggested that members of a co-op would have engaged in mutual monitoring or screening to limit (if not eliminate) this practice. We model this in a manner similar to Kandel and Lazear's (1992) analysis of peer monitoring in profit-sharing partnerships.[14]

Specifically, let $R(A,K,\theta)$ be the revenue earned by the team as a function of the average ability of the players, A, a capital input, K, and a random variable θ. To capture peer monitoring, we write the average ability as $A=A(e_1,\ldots,e_n)$, where e_j is the level of effort that player j devotes to screening (measured in dollars), and $A_j \equiv \partial A / \partial e_j > 0$ for all j. Given equal sharing of net revenue, the problem for each player on the co-op is to

$$\max_{e_j} \frac{R(A(e_j, e_{-j}), K, \theta) - rK}{n} - e_j, \qquad j=1,\ldots,n, \tag{1}$$

where r is the cost of capital. The resulting first-order condition is

$$\frac{1}{n}(R_A A_j) - 1 = 0, \qquad j=1,\ldots,n. \tag{2}$$

For simplicity, we assume that the optimal effort for all players is the same and equal to e^* (that is, the marginal productivity of effort, A_j is the same for all players). The Nash equilibrium thus yields a return for each player equal to

$$\frac{R(A(e^*), K, \theta) - rK}{n} - e^*. \tag{3}$$

The desirability of a co-op can now be seen to depend on the efficacy of mutual monitoring in preventing free riding by below-average players. And since (2) implies that incentives for individual team members to engage in such monitoring were fairly weak for moderate-sized teams ($n \approx 10$), we expect that co-op clubs would have had inferior talent compared to the fully informed stock clubs (assuming that the latter had employed only high ability players). This is consistent both with their poorer performance on the field and their shakier financial status.

Despite the above disadvantages of co-op clubs both on and off the field, they nevertheless served a useful purpose by allowing untried players an opportunity to display their abilities. In this sense, one might think of them as nascent "minor league" teams in the days before teams created their own specialized farm systems. Although good players would have coveted salaried positions on the stock clubs, their best option was to play on a co-op club where they could prove their ability and eventually earn a birth in the "majors." (The situation is analogous to a salesman who initially agrees to work entirely on commission, thereby bearing all of the risk of failure, but eventually hopes to be promoted to a salaried position.) At the same time, players discovered to have low ability (free riders) would have been cut from the team. If this logic is correct, the model implies that once the ability of co-op players was revealed, "good" players would have succeeded in jumping to stock clubs, while "bad" players would have remained with co-ops or been cut. We offer some evidence on this prediction in the next section.

Before turning to the empirical evidence, we speculate on the demise of co-ops in professional baseball (none survived to join the new National League in 1876). To do so,

we compare the above analysis of mutual screening in co-ops under imperfect information to specialized screening in fixed wage clubs along the lines of Alchian-Demsetz (also see Lueck, 1994). To examine this case, we write *A(E)* as the average ability of players on a wage club, where *E* is the level of screening by the specialized monitor and $A_E>0$. If the monitor is also the residual claimant, he will choose *E* to solve

$$\max_E R(A(E)), K, \theta) - wn - rK - E\,, \tag{4}$$

where *w* is the fixed wage paid to players who make the team. The first-order condition for optimal monitoring is

$$R_A A_E - 1 = 0\,, \tag{5}$$

and the resulting maximized return to the owner/monitor is

$$R(A(E^*), K, \theta) - wn - rK - E^*. \tag{6}$$

Now suppose that the owner offers players who make the team a wage equal to their return from an optimally managed co-op as given by (3). This will attract players (especially if they are risk averse) and will yield the owner profits if

$$R(A(E^*), K, \theta) - E^* > R(A(e^*), K, \theta) - ne^*. \tag{7}$$

This condition turns on the relative effectiveness and cost of mutual versus specialized screening/monitoring. We have suggested that in early baseball, mutual monitoring was probably at least as effective as specialized monitoring (despite the incentive problem noted above) because players *were* the specialists. This favored co-ops. However, as baseball matured, a class of non-playing specialists emerged, primarily from the ranks of former players. Also, as the sport became more profitable, teams devoted more resources to scouting and coaching. These factors likely combined to alter the technology of monitoring in favor of specialization. And once the screening advantage of co-ops was

eliminated, the superior risk-bearing ability of owners compared to players presumably reinforced the desirability of fixed wage contracts. For these reasons, it is not surprising that cooperative clubs, although they briefly served a useful purpose, were short-lived in professional baseball.

EMPIRICAL EVIDENCE

In this section we explore the implications of our theoretical arguments using data on the characteristics of all players who played on one of the National Association's eleven teams in 1872. The data roughly verify our conjecture that the co-op clubs of the National Association (NA) functioned as a nascent minor league, where players of unknown quality exhibited their skills, and then had a tendency to graduate to a stock club once their abilities had been demonstrated.

Although the NA formed in 1871, we use 1872 as our base year because it is the year for which the split between wage and co-op teams was most even.[15] As shown in Table 1, the six stock (wage) teams (Boston, Philadelphia, Baltimore, New York, Troy, and Cleveland) finished the 1872 season with a combined record of 158-86 (.648),[16] while the five co-ops (Brooklyn Atlantics, Washington Olympics, Middletown, Brooklyn Eckfords, and Washington Nationals) compiled a combined record of 18-90 (.167).

Table 2 summarizes the characteristics of NA players by team and by team type (stock or co-op) for the 1872 season. The table includes each team's mean batting average, which is our primary measure of player quality,[17] but it also includes several measures of player experience. The first such measure is the percentage of players on each team with prior NA experience (meaning that they played on an NA team in 1871). The second measure is the average number of years of prior experience in top semi-

professional clubs prior to the formation of the NA. Ryczek (1998) provides a list of such teams for the years 1865-1870; any player who was a member of one of these clubs was considered to have had top-flight base ball experience. Finally, Table 2 also includes the number of years that an average player on each team stayed in professional base ball after 1872, which may be cautiously interpreted as an additional proxy of player quality. Included here are years spent on NA teams from 1873-1875, as well as years spent on teams in the National League (which formed in 1876), the American Association (which existed from 1882-1891), the Union Association (1884) and the Players' League (1890).[18]

The data reveal marked differences between stock and co-op players. It is apparent that stock teams simply had significantly better players. Players on stock teams had a batting average a full 50 points higher than players on co-op teams in 1872. In addition, stock players had longer careers after 1872, playing almost 2 years longer on average than their counterparts on co-op teams. Moreover, 90% of stock players had prior experience in the NA and other semi- professional leagues. By contrast, only 27% of co-op players had prior experience in the NA, and the mean number of years experience in other (non-professional) leagues for a co-op player was 1.3, as compared to 3 years for stock players. Thus, not only were stock players better in 1872, they had been around base ball a longer period of time and were on average older, making it more likely that others had knowledge of their skills.

Table 3 presents the results of fitting two simple logit models to the above data, where the dependent variable is equal to one if a player was on a stock team, and zero if the player was on a co-op. The second model drops age from the equation; because age

is unknown for some players, inclusion of age in the model reduces degrees of freedom, and in any case, age is moderately correlated with experience. Both models fit the data well and reveal that the two most important joint predictors of what type of team a player was on in 1872 are batting average (quality) and prior experience in the NA--specifically, better players and those with more experience disproportionately populated stock teams in 1872. These results support our claim that stock teams were formed first with players known to be of high ability.

We next ask what became of the players after the 1872 season. In particular, did the better co-op players tend to move to stock clubs? Of the 90 players in the league in 1872, 54 played on stock teams in 1873, 12 remained on co-ops in 1873, 23 dropped out of the league, and 1 died. Table 4 shows the results of fitting simple ordered logit models using this information.[19] For all the models in Table 4, the dependent variable is the player's employment status in 1873. Specifically, the dependent variable equals 2 if the player played for a stock team in 1873, 1 if the player played for a co-op team in 1873, and zero if the player dropped out of the league (the one player who died is excluded from these models).

As explanatory variables for the player's employment status in 1873, we use the same variables as before (batting average, age, prior NA experience, and experience in other leagues), but we include two additional explanatory variables. We first include the type of team (stock or co-op) the player played on in 1872 as a control variable. Intuitively, it is likely that a player with experience on a stock club has known attributes. We also include a dummy variable equal to one if the player played an infield position or was a catcher in 1872, and zero otherwise.[20] Our reasoning in including the latter

variable was to control for the possibility that some players were more skilled defensive players than others, and players who came to be known as skilled defensive players would also be more likely to move to stock clubs, or at least stay in the league on a co-op team. (In early base ball, players often played a variety of positions, and those who played a majority of the time at catcher or in the infield were likely to be a team's better defensive players.)

While parameters of an ordered logit are generally difficult to interpret directly, the fitted models displayed in Table 4 show that players with higher averages and infielders were more likely to be placed higher in the ordering. Previous NA experience and other experience were not statistically significant, but this is not surprising given that by 1873, all players in the league had by definition one year of experience in the National Association. Some of the variables are collinear and a clearer and simpler picture of player transition emerges in the stripped down model *III*. To aid in interpretation of the model, Table 5 uses model *III* to form predicted probabilities of observing different types of player movement between the years 1872 and 1873 based on simple characteristics of some hypothetical players.[21]

Table 5 reveals, first, that players who were on stock teams were fairly likely to remain on stock teams in 1873. S1, for example, is a hypothetical player who played on a stock team in 1872, played in the infield, and batted the league average (.271). The likelihood that a player like S1 would remain on a stock team in 1873 was approximately 88%. Player C1 is identical to S1 except for the fact that he played on a co-op in 1872. While C1 was more likely to move to a stock team than either of the other possibilities, his likelihood of moving to a stock team was only 48%. However, C3, who might be

considered one of the better players in the league, batting .331 and playing in the infield, stood a 60% chance of moving up to a stock team in 1873. By contrast, C6, a marginal player at best who was on a co-op team in 1872, stood a very high (67%) chance of dropping out of the NA.

While players who were on stock teams in 1872 were likely to remain on stock teams in 1873 (even the worst hypothetical player, S6, had a 62% chance of remaining with a stock team), the best players on co-ops were likely to move to stock teams. Table 5 also reveals that it was generally unlikely that players would remain with co-ops for both 1872 and 1873, or move from stock teams to co-ops between the two years. Indeed, 1872 co-op players were more likely to drop out of the league than to remain on co-ops, particularly average to poor co-op players. These results generally support our theoretical predictions about player movements and our interpretation of co-ops as an early minor league system.

CONCLUSION

Economists have devoted considerable attention to the study of different types of organizations. This paper has contributed to that literature by studying the organization of early professional base ball clubs. The specific question we addressed was why some of these clubs paid players fixed wages while other were organized as player cooperatives. Our theoretical analysis suggested that player cooperatives were a response to a potential adverse selection problem in the market for players, once the players of known ability were signed to fixed wage contracts. We argued, however, that cooperatives would only have been partially successful in screening out low quality players because of the team production problem. This explains the observation that cooperative clubs were inferior to wage clubs. Co-ops nevertheless served a useful

function in early base ball by giving untested players an opportunity to prove their ability. As a result, we suggested that they could be viewed as an early form of minor league.

Our empirical analysis using data on player performance and experience generally supported this view of cooperative clubs. In particular, we found, first, that members of stock clubs tended to be those of higher ability and more experience, and second, that the best co-op players tended to move to stock clubs while little movement in the other direction occurred.

Just as play on the field has evolved, the organizational structure of professional baseball has evolved too. Improvements in scouting and player evaluation eventually eliminated the primary benefit of cooperative teams. Thus, they were destined to go the way of the underhand pitching delivery and become part of baseball's history.

Table 1:Performance of Stock versus Co-op Teams, 1872 Season

Team	Type	1872 Record	Pct.
Boston Red Stocking	wage	39-8	.830
Philadelphia Athletics	wage	30-14	.682
Lord Baltimores	wage	34-19	.642
New York Mutuals	wage	34-20	.630
Troy Haymakers	wage	15-10	.600
Cleveland Forest Citys	wage	6-15	.286
Brooklyn Atlantics	co-op	8-27	.229
Washington Olympics	co-op	2-7	.222
Middletown Mansfields	co-op	5-19	.208
Brooklyn Eckfords	co-op	3-26	.103
Washington Nationals	co-op	0-11	.000

Source: Ryczek (1999: p. 93)

Table 2: Stock and Co-op Team Averages

	Batting Average (position players only)	*Age*[*]	*% National Association Experience*	*Mean prior years experience, other leagues*	*Mean Years played after 1872*
Athletics (N=8)	.308	25.3	100%	2.6	8.3
Baltimore (N=9)	.281	24.7	100%	3.2	5.9
Cleveland (N=8)	.293	24.8	88%	2.4	6.5
Mutuals (N=8)	.276	25.9	75%	3.5	5.8
Red Stockings (N=8)	.307	25.6	88%	3.0	5.4
Troy (N=8)	.294	25.5	88%	3.3	2.9
Stock Teams (N=49)	.293	25.3	90%	3.0	5.8
Atlantics (N=8)	.241	23.3	13%	1.4	5.9
Eckfords (N=8)	.206	23.9	25%	2.3	4.0
Mansfields (N=9)	.278	20.3	0%	0.0	4.9
Nationals (N=8)	.254	22.0	25%	1.0	3.6
Olympics (N=8)	.233	23.6	75%	2.1	1.6
Co-op Teams (N=41)	.243	22.5	27%	1.3	4.0

[*] 10 age observations missing.

Table 3: Logit models: Dependent variable = 1 if player on a stock team, 1872

Independent variables	*I*	*II*
Constant	-12.84*	-7.55*
	(-2.83)	(3.89)
National Association Experience?	2.58*	2.91*
	(3.26)	(4.04)
Average	24.68*	20.06*
	(3.02)	(3.08)
Prior years experience, other leagues	0.013	0.29
	(0.05)	(1.52)
Age	0.21	-
	(1.4)	
X^2	49.19	56.46
N	80	90

t-statistics in parenthesis under estimated coefficients
* denotes significance at the 99% level

Table 4: Ordered logit models: Dependent variable = team type, 1873

Independent variables	*I*	*II*	*III*
National Association Experience?	0.51 (0.71)	0.64 (0.96)	-
Average	8.56*** (1.60)	8.72*** (1.85)	8.22*** (1.78)
Years experience, other leagues	-0.16 (-0.80)	-0.15 (-0.91)	-
Age	.03 (0.28)	-	-
Played for stock team, 1872?	1.65** (2.18)	1.96* (2.78)	2.05* (3.62)
Infielder or catcher in 1872?	.83 (1.46)	0.92*** (1.7)	1.01*** (1.90)
Ancillary Parameters:			
Cutoff 1	2.96	2.57	2.51
Cutoff 2	3.63	3.38	3.31
X^2	25.3	34.57	34.89
N	79	89	89

z-statistics in parenthesis under estimated coefficients
* denotes significance at the 99% level
** denotes significance at the 95% level
*** denotes significance at the 90% level

Table 5: Predicted Probabilities associated with Model III (Table 3)

	Batting Average in 1872	*Infielder or catcher in 1872?*	*Played for Stock team, 1872?*	*Predicted Prob. out of NA 1873*	*Predicted Prob. on a Co-op team 1873*	*Predicted Prob. on a Stock team 1873*
Average Player:	0.271	0.61	0.55	0.19	0.15	0.66
Hypothetical 1872 Co-op Players:						
C1	0.271	1	0	0.33	0.19	0.48
C2	0.271	0	0	0.57	0.18	0.25
C3	0.331	1	0	0.23	0.17	0.60
C4	0.331	0	0	0.45	0.20	0.36
C5	0.221	1	0	0.42	0.20	0.38
C6	0.221	0	0	0.67	0.15	0.18
Hypothetical 1872 Stock Players:						
S1	0.271	1	1	0.06	0.06	0.88
S2	0.271	0	1	0.15	0.13	0.72
S3	0.331	1	1	0.04	0.04	0.92
S4	0.331	0	1	0.09	0.09	0.81
S5	0.221	1	1	0.08	0.08	0.83
S6	0.221	0	1	0.20	0.16	0.64

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NOTES

[1] The title does not contain a typo: base ball in the nineteenth century was written as two words.
[2] Prior to the Red Stockings, several of the top players on amateur teams were paid in one form or another.
[3] See Ryczek (1999) for a comprehensive history of the National Association.
[4] See, e.g., Scully (1989), Sommers (1992), and Zimbalist (1992).
[5] Stiglitz (1974) examines the trade-off between risk-sharing and incentives under share contracts.
[6] See Barzel (1989: pp. 30-31) and Alchian and Demsetz (1972: pp. 784-785), who also eschew risk-sharing explanations for different organizational forms. We do suggest below, however, that the demise of cooperative teams in professional baseball was due in part to the superior risk-bearing ability of owners compared to players.
[7] Burk (1994, p. 45) notes that player statistics were developed at this time, in part, to allow "cost-conscious bosses … a means of relating performance to pay," but the problem, then as now, was how to "adjust these team-dependent numbers for the shortcomings of the rest of the lineup."
[8] By the 1870's, players tended to specialize in positions as in modern baseball, but most had experience at other positions.
[9] Modern baseball, however, has clearly moved in the direction of a single specialized monitor who is subject to dismissal by the owner (the residual claimant). Thus it looks more like the Alchian-Demsetz model. See the discussion below.
[10] See Ryczek (1998) for a history of organized baseball from the Civil War up to the era of professionalism.
[11] Apparently, even players at the low end of the wage scale generally earned more than they could have outside of baseball. See Goldstein (1989: p. 114), Burk (1994, p. 42), and Ryczek (1999: p. 35).
[12] At this point, one might ask why players known to have high ability were willing to join stock teams for a fixed wage rather than forming co-ops of their own. Although the expected returns under the two organizations would have been identical, players would have borne all the risk in a co-op. Thus, even slightly risk averse players would have preferred the fixed wage arrangement.
[13] Also see Lazear (2000), where he discusses output-based pay as a sorting mechanism.
[14] One difference is that they focus on mutual monitoring to prevent shirking rather than to screen out inferior workers.
[15] All of the co-op teams in 1872 were new to the league in that year, and all folded prior to the start of the next season. Only two co-ops had been in the league in 1871, but both dropped out before the the 1872 season, while the Washington Olympics, a wage team in 1871, played as a co-op in 1872 (Thorn, Palmer, and Gershman, 2001).
[16] Cleveland (6-15) appears to be an outlier among the wage teams for reasons that are unclear.
[17] We have excluded pitching statistics from the analysis because of the small number of pitchers. There are nine observations for Baltimore and the Mutuals because these two teams had an additional position player who played a significant amount of time.
[18] We do not distinguish among these leagues as all are classified by baseball historians as "major leagues."
[19] See Greene (1997). Some details are discussed in footnote 21.
[20] It was, of course, impossible to do this in the previous logit models, as in 1872 each team had the same number of infielders and catchers.
[21] Predicted probabilities are formed as follows when there are three ordered outcomes. If $y_j=\beta_1 x_{1j}+\beta_2 x_{2j}+\beta_3 x_{3j}$, where the β_js are estimated parameters, and κ_1 and κ_2 denote the estimated ancillary parameters (cutoff points), then the (predicted) probability that the dependent variable is equal to zero is $1/(1+e^{yj-\kappa 1})$, the probability that the dependent variable is equal to one is $1/(1+e^{yj-\kappa 2})-1/(1+e^{yj-\kappa 1})$, and the probability that the dependent variable is equal to two is $1/(1+e^{yj-\kappa 2})$.