

The Effect of Major League Baseball Rehab Assignments on Attendance in the International Baseball League

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I. Introduction

Dustin Pedroia successfully launched his first full season in Major League Baseball (MLB) by winning Rookie of the Year honors and helping his team win the 2007 World Series. He would follow-up his rookie season in 2008 by being voted an All-Star by fans, receiving the American League Most Valuable Player Award from the Baseball Writers Association of America, and named a Gold Glover and Silver Slugger. By the summer of 2010, Pedroia had already been selected to a third consecutive All-Star game. One can intuitively expect that a player with such success should positively affect attendance during a rehab assignment in Minor League Baseball (MiLB).

This is exactly what happened. Attendance averaged 10,661 fans during Pedroia's three game rehab assignment with the Pawtucket Red Sox in August of 2010. This compares to an average August attendance of 9,671 fans. Why such a difference in the average attendance? Rehab assignments provide a unique opportunity to the MiLB community. They afford fans access to players that typically possess a level of talent that is reserved for MLB. Previous studies identify factors that affect attendance in MiLB. This study introduces a new explanatory variable – rehab assignments.

A rehab assignment is when a MLB player is assigned to a MiLB club prior to his return from the disabled list. The effect of MLB rehab assignments on MiLB attendance is a question that is particularly pertinent to baseball operations. In MiLB, ballpark staffing varies game-to-game. Portions of ballpark staff are hired on an "on-call" basis due to inconsistencies in daily attendance. Ticket pre-sales are limited in their ability to forecast daily attendance because walk-up fans purchase the majority of tickets. An advantage of considering the impact of rehab assignments on attendance is that management will better understand fan preferences and have an improved ability to forecast input needs.

The International Baseball League (IL) is a MiLB league at the in Triple-A (AAA) level. Team composition at the AAA level tends to consist of young top-rated prospects, along with veterans who appear to have reached a professional ceiling. In the year studied, 2010, the IL consisted of three divisions (North, South, and West) and had a total of 14 teams. All of the teams are affiliates of MLB teams.¹ A regression model is specified to determine the effect of MLB rehab assignments on attendance in the IL. Other independent variables considered include: win percentages and streaks, promotions, team effects, and day of the week. Data from 11 IL teams are analyzed to provide insight on the significance of each variable.²

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A second contribution in this paper is that a new technique is introduced to measure the impact of rivalry. The rival variable measures the intensity of a particular matchup. I examine rivalries in the IL, as well as the rivalries of their MLB affiliates and a combination of both. For example, consider the rivalry between the Pawtucket Red Sox and the Scranton/Wilkes-Barre Yankees. These two teams are rivals in both MLB and AAA baseball because they are in the same division at each level. It can be assumed that when opponents are both MLB and AAA rivals, the effect on attendance will be greater because the rivalry is more intense.

The paper proceeds as follows. Section II provides a review of literature on the topic. Section III presents the data analysis, methodology, and regression model. Section IV discusses the results and Section V concludes.

II. Literature Review

Many economists have studied the factors that drive fan attendance in baseball, from collegiate baseball to MiLB to MLB. Variables considered include: population, per capita income, stadium age, star players, ticket price (Noll, 1974), team composition (Kahane and Shmanske, 1997), team payroll (Rivers and Deschrive, 2002), wins versus championships (Whitney, 1998), divisional and interleague rivalries (Lemke et al., 2010), categorized promotions (Boyd and Krehbiel, 2003), and promotions combined with interaction variables (Boyd and Krehbiel, 2006). It is clear that attendance is affected by many variables and that understanding the components of fan demand is essential for forecasting input needs.

Noll (1974) is considered the pioneer attendance study in MLB. He examines a variety of variables and their effect on MLB attendance, including income, playing success, number of star players, competition, stadium age, ticket prices, population, and race. His approach consists of multiplying each independent variable by population, creating a series of interaction terms. Noll's technique is hindered by problems of multicollinearity and yields results that are difficult to interpret.

Whitney (1988) considers whether the pursuit of wins and championships are interchangeable components of fan interest. He concludes that fan interest is motivated by, "a mix of game-winning and flag-winning prospects," with the latter having a slightly greater effect (Whitney, 709). Studies on attendance in MLB were further expanded in 1997 when the effect of team roster turnover and the importance of team composition were considered. Kahane and Shmanske (1997) examine several turnover measures, such as roster turnover³ and salary-weighted turnover.⁴ Kahane and Shmanske (1997) found that all turnover measure variables significantly affect attendance, a conclusion that represents a source of bias in existing work that has omitted the roster turnover effect. Rehab assignments represent a source of changes in team composition and roster turnover.

McDonald and Raseker (2000) focus on the effect of promotions on MLB attendance and, more importantly, include a "watering down effect," when fans are overexposed to promotions. They find promotions significantly affect attendance and a "watering down effect" is evident. As the number of promotions increases, the marginal impact of each promotion decreases. The authors do not consider if

the effect is present in variables other than promotions. Rehab assignments may be subject to the same “watering down effect” as promotions. Players with extended or multiple rehab stints are likely to become too familiar to ballpark fans, thus reducing the marginal impact of each assignment.

Other studies consider the effect of star players on attendance. Rivers and Deschriver (2002) focus on whether relationships exist between attendance at MLB games and both team payroll and star player presence. Team payroll is determined to be positively related to attendance. The authors also note that larger variations in salaries negatively affect attendance. However, the presence of players who were stars in the previous year or during the prior five years does not significantly affect attendance. Similarly, rehab assignments can consist of star players from MLB teams. It is likely that a star rehab assignment has a greater impact on attendance than a normal rehab assignment.

Boyd and Krehbiel (2003) introduce variable categorization. They focus on three different categories of promotions and their effect on MLB attendance: special pricing, giveaways, and special features. The authors expand prior research, examining the effects of promotions when combined with two interaction variables, weekday/weekend games and games against non-rivals/rivals. For six clubs, they determine that giveaways and special features significantly affect attendance. Decreasing marginal returns occur when promotions are combined with interaction variables that increase game attractiveness.

In a follow-up investigation (2006), Boyd and Krehbiel’s sample size is expanded to every game played in 2002 for all MLB teams. The new variables considered include: team, inter-league game, inclement weather, bobblehead, giveaway valued less than \$5, giveaway valued greater than \$5, two or more special events, and a combination of a giveaway and a special event. Promotions are found to significantly affect attendance for 16 MLB teams. They conclude that bobblehead giveaways, a combination of a giveaway and special event, and two or more special events have the greatest impact on attendance.

Siegfried and Eisenberg (1980) replicate Noll (1974) and other studies of MLB attendance for factors that affect attendance at MiLB games. Their model explains 80 percent of the variation in MiLB attendance, compared to Noll’s 69 percent. Attendance is negatively related to price, which supports the theory of consumer demand. Per capita income and winning have little or no effect on attendance, while promotions increase it. These conclusions differ from Noll’s in that per capita income is negatively related to attendance and that the demand for MLB games is price inelastic.

Paul et al.’s (2007) study of attendance in the NY-Penn League extended Siegfried and Eisenberg’s (1980) attendance study and included the effects of demographic, team performance, game time, and promotion variables. Few previous studies examine MiLB attendance, and those that do use a sample from varying levels (A, AA, AAA), rather than a sample of all teams from one specific league. They conclude that NY-Penn League games are a normal good and that promotions, income per capita, win percentage, day of the week, and promotion variables significantly affect attendance.

Bernthal and Graham (2003) extend MiLB and MLB studies into collegiate baseball. Their study focuses on differences in fan motivation factors between MiLB and collegiate baseball. This study was

the first to explore fan motivation in two different settings of the same sport. Bernthal and Graham (2003) chose MiLB A and NCAA Division I baseball because they believe that the two levels are similar in terms of level of play. Another reason for their choice is that the two levels tend to be present in the same cities. This availability of comparable substitutes means teams compete for fans in the same market. The authors conclude MiLB attendance is driven by value and entertainment factors, while collegiate attendance is influenced by game and communal factors.

III. Data Sample & Methodology

An Ordinary Least Square (OLS) regression model is specified to determine the factors that affect attendance in the IL from a sample of 11 IL teams that responded to information requests. Attendance at each home game for clubs of home teams in 2010 is the dependent variable. The 59 independent variables relate to team performance, promotions, and game timing. Rehab assignments, of both normal and star players, are the primary focus for this study.

Data were collected on the variables shown in Table 1 for a total of 771 home games. A total of 68 to 72 home games were played per team. The OLS regression model is defined as:

$$\begin{aligned} \text{ATTEND}_{ij} = & \beta_0 + \beta_1 \text{ATTEND_L}_{ij} + \beta_2 \text{OD}_{ij} + \beta_3 \text{LD}_{ij} + \beta_4 \text{MON}_{ij} + \beta_5 \text{TUE}_{ij} + \beta_6 \text{THU}_{ij} + \beta_7 \text{FRI}_{ij} + \beta_8 \text{SAT}_{ij} + \\ & \beta_9 \text{SUN}_{ij} + \beta_{10} \text{TUETD}_{ij} + \beta_{11} \text{FRIFIRE}_{ij} + \beta_{12} \text{GP15}_{ij} + \beta_{13} \text{GP2}_{ij} + \beta_{14} \text{APR}_{ij} + \beta_{15} \text{MAY}_{ij} + \\ & \beta_{16} \text{JUL}_{ij} + \beta_{17} \text{AUG}_{ij} + \beta_{18} \text{SEPT}_{ij} + \beta_{19} \text{WLPCT}_{ij} + \beta_{20} \text{OPPWLPC}_{ij} + \beta_{21} \text{FHOME}_{ij} + \\ & \beta_{22} \text{LHOME}_{ij} + \beta_{23} \text{WIN3}_{ij} + \beta_{24} \text{LOSE3}_{ij} + \beta_{25} \text{AAA}_{ij} + \beta_{26} \text{MLB}_{ij} + \beta_{27} \text{BOTH}_{ij} + \beta_{28} \text{STRAS}_{ij} + \\ & \beta_{29} \text{BOB}_{ij} + \beta_{30} \text{FIRE}_{ij} + \beta_{31} \text{GA}_{ij} + \beta_{32} \text{CD}_{ij} + \beta_{33} \text{TD}_{ij} + \beta_{34} \text{SF}_{ij} + \beta_{35} \text{NORM1}_{ij} + \beta_{36} \text{STAR1}_{ij} + \\ & \beta_{37} \text{BUF_H}_{ij} + \beta_{38} \text{CHA_H}_{ij} + \beta_{39} \text{COL_H}_{ij} + \beta_{40} \text{GWN_H}_{ij} + \beta_{41} \text{IND_H}_{ij} + \beta_{42} \text{LOU_H}_{ij} + \\ & \beta_{43} \text{PAW_H}_{ij} + \beta_{44} \text{SWB_H}_{ij} + \beta_{45} \text{SYR_H}_{ij} + \beta_{46} \text{TLD_H}_{ij} + \beta_{47} \text{BUF_A}_{ij} + \beta_{48} \text{CHA_A}_{ij} + \\ & \beta_{49} \text{COL_A}_{ij} + \beta_{50} \text{DUR_A}_{ij} + \beta_{51} \text{GWN_A}_{ij} + \beta_{52} \text{IND_A}_{ij} + \beta_{53} \text{LHV_A}_{ij} + \beta_{54} \text{LOU_A}_{ij} + \\ & \beta_{55} \text{NOR_A}_{ij} + \beta_{56} \text{PAW_A}_{ij} + \beta_{57} \text{SWB_A}_{ij} + \beta_{58} \text{SYR_A}_{ij} + \beta_{59} \text{TLD_A}_{ij} + \varepsilon \end{aligned}$$

Autocorrelation was a concern in the original model. This issue was resolved with the inclusion of a lag of the dependent variable as an independent variable.⁵ ATTEND_L represents attendance at each team's previous home game. The first observation lag, per team, is set equal to the team's first home attendance of the season. Dropping each team's first observation did not significantly affect the independent variables, thus these observations are included in the final model. Tests for multicollinearity and heteroskedasticity were performed. The results proved the absence of multicollinearity, but indicated problems with heteroskedasticity.⁶ White's heteroskedasticity-constant standard errors and co-variance adjustment is applied in the reported results.

The OLS regression model represents unbalanced panel data, due to the variation in the number of home games per team. Home and away team dummy variables are added to capture fixed effects. Unlike previous studies, population and income per capita variables are excluded from the model.

Table 1. Description of Variables

Variable	Description
ATTEND	The attendance at home games of team <i>i</i> on dates <i>j</i> .
ATTEND_L	The lagged attendance at home games of team <i>i</i> on dates <i>j</i> .
OD	A dummy variable; 1 if the game took place on Opening Day, otherwise 0.
LD	A dummy variable; 1 if the game took place on the last home game, otherwise 0.
MON	A dummy variable; 1 if the game took place on Monday, otherwise 0.
TUE	A dummy variable; 1 if the game took place on Tuesday, otherwise 0.
THU	A dummy variable; 1 if the game took place on Thursday, otherwise 0.
FRI	A dummy variable; 1 if the game took place on Friday, otherwise 0.
SAT	A dummy variable; 1 if the game took place on Saturday, otherwise 0.
SUN	A dummy variable; 1 if the game took place on Sunday, otherwise 0.
TUETD	A dummy variable; 1 if the game took place on a Tuesday and featured a ticket discount, otherwise 0.
FRIFIRE	A dummy variable; 1 if the game took place on a Friday and featured post-game fireworks, otherwise 0.
GP15	A dummy variable; 1 if a combination of a scheduled game and an unfinished game were played, otherwise 0.
GP2	A dummy variable; 1 if a combination of a scheduled game and a postponed game were played (a.k.a. doubleheader), otherwise 0.
APR	A dummy variable; 1 if the game took place in April, otherwise 0.
MAY	A dummy variable; 1 if the game took place in May, otherwise 0.
JUL	A dummy variable; 1 if the game took place in July, otherwise 0.
AUG	A dummy variable; 1 if the game took place in August, otherwise 0.
SEPT	A dummy variable; 1 if the game took place in September, otherwise 0.
WLPCT	The home team's winning percentage prior to the start of the game. The first observation, per team, represents the home team's winning percentage at the end of the 2009 season.
OPPWLPCT	The away team's winning percentage prior to the start of the game. The first observation, per team, represents the away team's winning percentage at the end of the 2009 season.
FHOME	A dummy variable; 1 if the game was the first game of a home stand, otherwise 0.
LHOME	A dummy variable; 1 if the game was the last game of a home stand, otherwise 0.
WIN3	A dummy variable; 1 if the home team had a 3+ winning streak, otherwise 0.
LOSE3	A dummy variable; 1 if the home team had a 3+ losing streak, otherwise 0.
AAA	A dummy variable; 1 if the game was played against an AAA divisional opponent, otherwise 0.
MLB	A dummy variable; 1 if the game was played against an MLB divisional opponent, otherwise 0.
BOTH	A dummy variable; 1 if the game was played against both an AAA and MLB divisional opponent, otherwise 0.
STRAS	A dummy variable; 1 if Stephen Strasburg was the starting pitcher, otherwise 0.
BOB	A dummy variable; 1 if the game featured a bobblehead giveaway, otherwise 0.
FIRE	A dummy variable; 1 if the game featured post-game fireworks, otherwise 0.
GA	A dummy variable; 1 if the game featured a merchandise giveaway (magnetic schedule, team card set, team autograph booklet, etc.), otherwise 0.

CD	A dummy variable; 1 if the game featured a concession stand discount (25 cent hotdogs, \$1 Budweiser, etc.), otherwise 0.
TD	A dummy variable; 1 if the game featured a ticket discount, otherwise 0. Ticket discounts were normally subject to a requirement (report card, membership identification, KRAFT Singles wrapper, etc.).
SF	A dummy variable; 1 if the game offered a special feature (Kids Run the Bases, Have a Catch Sunday, Dora the Explorer appearance, etc.), otherwise 0.
NORM1	A dummy variable; 1 if a normal rehab assignment player started the game, otherwise 0.
STAR1	A dummy variable; 1 if a star rehab assignment player started the game, otherwise 0. Star status is defined as a player that was honored as an All-Star, Gold Glover, or Silver Slugger at any time during his career prior to the 2010 season.
BUF_H	A dummy variable; 1 if the Buffalo Bisons were the home team, otherwise 0.
CHA_H	A dummy variable; 1 if the Charlotte Knights were the home team, otherwise 0.
COL_H	A dummy variable; 1 if the Columbus Clippers were the home team, otherwise 0.
GWN_H	A dummy variable; 1 if the Gwinnett Braves were the home team, otherwise 0.
IND_H	A dummy variable; 1 if the Indianapolis Indians were the home team, otherwise 0.
LOU_H	A dummy variable; 1 if the Louisville Bats were the home team, otherwise 0.
PAW_H	A dummy variable; 1 if the Pawtucket Red Sox were the home team, otherwise 0.
SWB_H	A dummy variable; 1 if the SWB Yankees were the home team, otherwise 0.
SYR_H	A dummy variable; 1 if the Syracuse Chiefs were the home team, otherwise 0.
TLD_H	A dummy variable; 1 if the Toledo Mud Hens were the home team, otherwise 0.
BUF_A	A dummy variable; 1 if the Buffalo Bisons were the away team, otherwise 0.
CHA_A	A dummy variable; 1 if the Charlotte Knights were the away team, otherwise 0.
COL_A	A dummy variable; 1 if the Columbus Clippers were the away team, otherwise 0.
DUR_A	A dummy variable; 1 if the Durham Bulls were the away team, otherwise 0.
GWN_A	A dummy variable; 1 if the Gwinnett Braves were the away team, otherwise 0.
IND_A	A dummy variable; 1 if the Indianapolis Indians were the away team, otherwise 0.
LHV_A	A dummy variable; 1 if the LV Iron Pigs were the away team, otherwise 0.
LOU_A	A dummy variable; 1 if the Louisville Bats were the away team, otherwise 0.
NOR_A	A dummy variable; 1 if the Norfolk Tides were the away team, otherwise 0.
PAW_A	A dummy variable; 1 if the Pawtucket Red Sox were the away team, otherwise 0.
SWB_A	A dummy variable; 1 if the SWB Yankees were the away team, otherwise 0.
SYR_A	A dummy variable; 1 if the Syracuse Chiefs were the away team, otherwise 0.
TLD_A	A dummy variable; 1 if the Toledo Mud Hens were the away team, otherwise 0.
i	1, 2, . . . , 11 teams in sample.
j	1, 2, . . . , "n" home games per team in sample (n = 68 to 72 home games).

These effects are captured by the inclusion of team dummy variables. The Rochester Red Wings had the worst record during the 2010 season (49-95) and represent the team dummy reference. Winning and losing streaks are added to capture intertemporal effects.

Data were collected from three sources. Rehab assignment data are from each team's transaction history obtained at www.mlb.com and www.milb.com, as well as award and game log data found at www.baseball-reference.com. Data for the remaining variables were obtained from www.milb.com and personal correspondence with the teams. It is important to note that the rehab assignment designation was selective. Some players are sent down or outrighted to the minor leagues after spending time on the disabled list. This is not a rehab assignment, since an outrighted player is removed from the MLB 40-

man roster. This differs from simply being sent down because the player is still paid according to his MLB contract. Including these data in the study would create a bias in the results, as a rehab assignment should reflect the expectation that the player will return to the majors.

Summary statistics for the variables are shown in Table 2. The average 2010 game attendance was 7,007 fans, with a high of 17,527 and a low of 1,111. The 11 IL teams in the sample held 1,060 promotions during the 2010 season. Special features accounted for the largest percentage of promotions at 33.0 percent. Ticket discounts, giveaways, concession discounts, fireworks, and bobbleheads accounted respectively for 22.5, 17.0, 14.7, 12.2, and 0.6 percent of promotions. In terms of game days, Saturday is most common, 120 games, and Wednesday is least common, 88 games.

Table 2. Descriptive Statistics for International Baseball League Games during the 2010 Season

Dependent Variable	MEAN	SD	MIN	MAX	FREQ
Attendance ¹	7,007	2,952	1,111	17,527	771
Time Factors					
Lagged Attendance	6,999	2,942	1,111	17,527	771
Opening Day	0.014	0.119	0	1	11
Last Home Game	0.014	0.119	0	1	11
Played on Monday	0.141	0.349	0	1	109
Played on Tuesday	0.136	0.343	0	1	105
Played on Thursday	0.153	0.360	0	1	118
Played on Friday	0.147	0.354	0	1	113
Played on Saturday	0.156	0.363	0	1	120
Played on Sunday	0.153	0.360	0	1	118
Played on Tuesday and featured a ticket discount ¹	0.109	0.312	0	1	84
Played on Friday and featured post-game fireworks ¹	0.080	0.272	0	1	62
Played scheduled and postponed game	0.012	0.107	0	1	9
Played doubleheader	0.025	0.155	0	1	19
Played in April	0.162	0.369	0	1	125
Played in May	0.195	0.396	0	1	150
Played in July	0.192	0.394	0	1	148
Played in August	0.209	0.407	0	1	161
Played in September	0.038	0.190	0	1	29
Fan Interest					
The home team's win percentage	0.507	0.093	0	1	771
The away team's win percentage	0.495	0.101	0	1	771
First game of home stand	0.175	0.380	0	1	135
Last game of home stand	0.175	0.380	0	1	135
Three or more game winning streak	0.149	0.356	0	1	115
Three or more game losing streak	0.112	0.315	0	1	86
An AAA divisional game	0.486	0.500	0	1	375
An MLB divisional game	0.213	0.409	0	1	164
An AAA/MLB divisional game	0.117	0.321	0	1	90
Stephen Strasburg was the starter	0.008	0.088	0	1	6

FALL 2013

Game featured a bobblehead giveaway ¹	0.009	0.095	0	1	7
Game featured post-game fireworks ¹	0.167	0.373	0	1	129
Game featured a merchandise giveaway ¹	0.233	0.423	0	1	180
Game featured a concession stand discount ¹	0.202	0.402	0	1	156
Game featured a ticket discount ¹	0.309	0.462	0	1	238
Game offered a special feature ¹	0.454	0.498	0	1	350
Rehab Assignment					
Normal rehab assignment player present ^{1, 2}	0.256	0.436	0	1	197
Star rehab assignment player present ^{1, 2, and 3} (All-Star, Silver Slugger, or Gold Glover)	0.115	0.320	0	1	89
Home Team					
Buffalo Bisons	0.091	0.287	0	1	70
Charlotte Knights	0.093	0.291	0	1	72
Columbus Clippers	0.092	0.289	0	1	71
Gwinnett Braves	0.091	0.287	0	1	70
Indianapolis Indians	0.092	0.289	0	1	71
Louisville Bats	0.092	0.289	0	1	71
Pawtucket Red Sox	0.092	0.289	0	1	71
Scranton/Wilkes-Barre Yankees	0.088	0.284	0	1	68
Syracuse Chiefs	0.088	0.284	0	1	68
Toledo Mud Hens	0.091	0.287	0	1	70
Away Team					
Buffalo Bisons	0.071	0.258	0	1	55
Charlotte Knights	0.061	0.239	0	1	47
Columbus Clippers	0.074	0.262	0	1	57
Durham Bulls	0.071	0.258	0	1	55
Gwinnett Braves	0.058	0.235	0	1	45
Indianapolis Indians	0.078	0.268	0	1	60
Lehigh Valley Iron Pigs	0.079	0.270	0	1	61
Louisville Bats	0.074	0.262	0	1	57
Norfolk Tides	0.074	0.262	0	1	57
Pawtucket Red Sox	0.071	0.258	0	1	55
Scranton/Wilkes-Barre Yankees	0.070	0.255	0	1	54
Syracuse Chiefs	0.070	0.255	0	1	54
Toledo Mud Hens	0.077	0.266	0	1	59

Notes: The data set includes 771 home games played during the 2010 International League season.

¹ Minor League Baseball (www.milb.com)

² Major League Baseball (www.mlb.com)

³ Baseball-Reference
(www.baseball-reference.com)

Correlations between variables are shown in Table 3. Variables followed by “1” denote a rehab assignment player started and when followed by “2” denote a rehab assignment player was present. All-Star (AS1, AS2), Gold Glover (GG1, GG2), and Silver Slugger (SS1, SS2) variables are highly correlated. This means that an All-Star player has a tendency to be either a Gold Glover or Silver Slugger too. The six variables are combined into two variables, STAR1 and STAR2. An Excel IF function is used to

Table 3. Correlation of Variables

Variable	TUE	FRI	FIRE	TD	AS1	GG1	SS1	AS2	GG2	S2
Tuesday Game	1.000	-0.165	-0.178	0.422	-0.005	0.003	-0.014	-0.013	-0.028	-0.043
Friday Game	—	1.000	0.423	-0.205	-0.028	-0.029	-0.042	-0.035	-0.032	-0.010
Fireworks	—	—	1.000	-0.247	-0.028	-0.009	-0.004	-0.031	0.000	0.032
Ticket Discount	—	—	—	1.000	0.026	-0.028	-0.016	-0.013	-0.071	-0.051
All-Star Playing	—	—	—	—	1.000	0.496	0.546	0.760	0.361	0.409
Gold Glover Playing	—	—	—	—	—	1.000	0.542	0.376	0.759	0.417
Silver Slugger Playing	—	—	—	—	—	—	1.000	0.414	0.405	0.734
All-Star Present	—	—	—	—	—	—	—	1.000	0.496	0.567
Gold Glover Present	—	—	—	—	—	—	—	—	1.000	0.572
Silver Slugger Present	—	—	—	—	—	—	—	—	—	1.000

perform a logical true or false test. STAR1 (STAR2) is assigned a value of 1 if the sum of AS1, GG1, and SS1 (AS2, GG2, and SS2) is greater than zero.

A high correlation is also noted between the variables FRI and FIRE, along with TUE and TD. This means fireworks have a tendency to take place on Friday and ticket discounts have a tendency to take place on Tuesday. Interaction variables are included in the model by multiplying FRI by FIRE and TUE by TD. The FRIFIRE variable, when its value is 1, represents games that take place on Friday and feature post-game fireworks. The TUETD variable, when its value is 1, represents games that take place on Tuesday and feature a ticket discount.

IV. Results & Analysis

The first regression determines the significance of the NORM1 and STAR1 variables and the second regression determines the significance of the NORM2 and STAR2 variables. The NORM2 and STAR2 variables are defined as:

NORM2: A dummy variable; 1 if a normal rehab assignment player was present during the game, otherwise 0.

STAR2: A dummy variable; 1 if a star rehab assignment player was present during the game, otherwise 0. Star status is defined as a player that was honored as an All-Star, Gold Glover, or Silver Slugger at any time during their career prior to the 2010 season.

The complete list of “normal” and “star” rehab assignments is shown in Table 4. When the linear regression is estimated using NORM1 and STAR1, 30 out of 59 variables presented in Table 5 are found to be statistically significant. The NORM1 and STAR1 variables are not found to be statistically significant. When the linear regression is estimated using NORM2 and STAR2, 35 out of 59 variables presented in Table 6 are found to be statistically significant, including the NORM2 and STAR2 variables.

Table 4. Rehab Assignment Players

Last Name	First Name	Status	Last Name	First Name	Status
Ambriz	Hector	Normal	Marquis	Jason	Star
Baez	Danys	Star	Matsuzaka	Daisuke	Normal
Bailey	Homer	Normal	Mijares	Jose	Normal
Bartlett	Jason	Star	Mitre	Sergio	Normal
Beckett	Josh	Star	Niese	Jon	Normal
Bonser	Boof	Normal	O'Flaherty	Eric	Normal
Buchholz	Clay	Normal	Okajima	Hideki	Star
Cameron	Mike	Star	Park	Chan Ho	Star
Cash	Kevin	Normal	Patterson	Eric	Normal
Castro	Ramon	Normal	Pedroia	Dustin	Star
Condrey	Clay	Normal	Perez	Oliver	Normal
Detwiler	Ross	Normal	Perry	Ryan	Normal
Diaz	Matt	Normal	Prado	Martin	Normal
Ellsbury	Jacoby	Normal	Romero	J.C.	Normal
Escobar	Yunel	Normal	Ruiz	Carlos	Normal
Glaus	Troy	Star	Saito	Takashi	Star
Gonzalez	Mike	Normal	Saltalamacchia	Jarrold	Normal
Granderson	Curtis	Star	Schneider	Brian	Normal
Guillen	Carlos	Star	Shoppach	Kelly	Normal
Harang	Aaron	Normal	Teahen	Mark	Normal
Hermida	Jeremy	Normal	Thames	Marcus	Normal
Jurrjens	Jair	Normal	Threets	Erick	Normal
Lidge	Brad	Star	Uehara	Koji	Normal
Lowell	Mike	Star	Varitek	Jason	Star
Lowrie	Jed	Normal	Victorino	Shane	Star
Madson	Ryan	Normal	Volquez	Edison	Star
Maine	John	Normal			

A comparison of the results shows that rehab assignment players only have to be present and do not have to play in the game. One possible explanation for this is that fans are more interested in autographs than a player's performance. Another possible explanation is that starting lineups for any given game are not posted well in advance, thus a fan's expectation that a player might start holds more weight than the actual outcome. The significance of NORM2 reaffirms the importance of “star” status, as typical rehab assignments decrease attendance.

Table 5. Regression Results (NORM1, STAR1)Adjusted R² – 0.654

Degrees of Freedom – 711

Observations – 771

F Statistic – 25.71

Dependent Variable – Attendance

Explanatory Variable	COEFF	STD ERR	T-STAT	SIGNIF	
Time Factors					
Lagged Attendance **		0.08	0.03	2.48	0.013
Opening Day ***		2,918.22	648.10	4.50	0.000
Last Home Game ***		1,935.85	692.34	2.80	0.005
Played on Monday *		-481.19	255.64	-1.88	0.060
Played on Tuesday		-561.79	344.10	-1.63	0.103
Played on Thursday		149.65	251.69	0.59	0.552
Played on Friday ***		1,063.70	311.84	3.41	0.001
Played on Saturday ***		1,609.14	274.57	5.86	0.000
Played on Sunday		374.31	269.47	1.39	0.165
Played on Tuesday and featured a ticket discount		424.35	385.72	1.10	0.272
Played on Friday and featured post-game fireworks		-174.50	478.43	-0.36	0.715
Played scheduled and postponed game ***		-1,121.26	353.69	-3.17	0.002
Played doubleheader		-51.74	352.48	-0.15	0.883
Played in April ***		-1,532.36	231.38	-6.62	0.000
Played in May ***		-693.59	199.57	-3.48	0.001
Played in July **		426.13	190.90	2.23	0.026
Played in August		193.20	193.80	1.00	0.319
Played in September		120.77	476.01	0.25	0.800
Fan Interest					
The home team's win percentage		1,042.68	1,209.31	0.86	0.389
The away team's win percentage **		3,232.54	1,268.31	2.55	0.011
First game of home stand **		438.78	198.03	2.22	0.027
Last game of home stand ***		460.68	175.19	2.63	0.001
Three or more game winning streak		270.05	190.56	1.42	0.157
Three or more game losing streak		181.72	209.40	0.87	0.386
An AAA divisional game		-67.15	175.96	-0.38	0.703
An MLB divisional game		54.31	216.68	0.25	0.802
An AAA/MLB divisional game		-139.60	309.52	-0.45	0.652
Stephen Strasburg was the starter ***		6,855.46	957.70	7.16	0.000
Game featured a bobblehead giveaway ***		1,772.92	547.74	3.24	0.001
Game featured post-game fireworks ***		2,049.79	312.14	6.57	0.000
Game featured a merchandise giveaway		221.26	169.65	1.30	0.193
Game featured a concession stand discount **		402.63	180.71	2.23	0.026
Game featured a ticket discount **		-394.54	185.23	-2.13	0.034
Game offered a special feature **		392.27	173.20	2.26	0.024

*** Statistically significant at 1 percent level

** Statistically significant at 5 percent level

* Statistically significant at 10 percent level

Table 5. Regression Results (NORM1, STAR1)Adjusted R² – 0.654

Degrees of Freedom – 711

Observations – 771

F Statistic – 25.71

Dependent Variable – Attendance

Explanatory Variable	COEFF	STD ERR	T-STAT	SIGNIF	
Rehab Assignment					
Normal rehab assignment player started		-282.51	201.75	-1.40	0.162
Star rehab assignment player started (All-Star, Silver Slugger, or Gold Glover)		285.39	304.02	0.94	0.348
Home Team					
Buffalo Bisons ***		1,533.16	375.61	4.08	0.000
Charlotte Knights ***		-1,968.94	326.76	-6.03	0.000
Columbus Clippers ***		2,269.61	397.24	5.71	0.000
Gwinnett Braves ***		-1,180.80	286.40	-4.12	0.000
Indianapolis Indians ***		1,461.59	370.84	3.94	0.000
Louisville Bats ***		1,679.31	349.68	4.80	0.000
Pawtucket Red Sox ***		2,114.81	318.13	6.65	0.000
Scranton/Wilkes-Barre Yankees ***		-1,227.09	340.81	-3.60	0.000
Syracuse Chiefs		-591.33	395.23	-1.50	0.135
Toledo Mud Hens ***		865.71	316.37	2.74	0.001
Away Team					
Buffalo Bisons *		-661.96	386.28	-1.71	0.087
Charlotte Knights		-403.92	364.92	-1.11	0.269
Columbus Clippers		-634.56	432.92	-1.47	0.143
Durham Bulls *		-779.68	442.89	-1.76	0.079
Gwinnett Braves		-197.87	373.91	-0.53	0.597
Indianapolis Indians		-331.97	370.37	-0.90	0.370
Lehigh Valley Iron Pigs		-251.44	323.56	-0.78	0.437
Louisville Bats		-554.21	356.05	-1.56	0.120
Norfolk Tides		-123.73	387.45	-0.32	0.750
Pawtucket Red Sox		77.72	356.73	0.22	0.828
Scranton/Wilkes-Barre Yankees		-297.86	454.37	-0.66	0.512
Syracuse Chiefs		-553.61	476.91	-1.16	0.246
Toledo Mud Hens		-168.88	402.70	-0.42	0.675

*** Statistically significant at 1 percent level

** Statistically significant at 5 percent level

* Statistically significant at 10 percent level

The promotion variable with the biggest effect on attendance is post-game fireworks (FIRE). This variable is statistically significant at the 1 percent level and helps draw an additional 2,059 fans to the ballpark. Bobbleheads, concession discounts, and special features (listed in order of largest to smallest effect) are statistically significant at the 1 and 5 percent levels. The BOB variable, CD variable, and SF variables increased attendance by: 1,626; 396; and 393 fans respectively. Ticket discounts are statistically

Table 6. Regression Results (NORM2, STAR2)Adjusted R² – 0.659

Degrees of Freedom – 711

Observations – 771

F Statistic – 26.19

Dependent Variable – Attendance

Explanatory Variable	COEFF	STD ERR	T-STAT	SIGNIF	
Time Factors					
Lagged Attendance **		0.07	0.03	2.18	0.029
Opening Day ***		3,023.81	656.80	4.60	0.000
Last Home Game ***		1,868.77	690.14	2.71	0.007
Played on Monday *		-489.65	256.11	-1.91	0.056
Played on Tuesday		-570.88	350.88	-1.63	0.104
Played on Thursday		138.45	250.14	0.55	0.580
Played on Friday ***		1,086.05	310.98	3.49	0.001
Played on Saturday ***		1,624.04	275.05	5.90	0.000
Played on Sunday		385.98	270.72	1.43	0.154
Played on Tuesday and featured a ticket discount		397.15	387.08	1.03	0.305
Played on Friday and featured post-game fireworks		-199.60	477.99	-0.42	0.676
Played scheduled and postponed game ***		-1,080.38	363.60	-2.97	0.003
Played doubleheader		-35.38	349.32	-0.10	0.919
Played in April ***		-1,500.02	231.19	-6.49	0.000
Played in May ***		-726.44	199.55	-3.64	0.000
Played in July *		371.53	190.14	1.95	0.051
Played in August		192.96	196.23	0.98	0.326
Played in September		154.51	472.49	0.33	0.744
Fan Interest					
The home team's win percentage		1,291.21	1,215.70	1.06	0.289
The away team's win percentage ***		3,379.01	1,265.93	2.67	0.008
First game of home stand **		440.05	196.21	2.24	0.025
Last game of home stand ***		469.69	174.87	2.69	0.007
Three or more game winning streak		248.26	188.85	1.31	0.189
Three or more game losing streak		188.78	206.35	0.91	0.361
An AAA divisional game		-75.42	174.61	-0.43	0.666
An MLB divisional game		88.21	227.14	0.39	0.698
An AAA/MLB divisional game		-143.17	319.52	-0.45	0.654
Stephen Strasburg was the starter ***		6,859.91	940.30	7.30	0.000
Game featured a bobblehead giveaway ***		1,626.24	543.55	2.99	0.003
Game featured post-game fireworks ***		2,058.77	315.32	6.53	0.000
Game featured a merchandise giveaway		232.72	168.08	1.38	0.167
Game featured a concession stand discount **		395.93	180.23	2.20	0.028
Game featured a ticket discount **		-366.38	183.08	-2.00	0.046
Game offered a special feature **		392.86	171.42	2.29	0.022

*** Statistically significant at 1 percent level

** Statistically significant at 5 percent level

* Statistically significant at 10 percent level

Table 6. Regression Results (NORM2, STAR2)Adjusted R² – 0.659

Degrees of Freedom – 711

Observations – 771

F Statistic – 26.19

Dependent Variable – Attendance

Explanatory Variable	COEFF	STD ERR	T-STAT	SIGNIF	
Rehab Assignment					
Normal rehab assignment player present **		-326.31	161.92	-2.02	0.044
Star rehab assignment player present *** (All-Star, Silver Slugger, or Gold Glover)		613.09	218.94	2.80	0.005
Home Team					
Buffalo Bisons ***		1,522.05	374.18	4.07	0.000
Charlotte Knights ***		-1,993.91	322.65	-6.18	0.000
Columbus Clippers ***		2,281.98	393.51	5.80	0.000
Gwinnett Braves ***		-1,239.65	281.47	-4.40	0.000
Indianapolis Indians ***		1,477.92	369.31	4.00	0.000
Louisville Bats ***		1,693.13	349.48	4.84	0.000
Pawtucket Red Sox ***		2,112.58	316.81	6.67	0.000
Scranton/Wilkes-Barre Yankees ***		-1,316.33	337.02	-3.91	0.000
Syracuse Chiefs *		-712.00	393.05	-1.81	0.071
Toledo Mud Hens ***		833.74	315.00	2.65	0.001
Away Team					
Buffalo Bisons *		-724.79	385.13	-1.88	0.060
Charlotte Knights		-477.90	364.36	-1.31	0.190
Columbus Clippers *		-722.54	433.86	-1.67	0.096
Durham Bulls **		-926.62	444.41	-2.09	0.037
Gwinnett Braves		-196.51	384.54	-0.51	0.601
Indianapolis Indians		-423.71	368.88	-1.15	0.251
Lehigh Valley Iron Pigs		-344.57	322.56	-1.07	0.286
Louisville Bats *		-614.27	356.29	-1.72	0.085
Norfolk Tides		-182.97	384.23	-0.48	0.634
Pawtucket Red Sox		-31.63	364.39	-0.09	0.931
Scranton/Wilkes-Barre Yankees		-389.00	450.64	-0.86	0.388
Syracuse Chiefs		-674.72	479.72	-1.41	0.160
Toledo Mud Hens		-313.14	402.76	-0.78	0.437

*** Statistically significant at 1 percent level

** Statistically significant at 5 percent level

* Statistically significant at 10 percent level

significant at the 5 percent level and cause attendance to decrease by 366 fans. This discount likely tends to be offered on days when average attendance is already low. In addition, ticket discounts are usually subject to a requirement (membership identification, KRAFT Singles wrapper, etc.). The cost of acquiring a membership card or package of KRAFT Singles likely reduces the net expected benefit.

In terms of timing of the game, Friday and Saturday are statistically significant at the 1 percent level. Friday games, compared to Wednesday games, draw an additional 1,086 fans. Saturday games, compared to Wednesday games, draw an additional 1,624 fans. Monday is statistically significant at the 10 percent level and causes attendance to decrease by 490 fans compared to Wednesday games. Fans have a higher opportunity cost for attending weekday games. Between Monday and Thursday, students have school assignments to complete or school events to attend, while parents have home and work obligations.

Month variables are used as a proxy for average weather conditions. April and May games, compared to June games, draw 1,500 and 726 fewer fans respectively, which is statistically significant at the 1 percent level. July games draw an additional 372 fans compared to June games which is statistically significant at the 10 percent level. Average temperatures tend to be colder in the beginning months of the season and school is still in session. Both of these factors likely impose higher opportunity costs on fans. On days in which a scheduled game and an unfinished game were played, the GP15 variable, attendance decreased by 1,080 fans. One possible explanation for this is that staying an additional amount of time at the ballpark causes opportunity cost of attendance to increase because games are played later into the night.

The Strasburg effect is measured by the STRAS variable. Stephen Strasburg is the much-hyped first pick in the 2009 Major League Baseball Draft. On days Strasburg pitched, an additional 6,860 fans attended and it is statistically significant at the 1 percent level. This increase in attendance can likely be explained by a variety of factors including: his collegiate performance while at San Diego State, his record-breaking contract for a first round draft pick, media attention, and analysts' expectations of a quick ascension to the majors.

The significance of winning percentage variables of the home and away team were split. A home team's winning percentage, (WLPCT), is not found to be statistically significant. This differs from the results of other studies. Baseball fans likely display loyalty to their home team regardless of its record. The opponent's winning percentage, (OPPWLPC), is statistically significant at the 1 percent level. Fans likely respond to the quality of the opposing team because it makes for a more competitive game, not to mention bragging rights to the winning team.

Winning and losing streaks of three or more games are not found to be statistically significant. The impact of rivalries, as defined by three different measures (AAA, MLB, and BOTH), are not found to be statistically significant. One possible explanation is that an opponent's winning percentage holds considerably more value than a rivalry itself. What good is a rivalry if one team is leading the division and the other team is in last place? It can be argued that a rivalry only holds value when the two teams are in close competition for a common goal, such as a divisional crown or playoff spot.

Opening Day, (OD), and the last home game of the season, (LD), are statistically significant at the 1 percent level by drawing an additional 3,024 and 1,869 fans respectively. This effect is reflected to a lesser degree in the FHOME and LHOME variables. The first game of a home stand is statistically

significant at the 5 percent level and draws an additional 440 fans to the ballpark. The last game of a home stand is statistically significant at the 1 percent level and draws an additional 470 fans to the ballpark. One possible explanation is that fans take part in welcoming back and sending off teams. Another possible explanation is that a lack of comparable substitutes causes fans to open up their schedules when the team returns to town.

All home team dummy variables are found to be statistically significant at either the 1 or 10 percent level. The Columbus Clippers, Pawtucket Red Sox, Louisville Bats, Buffalo Bisons, Indianapolis Indians, and Toledo Mud Hens (listed in order of largest to smallest effect) draw additional fans compared to the Rochester Red Wings. The Charlotte Knights, Scranton/Wilkes-Barre Yankees, Gwinnett Braves, and Syracuse Chiefs (listed in order of largest to smallest effect) draw fewer fans compared to the Rochester Red Wings. Four away team dummy variables are found to be statistically significant and each has a negative impact on attendance, compared to the Rochester Red Wings.

V: Conclusion

The primary objective of this study is to determine the effect of MLB rehab assignments on attendance in the IL. Regression results reveal two important conclusions. First, players on rehab assignments only need to be present to affect attendance in the IL. This is reflected in the insignificance of the NORM1 and STAR1 variables. Two possible explanations discussed include a player's availability for autographs and timing factors related to the release of starting lineups. Second, rehab assignments have a conditional effect on attendance in the IL. Players on rehab assignments must be of star status in order to draw additional fans. The NORM2 variable is statistically significant at the 5 percent level. A normal player on rehab assignment decreases attendance by 326 fans. The opposite is true for the STAR2 variable. A star player on rehab assignment draws an additional 613 fans to the ballpark and is statistically significant at the 1 percent level.

The results of this study may not hold across different levels and leagues of MiLB (North, South, East, West; AA, A, A-SS, Rookie). Levels vary in player quality and leagues are subject to demographic and geographic differences. Researchers have the opportunity to expand on this study in the future through the consideration of different levels and leagues. The results of this study help provide a better understanding of consumer preferences and allow minor league teams to better forecast supply needs associated with profit maximization. Teams leave profits on the table if they are understaffed and lack the appropriate inventory. On the other hand, teams incur unnecessary expenses if they are overstaffed and have excess inventory.

ENDNOTES

1. Buffalo Bisons (New York Mets), Charlotte Knights (Chicago White Sox), Columbus Clippers (Cleveland Indians), Durham Bulls (Tampa Bay Rays), Gwinnett Braves (Atlanta Braves),

Indianapolis Indians (Pittsburgh Pirates), Lehigh Valley Iron Pigs (Philadelphia Phillies), Louisville Bats (Cincinnati Reds), Norfolk Tides (Baltimore Orioles), Pawtucket Red Sox (Boston Red Sox), Rochester Red Wings (Minnesota Twins), Scranton/Wilkes-Barre Yankees (New York Yankees), Syracuse Chiefs (Washington Nationals), and Toledo Mud Hens (Detroit Tigers).

2. The Durham Bulls, Lehigh Valley Iron Pigs, and Norfolk Tides declined to provide promotion data and are not included in the data set. This reduced the overall sample size from 14 to 11 teams.
3. Players in Year_{t-1} versus Players in Year_t.
4. Team Payroll in Year_{t-1} versus Team Payroll in Year_t.
5. The Durbin-Watson statistic was calculated with the addition of a lag of the dependent variable. No autocorrelation was found with reported values of 1.97 and 1.98 respectively.
6. The variance inflation factor analysis was carried out to test for multicollinearity. White's test was performed and rejected the null hypothesis of no heteroskedasticity.

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ACKNOWLEDGMENTS

The author would like to thank the editor, any anonymous referee(s), Michael McAvoy, Byoung Park, and David Ring for their invaluable comments on earlier drafts of this article.