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Examining the relationship between team's payroll spending and performance in North American sports leagues

Bachelor's Thesis
Programme INTERNATIONAL BUSINESS ADMINISTRATION, specialization finance

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Tallinn 2018

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ABSTRACT

Professional sports are a million-dollar business where player salaries account for the largest expenditures for teams. This research explores the relationship between team's payroll spending and performance in four North American leagues (NBA, NHL, MLB and NFL), examining the results from season 1995 to 2015. Measuring the performance by the number of won games during the season, this paper aims to discover whether an increased spending is associated with greater success. Including the previous season's payrolls and performance, this paper seeks to find the most suitable way to measure how increased payrolls influence the team's success. The finding from the previous literature (that payroll influences the success) remains true even if we define success differently (by number of games won during the whole season) and if we also control for the previous year payroll and success.

Keywords: Professional sports, payroll, performance

INTRODUCTION

USA is one of the most successful sports countries in the world. There are different sports leagues that are followed by millions of people around the world, which gives these leagues great appreciation, and of course, great financial support. Professional sports are a multi-million industry, where player salaries account for the greatest share of expenses. In sports business, players are considered as assets for the team: they can either generate great revenues and bring success or cause massive expenses and bring the whole franchise down. Teams need to make important financial decisions when they are building the team. The question is, should they prioritize winning and hire as many good players as possible? Or should they save on player salaries and invest on something they find more important? Like in any business, the best performing individuals receive the greatest compensation, and professional sports is not an exception. If team decides to invest in an exeptional player, they are usually expecting the team to perform better as well. Does this lead to a conclusion, that the more the great players team has, the better the success? Furthermore, does increased payrolls lead to greater success? This paper explores the relationship between player salaries and team's success. Ultimately, the paper seeks to answer the following question: does higher spending on player's salaries lead to greater success as measured by the number of wins during the season for the teams in the four major sports leagues?

Four major sports leagues in the United States are National Basketball Association (NBA), National Football League (NFL), National Hockey League (NHL) and Major League Baseball (MLB). All these leagues consist of approximately 30 teams across the USA, all of them aiming for the similar goal of becoming a champion. In 2015, these four leagues received a total of 30,53 billion dollars in revenue and spent 25,53 billion dollars in total expenditures (Shorin 2017, 5). Player salaries accounted for the biggest part with 14,97 billion dollars, which is over 60% of the total expenditures (Statista, 2001-2016). Each league has some restrictions on player payrolls, which are also called salary caps. The main goal of the salary caps is to keep the

competition tight as well as restricting the wealthier franchises from buying all the top players (Pagels J. 2014).

NHL and NFL have the strictest restrictions on payrolls due to hard cap implementation on salaries. MLB has the greatest flexibility on player payroll spending followed closely by NBA. These two leagues apply luxury tax payments, which allows teams to exceed the salary cap by paying taxes from the excess amount (Shorin 2017, 6 originally from Staudohar, 1998). Luxury taxes are made to discourage teams on having higher payroll expenses than the rest of the teams and this way keeping the competition balanced. NBA applies the combination of soft cap and luxury taxes, which allows teams to exceed the predefined limits on payrolls. Luxury tax payments have been used for a long time already: in 2003, 26 teams applied luxury taxes (Shorin 2007, originally Shamsports, 2015). Unlike NBA and MLB, NFL and NFL use hard caps on player salaries which strictly limits the amount that teams can spend on payrolls. These restrictions on player salaries ensure, that there are no outliers and the leagues remain competitive, where one team cannot simply buy all the greatest players and become pre-eminent.

The inclusion of salary caps leads to assumption, that payrolls would not have an influence on success. However, the previous researches have found a link between payroll spending and team's performance. The aim of this paper is to see, whether this relationship still holds when we define success differently (regular season and payrolls) and when we include the lagged variables into the regression model.

I chose these four leagues as a data source for this paper because the data is easily accessible and already available. This paper analyses the relationship between team's payroll and the performance from each season for 20 years (1995 to 2015), comparing the results between the teams in four leagues. The research that matches most closely to this paper is Grant Shorin's "Team Payroll Versus Performance in Professional Sports: Is Increased Spending Associated with Greater Success?" (Shorin, 2017), where the author compares success in regular season, post-season and by financial figures. Shorin's research found a link between payroll spending and performance, but the author focused solely on regular season success, leaving playoffs out of consideration. I believe, that team's success is determined through playoffs, since playoffs ultimately determines which team becomes the championship. Regular season success is not enough to tell whether payrolls and performance are linked to each other, since payroll expenses, franchise's revenues and team's performance can fluctuate during the playoffs. When

team is performing well, they can usually spend more on payrolls due to increased revenues from fans and sponsors. In each league, playoffs have different characteristics and teams have varying financial situations, which makes this research interesting.

This paper differs from previous researchers in three ways. Firstly, this paper explores all the four major sports leagues instead on focusing on one. Secondly, team success is determined through both regular season and playoffs. Lastly, this research also considers the last year's payroll spending and performance. In professional sports, last year's performance often predicts next year's performance. If teams remain similar from year to year, they could expect to have similar performance as well. Previous researches haven't considered these factors, which could potentially have an impact on the payroll and performance relationship.

The results of empirical analysis indicate that increasing the payrolls by one standard deviation in the current season, the team's performance should increase by approximately 5.8 wins in NBA, 3.7 wins in NHL, 4.4 wins in MLB and 0.5 wins in NFL. After including the previous season's wins and previous season success in the regression model, the main result remains robust for all four sports leagues. The last year's success has an influence on current season's success-, while previous year's payrolls have a negative influence on the next year's success in three leagues (NBA, NHL and MLB).

This paper begins with the background section where findings from previous literature are explained. Then, it describes the methodology used for this research. Lastly, results and conclusion are revealed to understand the relationship between team's payrolls and success.

1. BACKGROUND

Money is a crucial part of professional sports. Before the season even starts, franchises need to start making financial decisions. There are various factors that affects the franchise's budget such as staff salaries, player's equipment and traveling expenses. However, the biggest part of team's expenses is the player expenses. In professional sports, players receive compensation based on their performance. The better the performance, the larger the salary. Basically, players are considered as assets for the team: they can either bring value for the franchise or bring the whole team down. Furthermore, franchises create labour markets where they make decisions on how to reach their desired goals with the existing assets. The following sections explains few concepts that help to understand the relationship between payrolls and performance.

1.1. Previous findings

Research that matches closely to this paper is Shorin's (2017) paper "Team Payroll Versus Performance in Professional Sports: Is Increased Spending Associated with Greater Success?". Author compares payrolls, raw and standardized winning percentages and Simple Rating System values from each team and compared the results between the leagues. Since each league has different characteristics, the paper compares them separately. To begin with the payroll and performance comparison, author split teams into four quartiles based on how much they spent on player's wages. From quartile comparison author found that MLB is the only league where a single game does not have a big impact on the overall performance. This can be explained through the amount of games, sine MLB's regular season is 162 games (Shorin 2017, 29). This is nearly double the length of NBA's and NHL's regular season (82 games) and over 10 times longer than NFL's (16 games) (Shorin 2017, 29). Furthermore, teams in MLB have more opportunities to win and show how they're superior, compared to other leagues with shorter seasons. Also, baseball is an unlike team sports, where the game consists of different one-to-one match-up. Team dynamics is not as important as in other leagues, since the team contact is

minimal. This feature is unique to baseball, which makes the team payroll and performance relationship differ from other team sports.

In NHL, four quartile comparisons show a clear relationship between payrolls and performance. When solely looking at the regular season performance, quartiles that spent a high amount on payrolls had significantly better success, with 80% of the highest spending quartile teams making to the playoffs and only 20% of lowest spending quartile teams (Shorin 2017, 32). However, when comparing teams during the post-season, three most spending quartiles had fairly similar performance. The relationship between payroll and full-season performance have remained unclear, and this paper aims to solve the unanswered case.

Out of all leagues NFL shows the least significant relationship between payrolls and performance. Across the quartiles, teams appear to achieve playoff success at similar rates, suggesting that team payroll is not strongly related to performance (Shorin 2017, 32). Two things can explain this: Firstly, league's salary caps restrict teams from spending over the predefined limits, which means that there is no significant difference between highest and lowest spending teams (Shorin 2017, 32). Secondly, the regular season consists of 16 games, and the playoff system is unique: each playoff matchup has only one game, where the winner moves forward, and the loser's season is over. There are a lot of other characteristics related to shorter seasons, such as pure luck and possibility of injuries. These might be considerable factors in real world but will not be covered in this paper.

To allow for the comparison across the years and preserve the differences in payrolls, paper presents the following equation:

$$ZScorePayroll_{it} = \frac{TeamPayroll_{it} - LeagueAveragePayroll_t}{StandardDeviationLeaguePayroll_t}$$

where ZScorePayroll*it* is the resulting z-score for team *i*'s payroll in year *t*, TeamPayroll*it* is team's payroll in year *t*, LeagueAveragePayroll*t* is the average payroll for all teams in year *t*, and StandardDeviationLeaguePayroll*it* is the standard deviation of team payrolls in year *t*. ZScorePayroll*it* is used in all payroll calculations throughout the paper, since it provides relative payroll differences and allows for a proper comparison between sports over time (Noponen 2017, 6)

To calculate how payroll z-scores affect the team's winning percentages, author formed a following regression (Hasan, 2008):

$$WinPercent_{it} = \beta_1 PayrollZScore_{it} + FE_1 + \varepsilon_{it}$$

where WinPercent*it* is calculated from team's regular season results, PayrollZScore*it* represents corresponding z-score for team *i*'s payroll in year *t*, and FE*i* represents fixed effects for each team (Noponen 2017, 7). Regression shows in general that teams who spend more on payrolls tends to have higher winning percentages. Moreover, if team spends one additional standard deviation on payrolls, they are expected to have 2.3 to 5.4 percentage points higher winning percentage compared to those who spent the league average (Shorin 2017, 41).

Simple Rating System (SRS) provides additional information on team's performance (Fromal 2016). It reveals how many units (runs, goals or points) a team is better (or worse) than the league average (Shorin 2017, 45). SRS provides a more accurate measure for team performance than a win-loss record, which does not tell whether team won or lost narrowly. The SRS regression is stated as:

$$SRS_{it} = \beta_1 PayrollZScore_{it} + FE_1 + \varepsilon_{it}$$

where SRS*it* is the corresponding SRS value for team *i* in year *t*. Team's payroll and their SRS figure for that year shows a positive correlation meaning that higher spending is associated with greater success. For example, in NBA, Golden State Warriors had an SRS of 10.38 in 2015, meaning they were 10.38 points better than the average NBA team that year (Shorin 2017, 44). However, performance is measured differently in different leagues: MLB has runs, NBA and NFL have points and NHL has goals. Although it is not possible to directly compare the performance between leagues (a point in basketball is not the same as a run in baseball), it is still possible to see the positive relationship between team's payroll and their SRS for that year (Shorin 2017, 44).

The paper also explores the post-season performance, measured by the number of championships won by a team. In MLB, 18 out of 21 league champions were the teams who spent above the average payrolls (Shorin 2017, 46). There is a little more variation in NBA, but

most of the champions spent above the average. In NHL, almost every league champion spent above average, whereas NFL champions are the most evenly distributed (Shorin 2017, 47). The regression below is used for post-season analysis:

$$Championship_{it} = \beta_1 PayrollZScore_{it} + FE_1 + \varepsilon_{it}$$

where Championships*it* is an indicator for team winning a title (taking a value of "1" if a team wins and "0" otherwise), PayrollZScore*it* represents the corresponding z-score for team *i*'s payroll in year *t*, and FE*i* represents fixed effects for each team (Noponen 2017, 7).

The championship equation is a logistic regression, and so for the values of coefficients cannot be interpreted directly from the regression output (Shorin 2017, 48). However, odds-ratio can be calculated to see whether an increase in payrolls increases the likelihood of winning. In NBA and NHL, teams are approximately twice as likely to become a championship (the odds-ratio about 2) when increasing the payrolls by standard deviation, which means that there is a positive relationship between higher payroll spending and becoming a championship (Shorin 2017, 48). The baseline odds for winning is about 3.3%, which means that when odds-ratio is 2, spending additional standard deviation on payrolls raises the winning odds to 6.6% (Shorin 2017, 48). Spending two standard deviations above the average raises odds already to 13.2%, which is a significant increase. This further suggests that in NBA and NHL, higher payroll spending can drastically increase the likelihood of winning and becoming a championship (Shorin 2017, 48).

There are many ways to measure financial performance, but Shorin's paper uses operating income. It is a convenient way to measure performance since it accounts for both revenues and costs, and the figures are closely tied to team's season performance. The equation is stated as:

$$OperatingIncome_{it} = \beta_1 PayrollZScore_{it} + FE_1 + FE_t + \varepsilon_{it}$$

where OperatingIncome*it* is Forbes' estimate of team *i*'s operating income (in millions of dollars) in year *t*, PayrollZScore*it* is the corresponding z-score for team *i*'s payroll in year *t*, FE (*i, t*) are fixed effects for each team in each year (Noponen 2017, 8). Fixed affects are included due to changing economic conditions, such as leagues collective bargaining agreements (Shorin 2017, 53).

When increasing payroll spending by one standard deviation, the operating income tends to fall. This means that there is a negative relationship between operating income and payroll expenses for each league, which is quite logical: Operating income equals revenues minus expenses, so the increase in payroll expenses (costs) has a negative impact on the overall profit. Growing revenues do not offset direct expenses (Leeds, M., & Allmen, P. V. 2011), which supports the decision to focus on operating income over revenues, since it allows to see the net effect of both revenues and expenses (Shorin 2017, 52-53).

In professional sports, poor team success is not only affecting the players, but also the profits of the franchise. Sponsors and fans are a major part of sports business, and they can bring great revenues to a franchise. When team wins more frequently than loses, fans and sponsors usually get more excited about the team. This means, that people attend to the games more often (which raises the ticket sales revenues), and sponsors are willing to invest more money on the team. Furthermore, team has more money to invest on better players and achieve even greater success. Closely to previous regression, this one is stated as:

$$OperatingIncome_{it} = \beta_1 PayrollZScore_{it} + \beta_2 WinZScore_{it} + FE_1 + FE_t + \varepsilon_{it}$$

Where WinzScore*it* is the standardized winning percentage of team *i*'s regular season winning percentage in year *t*. While the relationship between operating income and payrolls is negative in all four leagues, winning in the regular season has a positive correlation in NBA, MLB and NHL (Shorin 2017, 54). This supports paper's prediction, where frequent winning is associated with increased interest for the whole franchise.

Altogether, Shorin found that operating income decreases when payrolls increases. Basically, this finding would suggest teams to spend less on their player payrolls. However, as discussed in the previous section, winning has a positive effect on operating income. This leaves teams with a question: Should teams prioritize winning or profits? The results seem to be in conflict, but as stated before, winning in MLB, NHL and NBA partially balances the drop in operating income. When higher spending on payrolls is associated with greater success, operating income tends to rise. If increased payroll spending does not lead to a greater success and a team keeps losing, the result is the opposite: operating income shrinks, and overall profits decrease (Shorin 2017, 56)

Another research exploring the payroll and performance relationship is my previous research paper, which focuses solely on NBA. The results from the research show a fair relationship between team payroll and performance, where one standard deviation increase on payrolls (approximately 17 million USD on average) results in approximately 3 additional wins. This founding is significant in tightly contested league, since each win can have a large impact on the overall performance.

1.2. Labour Market in Professional Sports

The competition against other teams starts already on the player selection, where each franchise aims to get the best players to join their team. Franchises try to improve their team performance by obtaining new players but also keeping their best existing players. Personal contributions in sports are relatively easy to observe and can be measured from a variety of data on past performances (Rosen and Sanderson 2000, 5). However, each franchise has different perspective on the meaning of the "best" players. Some teams place high value on player's performance stats, championship record and MVP selection record. Other teams may seek for players who fit well in the team, has a great personality, is known as a "hard-worker" or who gives a great market value. Team selection can go beyond the player level, where franchises might prefer high quality coaching or good medical services over the top players. After all, franchise's goal is to build the best possible team that performs well and creates great profits.

Professional sports labour market consists of teams (demand) and players (supply). Teams evaluate players based on their performance, personality and ability to fit into the team. When team wishes to employ a player, they offer a contract that is representative of how much they value that athlete (Shorin 2017, 14). In a perfect market, player's requested amount of compensation meets the contract offered by franchise, and each player chooses a team that offers the most. However, there are few factors that makes the perfect market challenging in a real world. Firstly, it is common that players ask for a higher compensation than their actual value is. Secondly, salary caps place limits on the player payroll amounts, where minimum and maximum salaries set the price floor and price ceiling, respectively. Lastly, players might not choose the team who simply offers the most money. Team chemistry, coaching and sponsorships might be more important for the player. Even though these factors might have an impact on how much the player is theoretically worth and how much they actually earn, players

usually receive a compensation that is comparable with their abilities. Ultimately, we could assume that the team who spends the most on payrolls gets the greatest players, which could in turn lead to greater success.

Contract is always mutually agreeable, which means that both parties must accept the terms of the contract. The primary part of contract includes the agreement on the compensation team offers as an exchange for player's services. Players tend to accept contracts with highest compensation and the greatest advantages for themselves. Since teams have the power to determine their players payroll budgets, this paper focuses on team's perspectives.

1.3. Salary Caps

Salary cap is an agreement on how much team can spend on their players, and it is implemented to keep the competition balanced. League's goal is to reduce the difference in talent levels between high-spending and low-spending teams to create a more equal playing field (Shorin 2017, 23). When implementing salary caps, each team has roughly the same economic conditions and so for the same amount of talent. This brings more economic benefits for the team, since audience is usually more interested about the league when competition is more balanced. If salary caps wouldn't exist, wealthiest teams could simply buy all the best players and ensure the winning. This in turn, would make the league less interesting and would result in lower ratings.

NBA was the first league to implement the salary cap system in 1984-1985. NFL implemented the system before season 1994 and NHL was the last league to install the system in season 2005-2006 (Totty and Owens 2011, 2). Salary caps can be defined as hard caps or soft caps. Hard caps set strict limits and those cannot be exceeded in any circumstances, whereas soft caps can be exceeded in limited circumstances when paying a penalty. NHL and NFL use hard salary caps, but NFL has a one exception. All contracts must be approved by the league office, and contracts that place a team over the salary cap are rejected for that year (Thurnman 2016, 8). This exception is named as the carry over rule, which states that if team spent under the cap in one year, they may carry over the difference into the next season (and so for spend over the cap in the next season) (Thurnman 2016, 8). For season 2014, NFL salary cap was $133 million, which is significantly higher than in other leagues (Lester 2014, 6).

NBA uses the combination of soft cap and luxury taxes, and MLB implements only luxury taxes. For example, in NBA, each team had a soft salary cap of $63 million on season 2014-2015, which allows team to spend over this amount when paying penalties (Huang 2016, 3). One of the most known salary cap exemptions are named as Larry Bird Exemption, the Rookie Exemption and the Mid-Level Exemption (Shorin 2017, 24). Every league has different methods on controlling the payroll spending and it is important to keep these differences in mind throughout the paper.

Another thing that causes inequity in leagues is the geographical location of the team. Teams who play in big cities (for example in Los Angeles) receive more revenues from local markets compared to the smaller cities (such as Green Bay with population of 100,000). Tourists can also bring great revenues for the franchise by attending to the games and possibly buying the by-products, such as game jerseys. However, this is more frequent in big and popular cities such as New York, San Francisco and Miami, where sports games are one of the main tourist attractions in the city. As a conclusion, small city teams receive less revenues than big city teams, which will in turn limit the amount that team is able to spend on players.

1.4. Luxury tax

Luxury taxes are implemented to keep the competition more balanced, and it is set by the Collective Bargaining Agreement (CBA). The luxury tax was essentially designed to slow the growth of salaries and to prevent large-market teams from signing all the top players within a league (Dietl, Lang, Werner 2009, 2). Teams pay taxes when their payrolls exceed the predetermined limits, and the derived tax money is divided among the teams that play in smaller markets to allow them to buy high-quality players. The only exception is MLB, where the tax money is given to the league for predefined purposes.

MLB was the first league to introduce the luxury taxes in 1996 as a part of its Collective Bargaining Agreement. For the five highest spending teams, the luxury tax was 35% for the first two years and 34% for the third year (from 1997 to 1999). The revenue-sharing system was used from 2000 to 2002 before the luxury tax system was reintroduced again in 2003. The system limits payrolls separately for each year: in 2006 the limit was 137 million dollars and 148 million dollars in 2007. If team exceeds the payroll for the first time, the tax is 22.5%. The

second surplus on payrolls is taxed at 30% and third or more is 40% (Dietl, Lang, Werner 2009, 3).

2. METHODOLOGY

This thesis follows closely Shorin (2017) paper as well as my previous research paper (Noponen, 2017). This research explores all the four major sports leagues in United States, rather than focusing solely on one league. I believe it is important to include all the leagues to fully understand the relationship between payroll spending and performance in professional sports. Each league has unique characteristics and interesting aspects, and so for the inclusion of each league is substantial.

Secondly, this paper defines success differently by exploring both regular season and playoffs. In previous paper, author examines league's post-season success by team's championship record. When examining team's finances, total amount of games and narrow games impacts the figures drastically. As the season progresses, fans often get more excited about the team which gives franchises greater revenues. After all, regular season success or championship title is not enough to tell how team's payrolls and success fluctuate throughout the season.

It is important to look at the number of total wins after the season, since team's success is dependent on both regular season and playoff wins. For example, in NBA, Atlanta Hawks was the winner of Eastern conference on 2014/15 regular season, but they didn't make it to the NBA finals due to losses on playoffs. Vice versa, Cleveland Cavaliers had seven wins less than Hawks (53 versus 60) but their playoff success took them all the way to the finals (Noponen 2017, 11). In basketball, these kind of playoff series are not infrequent, since team must win four games on each match-up to ultimately becoming a championship. However, in baseball, playoff series consists of one game in each matchup. This system does not consider the home court advantage or team's luck (winning or losing narrowly), and this is a unique feature of baseball.

Rodney Fort's Sport Business page is used as a database for this paper. The site offers a great scope of different financial figures from major sports leagues, including NBA, MLB, NFL and

NHL. For example, team's payroll figures, revenues and ticket prices are available in his personal website (Rodney Fort's Sports Business Data Pages 2017), and the data is updated annually. The database is managed by the University of Michigan professor Rodney Fort, who gathers the information from different sources to develop a comprehensive dataset. Fort himself claims that dataset to be "the most complete data on the economics and business of U.S. professional sports leagues in existence" (Shorin 2017, 26).

The timeline for this paper is 20 years (from season 1995 to 2015), and Fort relies on two sources when estimating the payroll data. For seasons before 2000 the data is based on researches made by other experts who have collected payroll data with their own proprietary methods (Noponen 2017, 10). The largest amount of the payroll data comes directly from USA Today Index, all the way from 2000 to 2010. For seasons after 2010, the data is collected from league's specific sites, since USA Today Index discontinued tracking payrolls (Shorin 2017, 27). All in all, Fort has put together an extensive dataset which serves as a baseline for this paper.

Even though Fort's data is widely used and highly appreciated, the dataset relies on several sources, which raises a doubt about its accuracy. Nevertheless, the dataset is examined by one of the most prominent researchers in this field (Fort) which gives trustworthy for the data (Shorin 2017, 28). In sum, we should be confident that the dataset offers accurate information, and so for the results of this research are considered as correct information.

Performance data (including wins from regular season and playoffs) for each team is gathered from Sports Reference LCC. This website comprises performance stats by having four different sections for each league. There are various sports specific stats available, such as runs allowed vs hits allowed for MLB, specific shooting stats for NBA, power play goals vs power play opportunities for NHL and kick and punt returns for NFL. Combined with Sports Reference site, this paper also relies on league's own websites for measuring team's performance. Table 1 presents each league's descriptive statistics of wins. We can see that the minimum and maximum number of wins fluctuates a lot within the leagues. For example, in NFL the minimum number of wins is 0 whereas in MLB it is 43.

Table 1. Wins descriptive statistics

	NBA	NHL	MLB	NFL
Observations	520	494	520	465
Mean	42.873	41.085	81.923	8.369
Std.Dev	16.149	11.627	13.025	3.525
Min	9	15	43	0
Max	87	72	125	18

This paper measures success as the total number of wins during the season, but there are other considerable factors behind the success. In basketball, shooting percentages and rebounds are relevant as well powerplay stats and amount of goals in hockey. Even though these performance metrics are relatively important, the ultimate goal for each team is to win as many games as possible. Therefore, I decided to focus on the number of wins to keep this paper simpler.

Previous research finds, that the actual difference in payrolls seems to be more important factor than team's nominal ranking (Shorin 2017, 35). This paper applies pooled OLS regression with fixed effects to estimate the effect of payroll (independent variable) on team success (dependent variable). The calculation follows:

$$ZScorePayroll_{it} = \frac{TeamPayroll_{it} - LeagueAveragePayroll_t}{StandardDeviationLeaguePayroll_t}$$

Z-Score equals team's payroll minus leagues average payroll, divided by the standard deviation of leagues payroll (in year t), where Z-Score payroll is the resulting z-score for team's payroll in year t (Noponen 2017, 11). This standardized Z-score payroll model is used in all payroll calculations in this paper since it accounts for relative payroll differences and allows for appropriate comparisons between teams over the time (Noponen 2017, 11).

This results in the following regression:

$$WinGames_{it} = \beta PayrollZScore_{it} + FE_1 + \varepsilon_{it}$$

Where *WinGames* is the combine number of games the team *i* won in the regular season and playoffs in the year *t, PayrollZScoreit* represents corresponding z-value for team *i*'s payroll in year *t,* and *FEi* represents fixed effects for each team (Noponen 2017, 12). Table 2 presents each league's payroll z-score descriptive statistics, where we can see that the standard deviations and maximum and minimum z-scores are relatively similar. However, in NFL, the mean payroll z-score is a lot higher than in other leagues.

Table 2. Payroll Z-score descriptive statistics

	NBA	NHL	MLB	NFL
Observations	520	494	520	465
Mean	-2.14e-10	-3.33e-10	-7.18e-10	9.70e-10
Std.Dev	0.981	0.981	0.981	0.984
Min	-2.129	-2.846	-2.374	-2.971
Max	3.751	2.855	3.802	3.171

To calculate for the last year's performance, I include wins from the previous year into the regression. Last year's performance often influences next season's performance, so that the top teams in previous year frequently succeed in the following season. For example, in NBA, this is relatively significant, where from seasons 2010 to 2014 Miami Heat played in final four every year. However, this assumes that teams stay relatively same from year to year. The regression with lagged wins is stated as:

$$WinGames_{it} = \beta PayrollZScore_{it} + WinGames_{(t-1)} + FE_1$$

Where *WinGames(t-1)* corresponds the wins from the previous year.

As well as previous season's performance, previous year's payrolls often affects the next year's performance. Logically thinking, teams who spend high amounts on payrolls, usually perform better in that season, but also in the next season. To include the lagged payrolls, the regression is stated as:

$$WinGames_{it} = \beta PayrollZScore_{it} + WinGames_{(t-1)} + PayrollZScore_{(t-1)} + FE_i$$

Where *PayrollZScore(t-1)* corresponds the payroll z-score from the previous season.

This research combines four major sports leagues from United States, with over 100 teams in total (each league has 25-30 teams). Time scope for the research is 20 years and it is selected based on data availability and the desire to examine as far back as possible (Shorin 2017, 7). To run a regression, I excluded teams with missing values, and in the end the sample consists of 26 teams in NBA, NHL and MLB and 31 teams in NFL. The regression results are calculated with using Stata.

3. EMPIRICAL PART

It is important to understand that this research does not create a model that determines how payrolls affect success. Rather, it aims to show how payroll spending could be associated with team's win record, comparing this relationship between four different leagues. There are various things behind the team's success which are not related on the amount of money team spends on player's payrolls. Coaching, training conditions, ownership priorities and cultural differences may all affect team's success, and that is why I include team's fixed effects for the regressions. Ultimately, the inclusion of fixed effects gives a better understanding on the underlying relationship between payroll spending and performance.

3.1. Simple regression

To calculate the regressions, I converted each league's payroll data into Z-scores. It is the signed number of standard deviations that simply tells how far from the mean the observation or data point is. Score that is exactly on the mean corresponds to a Z of 0 (Adeyemi 2011, 1). Values above the mean have positive values whereas values below the mean have negative values.

First, I calculate the simple regression with team fixed effects separately for each league. The sample sizes vary between the leagues: for NBA, NHL and MLB the initial sample consists of 26 teams and MLB consists of 31 teams. Time scope for NBA and NFL is 20 years, whereas NHL consists of 19 years and MLB consists of 15 years. Some years are missing for NHL and MLB due to cancelled season in 2004 and unavailable payroll data for seasons 1995-1999.

Table 3 coefficient estimations shows that an increase of one standard deviation on payrolls (approximately $18,3 million in NBA, $16.4 million in NHL, $26 million in NFL and $37.9 million in MLB) leads to approximately 5.8 additional wins within the season in NBA, 3.7 wins in NHL, 4.4 wins in MLB and 0.5 wins in NFL. These numbers are relatively high considering

that league standings are often tightly contested, where each game can have an influence on team's ranking (Noponen 2017, 13). For example, for season 2015 in NBA, the difference in the Eastern Conference between the 3rd placed Miami Heat and the 8th placed Detroit Pistons (the last team to make the playoffs) was merely 4 wins (48 versus 44 wins) (Shorin 2017, 35). Since spending additional standard deviation on payrolls results to approximately 5.8 additional wins in NBA, team's decisions on payroll spending can have a significant change on league standings.

Table 3. WinGames regression

Dependent Variable: Win Games				
	NBA	NHL	MLB	NFL
PayrollZScore	5.817***	3.723***	4.397***	0.525***
	(0.774)	(0.603)	(0.790)	(0.151)
Observations	520	494	520	465
R2	0.0933	0.1439	0.1906	0.0285
F Statistic	56.45***	38.09***	30.95***	12.03***
	(df=1;467)	(df=1;467)	(df=1;493)	(df=1;433)

Note: *p<0.1; **p<0.05, ***p<0.01

The situation is relatively similar in other leagues. In season 2015 of NHL, western conference teams who received a wild card to playoffs were Minnesota Wild with 46 wins and Winnipeg Jets with 43 wins. Los Angeles Kings won 40 games and was placed 3rd, leaving them outside the playoffs. During season 2015 in MLB, the top two wildcard teams (New York Yankees and Houston Astros) from the American League played in the playoff round. Yankees and Astros had slightly more wins than teams who did not made it to the playoff round, including Los Angeles Angels of Anaheim with only one less win. Finally, during the 2015 NFL season, three out of four teams within the final four had had the same record with 12 wins and four losses during the regular season. All in all, league's standings are often determined by narrow margins, which indicates that each additional win can be very meaningful (Shorin 2017, 36).

3.2. Lagged Wins

Lagged wins are often left out from time series regressions since researchers believe that it does not have an obvious impact on the outcome (Achen 2001, 2). Moreover, when lagged dependent variable is used in a mixed model regression, it usually results to severe bias (Allison, 2015). However, this paper includes only fixed effects into the regression model, leaving random effects unconsidered. Also, lagged variables are considered as independent variables instead of dependent variables.

The inclusion of lagged variable can be more suitable for the overall fit, and that is why I decided to include it into the regression. In sports, last year's performance often has an impact on the next year's performance. This can be explained in two ways: Firstly, teams who performed well in last year usually want to keep the same players in the team next year. If team keeps the same players as in previous year, it is likely that they are going to succeed in the next year as well. Secondly, it usually takes more time to build the team chemistry. In many cases it takes more than one year for players to get to know each other and learn what are their strengths and weaknesses. Adapting to coaches can also be challenging since they often have their unique way of interpreting with the players and their values might vary a lot among other coaches. These two things combined can cause a great team to fail in their first year but succeed in the following years.

Table 4. Lagged wins regression

	Dependent Variable: Win Games			
	NBA	NHL	MLB	NFL
PayrollZScore	2.585***	2.247***	2.532***	0.478***
	(0.795)	(0.654)	(0.867)	(0.155)
Lagged Wins	0.441***	0.259***	0.286***	0.081*
	(0.044)	(0.049)	(0.046)	(0.048)
Observations	494	442	494	434
R2	0.345	0.235	0.315	0.091
F Statistic	80.02***	29.47***	36.81***	7.02***
	(df=2;466)	(df=2;414)	(df=2;466)	(df=2;406)

Note: *p<0.1; **p<0.05, ***p<0.01

For NBA, MLB and NHL the inclusion of lagged wins is significant and could be a more accurate way to explore the relationship between payroll and performance. As we can see from table 4, there is a positive relationship between previous year's and next year's performance in three leagues. Even though the coefficients are smaller when lagged wins are involved, the numbers are still relatively high. R-squared values increase for these sports, which indicates that the relationship is more accurately measured when including the lagged wins (Shorin 2017, 46). However, in NFL, the inclusion of lagged wins does not seem to give as significant results as in other leagues. As we can see from table 4, the coefficient for lagged wins is slightly positive (significant at 10%), which indicates that the relationship is less clear than in other leagues, but still holds. Nevertheless, NFL has a lot shorter season than other leagues, so the result seems logical.

3.3. Lagged payroll Z-score and wins

Lastly, I include previous year's payrolls as well as previous year's performance for the regression. It is likely that last year's payrolls also affect this year's performance, since usually players have a contract that keeps them in the same team for many years. As team makes decisions on players payrolls they evaluate how much they spent last year and what were the results of the spending. If a franchise did not achieve the desired goals they might make changes on the payroll figures. It is important to calculate for both lagged wins and lagged payrolls to obtain a better understanding on the payroll and performance relationship.

Table 5. Lagged wins and lagged payrolls regression

	Dependent Variable: Win Games			
	NBA	NHL	MLB	NFL
PayrollZScore	3.672***	2.911***	4.575***	0.497***
	(0.903)	(0.711)	(1.125)	(0.155)
Lagged Wins	0.453***	0.275***	0.276***	0.068*
	(0.044)	(0.049)	(0.046)	(0.049)
Lagged Payroll	-2.189**	-1.580**	-2.911***	0.218*
	(0.881)	(0.687)	(1.031)	(0.156)
Observations	494	442	494	434
R2	0.358	0.237	0.311	0.085
F Statistic	55.99***	21.61***	27.56***	5.35***
	(df=3;465)	(df=3;413)	(df=3;465)	(df=3;400)

Note: *p<0.1; **p<0.05, ***p<0.01

Table 5 shows that for all leagues, the relationship is reverse. While last year's performance shows a positive relationship, the last year's payroll has negative values for coefficients in three leagues. This indicates that increase in independent variable (lagged payrolls), results in decrease in dependent variable (won games). This result seems counterintuitive since it is usually expected that if team spends more on payrolls and performs well, they are also likely to perform well in the next year. On the other hand, this result indicates that the teams that achieved higher success with less spending in previous year (so, they already have a good team that may benefit from the addition of one-two really good players) may benefit from the increase in payroll next season the most, which is logical.

3.4. Economic impact

The results of this paper show that increased payrolls and last year's higher win record are both associated with greater success in the current season. This finding can also be transferred into other businesses, where employee's increased payrolls often result to greater success. In the

short term (for current year/season), money can be a great motivator for employees and they might perform better when increasing their wages.

However, when thinking about the long-term motivators, salary is not the most valued factor. Other things such as helpful and supportive co-workers, fair manager and excessive work benefits can influence employee's motivations and work performance. A question that employees should ask themselves, is that do they want to get the highest salary in a weak organization or smaller payrolls in superior organization? Some employees place a high appreciation on being a part of a great team, which might lead to greater success together. As a conclusion, employees performance might not be dependent on payrolls, at least on a long term. This also goes along with paper's conclusion that higher payrolls in the last year does not lead to greater success in the next year.

This paper finds that last year's good success has a positive impact on next year's performance. This is often the case outside the sports industry as well, where great success motivates employees for greater success in the future as well. The feeling of being a part of a supportive, well-performing team can be a better motivator than simply receiving the highest salary.

However, if last year's good performance has a positive impact on next year's performance, the precondition is that the organization stays relatively same. When people inside the organization change, the results might also change. Moreover, future is often unknown: the economic conditions and firm's financial status might be totally different next year, which may result to worse success. That leads to a fact that employees often focus on the current season, when they have clear visions, familiar team and a specific compensation for their performance.

3.5. Limitations

While the results show a clear relationship between payrolls and performance, it is important to recognize few limitations. Firstly, the performance is defined differently between the leagues. For example, in NBA, the performance is measured by baskets, in NFL by points, in NHL by goals and in MLB by runs. Since a single point in American football has a lot bigger influence on the game's overall result than one basket in basketball, it is important to keep in mind the differences within the sports. The other thing that alters the results is the length of regular season

and playoffs, which vary a lot in different leagues. Regular season in MLB has over 160 games whereas regular season in NFL consists of 16 games, which means that a single game in NFL has a greater impact on the league standings. This also reflects into the results in this paper, since NFL does not show as clear relationship between payrolls and performance as the other leagues.

One thing that can cause a great team to fail is injuries. As injuries occur, the whole team's performance may suffer. Even when franchises have spent a great amount on player salaries, the performance might be poor due to unpredictable injuries. However, I decided to exclude injuries from the discussion since those are common in sports and each team has the same odds on having injuries.

Fixed effects are included for the regression calculations, which contains a variety of franchise factors such as management, coaching and team's geographical location. Even though the results show a link between payrolls and performance, these factors can have a significant change in team's success. For example, changing the head coach of the team could bring greater success without increasing the player's salaries. Ideally, it would be better to measure all these components to precisely model the relationship (Shorin 2017, 53). Some refinements could be made in the future research by developing a methodology to measure these factors, such as finding a proxy variable or devising a proprietary composite index (Noponen 2017, 15).

Subsequent analysis on different metrics of success could give a deeper understanding on the payroll and performance relationship. Playoff victories, team valuations and division rankings can all have an influence on the overall success of the team. However, this paper is solely focusing on the total amount of wins without specifying the rankings, playoff pairs or other aspects that could affect team's winning record.

Lastly, probably the most significant limitation is the direct by-product of the scope (Shorin 2017, 53). This research explores the payroll spending at the team level, which does not allow us to see the possible relationship at the player level. For instance, league's top player may have a significant impact on the league's standings. This has been the situation in NBA in the past seven years, where the team with Lebron James has been in the final four each year. Researches about the payroll spending contribution by certain positions (for example quarterbacks salaries) or by the role on team (defensive players vs. offensive players) could find that not all spending

equally translate into success (Shorin 2017, 53). This could also give valuable information on how franchises should effectively spend money to achieve their desired goals.

CONCLUSION

Professional sports are a multi-billion industry, where teams make meaningful decisions on how to use their money in the best possible way. Careful player selection is important since player's salaries account for the largest expenditure of team's budget. This research explores the relationship between payrolls and performance in four different leagues, measured by the number of won games during the whole season for 20 years.

Regression estimations shows that there is a significant relationship, meaning that team's payroll spending influences team's success. When increasing payrolls by one standard deviation, teams approximately obtain 5.8 additional wins in NBA, 3.7 wins in NHL, 4.4 wins in MLB and 0.5 wins in NFL. These numbers are significant in tightly contested leagues where each game can have a big impact on league's standings. For example, for season 2015 in NBA, the difference in the Eastern Conference between the 3rd placed Miami Heat and the 8th placed Detroit Pistons (the last team to make the playoffs) was merely 4 wins (48 versus 44 wins). In season 2015 of NHL, western conference teams who received a wild card to playoffs were Minnesota Wild with 46 wins and Winnipeg Jets with 43 wins. Los Angeles Kings won 40 games and was placed 3^{rd,} leaving them outside the playoffs. Since spending additional standard deviation on payrolls results to approximately 5.8 additional wins in NBA and 3.7 wins in NHL, team's decisions on payroll spending can have a significant change on league standings.

The results also show that previous year's performance has a positive impact on the next year's performance in three leagues (the coefficient estimate for NFL is also positive, but the level of significance drops to 10%). At the same time, last year's payroll has negative values for coefficients in three leagues (except NFL). This indicates that the teams that achieved higher success with less spending in previous year (so, they already have a good team that may benefit from the addition of one-two really good players) may benefit from the increase in payroll next season the most.

It is important to remember that franchise's payroll decisions are based on their own preferences. Some teams place a higher value on obtaining the greatest players while others might prefer high financial profits. The results show that increased payrolls are associated with greater success, but some teams simply don't want to buy the success with obtaining the greatest players. Nevertheless, this paper focuses on the relationship between payroll spending and performance, and so for does not take into consideration the team's own organizational goals.

This paper shows a significant relationship between the payroll and performance, but there are few limitations to notice. Firstly, fixed effects are included to control for differing franchise factors (such as coaching, location, management etc.), and in the future researches these features could me measured more specifically. Secondly, besides solely looking at the total amount of wins, there are other factors associated with payroll spending, such as division rankings, playoff victories and team valuations. Furthermore, one could argue that the total number of wins does not tell enough whether a team is successful or not. These aspects could all potentially affect the payroll figures and could be examined in the future researches.

Lastly, this paper explores the payroll and performance relationship on a team level. In professional sports, a single player can affect the whole team's performance and league's standings. Moreover, this suggests that equal spending on payrolls does not necessarily lead to a greater success. Payroll spending on a player level could be examined in the future researches to understand how the pre-eminent players can influence the league's rankings and other team's performance.

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