Attendance Demand for Baseball Games in Japan

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[Abstract]

This paper studies how competitive balance in the Japanese professional baseball teams has changed over time, and estimates the effect of competitive balance on attendance demand for baseball games. Nippon Professional Baseball Organization (the 'NPB' hereinafter) consists of the Central League and the Pacific League, and there are six teams in each league. In 2004, a series of changes took place in the Pacific League, including the merger of the two existing teams, the entry of a new team, the first-ever strike by ball players, and the relocation of a franchise team from Tokyo to Hokkaido. I estimate attendance at home games of the twelve teams for the period 1958 to 2013, and examine whether the Pacific League has become more competitive after the changes in 2004. The main results are: (1) The structural break in 2004 has increased competitive balance of the Pacific League relative to the Central League; and (2) home-team attendance is positively related to stadium capacity, the team's winning rate, previous year's attendance---indicating fan loyalty---, per capita real GDP, and competitive balance. The results imply that the leagues and the teams should take measures to promote competitive balance in order to increase attendance.

* I would like to thank Hiroshi Kitagawa, Yutaka Ueda, and Daisuke Sasaki for helpful discussions, and two anonymous referees at another journal for insightful comments. Of course, I alone am responsible for all the remaining errors.

1. Introduction

1.1 Motivation

Professional sport teams attract fan attendance by providing exciting games. According to the National Football League (NFL), the three conditions that maximize attractiveness of a sport game are “superb athletes” “playing their very best” “in a *competitive* setting, with teams competing fiercely with each other.” Watching games would not be much of a thrill if one of the teams is always certain to win the pennant. In other words, *competitive balance* among teams is a requisite for exciting games. Because financial imbalance among teams is detrimental to attain competitive balance, the NFL undertakes the following measures: It (i) pools revenues from sponsors and TV broadcasting, and distributes the revenues equally among the teams (‘revenue sharing’), (ii) imposes salary cap on players, and (iii) adopts the waiver system in which teams with low winning rates are given priority in drafting new players the next season (Taneda 2007; Sano 2011).

Likewise, the Major League Baseball (MLB) manages business in the national and international markets, by distributing revenues from sponsors, TV broadcasting (national and overseas broadcasts), and merchandise sales, among 30 teams. Individual teams manage local business, such as local sponsors, ticket sales, and local TV broadcasting. The MLB has experienced rapid growth in recent years; total revenue has more than quadrupled in ten years between 1996 and 2006 (Inoue 2009).

In contrast, professional baseball in Japan has been dominated by Yomiuri Giants, which has long been the strongest, richest, and most popular among the twelve teams, as shown in Table 1. The dominance was especially pronounced in the period 1958-2004 (hereinafter referred to as the ‘first period’). By recruiting star players, the Yomiuri Giants has won 29 divisional championships in the last 56 years (1958-2013), and has enjoyed immense popularity among baseball fans throughout Japan. Because professional baseball teams do not share revenues in Japan, the Yomiuri Giants has raked in higher ticket sales and TV broadcasting revenue than any other teams. The Yomiuri Giants was established in 1936, with Yomiuri Newspaper as a parent company. The then president of Yomiuri Newspaper founded Nippon TV Broadcasting Co., the first private TV broadcasting company, in 1952, and used it to broadcast baseball games. The Yomiuri Giants was perhaps at its best when it won the Central League divisional championships for nine consecutive years from 1965 to 1973. TV broadcasting of the

[Table 1] Average Attendance, Winning Rates, and Profits of the 12 Teams in Japan

<1958-2004>

	Mean for 1958-2004		Profits (¥ million)	
	attendance	*win-rate*	2003	2004
Central League	24,597			
Chunichi Dragons	24,297	0.512	– 400	– 350
Hanshin Tigers	25,178	0.486	1,300	250
Hiroshima Carp	14,251	0.498	80	66.8
Yakult Swallows	22,934	0.473	– 400	– 400
Yokohama Baystars	17,729	0.463	– 500	– 400
Yomiuri Giants	43,190	0.568	1,850	1,757
Pacific League	14,886			
Kintetsu Buffaloes	11,598	0.478	– 4,100	–
Lotte Marines	11,696	0.491	– 3,500	– 3,740
NipponHam Fighters	18,225	0.480	– 4,100	– 1,712
Orix Bluewave	12,264	0.527	– 3,000	– 3,000
Seibu Lions	17,501	0.523	N.A.	– 2,000
Softbank Hawks	18,032	0.500	– 1,000	– 1,000

<2005-2013>

	Mean for 2005-2013		Profits in 2010 (¥ million)	Subsidy from parent firm in 2010 (¥ million)
	attendance	*win-rate*		
Central League	27,839			
Chunichi Dragons	31,098	0.550	200	hundreds
Hanshin Tigers	41,254	0.532	397	none
Hiroshima Carp	19,695	0.448	401	none
Yakult Swallows	18,474	0.483	– 21	positive
Yokohama Baystars	16,306	0.398	– 503	about 2,000
Yomiuri Giants	40,205	0.563	1,540	none
Pacific League	21,891			
Rakuten Eagles	15,865	0.457	– 627	full subsidy
Lotte Marines	19,823	0.507	51	thousands
NipponHam Fighters	25,453	0.534	329	3,000
Orix Buffaloes	18,845	0.458	break-even	full subsidy
Seibu Lions	19,702	0.523	– 29	thousands
Softbank Hawks	31,660	0.553	1,222	5,000

Source for attendance and win-rate: Nippon Professional Baseball Organization (NPB).
Sources for profits: *Asahi Shimbun*, July 20, 2004; *Nihon Keizai Shimbun*, Dec. 15, 2005, and Oct. 23, 2010.

Giants games sold at more than 100 million yen per game. Giants would in turn use its riches to recruit top players, thereby widening the gap in team strength between itself and the rival teams (Ohtake 2002, 2005; Harada 2007; and Taneda 2007).

The problem is that there is a conflict of interests between the league and individual teams. A strong team would want to continue its winning streak, but if it is certain that one team always wins, fans might lose interest in attending the games; the league as a whole would lose. According to Ohtake (2002), there are three reasons why competitive imbalance among teams is undesirable. First, games are not thrilling because the outcome is easily predictable. Second, as the stronger team can readily beat the opponent, its players will not be motivated to play their very best; exciting performance will not be forthcoming. Third, if one of the teams recruits all the best players, some of them will not be able to play in the games; they would have been star players if they had stayed with weaker teams.

On the other hand, Ohtake (2005) points out that the fans may not necessarily welcome competitive balance among professional baseball teams. The following is an excerpt from Ohtake (2005):

> "If individual teams know that the fans want dead-heat competition and more fans will attend the games between two teams with closer strengths, the teams will strive to achieve competitive balance in order to maximize their own profits. Rich teams will then *not* try to recruit all the top-notch players, even if they can do so. The rational teams will trade their players according to their strategic needs, and the optimal allocation of players will be achieved in equilibrium. ...
>
> If, however, what fans really want is that their favorite team wins, rather than unpredictability and close competition, then attendance will increase as their favorite team keeps winning. In this case, competitive balance may not be achieved in equilibrium. In particular, teams located in big cities will have a stronger incentive than teams in small cities, as attendance and revenue will increase more in large cities by recruiting star players and making the teams stronger. Likewise for the teams that have TV broadcasting contracts than the ones that do not have contracts. Competitive balance will then be distorted according to where the home team is located and whether the team has TV broadcasting contracts. ...
>
> It is therefore necessary to first make clear what the fans really want most—close competition among equally strong teams, or that their favorite teams keep

winning. Only then will we be able to figure out how to increase fan attendance and improve the financial structure of individual teams as well as the structure of the professional baseball leagues in Japan." (Ohtake 2005, pp.66-70, 76.)

Following Ohtake's argument above, this paper empirically examines the effect of competitive balance on fan attendance of the professional baseball games in Japan. I also study whether the baseball leagues have become more competitive after 2004.

The rest of the paper is organized as follows. Sections 1.2 and 1.3 briefly describe the current state of the professional baseball teams in Japan and the existing studies on attendance demand for sporting games, respectively. Section 2 explains the estimation model and the dataset. Section 3 discusses the regression results, and Section 4 concludes.

1.2 State of the professional baseball teams in Japan

The Japanese professional baseball has hardly been "professional" as far as business management of individual teams was concerned. The twelve teams are owned by parent companies; the names of the teams are shown in Table 1. The corporate law enacted in 1954 decrees that the losses incurred by a baseball team can be subsidized by the parent company as advertising expense. The parent companies have long been subsidizing the teams' losses, expecting that the presence of the team would help advertise their brand names; the size of the subsidies from the parent companies in 2010 is given in the last column of Table 1. Not surprisingly, the Japanese professional baseball teams have become financially dependent on their parent companies, and have had little incentive to improve their financial standing; of the twelve teams, only Yomiuri Giants and Hanshin Tigers, traditionally the two most popular teams, and Hiroshima Carp, which is run on its own, have been financially independent; Hiroshima Carp is owned by the owner of Mazda, but is financially independent of Mazda (Taneda 2007; Harada 2011).

The situation surrounding the Japanese professional baseball teams has changed dramatically in recent years. Excessive popularity of Yomiuri Giants, a member of the Central League, has weakened popularity and lowered revenues of the Pacific League teams; financial losses of some of the Pacific League teams became serious, resulting in drastic changes in the structure of the Pacific League in 2004. Kintetsu Railroad could no longer afford to financially support Kintetsu Buffaloes, a team in the Pacific

League. In 2004, Kintetsu Buffaloes was merged with Orix Bluewave. The merged team was named Orix Buffaloes. As the number of teams was reduced from six to five in the Pacific League, team owners started discussing whether or not to unite all existing eleven teams into a single league. The players' union, definitely against the abolishment of the two leagues, waged the first strike in the history of the Japanese professional baseball. The national sentiment was in line with the players' union. The two league system was maintained as a new team, Tohoku Rakuten Eagles, was allowed to enter the Pacific League. Rakuten Eagles is sponsored by parent company Rakuten, a lucrative internet-based firm, and set the franchise in Sendai City in Tohoku, the Northeastern part of Japan. Also in 2004, Nippon Ham Fighters moved its franchise from Tokyo to Hokkaido, the northern-most island, and Daihei Hawks changed its parent company from Daiei (a struggling supermarket chain) to Softbank, a successful internet and telecommunications firm and a rival of Rakuten. All these changes took place in 2004 in the Pacific League (*Weekly Toyo Keizai* 2010; Harada 2011).

In the aftermath of these changes in 2004, the baseball teams started to be less dependent on their parent companies. The Pacific League teams are particularly striving to increase loyal fans by engaging in community-oriented services, such as holding baseball lessons to fans. Their efforts are paying off in the form of increased attendance. Nippon Ham Fighters and Softbank Hawks are especially popular in Hokkaido and Kyushu areas, respectively; see Table 1 for the average attendance of home games in the 2005-2013 years. Another major change in 2005 is that for the first the time the teams started reporting the real number of attendance; prior to 2004, the number of attendance reported was much larger than the actual figure (Inoue 2009; Harada 2011).

These changes and improved efforts were inevitable, considering the tough environment surrounding professional baseball in Japan. Attending a sporting game is a time-consuming leisure. In the past years, choice of sports attendance was rather limited to baseball and Sumo. Now there is a wide variety of other sporting games, including professional soccer (J. League, the professional soccer league, was founded in 1993), tennis, golf, and basketball. Moreover, star players in both baseball and soccer are increasingly playing at the teams in the United States and Europe. The Japanese professional baseball now faces increased competition from other sports such as the MLB and the J. League, as well as diversified forms of leisure and entertainment. As such, total revenue of the professional baseball teams in Japan has hardly grown since the 1990s; the total revenue has increased only marginally, from slightly below 100 billion yen in 1996 to 110 billion yen in 2006. This is in stark contrast with the MLB, whose revenue has more than quadrupled from 1996 to 2006 (Inoue 2009). It is imminently important for the Japanese professional baseball teams to find ways to attract more fans to attend the games.

1.3 Literature on attendance demand for sporting games

There are numerous empirical studies of attendance demand for professional sports. For example, Baade and Tienen (1990) examined the attendance of the MLB using panel data. Winfree, *et al*. (2004), who also examined attendance of the MLB using panel data, find that (i) fan loyalty (as measured by previous year's attendance) is a significant contributor to the estimation of gate attendance; (ii) team standing, divisional championship, population, income, and the newness of the home stadium also have positive effects on attendance, while (iii) the presence of a rival team (as measured by physical distance and new entry) lowers attendance, and that (iv) attendance is inelastic with respect to admission fee. Other studies that examine fan loyalty include Kahane and Shmanske (1997), and Depken (2000). Won and Lee (2008) theoretically derive optimal dynamic pricing of a sports team in the presence of fan loyalty.

Another strand of literature on attendance demand includes the studies that look at the relationship between TV broadcasting and stadium attendance, such as Baimbridge, *et al*. (1995). Gitter and Rhoads (2010) examine the relationship between attendance at the MLB and minor league baseball games.

Peel and Thomas (1997) and Forrest and Simmons (2002) study the effect of game uncertainty on attendance. Forrest and Simmons (2002) analyze attendance demand for English football (soccer) divisions 1 through 3 (excluding the Premier League). Betting on soccer games is popular in England, and the odds are announced by betting companies. At the same time, the probability of win at the home game is traditionally quite high. Hence the odds of win by a home team usually exceed unity; even weak teams are expected to win at home games. The closer the odds are to one, the more closely contested the game will be. Forrest and Simmons (2002) use the odds that they compute themselves as a proxy for the degree of game uncertainty, and find that attendance rises with the winning rate and the degree of uncertainty (as measured by how close the odds of winning are to one).

The studies that are most closely related to this paper are the literature examining the effect of competitive balance on game attendance. Yamamura and Shin (2009) investigate the relation between competitive balance and attendance at Japanese baseball games by using time series technique. They use convergence clusters approach to measure the degree of competitive balance. The seminal work of La Croix and Kawamura (1999) analyze how the change from an open-bidding regime to a player draft regime affected competitive balance of the Japanese baseball leagues. They use Hirschman-Herfindahl Indices of pennant winners and cellar dwellers as a measure of competitive balance.

In this paper, I use the standard deviation ('*SD*') of the winning rates of the six teams in each league---the Central League and the Pacific League---as a measure of competitive balance. The smaller *SD* is, the closer the teams are competing during the regular season,[1] and the higher competitive balance is achieved in each league. I will refer to *SD* as the 'competitive balance index,' and test whether or not the lower *SD* is associated with larger attendance.

2. Estimation method and dataset

2.1 Structural changes and the competitive balance

Two questions are addressed in this paper: First, whether or not the structural break in 2004 has affected just the competitiveness of the Pacific League; and second, whether competitive balance leads to higher game attendance. This section describes the method of studying the first question.

The first question is analyzed by using the difference-in-differences (DD) estimation.[2] The treatment group is the Pacific League, PL, and the control group is the Central League, *CL*; the dummy variable *dumPL* equals one for the treatment group and is zero otherwise. Let *dum2* denote a dummy variable for the second period (2005-2013); the first period refers to the years 1958-2004. The simplest equation for analyzing the impact of the structural change is

(1) $SD_{jt} = c + a_1\, dumPL + a_2\, dum2 + a_3\, dum2 \cdot dumPL + u_{jt}$,

where j stands for league ($j = CL, PL$) and t stands for year. The dummy variable

[1] In Japan, there are 144 baseball games during the regular season (14 of which are the exchange games between the Central League teams and the Pacific League teams). After one of the teams in each League wins a pennant, the two divisional champions fight for the national championship in the 'Japan Series' in October each year.

[2] This paragraph follows the exposition by Wooldridge (2010), pp.147-148.

dumPL captures possible differences between the two leagues prior to the structural change. The time period dummy, *dum2*, captures aggregate factors that would cause changes in *SD* even in the absence of a structural change. The OLS estimator of the coefficient, $\hat{a}_3$, has the following interpretation. Let $\overline{SD}_{PL,T}$ denote the sample average of *SD* for the Pacific League in period T ($T = 1, 2$). Define $\overline{SD}_{CL,T}$ similarly. Then difference-in-differences estimator, $\hat{a}_3$, can be expressed as

(2) $\hat{a}_3 = (\overline{SD}_{PL,2} - \overline{SD}_{PL,1}) - (\overline{SD}_{CL,2} - \overline{SD}_{CL,1})$.

This estimator measures the extent to which the structural changes in 2004 affected the competitiveness (as measured by the standard deviation of the winning rates of the six teams) of the Pacific League relative to the Central League.

2.2 Variables used for estimation and the dataset

This section explains the method of analyzing the second question, *i.e.*, the effect of competitive balance on attendance demand. Demand for leisure, including attendance demand for sporting games, will in general be a function of the following factors:

Demand (attendance) = f(price, income, quality of leisure, other attributes).

First, demand for a good or services is a function of its price. Unfortunately, data on admission fee are not available, so admission fees could not be included as an explanatory variable in this study. Average admission fee is obtained by dividing admission revenue by the number of attendance (Depken 2000), but none of the baseball teams in Japan report their admission revenues; being subsidiary of parent companies, they are not required to disclose their financial statements. Another way to derive average admission fee is to compute weighted average of fees of various seats. Winfree *et al*. (2004) employ the weighted average measure of admission fees as an explanatory variable. However, data on fees for various seats are available only for the recent years in Japan.[3] The previous studies report that attendance demand is inelastic to price (Depken 2000; Winfree *et al.* 2004), and Won and Lee (2008) theoretically show that attendance demand tends to be price-inelastic in the presence of fan loyalty. Accordingly, in order to increase stadium attendance, it would be more effective for the teams to provide higher-quality service and satisfaction to fans than lower prices.

Next, income (as measured by per capita real GDP) is thought to have a positive

[3] According to the websites of individual teams, currently the best seats cost between 5,000 to 10,000 yen, the infield seats cost about 3,000 to 4,000 yen, and the outfield seats cost about 1,000 to 1,500 yen per game.

effect on game attendance, as leisure is likely to be a normal good. Per capita real GDP is obtained by dividing real GDP (= nominal GDP ÷ GDP deflator, setting 2005 as the base year) by Japan's total population each year.

The most important variable representing the quality of a team is the team's winning rate. The winning rate is defined as 'the number of wins ÷ (the number of wins + the number of losses)'; namely, ties are not counted. The winning rate of each team is used as an explanatory variable.[4] It is expected that the winning rate will have a positive effect on attendance. Previous studies have also included such variables as league standing, divisional championships, number of star players, runs, and ERA's. These are all related with the winning rate, so in this paper only the winning rate will be used to represent the overall quality of the individual teams.[5]

Also included in the explanatory variables is the 'competitive balance index.' Recall from Section 1.1 that this study aims to examine whether the winning streak of a favorite team or unpredictability of a pennant race with dead-heat competition promotes attendance more. As mentioned in Section 1.3, the competitive balance index of league j in year t (SD_{jt}) equals the standard deviation of the winning rates of the six teams in league j in year t. The lower the value of SD, the smaller the gap among the teams, and the higher competitive balance is achieved in the league. If competitive balance does indeed help increase game attendance, the coefficient on SD should be negative. When higher competitive balance is achieved, even the teams that are unlikely to win the pennant race might enjoy increased attendance, as they will have games with the teams vying for league championships.

In addition, stadium capacity naturally sets the upper limit on the number of attendance; capacity is included as an explanatory variable.

It is also possible that the population of the area in which home team is located might affect game attendance. Teams located in big cities like Tokyo, Osaka, and Nagoya are more likely to enjoy larger attendance than teams located in small cities. On the other hand, teams located in small local cities, especially the Pacific League teams, have made tremendous effort to increase local fans in their communities. It is

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4 I use the winning rate rather than the number of wins, because the number of games in both leagues has increased from 130 in 1958 to 144 in recent years.

5 In particular, league standing and the winning rates are highly correlated. Estimation results using league standing instead of the winning rates yielded results that are similar to those presented in Section 3. Only the results using the winning rates are presented in this paper, because the winning rates seem to better capture the overall strength of individual teams than ordinal league standing.

possible that enthusiastic fans in smaller cities attend games more often than casual fans in big cities, in view of the fact that there is usually only one professional sports team in small cities. In order to represent the population effect, I have tried to include '*popu*' (*i.e.*, population of a prefecture in which a home team is located) as an explanatory variable. It turns out, however, that the coefficients on *popu* are weakly positive but not statistically significant in the final estimation, and the redundant variables tests cannot reject the null hypothesis that the coefficient on *popu* is zero. Accordingly, the population effect will not be reported in the estimation results in Section 3.

Fan loyalty is yet another factor that may affect attendance. Previous studies such as Baade and Tienen (1990) and Winfree *et al*. (2004) find that fan loyalty, as measured by previous year's attendance, has a significant positive effect on current attendance. This paper also examines fan loyalty in the baseball game attendance in Japan by including previous year's attendance as an explanatory variable.

Other attributes that may affect attendance at professional baseball games are the presence of alternative entertainment. Instead of watching a baseball game, people might watch other professional games such as soccer (J. league), the MLB, or visit theme parks or go to movie theaters. Because there are too many alternative forms of entertainment, however, these alternatives will not be included as explanatory variables in this paper. Nor will the effect of TV broadcasting be considered, as data on TV broadcasts of individual games are not available.

The dependent variable in this paper is the average annual attendance per home game (hereinafter referred to as '*attendance*'). The average annual attendance per home game is obtained by dividing the annual attendance at home games by the number of home games. The number of home games has increased from 65 in the 1950's to the current 72.

The data on the twelve baseball teams (six teams in the Central League and the other six in the Pacific League) for the years from 1958 to 2013 are used. The first period of the dataset refers to 1958-2004, and the second period refers to 2005-2013. 1958 is the first year in which twelve baseball teams were established, after years of increase in the number with new entry and decrease with merger. And, as mentioned in Section 1.2, major changes took place in the Pacific League in 2004, including the merger of Kintetsu Buffaloes and Orix Bluewave, the new entry by Rakuten Eagles, and the relocation of Nippon Ham Fighters from Tokyo to Hokkaido. Also, starting 2005, the teams started reporting attendance figures that reflect the true number of people who attended the games.

The dependent and explanatory variables used for estimation are as follows:

$$(3)\ Attendance_{it} = c + b_1\ attendance_{i,t-1} + b_2\ capacity_{it} + b_3\ pcr\text{-}GDP_t + b_4\ win\text{-}rate_{it} + b_5\ SD_{jt} + e_{it}\ .$$

Subscripts, i, j, and t in (3) stand for team i (i = 1, …, 12) and league j (j = 1, 2) in year t.

In (3), the dependent variable '*attendance*' is the average annual attendance per home game. The explanatory variable '$attendance_{i,t-1}$' is the *attendance* in year $t–1$; '$capacity_{it}$' is stadium capacity of team i in year t; '$pcr\text{-}GDP_t$' is per capita real GDP in year t ; '$win\text{-}rate_{it}$' is the winning rate of team i in year t ; and 'SD_{jt}' is the competitive balance index (=standard deviation of the winning rates of the six teams in league j) in year t.

The data sources are as follows: Average annual attendance per home game is from the Pacific League website and information provided by the NPB.[6] Stadium capacity is obtained from the websites of the individual teams. The winning rates of the individual teams are reported in the NPB website. The national and prefectural populations are from *Japan Statistical Yearbook 2014* by the Ministry of Internal Affairs and Communications. Population figures are reported only once every five years, so the figures in between are extrapolated. And real GDP (the base year = 2005) is from the *Systems of National Accounts*, respective years, by the Cabinet Office, the Government of Japan.

2.3 Estimation methods

Lagged dependent variables ($attendance_{i,t-1}$ in this paper) are known to be correlated with the disturbance term and hence are not exogenous. Estimating panel data with the lagged dependent variable by fixed effects model or random effects model does not yield consistent estimation results (Nickell 1981). The dynamic panel data need to be estimated either by the pooled IV (instrumental variables) method, GMM (generalized moment method), or the maximum likelihood method (Matsuura and McKenzie 2009, pp.415-421; Wooldridge 2010, pp.371-374).

Therefore, it is first necessary to find out whether the lagged dependent variable

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[6] In addition to the Central League and the Pacific League, the Nippon Professional Baseball Organization (NPB) exists as a coordinating body of the two leagues. The NPB organizes the all-star games in July and the post-season Japan Series, while the regular season games are run by the Central and the Pacific Leagues (Inoue 2009).

(as a measure of fan loyalty) should be included as an explanatory variable. As a preliminary study, equation (3) is estimated by the pooled OLS, using EViews 7. In case the lagged dependent variable is found to have a statistically significant effect on the dependent variable, the equation will be re-estimated by the IV method in the following manner, as proposed by Anderson and Hsiao (1981). (See Matsuura and McKenzie 2009, p.420; and Wooldrige 2010, pp.372-373, for detailed discussion of the IV method in panel data analyses.)

In equation (3), take the first difference of both the dependent and independent variables, in order to eliminate individual effects. We get

$$(4)\ \Delta(attendance)_{it} = b_1 \Delta(attendance)_{i,t-1} + b_2 \Delta(capacity)_{it} + b_3 \Delta(pcr\text{-}GDP)_t + b_4 \Delta(win\text{-}rate)_{it} + b_5 \Delta(SD)_{jt} + \Delta e_{it},$$

where the sign 'Δ' stands for the first-order difference, as in

$$(5)\ \Delta(attendance)_{it} = attendance_{it} - attendance_{i,t-1},$$

and likewise for the other variables.

Because $(attendance)_{i,t-1}$ and e_{it} are correlated in (3), $\Delta(attendance)_{i,t-1}$ and Δe_{it} in (4) are also correlated. Hence the pooled OLS estimation of (4) will result in inconsistent estimators. In this paper, equation (4) will be estimated by the pooled IV method.[7] The choice of the instrumental variables is discussed at the end of Section 3.3.

In Section 3, an F-test will be conducted on the estimation result of (4) to test whether there was a structural change between the first period (1958-2004) and the second period (2005-2013).

3. Results

3.1 Descriptive statistics

Descriptive statistics are given in Table 2. '*Attendance*' has risen over time. While Table 2 does not show the growth over time, the mean and median values of *attendance* evidently increased from the first period (1958-2004) to the second period (2005-2013). At the same time, Table 1 reveals that average *attendance* in the Central League is larger than that of the Pacific League, though the gap between the two leagues has narrowed in the second period. As a result of increased attendance, the average stadium capacity ('*capacity*') has also risen slightly from period 1 to period 2.

7 It would be desirable to compare the GMM and the pooled IV estimation results, but I was not able to conduct estimation by the GMM, due to the limited number of observations compared to the number of instruments.

Per capita real GDP has grown more than six-fold during the 1958-2004 period; the minimum value in Table 2 is that of 1958, and the maximum is that of 2004. In the ensuing 2005-2013 period, per capita GDP has not changed much, as can be seen from the smaller gap between the maximum and minimum values.

The winning rates of the twelve teams range from 0.238 to 0.685 in the first period. The range is reduced somewhat to 0.281~0.667 in the second period. The mean and maximum value of *SD* declined in the 2005-2013 period, indicating an improved competitive balance in the second period.

[Table 2] Descriptive Statistics

<1958-2013>

	attendance	*capacity*	*pcr-GDP* (per capita real GDP) (1,000 yen)	*SD* (std dev) of win-rates	*win-rate*
Mean	20,565	35,141	2,701.9	0.0808	0.5001
Median	18,386	35,000	2,789.0	0.0776	0.504
Maximum	54,462	47,808	4,125.8	0.1461	0.685
Minimum	2,777	20,000	608.6	0.0215	0.238
Std. Dev.	11,629	6,339.9	1,115.2	0.0263	0.0777
Observations	672	672	56	112	672

<1958-2004>

	attendance	*capacity*	*pcr-GDP* (1,000 yen)	*SD* (std dev) of win-rates	*win-rate*
Mean	19,741	35,005	2,451.3	0.0814	0.5001
Median	16,688	35,000	2,473.5	0.0776	0.504
Maximum	54,462	47,808	3,898.5	0.1461	0.685
Minimum	2,777	20,000	608.6	0.0215	0.238
Std. Dev.	11,909	6,281.7	1,043.8	0.0262	0.0781
Observations	564	564	47	94	564

<2005-2013>

	attendance	*capacity*	*pcr-GDP* (1,000 yen)	*SD* (std dev) of win-rates	*win-rate*
Mean	24,865	35,851	4,010.4	0.0775	0.5004
Median	21,560	35,712	4,009.0	0.0768	0.502
Maximum	43,669	47,808	4,125.8	0.1374	0.667
Minimum	13,370	22,098	3,825.0	0.0356	0.281
Std. Dev.	8,921	6,620	84.4	0.0270	0.0756
Observations	108	108	9	108	108

3.2 Difference-in-differences estimation of competitive balance

Has the structural change in 2004 affected just the competitiveness of the Pacific League? The DD estimation result of equation (1) is given in Table 3. The OLS estimator of coefficient *dum2･dumPL* is – 0.026 (*t* statistic = – 1.934, *p*-value = 0.056), which implies that the standard deviation of the winning rates of the Pacific League relative to the Central League decreased in the second period; namely, the structural break in 2004 improved competitive balance of the Pacific League relative to the Central League. The coefficient on *dumPL* is positive but statistically insignificant; competitive balance between the two leagues was not statistically different prior to 2004. Likewise, the coefficient on *dum2* is also a small positive number but is statistically insignificant, indicating that competitive balance of the Central League has not changed significantly between periods 1 and 2.

[Table 3] DD Estimation Result

Dependent Variable: *SD*
Method: Panel Least Squares
Sample: 1958-2013

Variable	Coefficient
C	0.077***
	(20.180)
dumPL	0.0085
	(1.562)
dum2	0.009
	(0.955)
dum2×dumPL	– 0.026*
	(– 1.934)
Observations	112
R^2	0.043
Adjusted R^2	0.016
S.E. of regression	0.026
Durbin-Watson	1.583

t statistics in parentheses.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

3.3 Estimating attendance demand: preliminary pooled OLS estimations

Estimation results of attendance demand are described in Sections 3.3 and 3.4. Following the discussion in Section 2.3, to see whether the lagged dependent variables help predict the current *attendance*, equation (3) was estimated by the pooled OLS as a preliminary procedure. The preliminary OLS results are given in Table 4.

As is evident from Table 4, previous year's *attendance* has a significant positive effect on the current *attendance*. Fan loyalty is apparent in the baseball game attendance in Japan. Note that $attend\text{-}cap_{t-2}$ and $attend\text{-}cap_{t-3}$ do not affect the current *attendance*; the coefficients are small and statistically insignificant (see model 4.2).

The preliminary pooled OLS estimation results clearly indicate that because the lagged dependent variable cannot be ignored, it is necessary to estimate the dynamic panel data using the pooled IV method, in order to obtain consistent estimates.

Before moving on to the estimation by the pooled IV method, I test exogeneity of explanatory variables, as well as presence of heteroskedasticity and serial correlation. Tests of exogeneity of explanatory variables, *i.e.*, whether the explanatory variables are uncorrelated with the disturbance term, are conducted as follows (see, *e.g.*, Matsuura and McKenzie 2012, pp.355-359): The explanatory variables other than $attendance_{i,t-1}$ — $capacity_{it}$, $pcr\text{-}GDP_t$ (per capita real GDP), $win\text{-}rate_{it}$, and SD_{jt} — are tested for strong exogeneity by adding one-period lead lag variable to equation (3) and estimating the equation by fixed effects model. For example, to test for strong exogeneity of $win\text{-}rate_{it}$, add $win\text{-}rate_{i,t+1}$ as an explanatory variable to equation (3), as in (6):

$$(6)\ Attendance_{it} = c + c_1\, attendance_{i,t-1} + c_2\, capacity_{it} + c_3\, pcr\text{-}GDP_t + c_4\, win\text{-}rate_{it} + c_5\, win\text{-}rate_{i,t+1} + c_6\, SD_{jt} + u_{it}.$$

The null hypothesis '$c_5 = 0$' in equation (6) is then tested by the *t* test. If the null hypothesis is not rejected, the variable in question satisfies strong exogeneity.

The tests reveal that all the explanatory variables satisfy strong exogeneity; the coefficients on the one-period lead lags of *capacity*, *pcr-GDP, win-rate*, and *SD* are not significantly different from zero.[8]

Next, following Wooldridge (2010), serial correlation is tested by estimating equation (4) by the pooled OLS. Under the null hypothesis of no serial correlation, $cor(\Delta e_{it}, \Delta e_{it-1}) = -0.5$. In other words, the residual of equation (4), $\Delta\hat{e}_{it}$, is regressed on

[8] The coefficients (and *t* statistics) of $capacity_{i,t+1}$, $pcr\text{-}GDP_{t+1}$, .$win\text{-}rate_{i,t+1}$, and $SD_{j,t+1}$ are, 0.176 (1.564), – 0.632 (– 0.330), – 865.39 (– 0.503), and – 2,795.95 (– 0.591), respectively.

[Table 4] Preliminary Pooled OLS Estimation Results

Dependent Variable: *attendance*
Method: Panel Least Squares

Variable	Coefficient	
	Model 4.1 Sample (adjusted): 1959-2013	Model 4.2 Sample (adjusted): 1961-2013
C	– 5,051.01*** (– 4.358)	– 5,023.18*** (– 4.109)
attendance(–1)	0.911*** (62.307)	0.811*** (20.90)
attendance(–2)		0.062 (1.234)
attendance(–3)		0.046 (1.204)
capacity	0.067*** (2.980)	0.070*** (2.941)
pcr-GDP	0.335** (2.564)	0.201 (1.417)
win-rate	9,201.18*** (6.003)	9,478.73*** (5.983)
SD	– 9,205.19** (– 2.044)	– 9,073.02* (– 1.904)
Observations	659	633
R^2	0.938	0.938
Adjusted R^2	0.9377	0.9376
S.E. of regression	2,908.84	2,915.74
Durbin-Watson	2.080	1.888

t statistics in parentheses.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

its own lagged variable by the pooled OLS, as in

(7) $\Delta \hat{e}_{it} = \rho \Delta \hat{e}_{i,t-1} + v_{it}$,

to test for the null hypothesis that $\rho = -0.5$. The Wald coefficient restriction test shows that serial correlation exists; χ^2 statistic is 134.1 with 1 degree of freedom (p-value is 0.000), so the null hypothesis of no serial correlation is clearly rejected. In order to correct for serial correlation, the variance-covariance matrix of the estimation of equation (4) will be corrected by White period correction.

Third, Breusch-Pagan test indicates that there is no heteroskedasticity in the error term; the BP test value and the corresponding BP p-value are, respectively, 23.86 and 0.067. The null hypothesis of homoskedasticity is not rejected at 5%.

Because the lagged dependent variable is correlated with the error term, it is necessary to include appropriate instrumental variables in estimating equation (4). Anderson and Hsiao (1981) propose to use $attendance_{i,t-2}$ or $\Delta(attendance)_{i,t-2}$ as an instrument. In the presence of serial correlation, however, the two-period lagged dependent variables are also correlated with the disturbance term, and are not appropriate as IV's. The possible candidates for an instrument in this paper are *popu* (population of the prefecture in which home team is located), and real GDP. An instrument needs to be both exogenous, *i.e.*, independent of the error term, and highly correlated with the lagged dependent variable in order to achieve consistent and efficient estimation. Exogeneity of the IV's will be tested by Sargan test in Section 3.4. To examine whether the instruments are weakly correlated with the lagged dependent variable, the following weak instruments estimation is conducted by regressing $attendance_{i,t-1}$ on the set of IV's:

(8) $Attendance_{it-1} = c + d_1\, capacity_{it} + d_2\, pcr\text{-}GDP_t + d_3\, win\text{-}rate_{it} + d_4\, SD_{jt} + d_5\, popu_{it} + w_{it}$,

and likewise for $real\text{-}GDP_t$.[9]

A high value of the F-statistic in (8) implies that the RHS variables are highly correlated with the lagged dependent variable, and are strong instruments. The preliminary estimation results of the weak instruments test of equation (8) are given in Table 5. Judging from the values of F statistic in Table 5, it can be concluded that the explanatory variables in equation (8) are indeed appropriate as the IV's, and that $popu_{it}$ performs better (model 5.1) than $real\text{-}GDP_t$ (models 5.2 and 5.3) as the IV.

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9 For a survey of weak instruments in GMM, see, *e.g.*, Stock, Wright, and Yogo (2002).

[Table 5] Weak Instruments Estimation

Dependent Variable: *attendance(–1)*
Method: Panel Least Squares
Sample (adjusted): 1959-2013

Variable	Coefficient		
	Model 5.1	Model 5.2	Model 5.3
C	– 37,759.8***	– 35,580.9***	– 36,012.5***
	(– 14.157)	(– 10.739)	(– 11.303)
capacity	0.800***	0.869***	0.797***
	(16.443)	(17.495)	(16.336)
pcr-GDP	4.856***	3.832	0.414
	(17.406)	(0.834)	(0.093)
win-rate	22,374.99***	22,844.87***	22,384.28***
	(5.811)	(5.705)	(5.813)
SD	4,560.215	9,432.138	4,814.141
	(0.393)	(0.782)	(0.415)
popu	0.718***		0.728***
	(7.308)		(7.372)
real-GDP		0.008	0.032
		(0.258)	(1.002)
Observations	659	659	659
R^2	0.592	0.559	0.593
Adjusted R^2	0.589	0.555	0.589
S.E. of regression	7,486.36	7,786.11	7,486.33
F-statistic	189.48	165.31	158.07
Durbin-Watson	0.270	0.248	0.269

t statistics in parentheses.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

To summarize, the variables used as instruments in this study are: a constant; the first-order difference of the explanatory variables—$\Delta(capacity)_{it}$, $\Delta(pcr\text{-}GDP)_{t}$, $\Delta(win\text{-}rate)_{it}$, and $\Delta(SD)_{jt}$; and $\Delta(popu)_{it}$.

3.4 Estimation results by the IV method

The final estimation result is presented in this section. Equation (4) is estimated by the IV method. Because both the dependent and explanatory variables are in the difference forms, the individual team effects have been eliminated. The estimation results of equation (4) are given in Table 6.

In Table 6, model (6.1) is the estimation result using $\Delta(popu)_{it}$ as an instrument. For the sake of comparison, the pooled OLS estimation result without using the instrument (an inconsistent estimation) is given in model (6.2).

Note that in both models 6.1 and 6.2, the change in the competitive balance index, $\Delta(SD)_{jt}$, has a statistically significant negative effect on the dependent variable; namely, as competitive balance in each league improves, the growth in attendance also rises. Returning to the initial question posed in Section 1.1, we find that the closer the teams are competing with each other, the higher the growth in game attendance will be.

The change in *capacity* has a significant positive effect on the change in attendance, as expected. And the change in *per capita real GDP* also has a significant positive effect on the change in attendance, indicating that baseball game attendance is a normal good. Also, the change in *win-rate* has a large, positive, and statistically significant effect, as expected; attendance increases as the team's winning rate rises.

The change in the lagged dependent variable has a positive but insignificant effect on the current change in attendance in model (6.1). As shown in Table 4, the preliminary OLS estimation result reveals that previous year's *attendance* has a strong positive effect on this year's *attendance*, indicating fan loyalty. In difference forms, however, an increase in last year's growth in attendance does not raise this year's growth in *attendance* in a statistically significant manner. It can be concluded that though there exists fan loyalty in attendance behavior, attendance does not grow indefinitely. On the other hand, in the pooled OLS estimation (6.2), the estimator on $\Delta attendance_{i,t-1}$ is negative and significant, which probably reflects inconsistency in estimation.

Next, we are interested in examining whether or not there was a structural change in attendance behavior between the first period (1958-2004) and the second period (2005-

[Table 6] Final Stage Estimation Results by the IV Method

Dependent Variable: *Δattendance*
Method: Panel 2SLS
Sample (adjusted): 1960-2013
White period standard errors & covariance (no d.f. correction)

Variable	Coefficient			
	Model 6.1 1960-2013	Model 6.1.1 1960-2004	Model 6.1.2 2005-2013	Model 6.2 (pooled OLS)
Δ(attendance(–1))	0.681 (1.301)	0.219 (0.959)	0.561 (1.106)	– 0.088*** (– 2.906)
Δ(capacity)	0.541*** (5.091)	0.606*** (3.978)	– 0.262 (– 0.304)	0.657*** (3.989)
Δ(pcr-GDP)	2.618* (1.807)	5.661*** (6.780)	– 8.191*** (– 3.137)	3.639*** (4.837)
Δ(win-rate)	17,179.81*** (3.865)	16,255.36*** (5.008)	7,010.89 (1.134)	13,185.39*** (8.072)
Δ(SD)	–10,176.11** (– 1.994)	– 4,123.1 (– 0.884)	– 52,618.6*** (– 3.004)	– 7,466.82** (– 2.580)
Instruments	*C, Δ(capacity), Δ(pcr-GDP), Δ(win-rate), Δ(SD), Δ(popu)*	*C, Δ(capacity), Δ(pcr-GDP), Δ(win-rate), Δ(SD), Δ(popu)*	*C, Δ(capacity), Δ(pcr-GDP), Δ(win-rate), Δ(SD), Δ(popu)*	(No IV's used)
Observations	646	540	106	646
R^2	– 0.389	0.157	– 0.301	0.197
Adjusted R^2	– 0.398	0.150	– 0.352	0.192
S.E.of regression	3,610.73	2,793.23	3,583.45	2,745.22
Durbin-Watson	3.017	2.609	2.740	2.106
Sargan statistic	3.427			
Sargan *p*-value	0.064			
H_0: No change between 2 periods				
F test	67.094			
F test *p*-value	0.000			

t statistics in parentheses.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

2013). This is done by performing two separate estimations for each period, as shown in (6.1.1) and (6.1.2) in Table 6, and then conducting an *F* test. The null hypothesis is that all the coefficients are the same between the two periods. The restricted model is (6.1), which estimates the entire period (1958-2013), and the unrestricted models are (6.1.1) and (6.1.2). Denote the residual sum of squares of the restricted model and the unrestricted models by RSS_R, RSS_{U1}, and RSS_{U2}. If H_0 is true, the following variable follows the *F* distribution with df (5, 646 – 2×5):

$$(9) \quad F = \frac{(RSS_R - (RSS_{U1} + RSS_{U2}))/5,}{(RSS_{U1} + RSS_{U2})/(646 - 2\times 5)}$$

where 5 is the number of restrictions, and 646 is the number of observations in model (6.1).

The *F* test clearly shows that there was indeed a structural change between the two periods; as shown in model (6.1), the *F* statistic is 67.094 (p-value < 0.001), rejecting the null hypothesis of no change at the 1%-level of significance. Models (6.1.1) and (6.1.2) reveal that in the first period, changes in capacity, per capita real GDP, and the winning rates have significant positive effects on changes in attendance; in the second period, on the other hand, changes in competitive balance *SD* has a significant effect, but changes in capacity and the winning rates become insignificant, and changes in per capita real GDP have a negative effect on changes in attendance.

Finally, in order for the IV estimation to yield consistent estimates, the instrumental variables need to be exogenous, *i.e.*, uncorrelated with the disturbance term. This is tested by Sargan test. Because the number of IV's (six) exceeds the number of explanatory variables (five), equation (4) is over-identified, which is necessary for conducting the test. The Sargan statistic and its p-value are 3.427 and 0.064 in model (6.1). Accordingly, the null hypothesis that the instrumental variables are exogenous is not rejected at the 5%-level; the instrument $\Delta popu$ is orthogonal to the disturbance term and the over-identification condition is satisfied.

4. Concluding remarks

This paper studied whether or not the structural break in 2004 has affected just the competitiveness of the Pacific League, and examined the effect of competitive balance on baseball game attendance during the period 1958-2013. The main results are as follows: (1) competitive balance (as measured by the standard deviation of the winning rates of the teams in each league) improved in the Pacific League relative to the Central League after 2004; (2) attendance is strongly and positively affected by previous year's attendance, capacity, the winning rate, and per capita real GDP. Each estimator indicates fan loyalty, stadium capacity, fan's willingness to attend games when the team is winning, and that game attendance is a normal good; and (3) changes in *SD* have a significant negative effect on changes in attendance.

Of these, the most notable result is (3), *i.e.*, competitive balance contributes to increased attendance; baseball fans attend the games not only when their favorite teams are winning, but also when the teams in the league are competing closely.

The implication of this study is that the leagues and the teams should take measures to promote competitive balance in order to increase attendance. We should keep in mind, however, that financially rich teams can afford to recruit top players; there is a conflict of interest between the league that benefits from competitive balance, and individual teams that strive to win more.

The Pacific League teams founded the Pacific League Marketing in 2007, and are jointly promoting marketing. The finding that competitive balance leads to increased attendance implies that the Pacific League teams as a whole will benefit from taking measures to promote competitive balance.

Despite these efforts, the professional baseball teams still have a long way to go to improve their financial independence. As Table 1 shows, most of the teams are still losing money from the baseball operations and are subsidized by their parent companies.

As an agenda for future research, it would be interesting to compare the effects of competitive balance on attendance at professional baseball and soccer games, as well as to compare attendance at the MLB and the professional baseball games in Japan.

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