Firm- specific human capital in different market conditions: evidence from the Japanese football league

Yamamura, Eiji and Ohtake, Fumio

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FIRM-SPECIFIC HUMAN CAPITAL IN DIFFERENT MARKET CONDITIONS: EVIDENCE FROM THE JAPANESE FOOTBALL LEAGUE

Eiji Yamamura (Seinan Gakuin Univ)

Fumio Ohtake (Osaka Univ)

Abstract

This paper examined how meeting the team-specific human capital is important in a football player's performance by comparing the top two league teams. From panel data of the Japan Professional Football League, we find that changing the team reduced a player's performance and that the team's performance improved as each player's tenure in the team increased, the returns from team-specific skills over time increased and then decreased as the years passed, the benefit from moving to a new team depends on the timing of moving, and neither tenure in the team nor experience affects a professional football player's performance.

JEL classification: J24; J69; L83; O15

Key words: Firm-specific human capital, Professional football, Player performance, Matching.

1. INTRODUCTION

How and to what extent does the productivity of labor decline when an employed worker is displaced from a job he has been working? This is one of the major questions a large number of researchers have been tackling in labor economics (e.g., Topel 1991; Jacobson et al. 1993; Kambourov and Manovskii 2009). Human capital can be classified into general and specific skills based on its influence on employee productivity. Specific skills are accumulated through experience. This can be roughly classified into three types. First, consider the workers of Coca-Cola. They cannot use their skills in Pepsi. When a skill gained in one firm is not useful in another, that skill is firm specific. Second, workers in a manufacturing industry have no use of their skills if they change work to another industry. This type of skill is industry specific. Third, workers belonging to the research department of a firm cannot use their research skills in the sales department. This shows that every occupation requires specific skills. Thus, a question that arises is, what are the important specificities in the labor market? The literature has conflicting views on this. Researchers have found that investment in occupation-specific skills is an important determinant of worker productivity (Shaw 1984, 1987; Zangelidis 2008; Kambourov and Manovskii 2009)[1]. Some have observed that tenure in an industry has a significant impact

[1] "It is true that the work setting (industry) can affect the job one performs, it seems implausible that the human capital of these workers is specific to the industry they work in rather than to the

on worker productivity (e.g., Neal 1995; Parent 2000). These studies have tried to derive general arguments on the role of occupational and industry specificities in the labor market from data covering various industries and occupations. This paper deals with the issue of firm-specific skills from a panel dataset of professional sports, because sports teams can be considered as firms, and we can pursue the player mobility between teams to explore the importance of professional skills.

Professional sports provide very useful data to examine the relation between productivity and tenure, because sports data include various individual performance records for sportspersons to pursue (e.g., Chapman and Southwick 1991; Ohtake and Ohkusa 1994; Ohkusa and Ohtake 1996; Prisinzano 2000.). Accumulated team-specific capital reduces the likelihood of player turnover when the firm-specific human capital hypothesis holds true in professional sports (Glenn et al. 2001). However, these works did not consider the difference in quality of goods provided by firms. The quality of goods provided by firms improve as the industry develops. In the less-developed stage of an industry, firms need to produce standardized and less differentiated goods in mass

type of work they do (their occupation)... when a truck driver switches industries (say, from wholesale trade to retail trade) or employers, he loses less of his human capital generated by the truck-driving experience than when he switches his occupation and becomes a cook" (Kambourov and Manovskii 2009, 64).

production (Otsuka and Sonobe 2006). In this case, firms demand labor with general skills rather than specific skills. However, in the developed stage, the quality of goods has to improve and be differentiated for firms to survive under competitive pressure, and for this, firm-specific skills are more likely to be required. In short, the importance of firm-specific human capital could depend on the development level of the industry. This paper focuses on a particular industry and examines how firm-specific human capital becomes important when we consider the difference in quality of goods produced by firms. Players improve their performance depending on their tenure in the team, because their team-specific human capital will accumulate over time. However, the team-specific human capital of a player in a team is useless for other teams. A player's performance will reduce once he changes his team. However, no study has so far considered the following dynamics. When team members gradually changed, the value of the players' team-specific human capital reduced, because cooperation and mutual trust between players is critical to realize the team strategy. A player's performance could possibly reduce if he stayed in the team for too long.

In the Japan Professional Baseball League (JPBL), players were required to acquire only general skills in any team, because team-specific skills are unlikely to exist (e.g., Ohtake and Ohkusa 1994; Ohkusa and Ohtake 1996). Unlike the Major Baseball League

(MLB) in the United States, the JPBL follows almost the same strategy for all teams (Ohtake and Ohkusa 1994)[2]. We can consider the difference between MLB and JPBL as follows. Compared to the United States, Japan has a more homogenous society. Therefore, unlike the MLB teams, JPBL teams share similar strategies and skills. Second, JPBL is at a lower level than the MLB. For lower-quality players in a less competitive situation, team-specific capital is less likely to contribute to win. However, in the 21st century, a large number of Japanese players moved to the MLB and exhibited spectacular performance[3]. Japanese players have improved significantly, and the JPBL has become more competitive than ever before. Increased competitive pressure in the market naturally made the teams to vary their strategy, leading to accumulated team-specific human capital.

The J-League was believed to experience similar conditional change due to transfer of skills from the more developed European leagues. The J-League is different from the JPBL in that they have a two-division system, with different teams playing for the first division (J1) and second division (J2)[4]. The champion and second-placed teams in J2 can

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2 Despite differences between JPBL and MLB, a large number of MLB players came to Japan to play in JPBL and greatly influenced JPBL (Kawaura and Croix 2016).

3 For instance, Ichiro, Hideki Matsui, Yu Darvish, Masahiro Tanaka, Hiroki Kuroda, Koji Uehara, and Shohei Ohtani.

4 In the JPBL, the same team is the first team and the farm team. For an example of

be promoted to J1. Top-class J-League players tend to play as members of the J1 teams, because the first division teams require players with higher performance than the J2 players. Accordingly, the J1 can be considered a more advanced league than the J2. Hence, it is plausible that specificity of skills is required in J1, but not in J2. We can examine whether the importance of firm-specific human capital depends on the developmental stage of professional sports by comparing the J1 and J2. Furthermore, various indices measure player performance. The level of player interdependence is critical, but varies by play. For instance, compared to "shoot," the success of "pass" is more likely to depend on the players' interdependence. Hence, the success of shoot is unlikely to depend on firm-specific human capital even in J1. Using the individual-level panel data of the J-League, this paper examines how the matching of players and teams depends on team-specific human capital by comparing the team-specific and general skills. Furthermore, we consider the effect of long-term deterioration of team-specific human capital. Our main findings are as follows. Increase in a player's tenure in a team accumulates his team-specific human capital and therefore improves the team performance in J1, but not in J2.

the Hawks, players of the first team might be relegated to the farm of the Hawks if their performance did not meet the level of the first team, although this mobility is within the Hawks.

However, from a more long-term viewpoint, the benefit of staying in a team disappears after 4 years from the rookie year. On the other hand, in J2, experience in the J-League is not an important determinant of player performance, because only players with talent to play in the J-League will survive.

The remainder of this paper is organized as follows. Section 2 presents our setting by overviewing the J League. Section 3 explains the data. Section 4 proposes our empirical method and presents the estimation results and their interpretation. Finally, section 5 concludes the study.

2. OVERVIEW OF PROFESSIONAL FOOTBALL LEAGUE IN JAPAN

In Japan, baseball had been the most popular team sports, with professional team sports almost monopolized by the Professional Baseball League, until the beginning of the 1990s[5]. Almost every day, professional baseball games had been on air. Naturally, the most physically talented boys had the motivation to play baseball and become professional baseball players. However, the establishment of the J-League in 1993 changed the situation. A number of star players were transferred from professional

[5] Traditional "Sumo" wrestling is also very popular in Japan. However, the Sumo is not a team sports, and so is unlikely to make the team sports market competitive.

football leagues in South America and Europe to the J-League. For example, Zico played in the J-League during the early stages, and more recently, in 2018, Andres Iniesta moved from FC Barcelona to Vissel Kobe.

The skills and performance of players in the J-League improved significantly for almost 25 years. Prior to 1993, the Japanese national team consisted of amateur players, and its performance was far below the level required to advance to the FIFA (the Fédération Internationale de Football Association) World Cup[6]. The Japanese team won its preliminary competition and qualified to play—for the first time—in the 1998 World Cup held in French. Thereafter, the Japanese team qualified five times in a row to play in the World Cup (2002, 2006, 2010, 2014, and 2018)[7]. In 1999, the J-League introduced a two-division system by setting up the J1 and J2 leagues. J1 is the top league of the J-League, and consists of teams performing at a higher level than the J2 teams. In 2004, the two J2 teams that won the first and second positions in the season of the J2 were promoted to the J1 League, while two J1 teams that came last and second-last in the season of the J1 were relegated to the J2 League. The J1 players required higher performance levels

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[6] About 200 countries belong to the FIFA, but only 32 teams can participate in the final tournament of the FIFA World Cup by winning the preliminary rounds.

[7] Japan and Korea were the host countries of the 2002 World Cup. Therefore, these countries were not required to win the preliminary rounds to advance to the World Cup.

than the J2 League players. As the J-League developed, the performance of their players varied (Yamamura 2015). That is, some of the star J-League players moved to the European football league and exhibited excellent performance. For instance, Hidetoshi Nakata led the AS Rome to win Italy's Serie A in 2001, enabling the AS Rome supporters to celebrate their championship after an interval of 18 years. Shinji Kagawa was the key player when "Borussia Dortmund" won the 2010–2011 season in Germany's Bundesliga after an interval of 9 seasons. On the contrary, some reserved J-League players could hardly play any game in the J2 and J1.

Players expected to perform excellently are more likely to play in a game. They would play subsequent games only if they actually meet the expectation of their team management. Therefore, in this paper, length of play time is a proxy variable for a player's general performance. Figures 1 (a) and (b) used kernel density to illustrate the total individual play time distribution in the J1 and the J2 league seasons, respectively. The figures compare the incumbent players with "moved players," defined here as those who moved from other J-League teams, and the rookie players at the start of each season[8]. Therefore, the present moved players would be the incumbent players in the next season if they did not change teams. A cursory examination of Figure 1(a) shows twin peaks for

[8] In Figures 1 (a) and (b), we do not distinguish between the players moving from the J1 and J2.

incumbent players, but not for the moved players in J1. Further, a larger number of incumbent players played more than 2000 minutes than the moved players. A note to Figure 1(a) shows a statistical difference in distribution between "incumbent players" and moved players. It is obvious that the incumbent regular player appeared in the pitch longer than moved players. Generally, moved players were treated as reserved players in the J1.

Turning to Figure 1(b) for J2, the range over 1000 minutes showed no distinct difference in play time between incumbent and moved players. Furthermore, as regards players with play time below 1000 minutes, the incumbents surpassed moved players, leading to a statistically significant difference between the incumbent and moved players. The difference between the J1 and J2 implies that the top J-League players were from the J1 teams and played regularly, while the J2 players showed little difference in skill and performance. Furthermore, the star J1 players are less likely to change teams. From Table 1, 18% of players moved in from other teams at the beginning of the season in the J1 League, while 24% moved in the J2 League. Thus, labor mobility was more evident in the J2 teams than J1 teams. What we can infer from this is that because team-specific human capital was required in J1, players accumulated their human capital; that is, they learned the team strategy and obtained the required skills to play as a team. This is consistent with the firm-specific human capital hypothesis (see Brown 1989; Topel 1991;

Glenn et al. 2001), rather than the matching hypothesis (see Chapman and Southwick 1991; Borland and Lye 1996; Brown et al. 2007). From Table 1, 42% of the team managers in the J1 were non-Japanese, which is significantly higher than the 9% non-Japanese managers in the J2. This is consistent with the argument that leading-edge football strategies are transferred from the football developed to less-developed countries through managers coming from the developed countries (Yamamura 2009). However, the manager turnover rate in the J1 League is 9%, which is higher than the 5% in the J2 League. Managers find it difficult to train the teams in sophisticated strategies and skills due to the difference in culture and language between them and the players.

3. DATA

We obtained the J-League player's individual basic information and career data from the Soccer Digest (various years), which gives the players' nationality, age, educational background, position, years of debut in the J-League, and teams played for. Further, it provides information about the manager of each team. Apart from these basic data, we gathered the data of player performance. The data included six measures of the J-League players' performance in each season from 2012 to 2016, and were based on the "Football

LAB" database[9]. We constructed the original data by matching the basic data and players' performance data. Our J1 sample included 755 players who appeared frequently for five seasons, thus leading to 2048 observations. The J2 sample included 1150 players who appeared frequently during the seasons, leading to 2909 observations.

During the studied period, several players changed their teams. In these cases, they played for a team that required their human capital gained from their former team. In a season, the J1 League has 18 teams and the J2 League has 22 teams. However, as explained earlier, promotions and relegations occur between the leagues. Hence, every year, the sets of the J1 and J2 teams keep on changing.

The roles of professional players in the teams varied, with their performances depending on their interdependence (Glenn et al. 2001). The performance of football players should be evaluated using various indices (Carmichael et al. 2000). In this paper, we use the following six indices to evaluate the players' performance.

(1) Total play time during the season

(2) Offense

(3) Pass

[9] The source is the site, but it is in Japanese. http://www.football-lab.jp/uraw/?year=2012 (Accessed on August 1, 2017).

(4) Cross

(5) Dribble

(6) Shoot

The primary player performance index was captured by total play time during the season, as already used in Figures 1 (a) and (b). A player has his own strong point. For instance, some players have refined skills in passing, while others have agility for dribbling. Thus, player performance can be evaluated by various skills. The Football LAB calculated the various player performance indices from the point of “chance building point” (CBP). The various player contributions in the field are classified by category (e.g., pass, cross, dribble) and field area, and evaluated by degree to prepare for shoot and difficulty level. To take an example, a player passed 1000 times, and his passes led to shoot 100 times. In this case, his pass contribution to shoot has a 10% point. In addition, passing in the opposite half is more difficult than passing in the own half from the opponents’ pressure, which is stronger in opposite half. The difficulty in each area is calculated from the accumulated data in the J-League. Thus, the players’ performances are evaluated by the rate of reaching a difficult shooting. Cross and dribble performances are evaluated in a similar way. Further, the index of offense is calculated by aggregating the pass, cross, and dribble index scores. Additionally, the shooting index is simply calculated by the rate of shots onto the goal[10]. In order to compare these variables, we use standardized variables in this paper, except in Figure 1[11]. Therefore, as shown in Table 2, these performance indices have possibly both positive and negative values.

The total play time in a season reflects the overall performance because players with higher performance are required to play more. The specificity of team skills from the viewpoint of player interaction is critical in the sports labor market because skills vary depending on the interdependence of players (Glenn et al. 2001). Apart from total time, player performance measures are roughly classified into two:

(I) team-specific skills required to understand and share the team's strategy and philosophy (offense, pass, dribble, and cross);

(II) general skills that depend only on the individual (shoot).

The teams are assumed to need a team-specific strategy and philosophy to win in the J-League. Since these are required more in the J1 than J2 league, the team can realize its

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[10] A detailed definition is provided in the site, but it is in Japanese. http://www.football-lab.jp/pages/cb_point/ (Accessed on March 1, 2019).

[11] In this case, "X" is the variable. Its average value and standard deviation in the sample are $\overline{X}$" and"ρ", respectively. The standardized value is calculated as "$(X-\bar{X})/\rho$".

strategy in J1 if the players shared their team-specific skills (understanding the team philosophy and mutual trust of team members). The need to adjust individual skills to the team-specific skills are considered more important in J1 than J2 to achieve the marginal product of players.

The data provide information on the season's rookie and the players who moved from other J-League teams. Further, the players who moved are categorized as those moving from the same division and from a different division. Thus, we compare the performance of incumbent players, rookie players, those who moved from the same division, and those who moved from a different division.

4. METHOD AND ESTIMATION

4.1 EMPIRICAL METHOD

This paper examines how firm-specific human capital can increase player productivity based on performance. We assess the relationship between player performance and team tenure by comparing the J1 and J2 leagues. We estimate various versions of the following econometric model:

$$\text{Performance}_{itkn} = \propto_0 J\_Tenure_{it} + \propto_1 Team\_Tenure_{itk} + \propto_2 Rookie_{it} + \propto_3 Move\ within_{it} + \propto_4 Move\ from\ J2_{\ it} + \theta_{it} + e_{itkn}, \quad (1)$$

where *Performance* is the performance of player i in period t, with team k and type of performance n; e_{itkn} is an error term. The key variables *J_tenure* and *Team_tenure* denote the player's tenure with J-League and the team, respectively. *J_tenure* is the learning effect of general skills through experience in the J-League. *Team_tenure* captures the learning effect of team-specific skills. From our argument thus far, we predict *Team_tenure* to have a positive sign in J1, but not in J2, when the players' skills are considered to depend largely on their degree of interdependence. Therefore, we do not predict *Team_tenure* to be statistically significant when the dependent variable is shoot for both J2 and J1.

Rookie is a dummy variable that takes the value of 1 when the player is in the first year with the J-League. In the J1 sample, *Move within* and *Move From J2* are dummy variables that take the value of 1 when the player is in the first year with the team after moving from other teams in the J1 and from the J2, respectively. We consider these in order to explore how the effect of team change differed in a situation. *Rookie* would have a negative sign if a gap existed between the skill levels required for the J-League and amateur teams. *Move within* captures the team-specific human capital effect. The general skill level in a league is the same, but the team-specific skills may vary depending on the teams. Thus far, we have shown that team-specific human capital is important in J1 but not in J2. Thus, we predict *Move within* to have a significant negative sign only in J1. A gap might exist in the required skills between J1 and J2. Therefore, players moving from J2 to J1 would find it difficult to adjust with the team because their skill levels do not meet the J1 level, leading to poor performance. Thus, as presented in Table 2 Panel A, the incumbent players and those who moved from J2 show difference in performance, with the moved players performing far below the incumbent players in J1, except for shoot. Thus, we predict *Move From J2* to have a negative sign in the J1 sample estimation. Conversely, players who move from J1 to J2 would easily adjust with the team and perform excellently even in the first year, because their skill levels exceed those of the J2 players. Consistent with this, as shown in Table 2 Panel B, the incumbent players and those who moved from J1 show difference in performance, with the moved players performing generally better than the incumbent ones in J2. Accordingly, we predict *Move From J1* to have a positive sign in the J2 sample estimation. As in previous studies (e.g., Altonji and Shakotko 1987; Kambourov and Manovskii 2009), the model contains the square and cube terms of *J Tenure* and *Team Tenure*. In addition, to control for the effect of manager change (De Paola and Scoppa 2012), the data include the dummy for manager change.

The other factors influencing performance can be captured as

$$\theta_{it} = \gamma_i + \mu_{ik} + \tau_{it}, \qquad (2)$$

where γ_i is an individual-specific component; μ_{ik} is a team-match component; τ_{it} denotes other control variables in (1), including an intercept term, year dummies, team dummies, age, and a square term for managers' age and characteristics.

We start with an ordinary least squares (OLS) estimation of model (1). However, the unobserved player–team match components are likely to be correlated with the tenure variables and dependent variable. One might expect a player with better team match to have a longer tenure and exhibit better performance. This correlation can bias the OLS estimation results model. To address this issue, we can use the established instrumental variable method employed in previous studies (Altonji and Shakotko 1987; Parent 2000; Kambourov and Manovskii 2009). Specifically, assuming that $\overline{Team\_Tenure_{ik}}$ is the average team tenure of player *i* during the current playing spell in team *k*, the instrumental variable is $\widetilde{Team\_Tenure}_{itk} = Team\_Tenure_{itk} - \overline{Team\_Tenure_{ik}}$ The squared and cubed team tenure variables are similarly instrumented: $\widetilde{Team\_Tenure}_{itk}{}^2 = Team\_Tenure_{itk}{}^2 - \overline{Team\_Tenure_{ik}}^2$ and $\widetilde{Team\_Tenure}_{itk}{}^3 = Team\_Tenure_{itk}{}^3 - \overline{Team\_Tenure_{ik}}^3$.
By construction, these instruments are orthogonal to the player–team match component. Similarly, we instrument the J-League tenure variable with its deviations from its

means.

When we use panel data to follow individuals over time, the error terms for an individual would be serially correlated. Consequently, we estimate the instrumented model with generalized least squares, a procedure referred to as IV-GLS.

4.2 ESTIMATION RESULTS

The J1 and J2 baseline results are reported in Tables 3 and 4, respectively. Table 3 shows that the coefficient of "*J_Tenure*" is positive and statistically significant, except in column (6). However, the coefficient of "*Team Tenure*" shows variations by column. Hence, an increase in tenure of the J-League has a positive correlation with the players' performance, whereas the relationship between team tenure and player performance is ambiguous. Note that *Rookie*, *Move within*, and *Move from J2* have a negative sign and are statistically significant at the 1% level, except for column (6). Therefore, the players are likely to perform poorly in their first year in a team. The rookies' experience in the J-League is less than a year, although they would have accumulated experience outside of the J-League. Therefore, their skill can be considered similar to the top-level amateur player skills. The absolute value of the "*Move from J2*" coefficient is almost twice that of the "*Move within*" coefficient, implying that former J2 players have far lower skills than former J1 players. That is, the absolute difference in value between *Move within* and *Move from J2* reflects the difference in level between the J1 and J2 players. Further, the reason for *Move within* to show a significant negative sign is that team-specific human capital is important for good performance. The reason of the statistical insignificance of "*Rookie,*" *Move within,* and *Move from J2* in column (6) could be that the quality of shoot does not depend on the interdependence of players, and that no quality difference exists between the top-level amateur and J-League players.

Table 4 shows that the coefficients of *J_Tenure* and *Team Tenure* are positive and statistically significant in most columns. Thus, the J-League and team tenures are positively correlated with player performance when team-specific skill is considered. The results for *Rookie* are similar to those shown in Table 3. This indicates the gap in level between the J-League and top-level amateur players. However, the general skills required for shoot are almost the same for the J1, J2, and top-level amateur players. *Move within* surprisingly does not show statistical significance in any column, which is remarkably different from the results in Table 3. As for J2, moving in from other J2 teams does not influence the player's performance level even immediately. Thus, the skills required in J2 is not team specific. "*Move from J1*" has a significant positive sign in columns (2)–(5), implying that J1 players have better skills than J2 players, and so perform better after moving to J2.

Tables 5 and 6 include the squared and cubed *J_Tenure* and *Team Tenure*, and provide the results for J1 and J2, respectively. In both tables, the OLS estimation results are reported in Panel A and IV GLS results are given in Panel B. Panel A of Table 5 shows a significant positive sign for *J_Tenure* and *"J_Tenure^3"* and a significant negative sign for *"J_Tenure^2"* in most cases. The exception in results is when *Shoot* is a dependent variable. *Team Tenure* does not indicate statistical significance in any column. Turning to IV GLS, Panel B of Table 5 shows the same estimated coefficients for *J_Tenure* as in Panel A. The estimated coefficients for *Team Tenure* is similar to those for *J_Tenure* in IV GLS. In our interpretation, players obtain general as well as team-specific skills through experience in a team when the estimation biases are controlled for in IV GLS. This implies that J1 requires specific human capital, because a unique strategy and philosophy are critical for J1 teams to win as they catch up with the teams in the European Football League in Spain, England, Italy, and Germany. For an example of teams in Europe, FC Barcelona and Real Madrid are obviously different in strategy and philosophy, but are the top-level club teams in the world. So, the J1 players need to have talent for football, learn the team philosophy, and be fit for the team. On closer interpretation, the coefficients of *"J Tenure"* in IV GLS are larger than the OLS estimations, implying that a highly talented player is likely to move to the European Football League early in his career even if he can stay with his J-League team. Hidetoshi Nakata and Shinjin Kagawa are role models for highly talented players to exhibit their skills in the European League. For another interpretation, top-level players are selected to the Japan national team, who over-schedules their career path. They have difficulty in maintaining their schedule since they have to play for their J-League team as well as for the national team. Furthermore, they frequently have to go abroad to play for the national team and then return to Japan to play for their J-League team. Thus, they become physically and mentally exhausted, and increase the risk of injury. Injury increases the probability of talented players leaving their team and retiring early from the J-League.

Next, we consider Table 6 for the J2 players. Panel A shows a significant positive sign for *J_Tenure* and *J_Tenure,* and a significant negative sign for J_Tenure^2 in most cases. Similar results are observed also for *Team Tenure*. However, in Table 6 Panel B, surprisingly, both *J_Tenure* and *Team Tenure* are not statistically significant in any column. That is, the significance of *J_Tenure* indicates that talented players can survive and increase their tenure in the J-League. Similarly, the significance of *Team Tenure* implies that players with better team match are likely to increase their tenure in the team. The relation between players' tenure and performance would disappear if these matching effects are controlled for. That is, players do not have to train and obtain general and team-specific skills in order to improve performance in the J2 teams if they are already a J-League player. Further, *Move within* does not show statistical significance in most cases. Players with enough talent to play for a J2 team can play for other J2 teams even if they do not improve their skills and attain the team specificity to adapt themselves to the team. Naturally, players are less likely to have an incentive to acquire team-specific skills in J2 because they can survive in the team only if they have the talent to play in J2. That is, in order to continue to play in J2, the only criterion is the talent to match the job of professional football players (Jovanovic 1979). In addition, the gap in level between J1 and J2 reduces the J2 players' incentive to improve their skills because they are unlikely to meet the J1 level. Thus, J2 players might fall into a rut and pass the day aimlessly, while J1 players improve their skills to survive in J1, and have burning ambition to move to the European Leagues, like Hidetoshi Nakata and Shinji Kagawa, in the future. Inevitably, the difference in talent between the J1 and J2 players have become larger over time.

On the whole, team-specific skills are not important in J2; this is consistent with the earlier studies on professional sports in Japan (Ohtake and Ohkusa 1994; Ohkusa and Ohtake 1996). J2 teams do not have a team philosophy, and so adopt the same strategy in all games. However, the J1 League is distinctly different from J2 League. As Table 1 shows, non-Japanese were managers of 40% of the J1 teams but only 9% of the J2 teams. European League teams have a longer history, and are far more matured and competitive than the J-League teams. Naturally, each European club team has a unique philosophy and strategy to win and fascinate their supporters. The non-Japanese managers seem to have taught the J1 league players the importance of team-specific skills based on the team's philosophy. However, the J2 league teams are more likely to stick to the domestic and common strategy. From our observations, the importance of team-specific skills depends on how the J-League catches up with the European Leagues, and not on the Japanese culture. This implies that competitive pressure increases the importance of team-specific human capital.

4.3 SIMULATION

From the results in Panel B of Table 5, we visualize the effects of *J Tenure* and *Team Tenure* on the standardized playing time in the J1 league in Figure 2. These are the effects of learning the general skills and team-specific skills, respectively. Clearly, the general skills have larger effects than the team-specific skills. We observe an inverted U-shape form, implying that both effects increased the playing time from the start and then decreased after reaching the peak. The general skills learning effect reached the peak 6 years after the rookie year, whereas the team-specific skills learning effect reached the peak when the team tenure reached 2 years. The team-specific skills learning effect disappeared when the team tenure reached 5 years. That is, the performance of a player with team tenure of five years is equal to that of a player in the first year of the team, other things remaining equal.

Naturally, the players' performance deteriorates over time with the decline in physical strength. However, the aging effect is controlled for in the results shown in Table 5 by including age and its square as independent variables. Therefore, Figure 2 does not reflect the aging effect on performance. From Figure 2, the acquired team-specific skills deteriorate over time. In football, the interdependence of players has a critical role in improving team performance. The reason for fall in team tenure effect is that the optimal skills matching of the team would change when a player moves out from the team. For an example, when Andres Iniesta moved, the other players of the FC Barcelona had to change their play style slightly, although the FC Barcelona had a firmly established philosophy to play. As for *J Tenure*, only about 25 years have passed since the J-League was established. Therefore, the J-League is in "the developing stage," and less matured than the European League. Thus, the strategy and skills required have changed, especially in J1, through the transfer of sophisticated strategy from the European League with the inflow of foreign managers and players to J1. The J Tenure effects thus reduced as the time passed. The strategy and skills of players gained through experience in J1 became outdated from the inflow of new talent from the European League.

Figures 3 (a) and (b) trace the players' performance measured by play time as the tenure increased. The tenure effect is calculated by aggregating the Team Tenure and J Tenure effects. Thus, the player performance in various settings can be simulated for illustration. Figure 3(a) compares the performances of a player when he stays in the team and when he moves to another J1 team when the J Tenure is 3 years. Until 2 years, the player shows no difference in path because he continues in the team where he first belonged to. At 3 years, and so the first year in the team he moved to, the player's performance declined by 0.29 points, because the coefficient of *Move within* is −0.29 in Panel B of Table 5. However, the gap between the cases of staying and moving first diminishes and then reverses after 4 years since moving. This is because the coefficient of *Team Tenure* in the new team is positive and larger than that in the team he stays. In any case, the effects of tenure become negative when the tenure of J-League is 10 years. Therefore, the learning effect disappears completely after 10 years from the rookie year.

Turning to Figure 3(b), the timing of moving to another team is changed to 5 years of

J Tenure. As in Figure 3(a), the reversal occurs in 7 years of J Tenure. However, the timing of reversal is the 3rd year of team tenure, that is, 2 years earlier if we consider the years since moving. Returning to Figure 2, the team tenure effect is 0 in 5 years of the tenure and negative the following years. Therefore, in Figures 3(a) and (b), the peak occurs in 5 years of tenure, and then the performance declines in case of staying in the team.

In Figures 3(a) and (b), the tenure effect is smaller for a player moving than for one staying after moving, but the former becomes larger than the latter several years later. However, it is unclear whether moving increases the tenure effect when we consider the whole period. Hence, we need to consider the total effect of moving on team performance. The total effect of moving is calculated by comparing the aggregated value of the tenure effect when a player moves with its opportunity cost. That is, the "aggregated tenure effect value during the period of 10 years when the player moves" minus the "aggregated tenure effect value during the period of 10 years when the player stays." The total effect of moving is negative and positive in Figures 3(a) and (b), respectively. That is, the player's staying team gives a larger benefit than his moving team at 3 years of tenure. However, the player's staying team gives a smaller benefit than his moving team at 5 years of tenure. Therefore, the effect of moving on the return from tenure depends on the timing of moving. Figure 4 illustrates how the effect of moving changes according to the timing of moving.

The moving team decreases the benefit during the tenure period of 1–3 years. At the least, the rookie player should not move until 4 years have passed. From Figure 4, the best timing to move is 7 years of tenure. This indicates that accumulating team-specific skills is important before they deteriorate in J1. Further, the mean and median of the J-League tenure is about 7 years. Thus, it is best for players to stay with the first team until the middle of their carrier.

Accumulated team-specific capital is likely to reduce a player's turnover if the firm-specific human capital hypothesis holds true in professional sports (Glenn et al. 2001). A player will improve his performance if his tenure in the team increases, because his team-specific human capital accumulates over time. However, a player's team-specific human capital is useless for other teams. A player's performance reduces once he changes his team. This argument, however, does not consider the possibility of the returns from accumulated team-specific human capital declining when some team members are replaced every season. Particularly in football, it is critical to play in concert with other players and promote cooperation between them. Therefore, team-specific human capital deters a player's turnover, which however depends on his tenure in the team.

5. CONCLUSION

Various types of skills are required to improve individual productivity. Team-specific skills in professional sports reflect firm-specific human capital. Using a rich panel dataset of individual J-League players, this paper examined how team-specific skills are critical to a football player's performance. Further, we explore whether the importance of team-specific skills depends on the league level and time elapsed. Our two findings are as follows: (1) In J1 league, changing teams reduced the player's performance, whereas his performance improved as his tenure in the team and experience in the J-League increased. This is not so in J2. (2) In J1, the returns from acquiring team-specific skills by playing the game over time increased and then decreased as the years passed. The timing of moving is important to increase the benefit of moving. These findings support the firm-specific human capital hypothesis in the top league and the job-matching hypothesis in the second league.

As seen in the JPBL, players tend to adopt the same strategy for similar situations even when the teams differed (Ohtake and Ohkusa 1994; Ohkusa and Ohtake 1996). Thus, the skills required for players were not team-specific in Japan. This to a certain extent reflected a feature of the labor market in Japan. However, globalization possibly changed this situation. For instance, to compete with foreign teams in the World Cup, the strategy and performance of the Japanese has to improve. Naturally, the skills required varied according to the J-League teams. At least in J1, the players are required to understand the sophisticated and unique team strategy and obtain team-specific skills. However, replacement of players leads to change in team skills, and the accumulated team-specific skills become useless as time passes. Hence, the benefit of moving from a J1 team becomes larger than that from staying. However, the J2 League reflects the JPBL scenario of the early 1990s, because it is less competitive than the J1 League. A big gap in skills exists between the amateur and professional players, but not between professional players. The J2 League players do not have to learn the team strategy and team-specific skills, but should have the physical strength and general skills of professional players.

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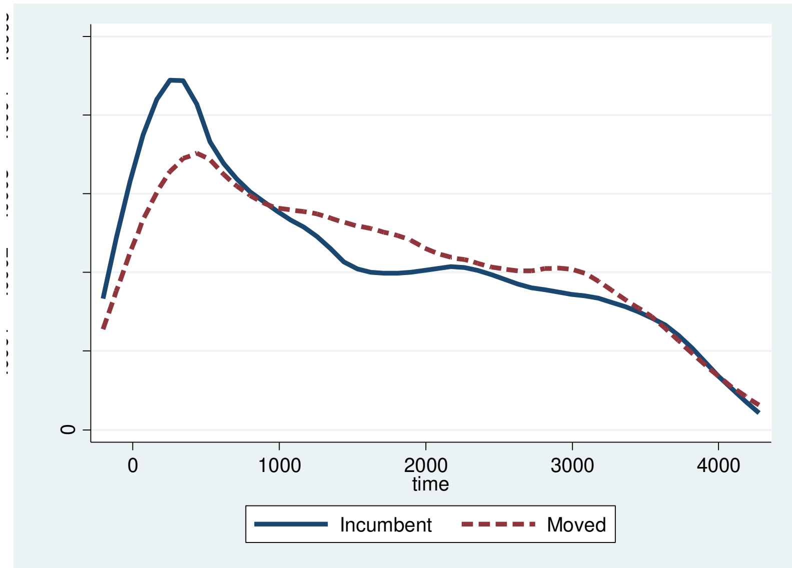
Figure 1.

KERNEL DENSITY FOR PLAY TIME (NON-STANDARDIZED MINUTES)

(a) J1 LEAGUE

Note: The Result of the Kolmogorov–Smirnov test shows difference of distribution between the two groups statistically different at the 1% level; that is, the play time of the incumbent group is longer than that of the moved group.



(b). J2 LEAGUE

Note: The result of the Kolmogorov–Smirnov test shows the difference of distribution between the two groups statistically different at the 1% level; that is, the play time of the moved group is longer than that of the incumbent group.

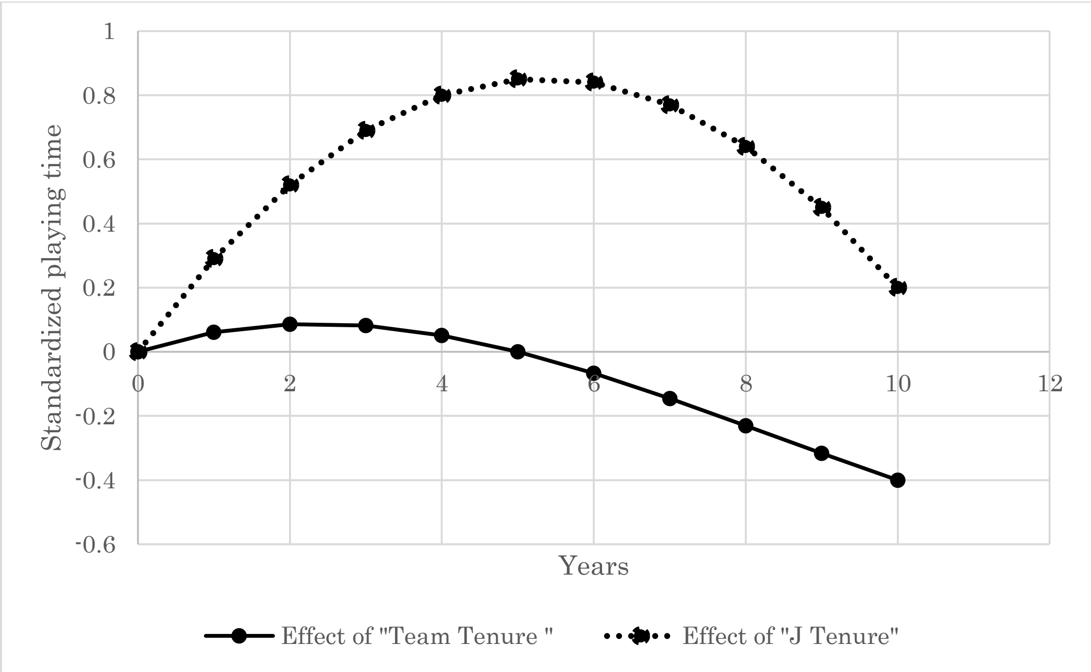


Figure 2.

TIME

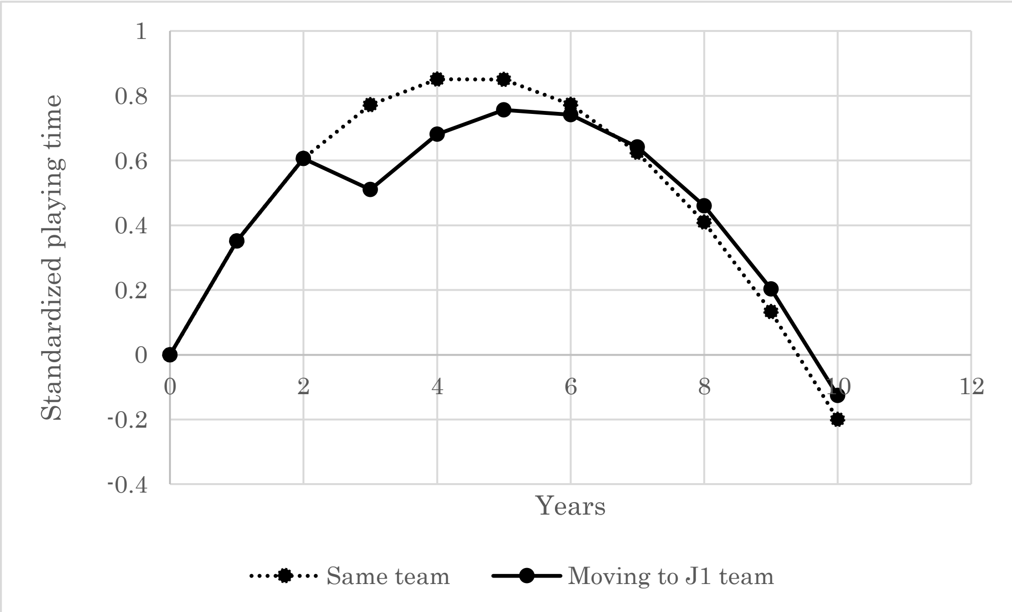


Figure 3 (a)

CASE: PLAYERS MOVING IN THE THIRD YEAR AFTER JOINING THE J1 LEAGUE

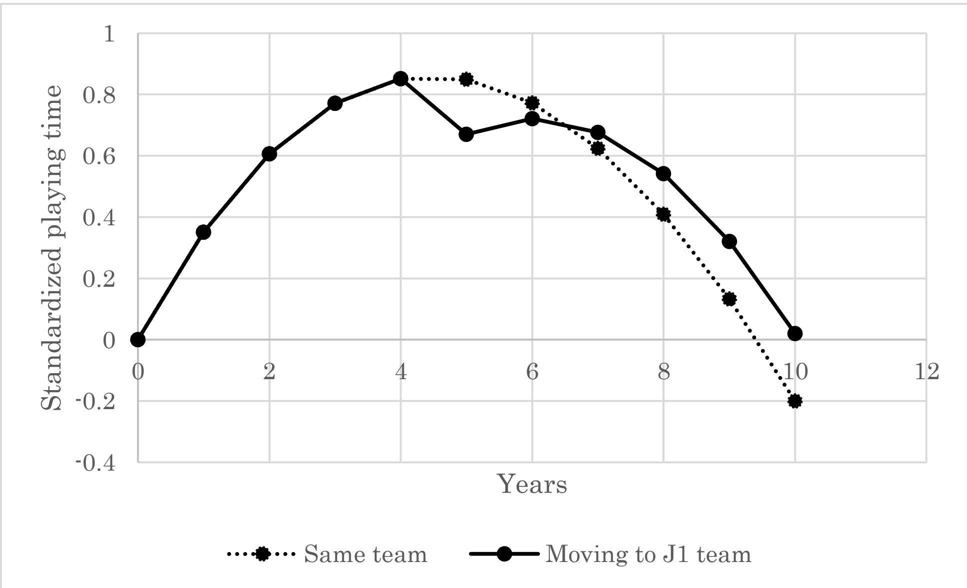


Figure 3 (b)

CASE: PLAYERS MOVING IN THE FIFTH YEAR AFTER JOINING THE J1 LEAGUE

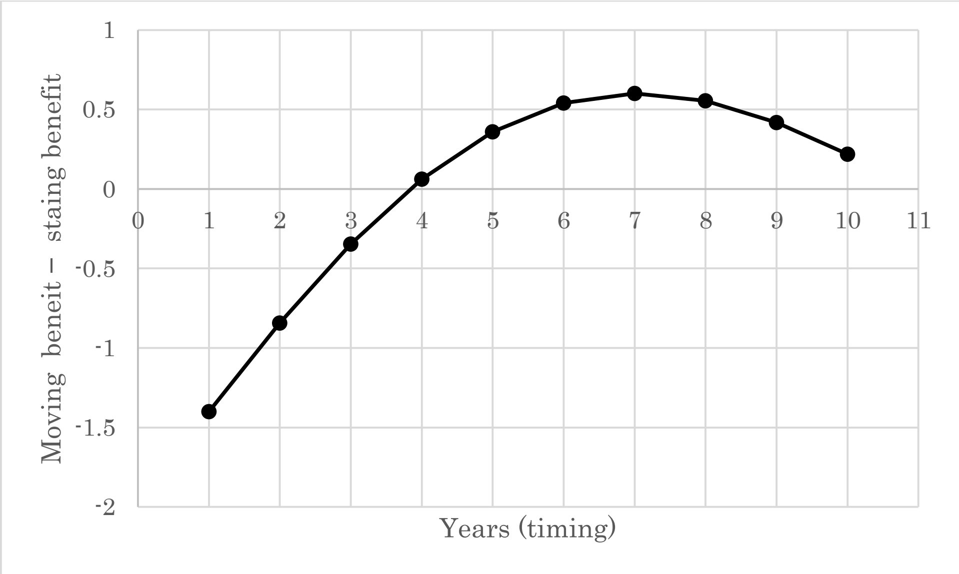


Figure 4.

BENEFIT OF MOVING AND TIMING OF MOVING TO J1

Note: In this case, that player can survive until 10 years from the rookie year. The benefit of moving is calculated as the total benefit of moving during the 10-year period minus the total benefit of staying during the 10-year period.

	Dummy for player moved from other teams.	Dummy for player moved from other teams belonging to the J1 league.	Dummy for player moved from other teams belonging to the J2 league.	Rookie dummy	Dummy for Manager change before the beginning of the season.	Dummy for non-Japanese managers
J1	0.18	0.10	0.08	0.19	0.09	0.42
J2	0.24	0.07	0.17	0.28	0.05	0.09

Table 1.

BASIC STATISTICS (COVERING 2012–2016 SEASONS)

Note: Players moved from other teams in the previous season

	(1)Incumbent	(2) Moved	(1) – (2)	t-values
Time for play	−0.03	−0.28	0.25	5.08***
Offense	0.01	−0.24	0.26	4.95***
Pass	0.01	−0.26	0.27	5.23***
Centering	−0.002	−0.11	0.11	2.19**
Dribble	0.01	−0.07	0.09	1.67*
Shoot	0.003	0.05	−0.05	−1.05
Observations	1,899	440		

Table 2

MEAN DIFFERENCE TEST OF PLAYER PERFORMANCE BETWEEN THE INCUMBENT PLAYERS AND THE PLAYERS WHO MOVED FROM OTHER TEAMS (COVERING THE 2012–2016 SEASONS)

Panel A.

SAMPLE OF J1 (THE TOP LEAGUE)

	(1) Incumbent	(2) Moved	(1) – (2)	t-values
Time for play	0.01	0.13	−0.01	−3.02***
Offense	−0.007	0.10	−0.11	−3.07***
Pass	−0.006	0.11	−0.01	−3.02***
Centering	−0.003	0.07	−0.07	−1.87**
Dribble	−0.008	0.03	−0.04	−1.10
Shoot	−0.01	0.004	−0.02	−0.44
Observations	3,022	990		

Panel B.

SAMPLE OF J2

Notes: Each value is standardized for comparison. *, **, and *** suggest statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1) Time	(2)Offense	(3) Pass	(4) Cross	(5)Dribble	(6)Shoot
J_Tenure	0.05***	0.05***	0.05***	0.03**	0.04**	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Team Tenure	0.01**	0.01*	0.02**	−0.01*	−0.02**	0.001
	(0.007)	(0.007)	(0.008)	(0.007)	(0.006)	(0.007)
Rookie	−0.34***	− 0.38***	−0.35***	− 0.27***	− 0.31***	− 0.07
	(0.08)	(0.07)	(0.07)	(0.07)	(0.09)	(0.08)
Move within	−0.22***	− 0.25***	−0.23***	− 0.19***	− 0.19***	0.05
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.08)
Move from J2	−0.42***	− 0.43***	−0.42***	− 0.28***	− 0.25***	0.001
	(0.07)	(0.06)	(0.06)	(0.06)	(0.07)	(0.07)
Age	0.39***	0.35***	0.35***	0.26***	0.14***	−0.02
	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)	(0.04)
Age^2	−0.01***	−0.01***	−0.01***	−0.004***	−0.003***	0.0002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.0007)
R^2	0.14	0.15	0.16	0.07	0.13	0.03
Observations	2,048	2,048	2,048	2,048	2,048	2,048

Table 3.

EFFECT OF TEAM CHANGE AND TEAM TENURE ON PLAYER PERFORMANCE (OLS MODEL)

SAMPLE OF J1

Note: *, **, and *** suggest statistical significance at the 10%, 5%, and 1% levels, respectively. The numbers in parentheses are robust standard errors clustered on individual players. The year dummies, position dummies, foreign manager dummy, and manager change dummy are controlled for, but their results are not shown.

	(1) Time	(2)Offense	(3) Pass	(4) Cross	(5)Dribble	(6)Shoot
J_Tenure	0.03*** (0.01)	0.03*** (0.01)	0.03*** (0.01)	0.02* (0.01)	0.02** (0.007)	0.01 (0.01)
Team Tenure	0.005 (0.009)	0.02** (0.01)	0.02* (0.01)	0.02* (0.01)	0.01* (0.007)	0.01 (0.0)
Rookie	− 0.36*** (0.07)	− 0.34*** (0.07)	− 0.30*** (0.07)	− 0.20*** (0.07)	− 0.42*** (0.07)	− 0.12 (0.07)
Move within	0.02 (0.05)	0.02 (0.05)	0.03 (0.05)	− 0.01 (0.05)	−0.03 (0.05)	0.01 (0.06)
Move from J1	0.11 (0.08)	0.25*** (0.08)	0.22*** (0.08)	0.26** (0.10)	0.19** (0.08)	−0.002 (0.09)
Age	0.32*** (0.04)	0.27*** (0.03)	0.29*** (0.03)	0.18*** (0.03)	0.05 (0.04)	−0.04 (0.03)
Age^2	−0.006*** (0.001)	−0.005*** (0.001)	−0.005*** (0.001)	−0.003*** (0.001)	−0.001*** (0.0005)	0.0005 (0.0006)
R^2 Observations	0.09 2,909	0.14 2,909	0.14 2,909	0.07 2,909	0.15 2,909	0.02 2,909

Table 4.

EFFECT OF TEAM CHANGE AND TEAM TENURE ON PLAYER PERFORMANCE (OLS MODEL)

SAMPLE OF J2

Note: *, **, and *** suggest statistical significance at the 10%, 5%, and 1% levels, respectively. The numbers in parentheses are robust standard errors clustered on individual players. The year dummies, position dummies, foreign manager dummy, and manager change dummy are controlled for, but their results are not shown.

	(1) Time	(2) Offense	(3) Pass	(4) Cross	(5) Dribble	(6) Shoot
J_Tenure	0.29***	0.30***	0.26***	0.24***	0.30***	0.02
	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)
J_Tenure^2×100	−2.77***	−3.14***	−2.56***	−2.98***	−3.50***	0.005
	(0.51)	(0.51)	(0.53)	(0.68)	(0.63)	(0.51)
J_Tenure^3×100	0.09***	0.11***	0.08***	0.12***	0.13***	−0.005
	(0.01)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)
Team Tenure	0.02	0.03	0.02	0.03	0.04	0.005
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Team Tenure^2 ×100	− 0.06	0.009	0.16	− 0.24	− 0.49	0.06
	(0.65)	(0.62)	(0.69)	(0.66)	(0.59)	(0.57)
Team Tenure^3 ×100	0.001	− 0.008	−0.009	− 0.007	0.007	−0.008
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)
Rookie	0.06	0.06	0.009	0.14	0.20*	−0.04
	(0.10)	(0.09)	(0.09)	(0.09)	(0.11)	(0.10)
Move within	−0.25***	−0.25***	−0.25***	−0.15**	−0.15*	0.06
	(0.08)	(0.08)	(0.07)	(0.08)	(0.08)	(0.09)
Move from J2	−0.46***	−0.46***	−0.45***	−0.28***	−0.26***	0.01
	(0.07)	(0.07)	(0.06)	(0.07)	(0.08)	(0.08)
R^2	0.16	0.17	0.17	0.09	0.15	0.04
Observations	2,048	2,048	2,048	2,048	2,048	2,048

Table 5.

EFFECT OF TEAM CHANGE AND TEAM TENURE ON PLAYER PERFORMANCES

SAMPLE OF J1

Panel A.

OLS MODEL

Note: *, **, and *** suggest statistical significance at the 10%, 5%, and 1% levels, respectively. The numbers in the parentheses are robust standard errors clustered on individual players. The year dummies, position dummies, foreign manager dummy, and manager change dummy are controlled for, but their results are not shown.

	(1) Time	(2)Offense	(3) Pass	(4)Cross	(5)Dribble	(6) Shoot
J_Tenure	0.32***	0.32***	0.33***	0.11	0.22***	0.08
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.09)
J_Tenure^2	−3.04***	−2.83***	−3.01***	−0.80	−2.07***	−0.75
×100	(0.87)	(0.81)	(0.83)	(0.69)	(0.75)	(0.92)
J_Tenure^3×100	0.04	0.04	0.04	0.004	0.04	0.02
	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)
Team Tenure	0.08*	0.09**	0.08**	0.07	0.09**	−0.02
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)
Team Tenure^2	− 2.02**	− 2.01***	− 1.87**	−1.29**	− 2.06***	0.06
×100	(0.80)	(0.72)	(0.74)	(0.63)	(0.70)	(0.86)
Team Tenure^3	0.08**	0.08**	0.07**	0.05*	0.09***	−0.005
×100	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
Rookie	0.08	0.15	0.17	0.03	0.14	−0.02
	(0.11)	(0.11)	(0.11)	(0.10)	(0.10)	(0.12)
Move within	−0.18**	−0.11*	−0.14**	−0.03	−0.01	−0.02
	(0.07)	(0.07)	(0.06)	(0.06)	(0.05)	(0.08)
Move from J2	−0.29***	−0.24***	−0.28***	−0.08	−0.04	−0.003
	(0.07)	(0.08)	(0.07)	(0.08)	(0.08)	(0.10)
Wald Chi^2	264	276	267	234	206	24
Number of groups	755	755	755	755	755	755
Observations	2,048	2,048	2,048	2,048	2,048	2,048

Panel B.

IV GLS MODEL WITH CONTROL OF PLAYER'S INDIVIDUAL CHARACTERISTICS

Note: *, **, and *** suggest statistical significance at the 10%, 5%, and 1% levels, respectively. The numbers in parentheses are robust standard errors clustered on individual players. The year dummies, position dummies, foreign manager dummy, and manager change dummy are controlled for, but their results are not shown.

	(1) Time	(2) Offense	(3) Pass	(4) Cross	(5) Dribble	(6) Shoot
J_Tenure	0.15***	0.12***	0.12***	0.06	0.07**	0.05
	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)	(0.04)
J_Tenure^2×100	−1.24***	−1.06***	−1.07***	−0.45	−0.73**	−0.47
	(0.42)	(0.40)	(0.40)	(0.42)	(0.34)	(0.40)
J_Tenure^3×100	0.03**	0.04**	0.04**	0.01	0.03**	0.01
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Team Tenure	0.10**	0.13***	0.10**	0.14***	0.14***	0.03
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
$Team\ Tenure^2$ ×100	− 2.48***	− 2.41***	− 1.98**	− 2.30***	− 2.53***	− 0.15
	(0.88)	(0.81)	(0.82)	(0.85)	(0.68)	(0.83)
$Team\ Tenure^3$ ×100	0.13***	0.11***	0.10**	0.09**	0.11***	0.006
	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)	(0.04)
Rookie	−0.09	−0.09	−0.08	−0.01	−0.20**	−0.02
	(0.10)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
Move within	0.06	0.08	0.07	0.08	0.05	0.03
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.07)
Move from J1	0.17**	0.33***	0.27***	0.35***	0.28***	0.02
	(0.08)	(0.09)	(0.08)	(0.10)	(0.09)	(0.09)
R^2	0.10	0.14	0.14	0.07	0.15	0.03
Observations	2,909	2,909	2,909	2,909	2,909	2,909

Table 6.

EFFECT OF TEAM CHANGE AND TEAM TENURE ON PLAYER PERFORMANCE

SAMPLE OF J2

Panel A.

OLS MODEL

Note: *, **, and *** suggest statistical significance at the 10%, 5%, and 1% levels, respectively. The numbers in parentheses are robust standard errors clustered on individual players. The year dummies, position dummies, foreign manager dummy, and manager change dummy are controlled for, but their results are not shown.

	(1) Time	(2)Offense	(3) Pass	(4)Cross	(5)Dribble	(6) Shoot
J_Tenure	0.08 (0.07)	0.09 (0.06)	0.09 (0.06)	0.004 (0.06)	0.05 (0.04)	−0.09 (0.09)
J_Tenure^2 ×100	−0.78 (0.90)	−1.26 (0.78)	−1.21 (0.80)	−0.52 (0.73)	−1.00* (0.57)	0.65 (0.92)
J_Tenure^3×100	0.01 (0.03)	0.03 (0.03)	0.02 (0.03)	0.01 (0.02)	0.03* (0.02)	−0.005 (0.03)
Team Tenure	0.03 (0.05)	0.04 (0.05)	0.02 (0.05)	0.07 (0.05)	0.05 (0.04)	0.04 (0.06)
Team Tenure^2 ×100	− 1.19 (1.24)	− 1.16 (1.10)	− 0.99 (1.09)	− 1.52 (1.11)	− 0.76 (0.80)	−0.44 (1.34)
Team Tenure^3 ×100	0.05 (0.07)	0.07 (0.06)	0.06 (0.06)	0.09 (0.06)	0.04 (0.04)	0.02 (0.07)
Rookie	−0.21** (0.11)	−0.16 (0.10)	−0.15 (0.10)	−0.07 (0.09)	−0.18** (0.08)	−0.18 (0.15)
Move within	0.08 (0.07)	0.07 (0.06)	0.05 (0.06)	0.09 (0.06)	0.07 (0.05)	−0.003 (0.10)
Move from J1	0.05 (0.08)	0.18** (0.08)	0.14* (0.08)	0.18* (0.09)	0.21*** (0.08)	−0.09 (0.07)
Wald Chi^2	209	643	529	545	505	67
Number of groups	1,150	1,150	1,150	1,150	1,150	1,150
Observations	2,909	2,909	2,909	2,909	2,909	2,909

Table 6.

EFFECT OF TEAM CHANGE AND TEAM TENURE ON PLAYER PERFORMANCE

SAMPLE OF J2

Panel B.

IV GLS MODEL WITH CONTROL OF PLAYER'S INDIVIDUAL CHARACTERISTICS

Note: *, **, and *** suggest statistical significance at the 10%, 5%, and 1% levels, respectively. The numbers in parentheses are robust standard errors clustered on individual players. The year dummies, position dummies, foreign manager dummy, and manager change dummy are controlled for, but their results are not shown.