The Performance Effects of Interorganizational Human Resource Practices: The Case of Inter-Club Networks in Professional Baseball, 1919-1940

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ABSTRACT


This study investigates the performance effects of two industry-specific human resource management innovations that dramatically changed the way professional baseball teams selected and trained ballplayers. In the early part of this century major league clubs developed and refined two player development practices based on “reserve team” and “farm team” systems. We use a panel data set of the win/lose records for the population of 16 major league clubs for the seasons from 1919 through 1940 to test hypotheses about the effect of human resource practices on organizational performance. The results suggest the reserve team practice had no significant impact on organizational performance. In contrast, the more complex farm team system, pioneered by Branch Rickey of the St. Louis Cardinals, improved organizational performance and diffused rapidly throughout the league. Four years after creating a farm team system, we estimated that it improved a team’s win rate by .068 points relative to non-adopters of the farm team system and teams with less than four years of prior experience with a farm team system. The results also show the farm team effect was not confined to St. Louis but was also experienced by later adopters. These results contribute to the growing literature showing a positive effect of human resource policies on organizational performance. The results also illustrate the important role the external environment plays in shaping this relationship (e.g., legal restrictions to labor mobility).

Recent research in human resource management has attempted to evaluate the performance impact of human resource practices and policies using contemporary data from either a single industry or from a sample of firms drawn from many industries. This study complements this research using historical data from major league baseball for the years 1919-1940 to investigate the performance effects of two industry-specific human resource management innovations that revolutionized the way professional baseball teams selected and trained ballplayers. The two practices, the “reserve team” and “farm team” systems, were human resource innovations built around the development and management of interorganizational linkages between a major league team and at least one minor league team.

The “reserve team network” was a relatively simple alliance between one major league team and typically one minor league club where the teams exchanged players during the season to meet short-run staffing needs caused by player performance slumps or injuries or to provide one of the teams with a competitive edge at a critical point in the season. Experimentation with this innovation began in the late 1800s.

The “farm team” network was a more radical strategy for selecting and developing player talent that combined one major league club with several minor league clubs. Teams with a farm team network contracted with a large number of promising athletes early in their careers and moved them through a network of minor league teams that played at increasing levels of competitiveness. This system allowed a major league team to identify players with the highest performance potential and develop their skills systematically over several years. Experimentation with “farming out” began in the second decade of the 20th century and was refined as a management practice during the study period. We use data on the adoption of the reserve and farm team networks and baseball season win/lose records to test propositions about the effect of these human resource management innovations on organizational performance.
Previous Research

Utilizing a resource based view of the firm (Barney, 1991; Wernerfelt, 1984), recent research has argued that the development of a firm’s human capital through its human resource policies can provide a sustainable source of competitive advantage for the firm (Lado & Wilson, 1994; Pfeffer, 1994). Some of this research has also found the performance effect of HR practices is contingent on the adoption of a “bundle” of complementary HR practices and work design policies (Ichniowski et al., 1995; MacDuffie, 1995). Workforce management practices interact with one another to impact on employee skills and motivation so the impact of any single practice on organizational performance is conditional on the “fit” between each practice and the entire set of workforce practices in the organization (Milgrom & Roberts, 1995). Thus, a change in a single practice may produce little or no positive benefit for the firm unless it is combined with supporting policies.

Several of the early empirical studies of the effect of human resource practices on performance relied on cross-sectional data. Although these studies found that certain practices had a positive effect on firm performance (MacDuffie, 1995; Huselid, 1995), they suffer from several limitations inherent in studies based on cross-sectional data. Perhaps the most fundamental limitation of these cross-sectional studies is the potential bias created by the non-random adoption of human resource practices. If more (or less) productive firms are early adopters of new human resource practices, the estimated performance differential between adopters and non-adopters will reflect both the causal impact of the policies and the unmeasured performance differences correlated with the adoption decision.

It is difficult to identify the direction of the bias caused by a non-random adoption process because it can arguably be either positively or negatively correlated with unmeasured performance differences. Several organizational theories (Cohen & Levinthal, 1990; Lieberman & Montgomery, 1988; Cyert & March, 1963) argue that more successful organizations are more likely innovators either because they have greater resources or because unobserved organizational characteristics make them both more
successful and more innovative. The greater resources available to more successful organizations imply they can afford both the investments required to experiment with new procedures and practices and can afford the “downside” risk if an innovation fails. More successful organizations may also be more innovative because of unobserved heterogeneity in organizational abilities; successful organizations may have competencies that are unobserved by the researcher which make them both more successful and more innovative. This could include higher quality managerial and worker human capital or more effective organizational routines for generating and using new ideas. Each of these explanations predict innovation is more likely among more “successful” organizations.

Other organizational theories predict less successful organizations are more likely to innovate. Successful organizations may develop “competency traps” (Levinthal & March, 1993; March, 1991; Levitt & March, 1988) and be unwilling to depart significantly from existing policies and practices that the organization believes are responsible for its past success (Miller, 1993). Less successful organizations may also have little to lose if an innovation fails and may be more willing to experiment with a dramatically different strategy to improve performance (Stopford & Baden-Fuller, 1994). These alternative theories about the timing of the adoption of new practices suggest the performance effects of adoption from a single period of data are likely to be biased.

A second and related potential weakness of studies that use cross-sectional data is caused by the tendency for organizations to make incremental changes in their policies and practices rather than a radical and rapid shift from one “bundle” of practices to an alternative bundle of complementary practices (Pil & MacDuffie, 1996). The slow diffusion and implementation process makes it difficult to identify the performance effects of policies in a single cross-section. At the time data are collected, few firms may have a fully consistent set of practices and many firms in the sample may appear to have “hybrid” sets of policies as they transition from one set of routines to another.

1 See Ichniowski, Kochan, Levine, Olson & Strauss (1996) for a review of this research.
Apart from the time it may take organizations to adopt a new bundle of policies, it may also take several years for the performance effects of human resource innovations to affect performance. If the policies are designed to influence staffing patterns, training investments, or the link between rewards and employee performance, several years may have to elapse before the performance effects are observable. Huselid and Becker (1996) have data on human resource practices for a sample of large firms for 1991 and 1993. They find HR practices measured in 1991 had a substantially larger impact on firm performance in 1992 and 1993 than in 1991. These results may mean that some firms in their sample were recent adopters of the policies and that there is a lag between the adoption of policies and changes in performance. However, with only two time periods and no information on the timing of the adoption of the human resource policies, one cannot determine if the full performance effect of the policies is reflected in their estimates or whether the effect of the policies on performance will continue to change over time.

The obvious research design that can potentially address some of these problems is a longitudinal panel where firms or work groups are followed over time as they modify their human resource practices.2 If human resource policy innovations are due to organizational fixed effects rather than transitory shocks to performance (e.g., a particularly poor performing year), then it is possible to statistically control for that portion of the adoption effect that is correlated with performance and constant over time within firms using longitudinal data. One of the strengths of the Ichniowski, Shaw & Prennushi (1995) study of steel finishing lines is their ability to identify the impact of changing human resource management practices after controlling for constant, unmeasured characteristics of each finishing line.3

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2 Athey & Stern (1996) show how this problem can be resolved with cross-sectional data by carefully modeling and distinguishing between the performance effects of the policies and the decision to adopt the policies. Their approach, however, places very high demands on both the theory and data, making this strategy very difficult in most empirical settings.

3 Their fixed effect estimates are virtually identical to the estimates they obtain when they do not control for fixed effects. This means the adoption decisions were not correlated with unmeasured fixed effects. This result could be because they studied a very simple, homogeneous production
In our study, the “natural experiment” created by the diffusion of the reserve and farm team systems over an 18 year period combined with excellent yearly team performance measures provides a nearly ideal setting for investigating the performance effects of human resource policies. The panel data allow us to test for the potential biasing effects of organizational fixed effects and look for possible lags between adoption of the system and its effect on performance.

**The Reserve and Farm Team System**

Interorganizational relationships between major league and minor league clubs are nearly as old as organized baseball itself. The first documented link between two teams occurred in 1884 when the Boston Beaneaters of the National League acquired the Boston Reserves in the Massachusetts State Association. The first team to exploit the potential of a reserve network occurred in 1894-1895 when John T. Brush transferred players during the season between his major league club in Cincinnati and his minor league club in Indianapolis. Brush would “loan” enough good players from the Cincinnati team to the Indianapolis team to help the minor league team at a critical point in the season and assure the team a minor league pennant victory. In subsequent years other major league clubs copied Brush’s practice by associating with or acquiring one or two minor league clubs and moving players between the teams (Hoie, 1989; James, 1986). In 1895 this practice of loaning surplus players from the major league team to a minor league team was labeled “farming out” by The Sporting News (Andersen, 1975).

Minor league team owners resented the manipulation of minor league players by major league owners and negotiated a ten year agreement in 1903 that attempted to restrict major league interference in the minor league by placing restrictions on major league ownership of minor league franchises and the movement of players between the minor and major leagues. During the 1903-1912 period this agreement forced major league owners to find other arrangements for moving players between a major league and a process where performance variability was reduced to a single measure of physical output per time period.
minor league team. This included formal agreements that defined the terms for sharing players and informal “gentlemen’s agreements” between teams (Hoie, 1989; James, 1986).

By 1912 major league teams again began to experiment with interorganizational networks based on an equity interest in a minor league team. Among those experimenting with “farming out” was St. Louis Brown’s owner Robert Hedges. Hedges hired Branch Rickey, a Michigan Law School graduate and coach of the University of Michigan baseball team, to build a scouting and farm team system (Andersen, 1975; Sullivan 1990). Subsequently, Hedges sold the Browns to a new owner who had little interest in developing the system envisioned by Rickey. In 1917 Rickey was hired away from the St. Louis Browns by an offer to become President of the nearly bankrupt St. Louis Cardinals. Financial problems facing the Cardinals and World War I postponed Rickey’s plans for a farm team network until 1919-20 when the club received a new majority owner that provided an infusion of new capital and gave Rickey the authority to begin development of a farm team network. By 1920 the Cardinals had at least a partial ownership interest in two lower division minor league clubs (Houston & Fort Smith, Arkansas). The further development of the St. Louis farm team network was facilitated by a new agreement in 1920 between the major leagues and the minor leagues that neither prohibited nor condoned the total or partial ownership of a minor league team by a major league team.

Baseball historians (Andersen, 1975; Sullivan, 1990) have noted that the Cardinals were able to produce substantial talent through their farm networks and attribute much of their later success to this HR innovation. Beginning in the 1920s the financially weak Cardinals were able to sign and then sell to other teams an unprecedented number of major league quality players that were identified and developed through their minor league farm team network (James, 1986). In 1926 the team, which had never placed

4 This was occurring despite a new baseball agreement in 1913 agreement that “banned” the ownership of a minor league team by a major league team.

5 This agreement also led to the appointment of the first Baseball Commissioner, Judge Landis. Throughout his 25 year tenure as Commissioner, Landis opposed Rickey’s efforts to institutionalize the farm team system.
better than third in the league, won the World Series against the New York Yankees. The Cardinals won the World Series again in 1934 and 1942 and the National League title in 1928, 1930 and 1931. By 1940 the St. Louis farm team network totaled 32 minor league teams; fifteen that were owned by the Cardinals and seventeen teams that were part of the network based on “working agreements” (Andersen, 1975).

Despite efforts led by baseball Commissioner Landis to discourage reserve and farm networks, the practice was eventually adopted by all major league teams. In 1938 all the major league teams had a network relationship with at least a couple of minor league clubs (Andersen, 1975). In 1937 The Sporting News noted that:

...when Baseball Commissioner Landis now looks around, he will be pained, but scarcely surprised, to note a baseball world that has been completely ‘Rickeyized.’ That is to say, he will find that Rickey’s chain-store idea has finally been sold to all major and minor league promoters. (cf. Andersen, 1975).

Figure 1 plots the fraction of teams in the two major leagues that had either a reserve network or a farm team network.6 This figure shows that in the early twenties slightly over 10 percent (St. Louis & Detroit) of major league teams had a reserve network. The diffusion of this practice, however, accelerated after 1926 when St. Louis won the World Series. The diffusion of the farm network lagged the diffusion rate of the reserve network system, accelerating rapidly only after 1933.7 The farm team system may have diffused more slowly than the reserve team network because it was a more radical shift from previous practices in the industry and required a larger commitment of financial and managerial resources (e.g. recruiting, scouting, coaching, coordinating, and monitoring capabilities).

6 These data come from several sources. The ‘Baseball Blue Book’ (1917-1940) and the ‘Minor League Digest’ (1936-1940) which annually published aggregated summaries based on league bulletins, commissioner bulletins and their annual mail survey of all baseball clubs belonging to a minor or major league baseball association. Information on interorganizational networks was also obtained from an unpublished list generated by Jerry Jackson, a member of the Society of Baseball Research. The precise coding of the reserve and farm team variables is discussed later in the paper.

7 Given how we define and construct the reserve and farm team network variables, the farm team networks cannot diffuse faster than reserve networks. The slower diffusion rate for the farm team network reflects the sequential nature of the adoption process from simple to more complex networks. The length of the lag between the adoption of the two practices is not constrained by the coding scheme.
The Hypotheses

In professional baseball selecting and developing human resources is critical to organizational performance and survival. The caliber of players directly affects a team’s ability to beat other teams. This success, in turn, draws spectators to the stadium and generates the revenue necessary to provide a return to team owners and the resources to invest in new player talent. The relationship between gate receipts and team financial success during the time period we study was very strong because it pre-dates significant revenues from radio and TV broadcasting rights. In 1929, for example, over 90 percent of industry revenues were obtained from gate receipts and stadium concessions (Leifer, 1995). This dependence on local fan support for revenue meant the success of a team was a function of the team’s player and coaching talent.

The industry, however, faced several problems in developing player talent that were addressed very effectively by the reserve and farm team networks. First, only a limited number of players could be on the roster of a major league team at any point in time both because of league rules on roster size and because of the travel and other expenses associated with carrying marginal players on the team. Even without these limitations, carrying marginal players on the major league roster to simply meet temporary staffing requirements was unsatisfactory because these players were likely to be poor substitutes for an injured player because of their limited playing time. We hypothesize the reserve network solved the short-term staffing problem by providing a pool of substitute players that gained valuable playing experience through their participation on a high-level minor league team. The first hypothesis tests if solving this short-run staffing problem had a positive impact on team performance:

H1: Teams with a reserve network were more successful than teams without a reserve network.
A second and bigger problem major league teams faced was how to identify and develop talented players. Since the skills involved in playing baseball were industry specific skills that were potentially of value to all teams in the industry, any individual team had very little incentive to invest in the selection, training and development of players without limits on player mobility (Becker, 1964). From the perspective of major league teams, this problem was solved by the industry’s exemption from the nation’s antitrust laws in 1922 and league rules that severely limited competition among teams for players.

The industry-imposed limitations on player mobility also made it more important for teams to identify and develop potentially outstanding players early in their careers. However, this objective was difficult to achieve because any valid selection device for predicting the performance of a young player required some information from observed performance on the diamond. Thus, a major league team needed a selection and training system that would allow the coaching staff to observe young players play baseball over an extended time period, permit the development of the more talented players, and prevent selected players from defecting to another team after they had proven they could be competitive in the major leagues.

We hypothesize the following complementary set of human resource practices that was refined or invented by Branch Rickey solved this second problem for major league teams. First, major league teams signed individual employment contracts with young players that had two key clauses which protected a team’s investment in player human capital. One clause gave the major league team the option on the baseball services of minor league players. Owning this option allowed a major league team to loan a player to a minor league team that it did not own and still be assured that the minor league team could not sell the player to another major league team. The second key clause was the “reserve clause” that gave the major league team ownership rights to a player’s baseball labor even if there was no salary contract
between the team and the player. This effectively limited the voluntary mobility of players from one team to another. The importance of these clauses is illustrated by the fact that by the end of the 1930s the St. Louis Cardinals had over 600 minor league players under individual contracts (Sullivan, 1990).

The option and reserve rights clauses made the investment in a farm team network by a major league team attractive because these clauses assured the major league team that it would capture the returns gained from identifying which “optionees” would be competitive in the major league. The ability to hold the option on the baseball services of young, undeveloped players provided teams with a farm team network a significant competitive advantage (Lazear, 1995).

The second element of the HR strategy developed by Rickey was targeted at the long term development of player skill. A network of relationships between the major league team and numerous minor league teams were used to train and develop the players who had signed individual employment contracts. Rickey, for example, developed a sophisticated scouting function which helped identify the “raw” talent that was the source of labor supply for his lower level teams. He also invented the use of the 2-5 day “tryout camp” to recruit and screen young athletes, introduced the “training camp” as a way to teach baseball fundamentals to inexperienced players and developed a crude information system to track the performance of individual players and their locations in the farm team network (Andersen, 1975).

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8 The option contract was not invented by Rickey. Its first reported use was in the 1870s (Sullivan, 1990). The option contract was, however, part of the “bundle” of HR practices that was integrated by Rickey to create a human resource management system.

9 The 1922 Supreme Court decision on baseball’s anti-trust exemption also ruled the reserve clause was legal.

10 Baseball labor regulations enforced at the time differ substantially from today’s baseball regulations. For example, time limits on option contracts (Dworkin, 1988) and “free agency” were only introduced after the time period studied (Chelius & Dworkin, 1982).

11 The information system included large blackboards on the office wall of the Cardinals farm team director where he kept track of the location of players in the network. Rickey was also known to carry a notebook containing performance information on individual players in the network (Andersen, 1975).
The farm team network and contractual limits on player mobility had many characteristics of an “up or out” internal labor market where inexperienced players entered the system through a team in the least skilled league (e.g., D league team) and were then “promoted” to more competitive teams if their performance was sufficiently high. Most players worked on a “D” league team for only one season and were either promoted into a higher level league or they left baseball for other jobs and careers. Ultimately, only a small percentage of players moved through the entire hierarchy and played in the major leagues, typically spending several years in the minor leagues. The system resembled an internal labor market because it had a well defined “entry port” and career path, but obviously differed from internal labor markets because it spanned several organizations that were linked together through working agreements, common ownership or informal understandings between owners. The farm team system may have also had an effect on player motivation by establishing a well defined promotion tournament (Lazear and Rosen, 1981) where players competed both for positions in higher level teams and played to maintain their current position relative to developing players coming from lower level teams in the system. The selection, training, promotion, and motivational features of this system are hypothesized to have had a positive impact on team performance. This leads to the following hypothesis:

$H_2$: A farm team network had a positive effect on team performance.

A farm team network included all the benefits of a reserve team network. A reserve team network was used to meet short-run staffing needs during the season that might be created by player injuries or poor player performance. Any team with a farm team network could also use players from one of the minor league teams for the same purposes. On the other hand, the reserve team system was less comprehensive than the farm team system because it did not include complementary recruitment, selection and training practices designed to facilitate long-term player development. We hypothesize the
bundle of complementary HRM policies included in the farm team system that aided long term player development had a larger impact on performance than the adoption of the simpler reserve team network:

**H3: The performance effect of the farm team system was larger than the performance effect of the reserve network.**

Evidence suggesting the farm team system had a substantial impact on the performance of the St. Louis Cardinals is evident in Figure 2 which plots data for the percentage of games won during a season over the 1905-1940 time period. The figure plots the winning percentage for the best and the worst major league team of each season and contrasts it with the fraction of games won by the Cardinals. The figure shows that from 1905 through the early twenties the Cardinals rarely came close to the winning percentage of the best team in baseball and frequently (5 years) had the worst record. After the 1922 season the pattern is reversed with St. Louis finishing with the best record in baseball or close to the best record in many years. Over the 1905-22 period the average season win rate for St. Louis was 43.4 percent and over the 1923-40 period the win rate was 55.6 percent or a 28 percent improvement. The change in performance corresponds to the development of the St. Louis farm team system and provides evidence consistent with H3. While this figure is informative, it is not an adequate test of H3 because the trend in Figure 2 may simply reflect a “St. Louis” or “Rickey” effect rather than the impact of the human resource system that began with the Cardinals but spread to the entire league. In the results we present later, we test whether the impact of the farm team system on performance extended beyond its apparent effect on the fortunes of the Cardinals.

The next hypothesis investigates the time period it took a farm team network to influence team performance. The cross-sectional design of most previous HR research in this area makes it difficult to identify the time period necessary to fully implement a radical change in organizational practice and realize the performance benefits (if any) from the innovation.
Why might there be a lag between the birth of a farm team network and the organizational performance effects? One explanation for a time lag focuses on the time it takes to develop the necessary managerial skill to successfully manage a farm team network. The successful farm team network required signing a large group of young players to individual employment contracts, development and management of a network of relationships between multiple minor league teams, monitoring player performance, and matching players to the various teams based on their changing skill levels. This was a complex set of management activities that may have taken several years to successfully master. A second explanation for a time lag focuses on the time necessary to develop major league quality player talent because it took several years for an eventually successful major league player to be promoted through the farm team network and contribute to a major league team (Andersen, 1975). Although we can’t differentiate between these two explanations in our data and do not have strong priors about the precise length of the time lag, we do expect the full performance effect of a farm team network on team outcomes developed only after several years. Formally, we hypothesize:

H₄: The effect of a farm team network on performance was fully realized only after it had been in place for several years.

The Data and Model Specification

A pooled cross-section/time series dataset of the win/lose records for the population of 16 major league teams for the seasons from 1919 through 1940 was constructed from secondary data (Thorn & Palmer, 1989; The Baseball Encyclopedia, 1990). Information on the reserve and farm team network for each team was coded for each of the major league teams using data from several sources (Minor League Digest: Inter-Club Organization, 1936-1940; Cardinals Farm Team Documents, 1925-1940; Jackson, undated). A major league team was coded as having a farm team network when the interorganizational linkages between a major league team and minor league teams fulfilled the following two conditions: (1)
the major league team had an alliance with at least 2 lower level minor league teams (e.g. B, C, D, or unspecified) that were not playing at a similar competitive level (e.g., both teams were not playing in B leagues); and (2) the team had an alliance with at least 1 minor league club playing at a high level of competitiveness measured by league classifications AA, A, or A-1. Because we don’t have data on player movement in the internal labor market created by the farm team network, the differing skill levels of teams in the network is used as a proxy for a system that selected and developed players by systematically moving better players from less to more highly skilled teams. Using these coding schemes, any team with a farm team network was also classified as having a reserve network because a major league club could use players from any minor league club in the network as a source of replacement players during the season. The effect of the time lag between the adoption of a farm team system and its impact on performance was evaluated by estimating models that include up to a ten year lag for the adoption of a farm team system.

In addition to the reserve and farm team network dummy variables, each regression model controlled for local market size using the population of the city where the team was located. City population estimates from the 1920, 1930, and 1940 U.S. Census were used to construct this measure and linear interpolation was used to estimate population values between each Census year. The dependent variable in all of the regression models was the fraction of games won by each team in each of the 18 seasons (WIN).12

Each regression model also includes a complete set of team and year dummy variables to control for the correlation between omitted variables correlated with performance and the timing of the adoption of the farm team system. Including the team dummy variables controls for any correlation between the winning percentage of teams prior to the “invention” of the farm team system and when a farm team

12 We have also estimated all of the models using the transformed dependent variable, log(WIN/(1-WIN)). While this is a more appropriate specification because the dependent variable is no longer constrained to fall between zero and one, the results using this specification are virtually identical to the results using WIN. This is probably because WIN falls within a relatively narrow range around .5.
The empirical results

Table 1 reports the regression parameter estimates for models that include the reserve team dummy and different lengths of the lag between performance and the existence of a farm team network. The first row of the table shows the estimated impact of having only a reserve team is small and never significantly different from zero across the different specifications. Thus, the data fail to support H1. Rows b-h of Table 1 show the coefficients on various lagged values of the farm team dummy variable. Collectively, these results are consistent with H2-H4.

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13 We report in the Tables both the coefficients and the estimated standard errors. Care should be used when interpreting the statistical tests of significance since the data used in this study include the entire population of major league ball clubs at the time the industry adopted reserve team and farm team systems. Because the population of clubs and not a sample of major league clubs is used in the analysis, statistical inference testing is not necessary to generalize to this population. Despite this caveat, we do believe the statistical tests are useful when comparing the different statistical models shown in Table 1.
Row i reports the p-value from the F-test of the hypothesis that the coefficients on the farm team variables are jointly equal to zero. Columns 1 reports the average effect of having a farm team system in year t on team performance in year t. The point estimate suggests a 0.018 change in the fraction of games won but this effect is not different from zero. Going across the columns from column 2 to column 7, the parameter on the longest lagged variable (e.g., t-k) measures the marginal effect on current performance of gaining another year of experience with a farm team. Thus, in column 2 the coefficient on Farm Team_{t-1} indicates that teams that had a farm team for at least one prior year had an estimated win rate 0.023 percentage points higher than teams who had just begun a farm team system (e.g., k=0). Therefore, the specification in column (2) implies that a team which began a farm team system in the current season could expect an increase in its win rate of 0.023 points next season.

The coefficient on Farm Team_{t} is an estimate of the effect on performance of starting a farm team in the current year on team performance in the current year. The sum of the coefficients on the farm team variables, which is shown in row j, is an estimate of the average total effect of having a farm team for at least k prior years relative to teams that have only a reserve team. Thus, column 2, row j shows the estimated effect of having a farm team this year and last year increases the win rate this year by 0.033 relative to teams that have only a reserve team system. The sum of the coefficients on the Reserve Team variable and all of the Farm Team variables in a model (row k) is an estimate of the effect of having a farm team for at least k years relative to teams that have neither a farm team system nor a reserve team.

Looking across columns 1-7 and comparing the magnitude and significance of the coefficient on the last lag variable suggests beginning a farm team four years prior to the current season (column 5) has a substantial and statistically significant impact on team performance relative to competitors that had a farm team three or fewer years. The coefficient on Farm Team_{t-4} in column 5 is 0.058 and is the largest estimated marginal effect on performance that is gained from an additional year of farm team experience relative to the marginal effects gained from a year of experience identified in the other specifications in
columns 1-7. In addition, the coefficients on Farm Team$_t$ through Farm Team$_{t-3}$ in column 4 are jointly not different from zero ($p=.767$) and the sum of these coefficients is not different from zero ($p=.215$). These results suggest a big jump in the performance effect from having a farm team system occurs in the fifth season following the adoption of the farm team system.

Column 6 adds Farm Team$_{t-5}$ and column 7 shows the estimates when Farm Team$_{t-6}$ is added to the specification. Although none of the coefficients are individually significant in these two specifications, the sum of the coefficients on Farm Team$_{t-5}$ and Farm Team$_{t-6}$ (e.g., $.026+.036=.062$) in column 7 is significant at the .05 level ($p=.027$). These estimates suggest a team with six or more years of experience with a farm team system prior to the current season had a win rate in the current season at least .062 points higher than teams with four or fewer years of prior experience with a farm team.

Column 8 shows the estimates for a specification that only includes Farm Team$_{t-4}$, Farm Team$_{t-5}$ and Farm Team$_{t-6}$. As expected, these coefficients change very little from the results in column 7 which show having a farm team system for less than four years prior to the current season has no significant impact on performance. Columns 9-11 show specifications using a lag of either four, five or six years. These coefficients are very similar to one another, again suggesting a significant one time jump in performance after four years of farm team experience. For this reason, in the remaining analysis we use a specification that measures the effect of the farm team system using only the Farm Team$_{t-4}$ variable.

One last point should be made about the interpretation of the .068 performance estimated effect of a farm team system that is shown in column 9. This value is the average difference in the winning percentage between teams with four or more prior years of experience with a farm team system relative to all other teams. The “other teams” in this comparison include some teams with a farm team system but that have not yet acquired four years of experience with the system as well as teams that have only a reserve team system and no farm team system. While the sum of the coefficients on Farm Team$_t$, Farm Team$_{t-1}$, Farm Team$_{t-2}$, and Farm Team$_{t-3}$ is not statistically significant, the point estimate of the effect on performance of having four or more years of experience relative to teams with no farm team system is
.100 with a standard error of .029 (row k, column 5). Thus, the coefficient on Farm Teamt-4 should be regarded as a conservative estimate of the effect of having four prior years of experience with a farm team system relative to teams that have not yet begun a farm team system.

The estimates shown in Table 2 report the results from different estimation strategies and models that test whether the farm team effect identified in Table 1 is simply due to a “St. Louis” effect or whether the system developed by Branch Rickey had a positive impact on the performance of later adopters of the system.

The first three columns of Table 2 report estimates using an OLS model without time or team fixed effects (column 1), a model that includes only team fixed effects (column 2) and a model that includes only time period fixed effects (column 3). Column 4 reproduces the estimates from a model with both team and time fixed effects reported in column 9 of Table 1. Compared to the estimates with both time and team dummies, the model without time and team dummies and the model with only team effects understates the impact of the farm team system while the model with only time dummies overstates the effect of having a farm team system. The joint hypothesis that the team effects are jointly equal to zero for the specification shown in column 4 is easily rejected (p<.001). Although the hypothesis that the time effects are jointly equal to zero (conditional on team effects) is not rejected (p=.246), we adopted the more conservative model and continue to include both time and team fixed effects.

The specification in column 5 includes an interaction term between the St. Louis team dummy and Farm Teamt-4. The coefficient on this variable measure the average impact on performance of the farm team system for St. Louis relative to other teams with four or more years of experience with a farm team system. While the coefficient on this variable is positive, it is statistically insignificant and suggests St. Louis was no more successful than other teams with four or more years of experience with a farm team system. Note that the coefficient on Farm Teamt-4 declines only slightly from .068 to .065 with
virtually no change in the standard error. Thus, teams other than St. Louis benefited significantly from the adoption of the system invented by the Cardinals and Branch Rickey.

Since several years passed before other teams adopted the farm team system, columns 6 and 7 report estimates where the time period from 1919-1940 is divided into two time periods. The estimates for the 1919-31 period shown in column 6 coincide with the period when only two teams, the St. Louis Cardinals in the National League and Detroit in the American league had four or more experience with a farm team system. For these two teams over this time period, the average performance effect is .08 and significant. The specification in column 7 shows this positive effect is due entirely to the “St. Louis” effect. Compared to teams with less than four years of prior farm team experience, the St. Louis win rate was .101 points higher (e.g., .009+.092).

Column 8 shows the estimates for the 1932-40 time period. The .058 coefficient is an estimate of the change in performance during the 1932-40 time period for teams other than St. Louis or Detroit that acquired four or more years of farm team experience. While the coefficient on Farm Team_{t-4} is smaller in the 1932-1940 time period than the .101 coefficient that identifies the effect of the St. Louis system over the 1919-31 time period, the difference between these coefficients is not statistically significant. The conclusion we draw from Table 2 is the farm team system did have a significant effect on team performance throughout the time period and that this effect on performance was shared by teams that copied the practices pioneered by St. Louis. Table 2 also provides modest but not strong support for the proposition that the benefit St. Louis gained from the system over the 1919-31 time period was larger than the benefit gained by adopters that gained four or more years of experience with the system during the 1932-40 time period.

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14 This coefficient does not include the impact of the farm team system on the performance of either Detroit or St. Louis because these teams had values of Farm Team_{t-4} equal to “1” over the 1932-1940 time period. Thus, the impact of the farm team system on these two teams is fully absorbed in the team fixed effect terms.
The final set of models that were estimated are reported in Table 3. This table reports estimates separately for the National and American league. In the National League St. Louis was the first adopter of the farm team system and Detroit was the first adopter in the American League. In the first model for each league (columns 1 and 3) only the Farm Team\textsubscript{t-4} variable is included and in the second model (columns 2 and 4) an interaction term between Farm Team\textsubscript{t-4} and a dummy variable for either St. Louis or Detroit is also included. These results are very consistent with the estimates in Table 2. In the two leagues there is a positive and virtually identical average performance effect between adopters with four prior years of experience relative to non-adopters and adopters with less farm team experience (.073 and .074). These estimates decline only slightly after controlling for the adoption effect of St. Louis and Detroit and the average effect across the two leagues for later adopters is .0645 with a standard error of .024.

**Discussion and Conclusions**

The farm team network was a significant innovation in the way baseball teams managed their human resources. It included individual player contracts that limited player mobility, a network of affiliated minor league teams, and a set of human resource practices intended to develop player talent. These management routines imbedded in the farm team system allowed major league teams to better recruit, select, and invest in the training of new players, giving major league clubs with a farm team system a significant competitive advantage. Although we lack the data necessary to identify the performance effects of either the individual components of the farm team system or any synergistic effects of the components of the farm team system, the estimates show the combined effects of this system had a substantial effect on a team’s winning percentage that was not confined to the St. Louis Cardinals. By 1938 five teams besides St. Louis had four or more years of experience with a farm team system and by 1940 the number had increased to thirteen. The results show the gains in performance enjoyed by these later adopters were approximately equal to the benefits enjoyed by St. Louis.
The benefit of a farm team system on team performance was not immediate. The estimates show virtually no improvement in team performance three years after the creation of the farm team network. However, after four years of farm team experience the fraction of games won by adopting teams improved by .068 points relative to non-adopters and adopters with less than four prior years of experience with the system. This result could reflect the two explanations identified earlier. First, the major league team had to learn to manage the interorganizational relationships and how to integrate the different HR practices into a consistent HR system. Thus, it may have taken several years after establishing the network relationships to develop the scouting, coordination and coaching expertise to effectively use the network. Secondly, the time lag could be attributable to the time it took to graduate player talent from the network in sufficient quantity and quality to improve a team’s win/lose record. We suspect there is some truth in both explanations and future research might attempt to identify the relative importance of these explanations.

What are the implications of these results for our understanding of the effect of human resource practices in other industries and in other time periods? On the one hand, this study has a high level of internal validity that was achieved through the use of panel data from a single industry. This design provides us with more confidence that the estimated effects of the farm team system were caused by the adoption of the farm team system and not due to omitted variables correlated with the adoption decision. On the other hand, concerns about whether these results generalize to other settings is a potential problem for any study of human resource practices in a single industry (MacDuffie, 1995; Dunlop & Weil, 1996; Ichniowski et al., 1995). Indeed, if the theory that human resource practices need to complement other practices of the firms is correct, the specific practices found to influence performance in one industry may have little to say about the precise set of practices that will be effective in another setting. Where complementarities between human resource practices and firm choices regarding production settings, information technology and work design are especially important, we’d expect limited generalizability to other industries. Baseball and the farm team system may fall into this category. Nevertheless, we think the results generate several conclusions that extend well beyond this particular industry and time period.
First, the results show the importance of linking human resource policies to the external environment. In their study of the U.S. apparel industry, Dunlop and Weil (1996) show the importance of the links between changes in the external product market, information technologies and human resource practices. In their study, modular manufacturing and complementary changes in training and compensation systems were driven by changes in the supply-chain management practices of large “lean” retailers. Our results show how the success of human resource practices also depends on characteristics of the labor market which are imbedded in the legal and institutional setting. The farm team system worked for teams because of the enforceability of the contracts which limited player mobility and gave teams control over the baseball labor services of players under contract even when those players were “farmed out” or loaned to minor league teams. It is unlikely the sophisticated farm team system observed during this time period could have developed if teams did not hold the option on the baseball playing careers of players in the farm team system. By implication, our results suggest the absence of social or legal limits on worker mobility in the U.S. labor market places a limit on general or industry specific training, especially across organizational boundaries (Becker, 1964). On the other hand, the estimates show the potential value to firms of an interorganizational training network in other national settings where there are more formal or informal restrictions on employee mobility beyond an interorganizational network.15

Second, the time lag before the organizational performance effects were observed in the data has implications for the evaluation of new management practices. Evaluations of high performance work practices based on either a single cross-section of data or a very short panel may be misleading and seriously biased downward. Thus, contemporary efforts to evaluate the performance impact of new HR, work design and management practices (e.g., team production systems, TQM) must include the collection of time-series data on both organizational performance and the adoption process over an extended time period.

15 We do not mean to imply that the farm team system was socially optimal. The legal limits on worker mobility in baseball gave teams monopsony power and undoubtedly benefited teams and their owners at the expense of the players (Scully, 1989; Dworkin, 1986).
Thirdly, we show a strong positive performance effect of a human resource system on organizational performance. This finding contributes to the growing literature that seeks to quantify the performance effects of human resource practices on organizational performance.
References


