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The Designated Hitter Rule and Team Defensive Strategy in Japan's Professional Baseball League

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ABSTRACT

Economists have debated whether and why the designated hitter (DH) rule in North American major league baseball led to an increase in hit-batsmen. We use data from Japan's professional baseball leagues, the Pacific League (DH rule) and the Central League (no DH rule), to re-examine this question. Our empirical findings reveal increases in hit-batsmen in the Pacific League after we control for the DH's effect on team batting performance. We argue that the DH rule induced changes in managerial defensive strategies that led to more hit-batsmen. Subsequent rule changes reduced the effectiveness of these strategies.

I. INTRODUCTION

Professional sports provide economists with opportunities to test

theoretical predictions with a rich array of performance data. As the rules of

the game are clearly defined for individual players as well as for

organizations such as teams and leagues, sports statistics are often used to

study rule changes and their consequences. Examples of

such investigations include the effects of rookie draft rules on team

competitive balance in Daly and Moore (1981), Fort and Quirk (1995) and

LaCroix and Kawaura (1999), and free agency and the allocation of player

talent in Eckard (2001).

This paper examines the effects of the designated hitter (DH) rule in

professional baseball on team defensive strategies. The DH rule allows

another player on the team roster to bat and run the bases in place of the

pitcher, thereby ensuring that the pitcher does not have to bat.   In North

American Major League Baseball (MLB), the American League (AL)

introduced the DH rule in 1973 and continues to use it, while the National

League (NL) has never used the rule. Using MLB performance data, Goff,

Shughart and Tollison (1997), hereafter GST (1997), found that AL batters

were hit by pitches more frequently than their NL counterparts during

DH-rule seasons.   They attributed this difference to moral hazard by

pitchers, arguing that pitchers in the DH-rule league can hit opposing

batters of their choice with less concern for personal retaliation as the rule

exempts them from facing opposing pitchers at the plate.[1] Trandel, White

and Klein (1998), hereafter TWK (1998), offered a new estimation equation

to measure the DH's effects on hit-batsmen, updated the sample of GST

(1997) by adding seven seasons (1991-1997), and found that the DH's effect

on hit-batsmen was statistically insignificant.   TWK (1998) also questioned

the moral hazard story by arguing that a pitcher merely acts as an agent of

his team's manager and that retaliation is rarely directed at pitchers

themselves.[2] They stressed that AL batters are on average better hitters as

the DH rule replaces a weak-hitting pitcher with a big-hitting slugger and

argued that pitchers have a lower opportunity cost of hitting sluggers than

[1] Batters can, however, charge the pitcher on the mound, and opposing pitchers can also
retaliate by hitting other players on the pitcher's team.   Since the pitcher cannot bat,
opposing team managers could order increases in these responses to limit dangerous
brush-back pitches against their players.

[2] In spite of the popular belief that retaliation is part of the game, researchers have
been unable to identify statistically significant retaliatory responses.   Trandel (2004)
argued that retaliation should result in a positive correlation between the number of
opposing batters hit by a team's pitchers and the number of hit-batsmen on the team.
Using MLB team data, he found no evidence of statistically significant correlations
between these two variables.   Levitt (1998) also found no evidence that pitchers who
frequently hit opposing batters are hit more often by opposing pitchers.

pitchers.   The lower opportunity cost of hitting sluggers should lead to more

hit-batsmen in the AL than the NL.   In response to these criticisms, Goff,

Shughart and Tollison (1998), hereafter GST (1998), acknowledged that the

DH effect disappears when the sample period is extended through the 1997

baseball season.   They hypothesized that the NL expansion in 1993 and the

players' strike in 1994-95 may have diluted NL pitching and led to more hit

batsmen in the NL, thereby diminishing the size and statistical significance

of the DH effects in the AL.

This paper has two objectives, the first of which is to contribute to the

debate over the effects of the DH rule on hit-batsmen by using data from the

two Japanese professional baseball leagues.   As in North American MLB,

one league in Japan—the Pacific League—introduced the DH rule in 1975

and continues to use it, while a second league—the Central League—has

never used it.   The parallel rule structures in Japan and North America

allow empirical inquiry into the effects of the DH rule with a new data set,

one which we believe is superior to the MLB data set.   Unlike MLB,

Japanese professional baseball did not have a major player strike during the

1958-2004 seasons (our sample period) and had a fixed number of teams (six

per league) from the 1958 through the 2004 seasons.[3] Japanese baseball

experienced a two-game player strike in September 2004 but this pales in

comparison to the strike in 1994/1995 in North American MLB which

resulted in the loss of the 1994 post-season and continued into the 1995

season.[4]   The more stable institutional environment for Japanese

professional baseball teams should serve to improve the reliability of

regression estimates of the DH's impact on variables such as the differences

in the number of hit batsmen between the two leagues, as variations in hit

batsmen cannot be due to changes in the number of teams or a player strike.

The second objective of the paper is to provide regression-based tests of the

various hypotheses offered to explain the increase in hit-batsmen under the

DH rule.   We find that the DH rule prompted a shift in team defensive

strategy, which led to more aggressive pitching and more hit-batsmen.

The article continues in Section II by establishing the effects of the

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[3] Operating with 8 teams between 1901 and 1960, the AL expanded to 10 teams in 1961, 12 teams in 1969, and 14 teams in 1977. Also operating with 8 teams between 1901 and 1960, the NL expanded to 10 teams in 1962, 12 teams in 1969, 14 teams in 1993, and 16 teams in 1998.

[4] None of the empirical results in our paper are affected by whether our sample period for Japanese baseball data includes the strike year (2004) or is truncated in 2003.   The MLB 1994/1995 strike began on August 12, 1994, resulted in the loss of the 1994 post-season, and was not settled until April 25, 1995 when play resumed after a federal judge ordered that the 1995 season begin under the rules of the expired contract.

DH rule on hit-batsmen and investigating whether the hit-batsmen differential across leagues can be explained by the improved batting line-up that results from replacing a pitcher with a designated hitter. Section III discusses the factors behind pitchers' more aggressive tactics under the DH rule.   The responses by team managers to the introduction of the DH rule and to subsequent induced rule changes are presented as a potential source of the change in pitchers' behavior. Section IV summarizes the findings.

II. THE DH RULE AND CHANGES IN HIT BATSMEN ACROSS LEAGUES

Figure I provides rates of hit-batsmen (hit-batsmen/10,000 plate appearances or HB rates) for the Pacific and Central Leagues since 1958.[5] When the sample period is divided into two sub-periods by the Pacific League's adoption of the DH rule in 1975, the average HB rates are greater in the post-DH period in both leagues.   In the Central League, the mean HB rate was 68.4 before 1975 and 75.0 thereafter, while in the Pacific League, the mean HB rate increased from 73.3 before 1975 to 81.7 thereafter.   The difference in the mean HB rate was 6.6 (with standard deviation of 13.8)

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[5] GST (1997) and TWK (1998) both use "at-bats" as a basis to normalize hit batsmen statistics. We use "plate appearances" because hit batsmen occur as part of plate appearances. At bats exclude hit batsmen.

after 1975 and 4.9 (with a standard deviation of 10.0) before 1975. Using a t-statistic test for difference in means, the null hypothesis that the average HB rates are equal in both leagues cannot be rejected at the 5 percent significance level for both the pre-DH and DH periods.

During the DH period, another rule change occurred in the Pacific League that could have affected the number of hit batsmen. In July 1982, the Acting Chairman of the Pacific League issued a memorandum to league umpires, stating that "dangerous balls" should not be tolerated. In 1989, both leagues formalized the 1982 Pacific League memorandum by adding a clause to the official rulebook prohibiting a pitcher from throwing "dangerous balls."[6] An umpire was given the authority to remove the pitcher or both the pitcher and his manager from the game when he judged that a pitcher had intentionally thrown at a batter. In the same year, the Pacific League adopted its own four-pronged guidelines providing umpires with more concrete guidance on how and under what circumstances to penalize pitchers and their managers for the occurrence of "dangerous balls".[7]

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[6] The "dangerous balls" clause was added to the 1989 Official Rulebook as Section 8.02(d). This section (8.02) enumerates a list of prohibited actions for pitchers.

[7] These four items are: (1) when umpires judge that a pitcher has thrown intentionally to a batter, the pitcher and his manager should be immediately removed from the game.

We note that the timing of the 1982 and 1989 rules changes is roughly consistent with the timing of the declining gap in the HB rate during the DH period.   After the issuance of the Pacific League "dangerous balls" memorandum in 1982, the gap between HB rates in the two leagues eventually disappeared over the course of the next seven seasons (1982-1988), with almost all of the catch-up occurring between 1985 and 1988.   In the 1989 season the Pacific League's HB rate fell (slightly) below the Central League's HB rate for the first time since the introduction of the DH rule in 1975.   The impact of the "dangerous balls" rule is also supported by the change in the mean difference of HB rates across leagues.   The average difference in HB rates was 4.9 prior to the introduction of the DH rule (1958-1974), which increased to 16.2 during the DH period before the dangerous ball rule was introduced (1975-1988).[8]   A *t*-test reveals that the difference in HB differentials across these two periods is statistically

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This applies even when the ball did not actually hit the batter; (2) when the ball hits the batter after players in the dugout have verbally instigated their team's pitcher to throw at batters, the pitcher and his manager should be immediately removed from the game. This applies even when the ball did not actually hit the batter, if the umpires judge that the pitcher has been engaged in dangerous pitching; (3) a warning is declared when a ball hits the batter on the head regardless of the umpires' judgment whether the pitch was intentional.   After the warning, any pitcher who hits batters on the head should be immediately removed from the game; and (4) umpires have the authority to give warnings to any pitcher they judge to be engaged in dangerous pitching, in which case item (3) above applies.

[8] The standard deviation was 10.0 and 11.3 for respective periods.

significant at the 1 percent level.   After the dangerous ball regime is

introduced (1989-2004), the mean differential in HB rates across the two

leagues falls to −1.7 (with a 10.0 standard deviation).   A *t*-test reveals that

the mean differential in HB rates during the dangerous balls period

(1989-2004) is not statistically different at the 5 percent level from the mean

differential in HB rates during the pre-DH period.[9]

　　We follow these simple difference in means tests with regression

analyses designed to test both for the existence of changes in hit-batsmen

across the three periods with different rules (no DH, DH, and DH with

dangerous balls rule) and **for** the rationale underlying these changes in team

behavior.

Effects of Designated Hitter Rule on Total Hit Batsmen

　　Our first set of regression analyses focuses on documenting changes

in the annual number of hit batsmen in the two leagues over time. First, we

replicate GST's (1997) original regression specification (1) using the

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[9] The *t*-statistic for the null hypothesis that there is no HB differentials between the pre-DH period (1958-1974) and DH period with no dangerous balls rule (1975-1988) is 2.929. The corresponding statistic for pre-DH period (1958-1974) and DH period with the dangerous balls rule (1989-2004) is 1.903; it is statistically insignificant at the 5 percent level but statistically significant at the 10 percent level.

Japanese data from 1958-2004.

(1) $Dif\text{-}HB_t = \beta_0 + \beta_1 DH + \beta_2 Dif\text{-}PA_t + \varepsilon_t$

The dependent variable, $Dif\text{-}HB_t$, is the difference in hit-batsmen across the

two leagues in year t. The DH dummy is one for the Pacific League between

1975 and 2004, and $Dif\text{-}PA_t$ stands for differences in plate appearances

across the two leagues.   Second, we rerun the original GST specification

with two DH dummy variables that represent DH rule regimes with and

without penalties for "dangerous balls" in the following form:

(2) $Dif\text{-}HB_t = \beta_0 + \beta_1 DH1 + \beta_2 DH2 + \beta_3 Dif\text{-}PA_t + \varepsilon_t$.

One dummy variable, DH1, covers the 1975-1988 DH period, while a second

dummy, DH2, corresponds to the 1989-2004 DH period with the "dangerous

balls" rule.[10] Third, we conduct the same analyses of the normalized (for

plate appearances) hit-batsmen interleague differences ($Dif\text{-}HBN_t$) using

TWK's revised regression specification:

(3) $Dif\text{-}HBN_t = \beta_0 + \beta_1 DH + \varepsilon_t$

(4) $Dif\text{-}HBN_t = \beta_0 + \beta_1 DH1 + \beta_2 DH2 + \varepsilon_t$.

   OLS regression results with these specifications are presented in

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[10] We also run this analysis with DH2 specified to begin in 1983, which is the season
after the Pacific League memorandum on dangerous balls was issued.   The results are
broadly similar.

Table I.   As in GST (1997) and TWK (1998), we correct for first-order

autocorrelation. Specifications with a single DH dummy, (1) and (3), have low

explanatory power (R^2) are statistically insignificant (F-statistic).   In

addition, estimated coefficients for the DH variable are not statistically

different from zero at the 5 or 10 percent levels.   These results do not

support the proposition that the DH rule led to an increase in hit-batsmen.

Dividing the DH period into two, however, produced results in equations (2)

and (4) that identify positive and statistically significant estimated

coefficients for DH1 at the 5 percent level.   This implies that the DH rule,

before specific penalties for hitting batters were imposed on pitchers and

their managers in 1989, was associated with an increase in the number of hit

batsmen in the Pacific League.

It is possible that the observed impact of the DH on hit-batsmen is

merely picking up the effect of the better batting lineup with the DH rule on

the number of hit-batsmen.   As TWK (1998) and Levitt (1998) point out,

adoption of the DH rule allows a team manager to have a stronger batting

line-up by replacing a weak-hitting pitcher in the batting line-up with a

designated hitter with a high slugging average.   Aggressive pitching to

sluggers comes with the expected cost of an occasional hit batsman and with

the expected gain of fewer big hits, due to the effects of brush-back pitches on

the batter's concentration and stance at the plate.   To the extent that a team

manager chooses to order pitchers to engage in aggressive pitching more

often to designated hitters than to pitchers, the number of hit batsmen

should be greater with the DH rule.

To test the TWK hypothesis that introduction of the DH rule

improves the batting line-up and hence leads to more hit-batsmen, we

specify the following regressions and run them using aggregate league data

and team data:

(5) $HB_t = \beta_0 + \beta_1 DH + \beta_2 PA_t + \beta_3 SA_t + \varepsilon_t$

(6) $HB_t = \beta_0 + \beta_1 DH1 + \beta_2 DH2 + \beta_3 PA_t + \beta_3 SA_t + \varepsilon_t$

where HB is hit-batsmen per season, PA is plate appearances, and SA

corresponds to slugging average.   SA is included in the specification to

isolate the effects of batting line-up differences across seasons and teams.[11]

League and team data are treated as panel data for the 1958-2004 seasons,

[11] In order to identify the effect of the DH rule on batting performance, the number of
bases is regressed on the DH dummy and at-bats for the Pacific League for 1958-2004
seasons. The adjusted R-squared is 0.577, and the DH coefficient is 1144.09 with a
t-statistic of 6.66. The size of the DH coefficient is 11.47% of the average number of
bases during the pre-DH seasons (9973.29), which supports the hypothesis that the DH
rule results in a better batting line-up.

and regressions estimates are obtained using the fixed-effects framework.

Estimated coefficients for both league and team panel specifications are presented in Table II.   The estimated coefficients on slugging average are statistically significant at the 1 percent level in both team and league regressions.   While the estimated coefficients on the DH and DH2 dummies are not significantly different from zero at the 10 percent level, the estimated coefficient on the DH1 dummy is positive but statistically insignificant with league data and positive and statistically significant at the 5 percent level with team data. These results reinforce our earlier results that the DH rule led to changes in the number of hit-batsmen until rule changes imposed larger penalties on managers and pitchers using "dangerous balls" strategies. The league results also provide support for the TWK hypothesis but the more disaggregated team results show that the DH rule was an independent source of hit-batsmen even after the effect of a stronger line-up is taken into account in the regression.

III. THE DH RULE AND TEAM PITCHING STRATEGY

The preceding analyses demonstrate that the DH rule in the Pacific

League was associated with more hit-batsmen and that a better batting line-up was responsible for some but not all of the increase. As GST (1997, 1998) discussed, the additional effects of the DH rule on hit-batsmen could be due to pitchers who maximize their own (rather than team) utility by throwing at the batters of their choice. This is an explanation based on moral hazard by pitchers who no longer have to face retaliation at the plate. We are skeptical of this argument because the pitcher is under the direct supervision of his manager, who is watching every pitch and every play from the nearby team dugout. Since it is the manager who decided which players play and for how long, his pitching behavior should reflect his manager's defensive strategy in a game. A pitcher who pays attention to his own preferences rather than the manager's orders is likely to be penalized by the manager and team. While self-indulgent behavior can be found in any organization, we do not believe it is important in this context.

We formulate the following scenario regarding the pitching strategy of a baseball team. Compare the strategies of managers of high-quality (winning) and low-quality (losing) teams: It is the manager of a losing team who is more tempted to use hit batsmen as a means of minimizing the

damage incurred by opposing teams' sluggers. A winning team does not

have to resort to this strategy as much as a losing team does, since it has a

better group of pitchers and a stronger batting line-up. For a losing team,

one obstacle to this strategy is that the team's pitchers may fear personal

retaliation at the plate from the other team's pitchers. Managers pay

attention to these concerns as they affect the ability of pitchers to carry out

their assigned duties. Once the DH rule is adopted and pitchers can

completely escape this particular form of retaliation, a losing team's manager

finds it easier to instruct his pitchers to engage in aggressive pitching which

includes brush-back and beanball pitches.[12]

In order to test whether the DH rule prompted such a change in

strategy, we conduct an analysis of the relationship between team

performance and pitching strategy in the Pacific League. The proxy for the

strategy is the "HB-ratio" that is the ratio of the number of hit batsmen a

team's pitchers throw at other teams' batters to the number of hit batsmen

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[12] A beanball is a ball thrown at an opposing batter's head. It should be noted that the hypothesis of aggressive pitching by poorly performing teams under the DH rule rests on the potential of personal retaliation and does not require that retaliation actually takes place. The correlation coefficient between team pitcher-HBs and team batter-HBs (in terms of their divergence from league averages) for Japanese teams in 1958-2004 is -0.145, which does not provide evidence of retaliation. This is parallel to Trandel's (2004) findings from MLB data.

its batters receive from other teams' pitchers. The more aggressive a team's

pitching is, the greater this ratio becomes. The HB-ratio for Pacific League

teams is regressed according to the following specification:

(7) $HB\text{-}ratio_{it} = \beta_0 + \beta_1 WIN_{it} + \varepsilon_t$

where WIN_{it} is team i's winning percentage in year t. Fixed-effects regression

estimates are first obtained for periods before and after the adoption of the

DH rule, and the DH period is further divided into two by the introduction of

the penalties on "dangerous balls" in 1989.

As is demonstrated in Table III, there was no statistical relationship

between team pitching strategy and team performance in the pre-DH period

(1958-1974) as the extremely low explanatory power of the regression

implies. Under the DH rule (1975-2004) the regression specification becomes

statistically significant as its F-statistic improves.   The estimated

coefficient on winning percentage is negative and statistically significant at

the 1 percent level.   The results are robust to the split of the DH period into

two periods marked by the passage of the dangerous balls rule in 1989.   We

therefore conclude that a losing team tends to engage in more aggressive

pitching than a winning team. This finding is consistent with the hypothesis

that the DH rule motivates managers of poorly performing teams to use hit batsmen as a defensive substitute for good pitching to sluggers. This strategy shift could be the source of the greater number of hit batsmen under the DH rule even when we control for the other team's slugging average.

IV. CONCLUSION

The results from our regression analyses of Japanese professional baseball league data show that the DH rule led to more hit batsmen until rule changes in 1989 prohibited pitchers from intentionally throwing dangerous pitches to a batter. It is notable that the impact of the DH rule can be isolated even after we control for the improved team batting line-ups in the Pacific League after the introduction of the DH rule. These new findings using Japanese data stand in contrast to TWK's (1998) findings using North American MLB data—that the increase in hit-batsmen in the American League is well within the range that would be observed due to improvements in the batting line-ups of AL teams.

Our result does not, however, necessarily lend support to the hypothesis that the increase in hit-batsmen in the Pacific League is due to

moral hazard by pitchers.   The DH rule also provided managers with a new

tool to formulate their competitive strategies and may have altered

managers' defensive strategies, particularly managers on losing teams with

poor talent.

Economists have extensively studied North American professional

baseball partly due to an intrinsic interest in the sport and partly due to the

massive array of team and player performance data that are publicly available

for analysis. In contrast, Japanese professional baseball has been largely

ignored by economists.[13] This is unfortunate, as the massive and

comprehensive data compiled for Japanese baseball players and teams could

provide economists with a rare natural experiment that could provide insights

into how robust the findings using U.S. data are.   In this paper we have shed

new light on the DH rule debate with Japanese data and have identified an

alternative explanation that has been considered in the literature using U.S.

data.

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[13] See, however, La Croix and Kawaura (1999), Ohkusa (1999), and Ohtake and Ohkusa (1994).

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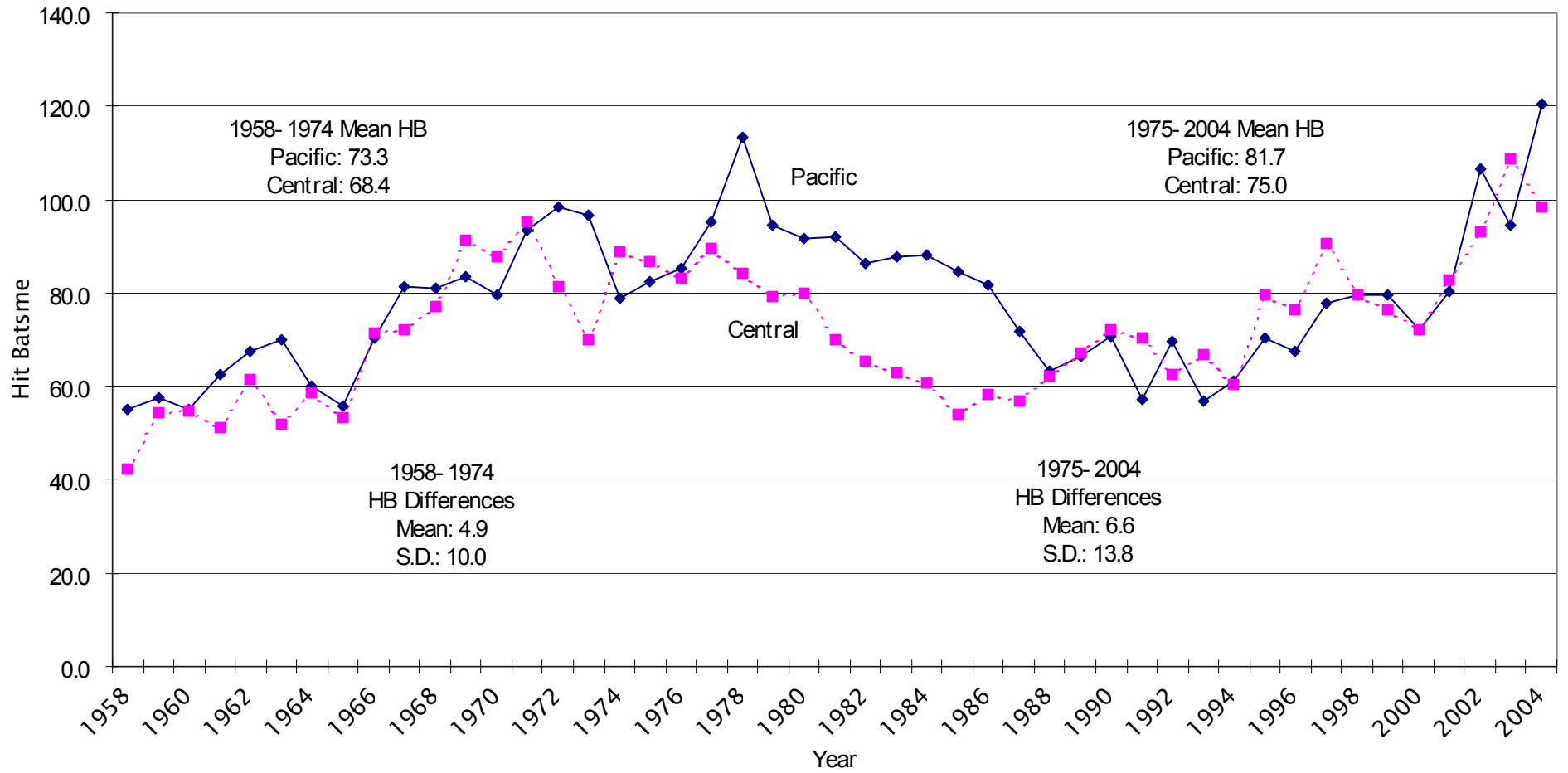Figure I. Hit Batsmen per 10,000 Plate Appearances, 1958-2004

TABLE I. OLS Estimates of Hit Batsmen Differences between Pacific and Central Leagues: 1958-2004

Dependent	HB Difference		Normalized HB Difference	
Variable	(1)	(2)	(3)	(4)
DH	7.16		3.45	
	(0.37)		(0.56)	
DH1		34.48**		11.50**
		(2.48)		(2.69)
DH2		-16.22		-5.78
		(1.21)		(1.39)
Plate App.	0.002	0.01		
Differences	(0.31)	(1.09)		
Intercept	14.39	12.22	3.74	4.44
	(0.87)	(1.17)	(0.55)	(1.50)
Adjusted R^2	-0.042	0.239	-0.015	0.249
F-statistic	0.09	5.71	0.32	8.45
rho	0.466	0.102	0.461	0.121
D.W.	2.080	1.842	2.046	1.852

Note: t-statistics are in parentheses. Asterisks indicate statistical significance at the 5% (**) level.

TABLE II. Fixed-Effects Estimates of Hit Batsmen by League and by Team: 1958-2004

Dependent Variable	League Hit Batsmen		Team Hit Batsmen	
	(5)	(6)	(5)	(6)
DH	-3.51		0.97	
	(0.24)		(0.69)	
DH1		14.08		4.09**
		(0.81)		(2.43)
DH2		-15.38		-1.27
		(0.97)		(0.82)
Plate Appearance	0.01*	0.01**	0.01***	0.01***
	(1.82)	(2.41)	(3.73)	(4.71)
Slugging Average	718.30***	665.41***	81.33***	73.84***
	(3.99)	(3.69)	(5.83)	(5.26)
Intercept	-264.42**	-332.82***	-35.87***	-47.60***
	(2.27)	(2.75)	(3.38)	(4.28)
Adjusted R^2	0.259	0.289	0.142	0.159
F-statistic	9.92	8.44	27.28	23.46
N	94	94	564	564

Note: t-statistics are in parentheses.   Asterisks indicate statistical significance at the 1% (***) and 5% (**) levels.

TABLE III. Fixed-Effects Estimates of HB-Ratio in the Pacific League 1958-2004

	Pre-DH Period 1958-1974	DH Rule Period 1975-2004	(DH1) 1975-1988	(DH2) 1989-2004
Winning	-0.38	-1.12***	-1.69***	-1.54***
Percentage	(1.02)	(3.00)	(2.91)	(3.21)
Adjusted R^2	-0.001	0.070	0.043	0.114
F-statistic	1.04	8.97	8.46	10.30
N	102	180	84	96

Note: t-statistics are in parentheses.   Asterisks indicate statistical significance at the 1% (***) level.