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Money and its Effects on Winning Games in MLB

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Abstract: The purpose of this research is to empirically examine the relationship between team wins and annual payroll for 29 Major League Baseball (MLB) teams, all domestic, through 15 seasons ranging from 2005-2019. The number of wins a team has per year is out of a 162-game season. If a team ends with fewer than 81 wins, then the team has had a losing season. It is hypothesized that the more money any sports team is willing to spend should correlate with a winning season or more wins than losses. The data used in the study excludes the post-season, where only a third of 29 domestic teams continue playing after 162 games. Therefore, our research is not to determine whether money can "buy" a championship, but rather if money can "buy" wins. By utilizing a panel technique for all 29 MLB teams, this study finds that the total real payroll, home game winning percentages, earned run average and total runs scored have a statically significant effect on the team victories. However, the coefficient on total real payroll becomes insignificant only when the National league teams are used to estimate.

Key Words: Team Performance; Major League Baseball; Panel Estimation

JEL Classification: C33; L83

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1. Introduction

With Major League Baseball (MLB) being the 2nd highest grossing sports league in the world, next to only the NFL, (Anderson 2019), it is safe to assume that individual MLB teams are willing to spend a heavy amount of their revenue on payroll to create a team that can get a lot of wins. However, during the 2019 baseball season, the Tampa Bay Rays had the lowest payroll of all 30 baseball teams and ended with a 96-win season, 27 more than what was expected, and earned a post-season berth. On the opposite end of the spectrum, the Boston Red Sox, who had the highest payroll in 2019, missed the playoffs and ended with 11 fewer wins than expected. The question is "How much does money matter in a team's ability to win?"

Many empirical studies investigate the factors affecting team performance either using one season's data or panel data covering an extended number of seasons. According to the study by Peach et al. (2016), the team's earned run average, ERA, is crucial to the number of wins teams get in their empirical analysis of the 2014 baseball season. Their empirical results suggest that every one-run drop in team ERA resulted in approximately 18 more wins. In a similar analysis of the 2015 season also done by Fullerton and Peach (2016), a one-run drop in team ERA was estimated to create eight more wins. The study also reported that the effect of a team being a member of the National League as opposed to the American League is negatively correlated with wins but not statistically significant. They discussed that the results of this may be due to the strength of the coaching staff of National League teams. However, in Fullerton and Peach (2016) the analysis of the 2015 season found the opposite results. If a team was a member of the American League, they were less likely to win more games than a National League Team. It is argued that each season should be examined individually, and not as a whole due to parameter heterogeneity.

The study by Hassan (2008) found a positive statistically significant relationship between the winning percentages and payrolls of MLB teams from 1992 to 2007. This study only focused on regular season games and omitted any post season games, as the regular season games stay more consistent and all teams will play the same number of games. This study found that teams which spent more than 100% over the league payroll average generally had an average winning percentage of 52%. On the opposite side, teams who spent less than 100% of the league payroll average had an average winning percentage of 47%, which is a losing season. When observed individually, only 30% of teams, out of 30, showed a statistically significant relationship between payroll and winning percentage. On the other hand, Jane et al. (2009) examined the effect of total payroll and payroll dispersion on team performance in Taiwan using an unbalanced panel data from 1990 to 1999. It was estimated that the impact of total salary on performance was very limited. They suggested that the nonexistence of significance can be attributed to the lack of mobility of players. By that, it could be hypothesized that payroll would matter more in a more competitive environment in which teams compete for players through trades or free agent acquisitions. This is evident in the U.S. as trades and changes in contracts for players are often and abundant.

Furthermore, the study by Ajilore and Hendrickson (2017) emphasized the importance of competitive balance in professional sports using a panel of 30 teams from 1995 to 2007. A forced competitive balance rule may hinder the ability for payroll to truly have a causal effect on wins. In MLB, there is a stipulation called a luxury tax that limits the amount of money teams spend on players up to a certain point without having to pay a substantial tax penalty. The purpose is to maintain a competitive balance between teams with less money and the wealthier teams. The luxury tax penalty max payroll limit is currently at 208 million dollars (Spotrac.com, 2020). The study found that the luxury tax has been a success at making the sport more competitive yet does not stop teams from spending an inordinate amount of money on player salary.

An interesting study by Shorin (2017) concluded that MLB has an advantage over other professional sports leagues (NBA, NHL, and NFL) since MLB has the largest number of games played through a single season. At 162 games per team, it nearly doubles that of the NBA, National Basketball Association, and the NHL, National Hockey League, coming in at 82 games apiece and is more than 10 times that of the NFL, National Football League, coming in at only 16 games per team (Shorin 2017). This means that MLB teams have many more opportunities to perform at the level they expect in relation to their payroll. Therefore, it could be assumed that MLB has a higher probability of payroll having a statistically significant positive effect on wins than the other sports leagues.

On the other hand, there have been some studies to focus on the predicting the scores and the winning teams. The study by Smith (2016) used a Markov chain model to predict outcomes of the 2015 MLB games. Another extensive study by Valero (2016) utilized four data mining methods and ten years of MLB regular seasons data. According to the study, the mining methods performed better than a regression method to predict the win-loss outcomes. Yang and Swartz (2004) recognized the importance of the past performance of the two teams, the batting ability as well as the starting pitchers to predict the probability of winning a game in MLB. The study utilized a two-stage Bayesian model using the 2001 baseball season. The study concluded that the two-stage Bayesian model is effective in predicting winners in the league.

The purpose of our study is to empirically examine the relationship between team performance and annual payroll for 29 Major League Baseball (MLB) teams, all domestic, through 15 seasons ranging from 2005-2019. Following the different studies (Peach at all. 2016 and Fullerton and Peach 2016, Hall 2002), it is evident that other factors such as each team's home winning percentage can go into a team's performance rather than just how much an MLB organization pays their players. In MLB, each team's home-field winning percentage will often be above 50 percent, which means teams win more games in their home city than when playing in the away from home. It is a common belief in most sports that the home team will have the advantage. In MLB, it is traditionally important to have the most wins at the end of a season to ensure home-field advantage throughout the playoffs. We have also included Earned Run Average (ERA) for each team every season in our analysis. Based on the existing literature, ERA is an important indicator of team success. An ERA is defined as the average amount of earned (not by error) runs allowed by the pitching staff per nine innings pitched. Total runs scored per team is also included in our estimation. Total runs scored include the complete number of runs scored per team each season. As ERA is a defensive measurement, total runs scored is an offensive measurement. Therefore, we can compare the effectiveness of pitching with the effectiveness of hitting in terms of the relationship with winning success.

Our contribution is two-fold. First, this study combines both teams and total games played during the 2005-2019 seasons, providing a better understanding of MLB teams' performance over a longer period. Second, total annual payroll per team is adjusted using the cost of living index for each city that the respective team resides in, making the comparison easier. By utilizing a panel technique for the entire sample period, this study finds that the payroll, home game winning percentages, ERA and total runs scored have positive and statically significant effects on the team victories. When both American League and National League teams were separately tested, it is observed that teams that are affiliated with the American League are dependent on payroll for wins more than the teams residing in the National League.

The data and the empirical specification are discussed in Section2. The empirical model and the estimation results along with the robustness tests are presented in Section 3. The main findings and their implication are discussed in the conclusion section.

2. Data and The Empirical Specification

2.1 The Data

The data consisted of regular season games played from 2005-2019 for the 29 domestic MLB teams which are comprised of 15 teams in the National League and 14 teams in the American league[1]. Each season consisted of 162-games excluding the post season. The sample contains a total of 435 observations. The data used are retrieved from baseballprospectus.com and baseball-reference.com. The number of wins for each season were recorded on an individual team basis. The study period starts at 2005 since it was the last time a new MLB team was established, when the Montreal Expos moved to Washington D.C. to become the Washington Nationals. Table1 summarizes the descriptive statistics of variables used in the estimation.

In this study, the total payroll is measured as the dollar amount each team committed to their major league players at the beginning of the season. To obtain the real total payroll, the total payroll is deflated by the cost of living index for each team's home city. The Council for Community and Economic Research publishes the quarterly Cost of Living Index data for urban areas in the U.S. Since our data is annual, the last quarter cost of living index data which is the unweighted average of prices accumulated from the previous three quarters are used. Interestingly, referring to Table 1, the maximum amount of real adjusted payroll spent each year is at over 282 million dollars for the Los Angeles Dodgers' 2015 season. The team won 92 games with .675 home winning percentage, an ERA of 3.44, and a total of 667 runs scored. The minimum amount of real adjusted payroll spent in each season is at just above 16 million for the team then known as the Florida Marlins' 2006 season and the team won 79 games with a home game winning percentage of .519, an ERA of 4.37, and a total of 758 runs scored. Just based on the descriptive statistics alone, there seems to be a relationship between teams with a high number of wins in a season and a strong performance regarding home game winning percentage, ERA, and total runs scored, and vice versa. With that in mind, we continue with our empirical model specification.

2.2 The Empirical Specification

The following estimation model is used to estimate the team performance:

$$WIN_{it} = \beta_0 + \beta_i' X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \tag{1}$$

where i denotes each team, t is game played and β_i are slope coefficients. WIN is the dependent variable and X_{it} represents a vector of independent variables. Both μ_i and λ_t terms are included to capture the team and year specific effects, respectively (Denaux at all. 2011). The model error term is represented by ε_{it}. The omission of those effects could bias the estimates. So, including team and time specific effects avoid having biased and inconsistent estimates of Equation 1. To compare the team performances among the leagues, the study separately examines three groups, namely MLB, the National and American Leagues, respectively.

It is important to test for slope homogeneity for the model before proceeding with the estimation. If the slope homogeneity assumption holds, then it is safe to assume that each team has the same characteristic properties which greatly simplify the estimation and statistical inference process. However, if the slope homogeneity assumption is rejected in the panel data model, then the estimates may lead to misleading statistical inferences and inconsistent estimates (Su and Chen, 2013). Therefore, this study uses $\tilde{\Delta}_{adj}$ and $\tilde{\Delta}$ slope homogeneity tests by Pesaran and Yamagata (2008) to examine the existence of homogeneity. Given the null hypothesis is that the slope coefficients are homogeneous, the test results are tabulated in Table 2 for three different sample groups namely, MLB, National League, and America League.

According to Table 2, the slope coefficients are homogenous for the sample groups. The next step is to determine the appropriate estimation model. To determine the appropriate estimation model, three traditional pooled estimators for homogenous panel data are compared, namely "the fixed effects", "random effects" and "pooled" for MLB League (pooled data), National League, and American League groups. Table 3 tabulates the estimation results for the model selection. The F-test is used to test the pool versus fixed effects under the null hypothesis that the team-specific effects don't vary in the model. The Breusch and Pagan test is used to test the pool versus random effects under the null hypothesis that the variance of random effect is zero. Table 3 displays the estimation results for the model selection. For the estimation purpose, a pool model is selected for three groups for the estimation technique.

3. The Empirical Model and Estimation

Equation 1 is used to estimate the team performance among Major League Baseball, the National and American Leagues, respectively. To be consisted with the existing literature, a range of factors affecting team performance are considered for the estimation. Therefore, Equation (1) can be re-written as the following linear way:

$$WIN_{it} = \beta_0 + \beta_1 RPAYROLL_{it} + \beta_2 HOMEWIN_{it} + \beta_3 ERA_{it} + \beta_4 RS_{it} + \mu_i + \lambda_t + \varepsilon_{it} \qquad (2)$$

where i = teams, t = games played from 2005-2019. WIN is the dependent variable for this analysis. RPAYROLL, HOMEWIN, ERA and RS are independent variables. Equation 2 is estimated by the Ordinary Least Square method employing balanced panel data for the MLB league (combined) and then the National and American Leagues, separately. The estimation results are tabulated in Table 4.

Table 4 displays some interesting results. First, RPAYROLL is statically significant at the one percent significance level when the entire MLB league teams are considered. It is approximated that every 1 million dollars in real payroll spent would result in approximately .011 increase in wins for MLB league. In other words, every approximately 91 million dollars spent will increase a team's wins by 1. Secondly, when only American league teams are used for the estimation, the coefficient on RPAYROLL is still significant but the magnitude of this coefficient has increased substantially. The coefficient on RPAYROLL becomes insignificant when the National league teams are used to estimate. Finally, regardless of the league consideration, HOMEWIN, ERA and RS are statically significant at the one percent significance level and are in the expected signs.

Interestingly, the magnitude of the coefficient on HOMEWIN has increased when American League teams alone are considered. The empirical finding suggests that the American League teams have a slightly stronger dependency on winning home games versus the National League teams. It can be inferred that this is due to the performance of American League teams in interleague matchups. Every season, each team plays 15-20 games against teams from the opposite league. When an American League team plays a National League team as the away team, they must use their pitcher as a hitter. When the American League team is the home team, both teams must use a designated hitter. Our findings suggest that American League teams tend to win more as the home team versus the National League teams during regular season interleague matchups, which is the reasoning behind the higher dependency on home game winning percentage.

The identical results have been observed for the coefficients on ERA and RS. As ERA is a defensive measurement, total runs scored is an offensive measurement. As expected, ERA and team performance have a negative relationship implying that the higher the ERA the more games a team is expected to lose. As displayed in Table 4, the National League teams are more negatively affected by high ERA than those in the American League. These results could be attributed to pitchers being a part of the batting lineup. The National League teams should hypothetically score fewer runs per game resulting in a higher dependency on a low ERA. When playing in an American League park, teams play with a designated hitter as a part of their 9-player batting order. When playing in a National League park, teams play without a designated hitter in the 9^{th} position. The 9^{th} position of the batting order will go to the starting pitcher, then usually to a pinch hitter later in the game. Therefore, American League teams get the advantage of having a player solely dedicated to hitting which makes that 9^{th} spot much more powerful when compared to the 9^{th} hitter in the National League.

Besides, RS and team performance show a positive relationship. Table 4 indicates that a one run increase in total runs scored results in a 0.06 increase in wins. So, it can be estimated that every 17 runs scored results in 1-win increase. As expected, National League teams have a slightly stronger dependency on runs than do the American League teams. Therefore, the coefficient on runs scored for National League is slightly higher.

4. Robustness Testing

In this section, the robustness of the above pooled OLS results to the two changes in the specification of the data and regression equations is explored. First, we exclude the Houston Astros team from the estimations since this team is the only one that switched the leagues during our study period. Second, a dummy variable for whether a team has switched leagues is included to see if there is any league effect in the model.

The coefficient on RPAYROLL becomes negative but still is insignificant when the National league teams are used to estimate with the exclusion of the Houston Astros team. For the three groups, the signs of other variables remain unchanged with a different magnitude of the estimated coefficients. On the other hand, the inclusion of the dummy variable into the estimation model did not change the earlier estimation results. Therefore, the results obtained from the original specification are *not* sensitive to the two changes in the data and regression equation.

5. Conclusions

This paper empirically examines the relationship between team wins and annual payroll employing a balanced estimation technique for 29 Major League Baseball (MLB) teams, all domestic, through 15 seasons ranging from 2005-2019. Besides real total payroll, a variety of team's performance measurements, including home game winning percentages, earned run average and total runs scored are included to analyze their effects on the team wins.

According to the empirical results, the real total payroll, home game winning percentages, earned run average and total runs scored are all found to be significant predictors of the team wins. However, the real payroll has been estimated to be statistically insignificant when measured only for the National League. A reasoning behind this may be that the National League still plays with the traditional batting lineup format. As explained in section 3, the designated hitter as the 9th spot in the batting order is only used in the American League while the National League team still uses the traditional method of pitchers taking the 9th spot of the batting order. With the designated hitter being enacted in the 1970s, the emphasis on high paid hitters increased greatly. However, because nothing changed with the National League, their dependency on payroll may have stayed around the same. It may be true that National League teams depend more on less expensive traditional aspects of baseball while the American League teams have gone a more expensive modern route. Another speculation is there are unmeasurable effects surrounding the National League teams that are not present or as present for American League teams. These effects could include payroll disparities, strength or weakness of coaching staff, injuries to high paid players, or poor morale amongst teams.

Endnote

1. It should be noted that these numbers are representing the period after the Houston Astros moved from the National League to the American League in 2013. Since this study only looks at the domestic teams, the Toronto Blue Jays team is excluded from the analysis.

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Table 1: Descriptive Statistics of Variables

	Definition	Mean	SD	Min	Max
	Dependent Variable				
Number of Wins (WIN)	The number of wins a team has at the end of a season	80.98	11.52	47	108
	Independent Variables				
Real Payroll (RPAYROLL)	Total dollar amount of real payroll per team at the beginning of each season	$106,406,688	$45,712,985	$16,960,500	$282,175,296
Home Winning Percentage (HOMEWIN)	Total percentage of games won at home per team for each season	.539	.0806	.272	.741
Earned Run Average (ERA)	Average number of earned runs allowed per nine innings	4.19	.522	2.94	5.65
Runs Scored (RS)	Total runs scored per team at end of each season	727.08	78.99	513	968

Table 2. Homogeneity test results for MLB, National and America Leagues:

H0: $\beta i = \beta = 0$

	MLB Leagues	National League	American League
$\tilde{\Delta}_{adj}$	0.651	0.958	0.685
$\tilde{\Delta}$	0.683	0.962	0.716

Note: Values in the table are p-values.

Table 3: The Model Selections for MLB, National and American Leagues

	Pooled vs. Fixed	Pooled vs. Random	Random vs Fixed	Final Model Decision
MLB Leagues	0.7720	0.3443	N/A	Pooled
National League	0.92249	0.1585	N/A	Pooled
American League	0.8026	0.2379	N/A	Pooled

Note: *, **, *** represent significance at 10%, 5%, and 1% level, respectively. Values in table are p-values.

Table 4: Estimation Results of Panel Data Estimation Method

	MLB League	National League	American League
Intercept	52.42***	58.47***	48.81***
	(0.0001)	(0.0001)	(0.0001)
RPAYROLL	0.011***	0.0003	0.022***
	(0.0424)	(0.9599)	(0.0076)
HOMEWIN	52.24***	45.21***	60.06***
	(0.0001)	(0.0001)	(0.0001)
ERA	-11.16***	-12.15***	-10.42***
	(0.0001)	(0.0001)	(0.0001)
RS	0.06***	0.07***	0.06***
	(0.0001)	(0.0001)	(0.0001)
$AdjR^2$	0.89	0.88	0.90
F-Stat	914.74*** (0.0001)	445*** (0.0001)	473***(0.0001)
N	435	233	202

Note: *, **, *** represent significance at 10%, 5%, and 1% level, respectively. Values in the table are p-values.