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School of Business

Salary Caps in Professional Team Sports - Balancing Competition or Balancing Costs in the National Hockey League?

Economics

Master's thesis

Antti Lipasti

2015

Department of Economics
Aalto University
School of Business

Aalto University
School of Business

Aalto University, P.O. BOX 11000, 00076 AALTO
www.aalto.fi

Abstract of master's thesis

Author	Antti Lipasti
Title of thesis	Salary Caps in Professional Team Sports – Balancing Competition or Balancing Costs in the National Hockey League?
Degree	Master's Degree in Economics and Business Administration
Degree program	Economics
Thesis advisor	Marko Terviö
Year of approval	2015
Number of pages	71
Language	English

Purpose of the study

The aim of this study is to introduce North American major sports league salary cap systems. I summarize the development and the history of job market regulation in professional team sports. Different types of salary caps and leagues are presented to create a comprehensive understanding about the topic. The theoretical implications of a salary cap are presented based on previous literature. Previous studies suggest that a salary cap has two main motivations: to balance the competition and to lower player costs. In the empirical part of the thesis I keep my focus in the National Hockey League (NHL). I test whether the consequences implied by theory are consistent with the results in the NHL after the introduction of the first league-wide salary cap in 2005. My aim is to find out if the competition has balanced during the regular season and during the playoffs. Additionally, I examine consequences of lower player costs to the team owners and to the players.

Data and methods

Data on player salaries is collected from the USAToday website which has gathered NHL player salaries since the 2000-2001 season. Yearly player salary data consists of 700 to 748 observations and in total the data set includes 9372 observations. Data on teams' success is collected from different statistical websites which are listed in the thesis. I use statistical analysis methods such as Gini coefficient and Herfindahl-Hirchman Index to examine and illustrate the differences before and after the salary cap.

Results

The results of this study mainly support those suggested by the theory. Regular season competition became more balanced after the 2005 salary cap. However, competitive balance in playoffs did not grow, contradicting the theoretical suggestion. League-wide player costs decreased after the salary cap but the growth in salaries rapidly revoked the decrease. Income inequality did decrease. The most expensive players experienced the greatest cut in salaries and the lowest paid players experienced an increase in salaries. Differences in positional average salaries decreased and the valuation of players on their position standardized.

Keywords Salary cap, professional team sports, competitive balance, player costs, North American major sports leagues, the National Hockey League, income inequality

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1. Introduction

Professional sports player markets in North America have been regulated since the late 19th century and the earliest job market problems were found in the baseball labor market (Kahn 2000). Job market regulation has become more common in professional sports and academic research has increased especially during the past fifty years. More complex regulation methods and salary cap systems have been introduced as professional sports grow in their economic importance. The National Hockey League season 2004-2005 was cancelled due to labor dispute between the league and the players' association. The labor dispute was followed by the first salary cap in the NHL's history. Salary caps have two main motivations; firstly, to balance competition and secondly, to limit the overall costs of teams (Dietl, Franck, Lang & Rathke 2012).

In this master's thesis, I focus on salary caps in professional team sports. I introduce related literature and build comprehensive understanding about the theoretical results of setting a salary cap. In the empirical part, I examine if these results are found in the National Hockey League after the setting of the 2005 salary cap.

In his study the Baseball Players' Labor Market, Rottenberg (1956) discusses a number of market problems in the baseball labor market. He suggests that monopsony power is frank in the baseball labor market and competitors must be approximately equal size if any are to be successful. Rottenberg divides the market of baseball players into three markets: the market for free agents where the player is the seller, the market for signed players where teams are sellers and buyers, and the market for the current services of contracted players where the player is the seller and the team that holds his contract is the buyer. He argues that this so called "reserve rule" did not equalize the distribution of playing talent as it was supposed to and teams with higher bids were able to draw better players.

Supporting Rottenberg, Neal (1964) states in his study the Peculiar Economics of Professional Sports that competitive balance is needed in professional sports and pure monopolism would be destructive. Neal suggests that the more frequently the standings chance, the larger will be the gate receipts. He concludes that in professional sports the league must be understood as the firm that acts as a natural monopolist. Within that league teams or athletes are the legally separate business firms that produce several joint products.

Staudohar (1998) focuses on the effects of salary caps in professional team sports. He presents labor market problems, such as salary caps, in four major leagues in the U.S.. In 1998 a salary cap was placed in two of the four leagues which are basketball and football leagues. Staudohar concludes that salary caps and payroll taxes may seem beneficial to owners but their effect is more symbolic and cosmetic than fundamental.

In his study, the Impact of Salary Caps in Professional Team Sports, Késenne (2000) concentrates on competitive balance, the level and the distribution of player salaries, owner profits and total league revenue. In Chapter 3.1, I show Késenne's idea in more detail as I consider it comparable to the salary cap in the NHL with some adjustments. Contradicting Staudohar (1998) Késenne argues that a salary cap improves the competitive balance and the player salary distribution, holds down the excessive top player salaries, and guarantees the club owners a reasonable profit rate.

Kaijalainen (2013) examined in her master's thesis how the first salary cap in the NHL altered wage determination and salary distribution. Her findings show that only the importance of experience increased remarkably when determining the player's salary. Also, her findings suggest that the demand of the most valuable players has decreased and the demand for upper middle class (based on talent) has increased.

The first aim of this research is to describe the theoretical implications of setting a salary cap on competition and teams' player costs. Secondly, in the empirical part of the thesis I test whether the implications of a salary cap suggested by the theory hold in the NHL. To do this, I use player and team salaries which are available on the USAToday website and team success information collected from different statistical websites. I examine the league-wide changes and my research questions are:

1. What are the consequences on competitive balance and teams' player costs implied by theory after the implementation of a salary cap?
2. Did the 2005 NHL salary cap balance competition?
3. Has the 2005 NHL salary cap limited the overall player costs of the teams?

    3.1 What are the results of limited player costs to the team owners and to the players?

A salary cap is expected to lower the player costs of a big market team and increase the player costs of small market team. Based on the leveling effect of a salary cap the talent distribution

should become more equal. Consequently, a salary cap should lead to a more competitively balanced league.

Empirical findings in this study suggest that the 2005 salary cap made regular season competition more balanced. This result is based on the more equal distribution of wins, points and standings after the regular season. On the other hand, playoff competition after the salary cap did not become more balanced. Playoff rounds are distributed less evenly and the distribution of wins during playoffs has not changed.

The 2005 NHL salary cap did limit the overall player costs of the NHL teams. Small market teams increased their spending and large market teams decreased their spending. Also, accumulated player costs decreased. The franchise values of the NHL teams started to increase. Players experienced a cut in average salaries and highest paid players felt the greatest cut.

The thesis is structured as follows: chapter one focuses on creating an extensive background information and motivation for the thesis. Chapter two introduces the history of salary caps in North America. Chapter three illustrates the theoretical effects of different kind of salary caps. Chapter four shows that there are differences between leagues and their objectives. In chapter five, I present the salary caps at the moment in U.S major leagues. Chapter six collects important information about the National Hockey League. In chapter seven, I introduce the data set and provide empirical research questions and research methods. In chapter eight, I analyze the research questions in detail one by one. In chapter nine, I make conclusions and suggest some possible areas for further and future research.

1.1 Definitions

When talking about salary caps there are some additional factors that need to be taken into account to fully understand the importance and relevance of salary caps. In this chapter, I introduce relevant concepts and define them briefly. Definitions will give a better understanding when reading the thesis as these concepts are highly linked to each other and need to be defined.

Introduction to salary cap

Salary caps in professional sports have two main motivations: firstly, to balance competition in professional team sports where economic powers between teams notably differ and secondly,

to limit the overall costs of teams (Dietl, Franck, Lang & Rathke 2012). The following definition for a salary cap is provided by www.businessdictionary.com: "the limit placed on a salary paid out to employees and enforced by the government or another organization". In the case of professional sports, league management and player associations negotiate a salary cap that satisfies both parties. Most salary caps have upper and lower limits that define the range of a total team spending on player salaries. In professional sports, players are seen as employees and salary caps limit salaries paid for them. Késenne (2000) states that in order to guarantee a more or less balanced competition, sport federations and league authorities have always tried to regulate the player labor market and to prevent the concentration of all playing talent in the rich big-city clubs that can offer better salaries than the small-town clubs.

As noted in Késenne's statement, the market size of clubs is one main character when determining the economic power of the team. Teams located in metropolitan areas with for example more than 10 million citizens have a cutting edge when compared with small-town clubs with for example half a million citizens. Therefore, most talented players would be compensated more open handedly for their services in big-city teams. Salary caps are to diminish this phenomenon. Also, salary caps reduce self-destructing behavior like overpaying talented players when a team does not have economic stability and power to do this (Késenne 2000). Without salary caps, small-town clubs would have a higher need to pay greater salaries for their star players as salary caps would not limit the purchasing power of big-city teams. Consequently, big-city teams are not able to gather all the star players of leagues as a salary cap start to limit spending when the agreed spending limit is reached. Thus, smaller clubs have a possibility to attract more talented players with their offers.

North American major leagues

North America has four major leagues. These leagues are Major League Baseball (MLB), the National Basketball Association (NBA), the National Football League (NFL) and the National Hockey League (NHL). Most of the academic studies on professional team sports in North America focus on these four or on one of them. I introduce salary cap systems in all four leagues keeping my main focus on the NHL.

Playoffs and the Stanley Cup

The NHL includes thirty teams that compete for the Stanley Cup which is the championship trophy awarded annually. During the regular season, all thirty NHL teams compete for playoff entry which is achieved by the sixteen most successful teams. These sixteen teams form a cup stage called the playoffs where teams play against each other in pairs. In every pair, team that first has four wins is the one to proceed to the next round. Two final teams left in the playoffs play in the Stanley Cup finals. The winner is declared the Stanley Cup winner.

The rookie draft system

All four major sports leagues in North America have experienced the effects of salary caps and rookie draft system. In a rookie draft event teams have a first possibility to sign young players that have come to a certain age. Teams draft players in reversed order of last season success; team that finished last in previous season will start the draft event of starting season. A rookie draft has a two-edged effect as noted by Rosenthal (1995): "The major positive aspect of the draft … is that the draft provides a way to distribute talent to teams and its goal is to do so both fairly and in such a way so as to maintain a competitive balance. On the other hand, the draft distorts the free market and eliminates the choice of amateurs to decide where they want to play and with whom to negotiate." This is a common situation in professional sports where the demand and supply of labor are in many ways not comparable to regular job markets. Salary caps and draft system both lower the power of players for negotiating as longer contracts are introduced and it is possible for a team to own a players' job supply for several years.

Free agency

Four major sports in North America all have a free agency system. Free agency system allows players to sell their services to other clubs after a certain period of time has elapsed (Staudohar 1998). In other words, players under contract are not allowed to make a new deal with other teams when they have a valid contract with one team. Team that owns the contract of a player can sell the contract of that player to another team meaning that a player can be sold without letting him know beforehand. When a player has been sold to another team, his or her contract is still valid and that player has an obligation to fulfill the original contract even though the

team (the owner of the player) has changed. Free agency is the only situation when players are not obligated to one team and have a power to negotiate their own contract.

Monopsony power in professional sports labor markets

The rookie draft system, lack of free agency regulations and limited amount of teams lead to a monopsony power of teams and leagues in player labor markets in professional sports. Boal and Ransom (1997) state that "numerous models of buyer market power have been developed that do not assume a single buyer or even a small number of buyers. Today the term "labor monopsony" is applied more broadly to any model where individual firms face upward-sloping labor supply." In professional sports, players have multiple teams to negotiate with but league regulations limit players' possibilities to negotiate with these teams. Boal and Ransom (1997) also argue that professional sports leagues in North America are organized with distinctive monopsonistic characteristics, such as the rookie draft, and agreements between teams that restrict the mobility of players within the league. According to these findings, professional sports leagues arguably have notable monopsonistic power. Teams might compete for talent but once a player is signed for one team league regulations lower the player's negotiation power.

Agency considerations help explain why salaries were related to performance, but surely wages would be higher in a contract system where players owned their contract rights and could negotiate freely with all teams in the league (Rosen & Sanderson 2001). More common labor contracts are known to have a few weeks term of notice and ability to negotiate with every company in the industry. Professional sports players have considerably low bargaining power as their multiple year contracts are owned by teams and can be sold without negotiations with the player.

2. The historical overview and development of salary caps in North America

In this Chapter, I present a summation to the history and development of salary caps in North America. Most of the existing literature is concentrated on salary caps and free agency in North American baseball leagues. Thus, I keep my main focus on baseball. Concentrated on the end of this chapter, I shortly introduce other major leagues. More analysis will take place in Chapter 5 where the most recent salary cap systems are introduced.

The 19th century – first salary cap introduced in the National League of Professional Baseball Clubs

Baseball is the oldest major league sport in the U.S., beginning with the birth of the National League of Professional Baseball Clubs (NL) in 1876. During this period, there was competition for player services from other baseball leagues. To protect itself against the competition of rival leagues and improve the team owners' balance sheets, the NL introduced the "reserve clause" in 1879, which meant that players were bound to the team that originally acquired the rights to contract with them. Consequently, owners now had additional monopsony power over players, and player salaries dropped. (Kahn 2000.)

This is a violation of free agency introduced in the previous chapter and thus gives more power to a team that has signed a player. Under reserve clause player contracts are owned by teams and consequently teams have higher ground when negotiating new contracts with players already signed to the team.

First known salary cap in North America was introduced in baseball. This was not a limit on total spending but a maximum salary that can be paid to one player. A $2500 salary cap per player was introduced in 1885 and this caused notable dissatisfaction among the players. After profitable 1889 season players struck back and established a separate league, called a Players' League, which had no reserve clause or salary caps but this league failed to overcome disadvantages of starting from scratch, and players put too much trust in the capitalists, who had their own agendas. (Riess 2012.)

After the failure of Players' League there were still two competing baseball leagues left: the NL and the American Association (AA). Kahn (2000) found in his study that in 1891, four of the AA teams were absorbed into the NL, and five dissolved American Association franchises

were bought out by the survivors. Kahn (2000) also states that this merger led to a NL owners' announcement in 1893 of a new salary policy: the maximum pay for a player was to be $2,400. This salary cap in North America was possible as the two competing leagues merged. As a result, salaries within one league were easier to agree on because of the lack of competition. Competition between the two leagues before the merger led to higher player salaries. Arguably, players benefitted more from competition than teams did as salaries paid for the players were greater before the introduction of salary caps. After the merger monopsony power of the league increased again as competition only existed within the league.

The 20th century – the development of salary caps and introduction of free agency

When coming to the 20th century, the NL again faced competition from another league. Beleaguered NL monopoly, which had survived challenges from rival leagues in the late 19th century for over two decades, was being faced with the formation of yet another rival in the American League of 1900 (Vrooman 2000).

"The huge success of the American League brought with it a dramatic rise in player salaries. In fact the salary increase appears to begin in 1900, perhaps reflecting anticipation of the new league. The two leagues merged during the 1903 season, at the end of which the first World Series was played. Then in 1903, salaries in Major League Baseball fell immediately by about 15 percent." (Kahn 2000.)

The early stages of American baseball seem to have familiar pattern as the NL faces competition and after tend to merge with its competitors. Competition increases player salaries as the monopsony power of the NL decreases. The NL tries to prevent the success of competing leagues by reserve clause regulations and deals negotiated with players under monopsony power it has. Competing league faces operational problems as it lacks experience and structures like stadiums to maintain competition with the NL. Problems faced make it more tempting for the capitalist managers of a competing league to merge with the NL. Consequently, the NL ends up with monopsony power once again and players' salaries decrease making players less satisfied.

Until 1976, players in each of the four major North American sports were bound by the reserve clause to remain with their original team, unless that team decided to trade or sell them to another team. The reserve clause maintained the monopsony power of leagues and resulted in

frustrated players. Players' union thrived for free agency in baseball and succeeded in 1976. This had a powerful impact on the salaries of baseball players: the average real increase in baseball salaries was from 0-2 percent per year from 1973-75 and in 1976 it was almost 10 percent. (Kahn 2000.)

The National Basketball Association (NBA) does not have as long history related to salary disputes as baseball has. Like the other four major sports, basketball went through its "dark ages" for player salaries during the years of owner application of the reserve clause (Staudohar 1998). Basketball players also won free agency in 1976 but via different route than baseball players (Kahn 2000). This increased salaries in NBA which eventually resulted in the introduction of a salary cap.

In the National Football League (NFL) free agency was not introduced in 1976. From 1977 to 1987 voluntary movement of players was virtually nonexistent because of the compensation required for teams that signed free agents (Staudohar 1998). Free agency existed but had clear limitations as required compensations blocked nearly all possible player sales and trades.

National Hockey League (NHL) had never had a work stoppage until 1992 and enjoyed many years of relatively placid negotiations (Staudohar 1998). This can partly be explained by the comparably short history of the NHL when compared with North American baseball leagues. Since the 1990s NHL has suffered strikes and lock-outs due to salary cap negotiations (see Chapter 6).

3. Different types of salary caps

In this chapter, I introduce and discuss different types of salary caps. Salary caps are roughly divided in hard and soft salary caps. Also, there are voluntary salary caps and different methods how to calculate salary caps. This chapter introduces hard, soft and voluntary salary caps, and how a percentage of revenue salary cap is calculated.

3.1 Hard salary cap

In the case of a hard salary cap team has a strict limit on how much it can spend on player salaries per season. In this chapter, I use two club model presented by Késenne (2000) as a framework when showing the theoretical effects of introducing a hard salary cap that only has a fixed upper limit that a team can spend and no lower limit. Firstly, Késenne (2000) assumes that a team can only have a fixed number of players (L) on the field so a club faces the restriction that:

$$L_1 + L_2 = L \qquad (3.1)$$

Where L_1 stands for top players and L_2 for regular players.

On the cost side Késenne (2000) assumes that a club's total cost only consists of player salaries. C_1 is the labor cost of a top player and C_2 is the labor cost of a regular player. The cost function can now be written, given the constraint above, as:

$$C = (C_1 - C_2)L_1 + C_2L \qquad (3.2)$$

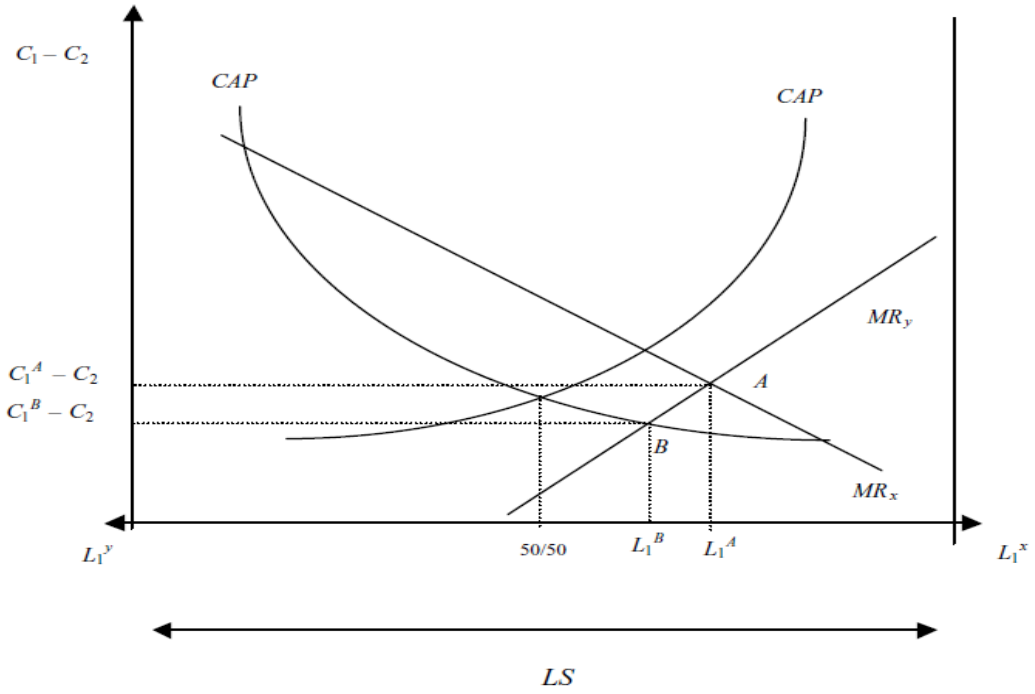
Third assumption we need to adopt form Késenne (2000) is that a salary cap is not effective for the small club, so that the demand conditions for top players are unchanged. Also, the big club has to maximize its profits under the constraint of the salary cap. When introducing a hard salary cap (CAP) the equation (3.2) can be written as:

$$CAP = (C_1 - C_2)L_1 + C_2L \qquad (3.3)$$

$$\rightarrow C_1 - C_2 = (CAP - C_2L)/L_1$$

The following figure draws two club model labor market equilibrium with one big team (X) and one small team (Y):

Figure 1: Salary caps and market equilibrium (Késenne 2000)

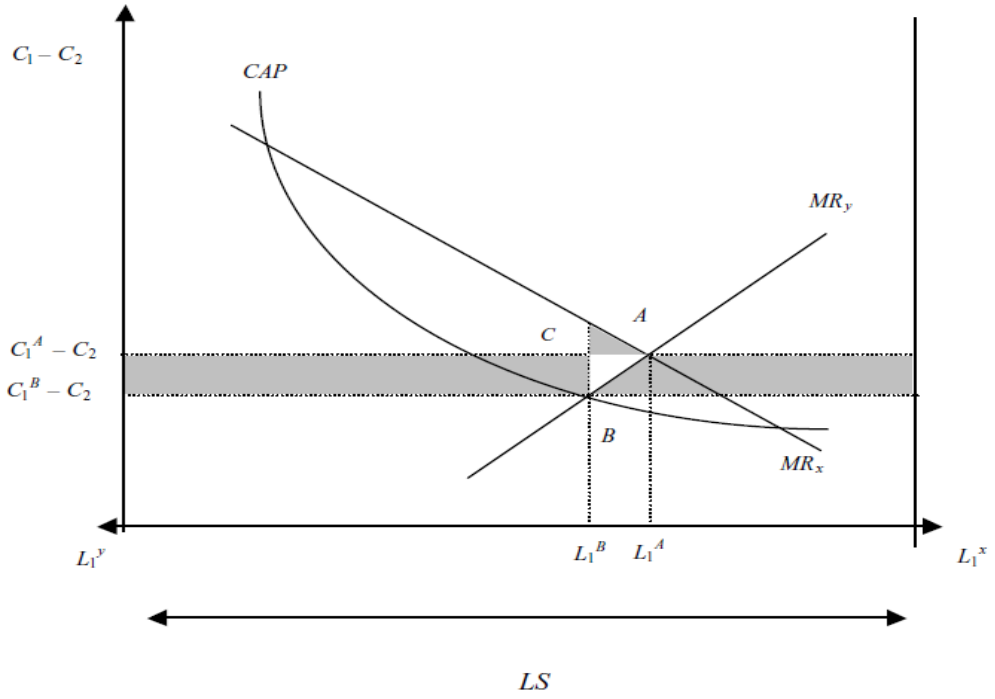


Without salary cap (CAP) labor market equilibrium is found from the intersection of marginal revenue curves (MR_x and MR_y) of the two teams at point A. Horizontal axis illustrates that there is a competition between the two teams for fixed amount of L_1 ($LS = \ labor\ supply$). At point A, big team has most of top players as L_1^A is located on the right side of 50/50 point of the given supply of L_1 on the horizontal axis. Salary distribution between L_1 and L_2 is presented on the vertical axis.

When a salary cap is introduced it effects the market equilibrium. As we can see from the figure marginal revenue curve for team X (MR_x) is above the CAP and thus salary cap limits spending on salaries. New labor market equilibrium is found at point B which is at the intersection of CAP for team X and marginal revenue curve for team Y. $C_1^B - C_2 < C_1^A - C_2$ illustrates that movement from equilibrium A to equilibrium B has made salary distribution between $L_1$and L_2 more even. Also, on the horizontal axis point L_1^B is closer to 50/50 point of given supply of top players than point L_1^A and thus the distribution is more even.

Arguably this theory presents how salary cap can have a balancing effect on labor market equilibrium. It is important to show how salary cap affects owner surplus. Figure 2 illustrates how owner surpluses are affected by a salary cap.

Figure 2: Salary caps and owner profits (Késenne 2000)



For the small club Y the model clearly shows a rise in profits as indicated by the shaded area on the right side of Figure 2. For the big club X which no longer can reach its profit maximizing position, the situation after the salary cap is only slightly more complicated. On the one hand there is an increase in profits as big as the shaded rectangular area on the left side of Figure 2, but there is a loss of profits indicated by the shaded triangular are in the middle. Comparing the size of both area's it is clear that also the big club's profits go up due to the salary cap. (Késenne 2000.)

In a two club model teams have greater surpluses and player salaries decrease and thus profit maximizing teams should encourage salary caps. Also, when salary cap is restrictive only for the big club it makes the league more equal which should increase its attractiveness. Fort and Quirk (1995) point out a different possible result of a salary cap in a multiple team league.

The league could begin to lose its TV audiences in strong-drawing cities as these traditionally powerful teams become just one of the bunch. Further, the reduction in strength of powerful teams could open the gate of rival leagues featuring strong teams in these centers of interest. It is not simply a matter of theoretical interest that league-wide revenues are not maximized under a cap (because marginal revenue products of teams are not equalized), it is a matter of real-world interest to leagues and players as well. (Fort and Quirk 1995.)

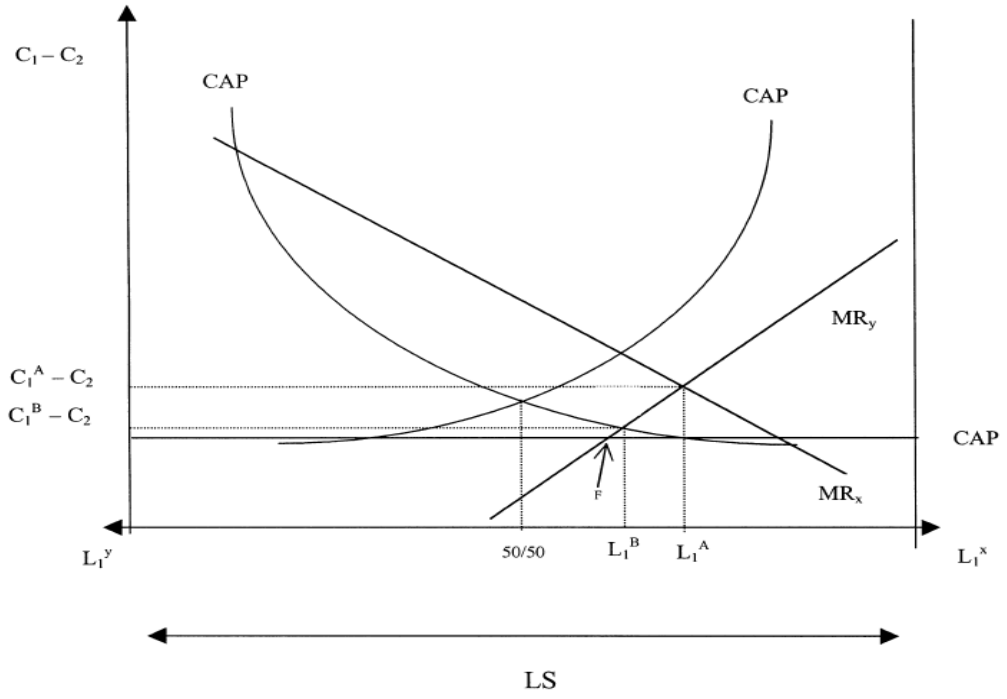
The owners of the bigger rich clubs are not, or cannot be, fully aware of the fact that the lack of uncertainty of outcome diminishes the public interest in the league championship, keeping people and television away from the ball park. Because of this overestimation of the marginal revenue of playing talent, the Pareto optimum can only be reached by restricting their demand for playing talent. The size of this externality, which can be derived from empirical studies of the impact of the uncertainty of outcome, should be taken into account when determining the level of the cap. (Késenne 2000.)

Both papers cited in this chapter make valid arguments on behalf of introduction of salary cap. Rich teams' purchasing power needs to be limited in order to avoid too uneven league. On the other hand, if purchasing power is too limited all teams become equal and rich team fans who are used to success might lose interest in following their team. Also, rival leagues might come up with bigger budgets and better success which might make them more interesting for audience.

Individual and team salary cap

Individual salary cap presented as a horizontal CAP line in Figure 3 needs to be set below market equilibrium to be effective. New market equilibrium will be found somewhere between point F and intersection of team salary cap for team X and individual salary cap. Késenne (2000) argues that market equilibrium will be found close to the intersection point of CAP for team X and individual salary cap as rich teams can offer the star players more non-wage or fringe benefits on top of their salary.

Figure 3: The individual salary cap (Késenne 2000)



The result of this individual cap is that the competitive balance becomes less equal than under a payroll cap, which is probably not what league wishes. The only positive outcome is that the individual cap further improves the salary distribution between stars and regulars. Késenne 2000

3.2 Soft salary cap

Soft salary cap means that teams have a salary cap but there are also exceptions that allow for exceeding the salary cap. In the National Basketball League (NBA), salary cap was and remains a soft cap and thus it can be used as an example when introducing a soft salary cap. According to Staudohar (1998) first exception made under salary cap in the NBA in 1983 was that teams were allowed to retain at any price one player who became a free agent, and that player's salary would not count against the cap. Under this exception teams are able to negotiate deals that are not counted against the cap as signed player may become a free agent after one year deal. Thus, the same team can pay notably higher wages for signed player after that one year has passed as it does not count against the cap anymore. For example, player might sign up a multiple season contract of half a million dollars per season. If the contract allows the player to become a free

agent after one season the team and the player can re-negotiate the deal with a higher salary and it does not count against the salary cap as the player is a free agent.

When a team has reached its salary cap it would not be able to sign rookies. Staudohar (1998) mentions that "another feature of the 1983 agreement was that teams that were at or over the salary cap could sign rookies to 1-year contracts for only $75,000 for first-round draft choices, and $65,000 for lower picks." This exception gives an opportunity for teams that have spent their whole cap to sign rookies with a lower price. Those players who are drafted to teams that have reached their cap level are signed for a lower salary than they most likely would have been able to negotiate if the cap has not been reached.

Salary cap exceptions are complex and they vary continuously as player associations negotiate with leagues. Most often these exceptions provide a possibility for a team to exceed the salary cap and in the soft salary cap examples presented the player is most likely to experience disadvantages.

3.3 Percentage of revenue salary cap

Percentage of revenue is a way to determine the level of a salary cap. The cap is calculated as a percentage of defined gross revenue of the league, based on the total revenue of all clubs together, during the previous season, divided by the number of clubs in the league (Késenne 2003). In NBA, percentage of revenue cap is in use and according to Staudohar (1998) this percentage was set at 53% in 1983 and has varied conformable to new agreements between NBA and National Basketball Players Association. Zimbalist (2010) argues that in the presence of unequal club revenues, if all teams are compelled to have payrolls within a certain narrow range, and such range is determined based on league-wide revenues, then markedly unequal rates of profit across the clubs may result. Thus, in the case of percentage of revenue cap the league should have as equal club revenues as possible in order to guarantee equal profits across the clubs.

3.4 Voluntary salary cap

Salary caps in U.S are strictly controlled by the league and agreements are expected to be obeyed. In European football league's strict salary caps has not been set and the situation is totally different. In European football league's biggest teams have formed voluntary contracts

to limit spending. Voluntary salary cap is not enforced by the league and obeying the rules is voluntary.

In the race for hiring and keeping the best players, the share of some clubs' payroll has risen to unsustainable percentages of their total budgets. Consequently, a salary cap, as it is proposed by the G-14, the association of the 18 most successful clubs in European football, is fundamentally different from the salary cap as it has been introduced in some major leagues in the U.S. (Késenne 2003.)

In European football leagues the best teams from a lower league are promoted to the next higher league, while the weakest teams in the latter are demoted to the former. The composition of an open league changes annually through promotion and relegation. Promotion and relegation decrease the probability of future interaction resulting in a stronger devaluation of future profits. Self-enforcing salary caps are ceteris paribus less likely in open leagues than in hermetic leagues. (Dietl, Franck & Nüesch 2006.)

Teams in an open league do not have an incentive to comply the voluntary salary cap if it results in a negative consequences for the team. For example a team that would otherwise relegate from the league can increase its profits when it spends more than voluntarily agreed. The team is able to retain its league position which will most likely result in higher incomes next season than in the case of relegation. Also, when other teams in the league are possibly promoted or relegated voluntary agreements are less beneficial as probability of playing against the same teams is lower than in a hermetic league.

Dietl et al. (2006) argue that based on their model with two identical profit-maximizing teams the self-enforcing character of salary caps increase with the clubs' discount factor and the importance of competitive balance. Additionally they state that that voluntary salary caps have to be self-enforcing in order to be effective in limiting player expenses. In European leagues where teams play national and international cups on the side of their national league competitive balance is not likely to be as important as in U.S and thus voluntary salary caps are not self-enforcing and will not effectively limit player expenses.

In a win-maximizing league a salary cap proposed by G-14 in European football, for reasons of financial prudence, can be expected to have negative impact on the distribution of talent among teams and on the competitive balance in a league as cost structures of the small and large market teams differ notably (Késenne 2003).

4. Different types of leagues and teams

4.1 Profit maximization in North American leagues

Debate on the profit maximization of professional sports leagues has not reached consensus. In this chapter, I present the profit maximizing behavior and my analysis follows the theory and the model presented by Ferguson, Stewart, Jones and Le Dressay (1991) in their article "The pricing of sports events: do teams maximize profits?"

Although sports fans may resist profit maximizing prices and teams may deny that they are motivated by profit maximization, it is not clear what this means for their actual behavior. When considering profit maximization in the case of professional sports, there are two main questions to be considered:

1. Will sports fans not attend a game of a favored (winning) team for profit maximization alone?
2. Will teams forego opportunities for more revenue?

The NHL is chosen as an example to test the pricing motivation for two reasons. Firstly, it is close to unregulated local monopoly for which data on prices, sales, product attributes and market characteristics are available for individual (teams). Secondly, there is an ongoing debate over the appropriateness of the profit maximization assumption on professional sports industries. (Ferguson et al. 1991.)

Assumptions, the model and the data

The approach chosen by Ferguson et al. (1991) require three assumptions:

1. Costs which vary with attendance are small so that profit maximization coincides with revenue maximization.
2. Games are sufficiently homogeneous that the depiction in terms of a representative game does not do undue violence to a team's actual calculations.
3. A single price is sufficient to describe a team's choice alternatives.

For the more extensive description of the assumptions see Ferguson et al. (1991).

Given the assumptions above it is possible to write down the inverse demand function which illustrates the demand for attendance at the representative game of a team

$$p = f(A, z; \Theta) \quad (4.1)$$

where p is the team's average ticket price, A is average attendance per home game within the season, z is a vector of attributes of the team and its home city and Θ is a vector of parameters. The team's ticket revenue is

$$R(A, z; \Theta) = Af(A, z; \Theta) \quad (4.2)$$

average attendance times the team's average ticket price. According to profit maximization hypothesis, the team is expected to choose a level of attendance A and corresponding price so as to

$$\max_A R(A, z; \Theta) \qquad \text{s.t. } A \leq C \quad (4.3)$$

where C is the arena capacity. This maximizes team's profits and naturally average attendance cannot be greater than arena capacity. Team's behavior is characterized by Kuhn-Tucker condition

$$\frac{dR(A,z;\Theta)}{dA} \geq 0, \qquad \frac{dR(A,z,\Theta)}{dA}(C - A) = 0, \qquad C - A \geq 0 \quad (4.4)$$

To represent the team's choices the equation

$$\frac{dR(A, z; \Theta)}{dA}(C - A) = 0$$

where marginal revenue times unused capacity equals zero is chosen.

Ferguson et al. (1991) use NHL data from 1981, 1982, and 1983 seasons to test either teams are profit maximizers or not. Then the league included 21 teams and the data set contains 63 observations describing team behavior.

The results

In their study Ferguson et al. (1991) conclude that even in the context of this simple model they fail to reject the hypothesis of profit maximization: econometric results offer considerable support for the profit maximizing behavior.

The study suggests that for sellout teams $(C = A)$ marginal revenue should be nonnegative and this is violated in only a single instance, whereas negative values for marginal revenue are more common for the non-sellout teams. Also, the rejection of the hypothesis that marginal revenue

equals zero tends to be more common for sellout teams than for non-sellouts support the results. Accordingly, Ferguson et al. (1991) find that NHL teams may well be consistent with profit maximization as economic agents generally are.

Alexander (2000) states that profit maximizing behavior is seen in MLB also: ticket prices has increased 92.7% since 1991 and club owners and players are getting richer at the expense of fans. Supporting Ferguson et al. Alexander (2000) empirically prove that MLB team owners are profit maximizers and set ticket prices as monopolists. Késenne (1999) argues that the most important difference between sports in the U.S. and Europe is that American clubs are business-type companies seeking to make profits, whereas the only aim for most European clubs so far is to be successful on the field. On the basis of this chapter and the studies presented, I found it reasonable to believe that the teams in four major North American leagues act as profit maximizers. In forthcoming chapters, I will analyze the effects of non-profit maximizing leagues.

4.2 Utility maximizing teams

In contrast to the previous chapter Dietl, Grossmann, and Lang (2011) argue in their paper, Competitive Balance and Revenue Sharing in Sports Leagues With Utility-Maximizing Teams, that empirical evidence from North American major leagues and European leagues supports the assumption that clubs trade-off profits and wins. Dietl et al. (2011) present a contest model of a sports league in which club owners maximize an objective function given by a weighted sum of profits and winning percentage. This chapter follows and compacts the model.

The core of the model is that each club maximizes its objective function given by a weighted sum of profits and winning percentage

$$u_i(x_i, x_j) = \pi_i(x_i, x_j) + \gamma_i w_i(x_i, x_j) \qquad (4.5)$$

where $u_i(x_i, x_j)$is the utility function for team i, $\pi_i(x_i, x_j)$, is the profit function for team i, $\gamma_i \geq 0$ is the win preference which characterizes the weight club owner i puts on winning in the objective function, and $w_i(x_i, x_j)$ is the winning percentage for team i. In the model presented in the previous chapter $\gamma_i = 0$ as teams' full focus in profit maximizing leagues is on the maximization of profits.

Competitive balance in utility maximizing league with two teams

Dietl et al. (2011) derive the win ratio (WR) from the equilibrium win percentages in two club league with utility maximizing club to be

$$WR = \frac{m_1+\gamma_1}{m_2+\gamma_2} \quad (4.6)$$

where m_1 is the market size for large market club and m_2 is the market size for small market club. $WR = 1$ illustrates a balanced league as $m_1 + \gamma_1 = m_2 + \gamma_2$ when $WR = 1$.

No matter what type of a league we consider, markets share usually differ between clubs ($m_1 \neq m_2$). In a utility maximizing league, the effect of a more win-oriented behavior on competitive balance depends on which club is the dominant team in the equilibrium. It is clear that a more win-oriented behavior of the dominant club j produces an even less balanced league as WR recedes from one. Competitive balance increases (WR approaches one) when the underdog i becomes more win-oriented until $\gamma_i < \gamma_i' \equiv m_j - m_i + \gamma_j \; with \; i,j = 2$ and $i \neq j$ as.

In a profit maximizing league, the large market team is the dominant team in the equilibrium as we know that $\frac{m_1}{m_2} > 1$. If the team owner of at least one club becomes more win-oriented, it can have a balancing effect on the competitive balance of the league. Small market team needs to become more win-oriented to balance the unbalanced win ratio caused by difference between teams' market share. (Dietl et al. 2011.)

The effect of utility maximization on team profits

In the first case, the large market team is a pure profit maximizer and the small market team is a utility maximizer ($\gamma_1 = 0 \; and \; \gamma_2 > 0$). When γ_2 increase the win percentage of the small market team increase and the win percentage of the large market team decreases (for proof see Dietl et al. 1991). Thus, the revenues of the small market team increase and the revenues of the large market team decrease (according to Dietl et al. $\frac{dR_2^*}{d\gamma_2} > 0 \; and \; \frac{dR_1^*}{d\gamma_2} < 0$). Firstly, increased investments in playing talent for small market team cannot be compensated by the increased revenue and secondly, the decreased revenues of the large market team cannot be compensated by the lower investments in playing talent. Consequently, the profits of both clubs decrease and thus aggregate team profits also decrease. (Dietl et al. 1991.)

In the second case Dietl et al. expect the large market team to be a utility maximizer and the small market team to be a profit maximizer ($\gamma_1 > 0 \; and \; \gamma_2 = 0$). In this case large market team fabricate higher revenues due to higher win preference γ_1.On the other hand, small market team yield lower revenues. Within certain conditions (see Dietl et al.) the higher profits of the large market team compensate for the lower profits of the small market team and aggregate team profits increase.

In a league where both teams are utility maximizers ($\gamma_1 > 0 \; and \; \gamma_2 > 0$) a higher win preference γ_2 for the small market team always yields lower profits for both clubs. When $\gamma_1 > \gamma_2$ the situation is more complex and an increase in aggregate team profits is possible. Thus, within a league that has utility maximizing team(s) the precondition for an increase in profits due to investments in talent is that the win preference of the large market club is greater than the win preference of the small market club ($\gamma_1 > \gamma_2$). (Dietl et al. 1991.)

4.3 The effects of salary caps on social welfare

According to BusinessDictionary.com social welfare is the well-being of the entire society but it is not the same as standard of living as social welfare is more concerned with the quality of life. A salary cap may increase or decrease social welfare depending upon the fans' valuation of competitive balance and aggregate talent (Dietl, Lang & Rathke 2009). Depending on the preferences of the society it will put more weight on competitive balance or on aggregate talent.

Within a balanced league (the case in which fans prefer competitive balance), a salary cap will reduce social welfare because it reduces the quality of the league by lowering the level of the competition (Dietl et al. 2009). A binding salary cap in a balanced league will decrease the competitiveness of the teams. Social welfare decrease as the loss of aggregate talent outweighs the increase in competitive balance.

Dietl et al. (2009) also suggest that if the league suffers from an unequal distribution of talent, the case in which fans prefer aggregate talent, social welfare (and club profits) can be increased through a salary cap. Salary cap decrease salaries (team costs) and thus increases team profits. This increase outweigh the loss of talent and consequently social welfare increases.

5. Season 2014-2015 salary caps in North American major leagues

In this chapter, I introduce salary caps that are in use in different leagues. I keep my main interest in the National Hockey League as the empirics part of this thesis focuses on the NHL.

The National Hockey League (NHL) salary cap:

Last lockout in the NHL was experienced in season 2012-2013 and it ended as the National Hockey League Player's Association (NHLPA) and the NHL signed the new collective bargaining agreement (CBA). According to the NHLPA "The Collective Bargaining Agreement between the NHLPA and the NHL was ratified by the NHLPA membership on January 12, 2013, concluding a four-month lockout by the owners of the National Hockey League Clubs. The Agreement sets out the terms and conditions of employment of all professional hockey players playing in the NHL as well as the respective rights of the NHL Clubs, the NHL and the NHLPA. The Agreement is set to remain in effect until September 15, 2022, with both the NHL and the NHLPA having the right to terminate the Agreement after eight years."

The CBA sets yearly lower limit and upper limit of the salary cap in the NHL: "For each League Year there shall be a "Lower Limit" and an "Upper Limit" at or between which each Club must have an Averaged Club Salary. The range between the Lower Limit and Upper Limit shall be known as the "Team Payroll Range" (=PR)." The midpoint of the salary cap, time period (t) = 0, is calculated as follows:

$$\frac{(50\% * HRR) - PB}{Number\ of\ clubs} = the\ Midpoint\ of\ the\ PR \qquad (5.1)$$

The CBA defines hockey related revenues (HRR) for league year as the operating revenues from all sources, whether known or unknown, whether now in existence or created in the future, of each Club or the League, for or with respect to that league year, on an accrual basis, derived or earned from, relating to or arising directly or indirectly out of the playing of NHL hockey games or NHL-related events in which current NHL Players participate or in which current NHL Players' names and likenesses are used, by each such Club or the League, or attributable directly to the Club or the League from a Club Affiliated Entity or League Affiliated Entity.

For any and all League Years under CBA, the Players' Share shall be fifty (50) percent of Actual HRR and the Applicable Percentage shall be fifty (50) (the CBA). Thus, HRR is multiplied by 50% when calculating the midpoint of the payroll range.

Projected benefits (PB) are defined in the CBA as the entire maximum aggregate amount of benefits projected to be paid to all players league-wide for such league year. During the season 2014-2015, the number of clubs playing in the NHL (Number of clubs) is 30.

The formula above (5.1) can only be used to calculate the midpoint of the payroll range when time (t) = 0. According to the CBA, the midpoint at t = 0 shall be adjusted upward by the factor of five (5) percent in each league year. Thus, the adjusted midpoint of the payroll range for the following year (t = 1) is:

$$\left(\frac{(50\% * HRR) - PB}{Number\ of\ clubs}\right) * 1{,}05 = the\ Adjusted\ Midpoint\ of\ the\ PR \qquad (5.2)$$

To calculate the upper and the lower limit for t = 1 the adjusted midpoint of the payroll range needs to be multiplied by 85% and by 115%:

$$Lower\ limit = the\ Adjusted\ Midpoint\ of\ the\ PR * 85\% \qquad (5.3)$$

$$Upper\ limit = the\ Adjusted\ Midpoint\ of\ the\ PR * 115\% \qquad (5.4)$$

According to CBA the lower limit and the upper limit of the range shall be calculated by the independent accountants no later than June 30th of the immediately preceding league year, using preliminary HRR and projected benefits, which shall be based upon the Initial HRR Report for the immediately preceding League Year.

Illustration:

NHL has set season 2014-2015 payroll cap (upper limit) at $69 million and floor (lower limit) at $51 million (http://www.nhl.com/ice/news.htm?id=724192). Accordingly we can calculate the adjusted midpoint of the payroll range for season 2014-2015 to be:

$$\frac{Upper\ limmit + Lower\ limit}{2} = the\ Adjusted\ Midpoint\ of\ the\ PR$$

$$\frac{\$69\ million + \$51\ million}{2} = \$60\ million$$

The (unadjusted) midpoint of the payroll range calculated before June 30th 2014 over preliminary information about season 2013-2014:

$$\frac{the\ Adjusted\ Midpoint\ of\ the\ PR}{1{,}05} = the\ Midpoint\ of\ the\ PR$$

$$\frac{\$60\ milloin}{1{,}05} \approx \$57{,}1429\ million$$

Accordingly we can calculate the players' share minus projected benefits:

$$the\ Midpoint\ of\ the\ PR * number\ of\ clubs = (0{,}5 * HRR) - PB$$

$$57{,}1429\ million * 30 = 1714{,}29\ million$$

Consequently, players' share minus projected benefits during the season 2013-2014 was equal to $1714.29 million. The amount mostly consists of Hockey Related Revenues which are operating revenues from all sources.

Cap Number and Cap Hit in the NHL

Many players sign multiyear contracts with teams. Players' salary may vary during the contract but the amount that is included in the salary cap, the cap number, is the same every year during that contract. For example, according to www.nhlnumbers.com Washington Capitals player Troy Brouwer has a three-year contract from season 2013-2014 to season 2015-2016 with an overall value of $11 million.

Table 1: Salary and Cap Number of Troy Brouwer three year contract (thousands of $)

Season	13/14	14/15	15/16	∑
Salary	$3,600	$3,650	$3,750	$11,000
Cap Number	$3,667	$3,667	$3,667	$11,000

As we can see from the table above, the salary varies between $3.6 million and $3.75 million during the three seasons but the cap number stays constant during the contract: $11 million / 3 seasons = $3.667 million per season.

A cap hit of a player is an amount that a team has to allocate in their total cap hit. For example, Marcel Goc was traded in the middle of the 2014-2015 season from Pittsburg Penguins to St. Louis Blues. The whole season lasts 186 days and he plays in St. Louis Blues for 74 days and thus (74/186 ≈ 0,4) around 40% of his salary of the season is allocated to St. Louis Blues total cap hit. (www.nhlnubers.com)

The National Basketball Association (NBA) salary cap

According to the collective bargaining agreement between the NBA and National Basketball Players Association (NBPA) the salary cap for 2014-15 is $63.065 million and the salary cap for each future season, subject to certain adjustments, will be calculated by multiplying projected "Basketball Related Income" by 44.74%, subtracting projected player benefits, and then dividing the result by 30. The determination of NBA salary cap is comparable to the NHL salary cap. Players' share is 5.26% lower as in NHL the players' share is 50% but otherwise the equation matches the one used in NHL.

The National Football League (NFL) salary cap

NFL collective bargaining agreement states that the salary cap for a league year shall be the player cost amount (percentage of all revenue) for that league year subtracting projected benefits for that league year, divided by the number of clubs in the league in that league year. Clearly, the calculation method for the salary cap in the NFL follows the same pattern as in the NBA and the NHL. These three leagues have some specializing features but the overall method is the same.

The Major League Basketball (MLB) salary cap

Baseball does not have any form of salary cap, although, it does have a luxury tax on clubs that yearly spend beyond a certain amount on salaries. The tax revenues go into a pool together with money from 2.5 percent tax on player salaries plus some local broadcast revenues from wealthy clubs. The pool is then distributed to 13 small-market teams. (Staudohar 1998.)

The MLB CBA sets a minimum amount for player salaries which is defined as follows: Individual Player salaries shall be those as agreed upon between a Player and a Club, as evidenced by the execution of a Uniform Player's Contract, subject to the following in 2015:

The 2014 rate ($500,000) per season plus a cost of living adjustment, rounded to the nearest $500, provided that the cost of living adjustment shall not reduce the minimum salary below $500,000.

6. Institutional background of the NHL

NHL was founded in November 26th, 1917 and it included five teams: the Montreal Canadiens, Montreal Wanderers, Ottawa Senators, Toronto Arenas, and Quebec Bulldogs (nhl.com). I shortly introduce the development of the NHL according to THE PUCK REPORT web page.

Ever since its foundation, the NHL has grown and during its history several teams have relocated and/or renamed. Altogether NHL has welcomed 36 teams from which 13 have relocated to a new city, 11 have changed their name while remaining in the same city, and six have experienced financial struggles and folded their operation. All teams that have joined the NHL after the foundation has paid an expansion fee to the league. An expansion fee has grown from $12,000 paid by Chicago Blackhawks in 1926 to $80 million paid by Minnesota Wild and Columbus Blue Jackets in 2000. An increase in expansion fees is compensated by increased estimates of franchise values ranging from $130 million to $ 1 billion. At the moment, the NHL includes 30 teams which are divided in two (Eastern and Western) conferences and in four divisions (Atlantic, Metropolitan, Central, and Pacific). (THE PUCK REPORT web site.)

During almost one hundred years of ice hockey the NHL has experienced two player strikes and three lockouts. I briefly introduce these labor disputes one by one using the information provided by http://proicehockey.about.com/.

The strike of 1925

The Hamilton Tigers players demanded a cash bonus of $200 for playing in the Stanley Cup Playoffs. Players argued that the Playoffs increased their workload (more games) and the team had turned a record profit. Thus, players should be compensated more open handedly. The NHL reacted quickly and actions were harsh: players were suspended and the Tigers' playoff games were defaulted. Additionally, the players involved in a strike needed to submit written apology before they were allowed to return to the ice.

The 1992 NHL Players' Strike

The first league wide work stoppage took place in the 1991-1992 season. The strike started by a vote (560 to 4) on April 1st, 1992 and ended only 10 days later on April 11th. The cancelled games were rescheduled and thus the whole season and playoffs were completed. After the strike players gain more control of marketing rights and their share of playoff revenue increased

from $3.2 million to $7.5million. Also, the regular season was extended from 80 games to 84 games to give the owners a revenue boost.

The 1994-1995 NHL Lockout

The owners wanted to establish a "luxury tax" to discourage increasing salaries and fund small market clubs. A tax would be set on those teams that exceed the average NHL payroll and the money would be distributed among the needy franchises. The NHLPA suggested that 16 wealthiest teams could be straight taxed to fund the poorer teams, unrelated to salaries paid by the teams. NHLPA proposition would not set additional rewards for smaller team payrolls and thus players favor straight tax rather than a salary related tax. As a result of the dispute, the rookie salary cap and greater restrictions on free agents were set, both benefitting the owners. On the other hand, the NHL dropped its demand for a luxury tax or any mechanism to control increasing salaries.

The 2004-2005 NHL Lockout

This was the first labor dispute that cancelled the whole season and no Stanley Cup winner was declared. NHL owners demanded an inflexible cap on salaries, claiming that the player costs require up to 75% of team revenues. The NHLPA was not going to accept any kind of salary cap and announced that players are ready to drop the whole season if necessary. During the season rumors and headlines suggested that the players' association began to be more compliant towards a salary cap. On February 18th, the first ever cancellation of the season was announced. Tentative agreement including the upper and lower limit was announced on July 13th, 2005. The 2005 Collective Bargaining Agreement included a salary cap and players' association was seen as a loser in the preceding negotiations. The salary cap guaranteed a fixed percentage (54%-57%) of the league revenues every year. Revenues increased notably in the years after consequently resulting in higher incomes for players (57% of revenues).

The 2012-2013 NHL Lockout

As the 2005 CBA expired in September 15th, 2012 the NHL and the NHLPA needed to resolve some issues that had occurred during the 2005 CBA. Firstly, the Players' share was under negotiation. The NHL considered 57% players' share too high as in other professional sports it is 50% or less. The NHLPA announced that they will agree on a 50% players share and after the negotiations the share was agreed to be 50%. Secondly, a salary cap floor caused problems for money-losing teams that would like to pay smaller salaries for their players. In the 2013

CBA the payroll floor is set at 85% of the adjusted midpoint of the payroll (see Chapter 5). Thirdly, The Guaranteed Contracts were under dispute. A player is guaranteed to earn every dollar that is agreed in the contract. The only option for the team that is not interest in the player's services anymore is to buy the player out from the contract. This can be expensive as player contracts can be as long as Ilya Kovalchuk's 17 season contract (which was shortened to 15 seasons by the NHL). In the 2013 CBA player contracts were agreed to be limited to seven-to-eight years. Fourthly, exact NHL revenues are determined at the end of the season and then the true numbers become clear. Players pay a percent of their salary (12.5% in 2010-2011) to the escrow which is divided after the season to guarantee that the targeted spilt came true. Players were concerned that troubled franchises drag down overall revenue and thus they wanted to eliminate the escrow payment. In the 2013 CBA the escrow mechanism is calculated in the same manner as it was under the 2005 CBA. Fifthly, players wanted to increase revenue sharing to even the financial playing field. Especially the rich teams were reluctant but some concessions were made and revenue sharing increased in the 2013 CBA.

6.1 NHL salary cap

In this chapter, I shortly introduce the features of the NHL salary cap before going into more detailed analysis. In a nutshell NHL salary cap is a hard salary cap that includes upper and lower limits for player costs. The midpoint of the payroll is calculated as a percentage of league wide revenues which is multiplied by 115% and 85% to get upper and lower limits. Additionally, NHL is considered a profit maximizing league as showed by Ferguson et al. (1991) and supported by other empirical studies.

Hard salary cap:

The NHL salary cap is a hard salary cap that cannot be exceeded without consequences. There is an upper (red curve in Figure 4) and lower limit (blue curve in Figure 4) defined by the salary cap and a team has to fit their player budget within those borders. Multiyear player contracts provide a possibility for teams to fractionate their cap number and salaries paid as presented in the table 1.

Two club model with marginal revenues and salary caps is presented in Figure 4. X is a large market club and Y is a small market club. Job supply is presented on the horizontal axis. Differing from Késennes illustration, Figure 4 presents the whole job supply not just top players' job supply. The vertical axis' illustrate player costs for team X and Y. Marginal

revenue curves are downward sloping due to the decreasing marginal revenues of additional players. Salary caps (high and low) are curves as they are calculated as upper (lower) limit divided by the number of players playing for the team.

Figure 4: NHL salary cap system

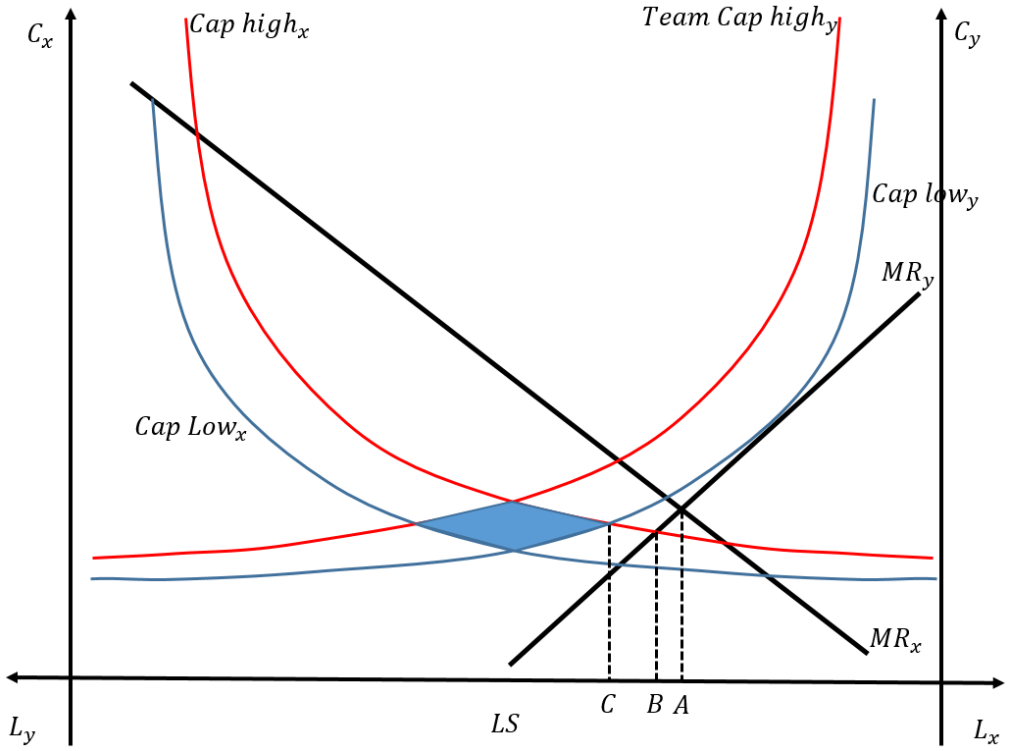


Figure 4 is a modified version of Késenne's (2000) illustration. In Figure 4, on the vertical axis's C = team player costs and on the horizontal axis L = labor (the number of players). There is no breakdown between top players and regular players as both types are expected to contribute to the teams' success and increase the amount of talent in the team. Additional to the Késennes study lower limits of team salary caps are included in the figure as blue curves, and red curves are upper limits on player salaries. Per player salary caps are not included in the figure. Maximum amount that can be spent on one player is 20 percent of the salary cap and minimum per player salary is $550,000 during season 2014-2015 (the NHL CBA).

All possible market balances are found in the blue area in the middle of Figure 4. Team salary caps form the upper and lower limits for a player spending. Point A is the labor distribution without the NHL salary cap where large market club owns most labor. Point B is the labor distribution with team total maximum amount that can be spent in labor (comparable to CAP in Figure 1). The lower limit (blue curve) is binding for small market team. It evens the distribution of labor and raises player costs when compared with market balance B. New

market balance is found somewhere in the blue area. Arguably, point C is the market balance with upper and lower limits. At point C, large team club is at its maximum player costs and small team is at its minimum player costs.

Percentage of revenue cap:

In the last collective bargaining agreement NHL and NHLPA has agreed that the players' share is 50% of the hockey related revenues. The percentage has decreased since the introduction of the salary cap after the NHL lockout in 2004-2005. A percentage of revenue cap guarantees that more money the owners make, the more money the players can earn (Staudohar 2005). This gives an incentive for the league and the players to cooperate in order to create more value.

Profit maximizing league

In this study, the NHL is considered as a profit maximizing league. Teams are expected to maximize their profits rather than utility or social welfare. In the sports literature there is no clear consensus on this topic but I found that most of the academic field support profit maximization in North American leagues (see Ferguson et al. 1991, Késenne 1999 and Alexander 2000). Teams' demands for salary cap support profit maximizing behavior as it lowers player costs and thus I argue that NHL teams are profit maximizers.

7. Empirics

In the empirical part of the thesis, I empirically explore if the theoretical factors presented in the previous literature have been put into effect in the NHL since the introduction of the salary cap. My study will complement the master's thesis: "The Effect of the Changes in the 2005 Collective Bargaining Agreement on the Labor Markets of the NHL Players" (Kaijalainen 2013). Also, I will preliminary discuss the causes of the changes in the 2013 CBA. My main aim is to find out if the NHL salary cap has balanced the competition between the teams and if it has limited the overall costs of the teams. This will be done by analyzing the individual player salaries that can be combined into teams' player costs.

7.1 Data set

The data set used in this thesis is collected from different sports statistics websites. USA Today (http://www.usatoday.com/sports/nhl/) is my main source as it collects individual and team salaries from 2000-2001 season to 2013-2014 season. Data is completed with some additional information from other sports statistics websites witch are: http://www.hockey-reference.com/, http://www.spotrac.com/nhl/, http://blackhawkzone.com/home/index.php and http://www.quanthockey.com/. Payroll data on the following table is mainly provided by the USA Today website and data on team success is collected from the sports statistics sites listed above.

Table 2: Player salary data set

Season	Observations	%
2001	700	7.47
2002	700	7.47
2003	721	7.69
2004	748	7.98
2005	Lockout season	Lockout season
2006	742	7.92
2007	725	7.74
2008	708	7.55
2009	722	7.70

2010	702	7.49
2011	735	7.84
2012	708	7.55
2013	714	7.62
2014	747	7.97
Total	9372	100

Teams' playing roster in the NHL may comprise from 20 to 23 players. As there are 30 teams in the NHL this means total of 600 to 690 players in all playing rosters together. Naturally there is some level of turnover in rosters during the season and in this data set all the players have had an influence on their teams' success. The whole cost of the player is allocated to the team that owned their contract last, during that season. Considering the overall cost of a team this is a bias but in terms of this thesis it would be too laborious to fix it considering a possible benefit.

Player salaries in the data set are true salaries paid by the team and not the cap hit allocated to the salary cap. This better reflects the overall costs of the teams per season and naturally at the end of the contract the accumulated amount of the true salaries and the cap hit is the same as presented in the table 1. Also, season bonuses paid by the team are added to the player salaries in the data set.

The data set provides a comprehensive collection of season salaries. Some player expenses are left outside the data set like those players that have not contributed to the team success in the NHL games. For example, players that are signed for a NHL team but played the whole season in the American Hockey League (AHL), which is considered a developmental circuit for the NHL, are left out from the data set. Many players in the data set played some part of the season in the AHL but also played games in the NHL and thus contributed to the overall success of the NHL team. The USA Today web site does not specifically determine what the limit for approval in the data set. In my random sample of the 5 lowest paid players per every season, I did not find any players that played less than ten games in the NHL during that season. The reason why I chose the lowest paid players to be tested is that they are usually the ones that play most of the season in the AHL. As all the lowest paid players played in the NHL during the season, this data set is relevant to illustrate the development of the player costs and relations between player costs and team success.

Throughout the examination period, the NHL consists of 30 teams. After the 2010-2011 season Atlanta Thrashers moved to Winnipeg and changed its name to Winnipeg Jets. Also, some teams have changed their names but this is not relevant considering my research as I focus on the competition and player costs on the league level, not on the individual team level.

7.2 Research questions

The empirical research aims to answer the following questions:

1. Did the 2005 NHL salary cap balance competition?
2. Has the 2005 NHL salary cap limited the overall player costs of the teams?

    2.1 What are the results of limited player costs to the team owners and to the players?

Research questions will be presented and analyzed in more detail in the analysis chapter.

7.3 Research methods

In the analysis chapter, I use statistical analysis methods and measures to illustrate differences before and after the salary cap. The values given by statistical methods and measures are displayed in different graphs and scatter plots Teams that are playing in playoffs during the season are considered successful. Attendance in playoffs is the minimum requirement for every team as it is the only way to compete for success and the Stanley Cup in the NHL.

Causality running from payroll to team success would be questionable and thus I do not use regression analysis as a research method. The presence of long term contracts and restrictive labor market rules prevent the identification of unambiguous one-way causality (Hall, Szymanski & Zimblaist 2002). These conditions match the NHL player markets and thus I believe that higher spending will not automatically lead to a greater success.

As mentioned earlier, payroll data is collected from 2000-2001 to 2013-2014. This time period is divided in two or three time periods in different figures presented later. When the data set is divided in two time periods the watershed is the 2004-2005 season which was cancelled and followed by the season with the first salary cap. When the data set is divided in three time periods, 2004-2005 season is another watershed and another is the end of season 2008-2009.

Consequently, the data set is divided as evenly as possible so that all three periods include almost the same amount of data.

Average (mean)

When analyzing question 1, I firstly calculate team average (mean) payrolls to illustrate team spending before and after the salary cap. Team averages are calculated by dividing combined team payrolls by the number of teams. In case of all teams the number of teams is 30 and in case of playoff teams the number of teams is 16.

Standard deviation

Question 1 is also analyzed by the payroll standard deviations of all teams and playoff teams. Standard deviation measures how spread the team payrolls are. Standard deviations before and after the salary cap illustrate the difference in the dispersion of team payrolls and player salaries. This variable gives an opportunity to discuss the changes in the payroll dispersion of successful and non-successful teams before and after the 2005 salary cap.

Pearson product-moment correlation

Pearson product-moment correlation (referred as correlation in this study) shows the linear dependence between two variables. It gets values between -1 and 1. -1 presents a perfect linear negative dependency. 0 means that there is no dependency at all. Value 1 means that there is a perfect linear dependency. In this study, correlation is used to show relations between team payrolls and success.

Covariance

Covariance illustrates how much two random variables change together. In this study, covariance is used to show the difference in changes between a payroll and ranking after the regular season before and after the 2005 salary cap.

Lorenz curve

Lorenz curve illustrates the cumulative distribution of the value being measured. A vertical axis illustrates the cumulative share of the value being measured, for example points. A horizontal axis illustrates a cumulative share of teams or players from the lowest share to the highest share. In Lorenz curve graphs, there is also an equality line in each. Equality line illustrates the equal distribution of the value being measured. Accordingly, equality line is a 45-degree line cutting the graph from the lower left corner to the higher right corner.

Gini coefficient

The Gini coefficient illustrates the inequality of distribution of the value being measured. The Gini coefficient can get a value from 0 to 1. 1 means that all income (points during regular seasons) is distributed to one player (team). Value 0 means that all income (points during regular seasons) are perfectly distributed among players (teams). The Gini coefficient is the proportion of the area under the equality line. To calculate Gini coefficient the area under the Lorenz curve is needed. Second, the area between equality line and Lorenz curve is calculated as 0.5 (the area under equality line) minus the area under the Lorenz curve. Third, divide the area between equality line and the Lorenz curve by 0.5 (the area under equality line). The result is the Gini coefficient which is between 0 and 1 depending on the equality of distribution.

Herfindahl-Hirschman Index

Herfindahl-Hirschman Index (HHI) is used to measure competitive balance during regular seasons. It illustrates the most equal distribution of wins. This method is adapted from Larsen, Fenn and Spenner (2006). According to the authors, HHI is a quadratic summation of all firm market shares in an industry and defined as

$$HHI = \sum_{i=1}^{N} MS_i^2 \qquad (7.1)$$

where MS_i^2 is the market share of the ith firm, and N is the number of firms. In this study output of a team is measured in total wins. Following Larsen et al. (2006) a team's market share is its percentage of wins in the league in a given season. Accordingly, the definition of HHI is

$$HHI = \sum_{i=1}^{N} \left(\frac{2Wins_i}{NG}\right)^2 \qquad (7.2)$$

where $Wins_i$ is the number of wins for the ith team, N is the number of teams in the league, and $G_i = G$is the equal number of games played by each team during a given season. Comparison of HHI and the most equal distribution should disclose if during the season wins are divided in a more equal manner after the 2005 salary cap.

In addition to the methods mentioned above, I use column charts and player positional variables to illustrate changes in player costs. Column charts illustrate how team values have developed before and after the 2005 salary cap. Player positional variable show how the salary cap is related to player salaries and positional relations between them.

8. Analysis

8.1 Is competition in the NHL more balanced after the introduction of the 2005 salary cap?

Team owners highlight the balancing effect of salary caps. Recent discussion on the academic field (see for example Késenne 2000, Larsen et al. 2006, Dietl et al. 2012) supports the hypothesis of more balanced competition after the introduction of a salary cap. In this chapter, my aim is to find out if there is empirical evidence to support this claim in the NHL after the 2005 salary cap. A salary cap only affects player costs. Thus, for a salary cap to be able to balance competition there needs to be a relation between player costs and success. Firstly, I show that the relation of payroll and team success during regular season exists and it decreased after the salary cap. Accordingly, a salary cap may have a relation with competitive balance. Causality tests of pay and performance are left for future studies. Secondly, I show and discuss the changes in competitive balance after the salary cap.

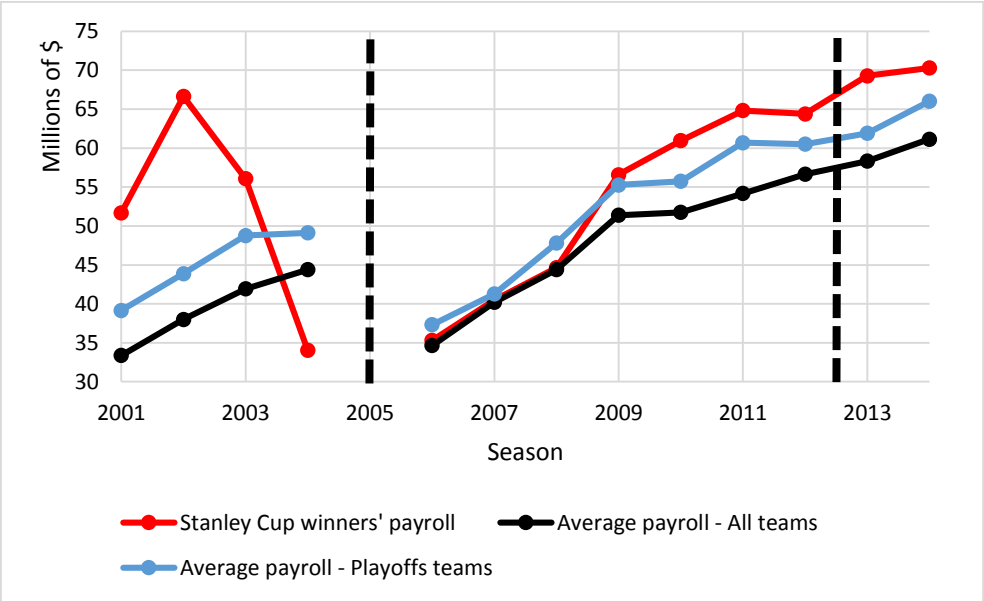
8.1.1 Relation of team payroll and success

In this chapter, I illustrate the relation of team payrolls and team success. My aim is to show the difference between the payrolls of successful and non-successful teams. This is done by analyzing the payrolls of playoff and non-playoff teams and regular season success of teams before and after the 2005 salary cap.

8.1.1.1 Have seasonal average payrolls and Stanley Cup winners' payrolls approached each other?

Figure 5 shows the development of teams' average payrolls, playoff teams' average payroll and Stanley Cup winners' average payroll. The first vertical dash line in Figure 5 illustrates the imposition of the 2005 salary cap and the second vertical dash line between 2012 and 2013 illustrates the readjustments made to the salary cap in the 2013 CBA. Dash lines are also presented in previous figures.

Figure 5: Teams' average payrolls

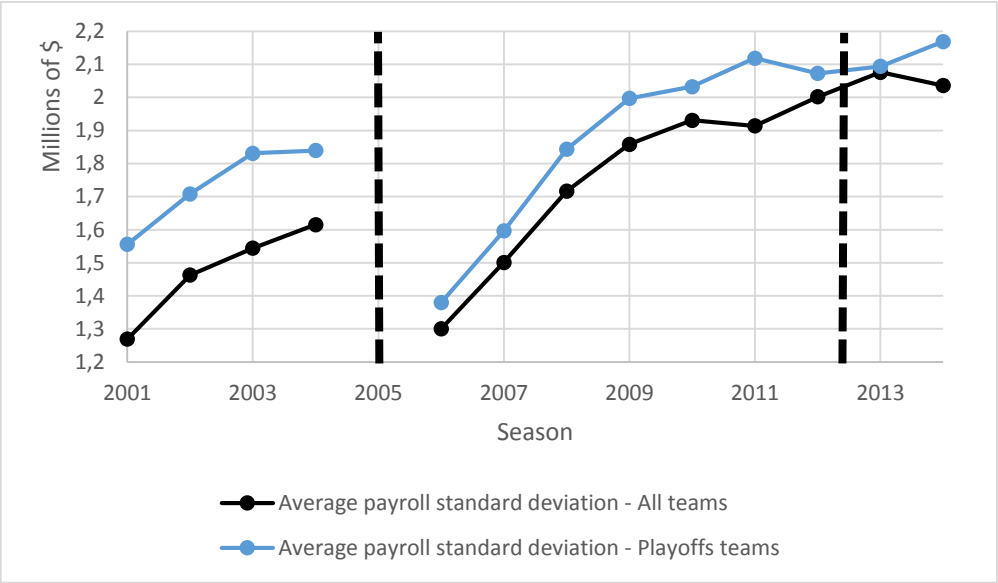


Clearly, Stanley Cup winners' payroll has greater dispersion before the 2005 salary cap than after. After 2008 Stanley Cup winners' payroll seem to diverge again from average payrolls and every year it is notably greater than averages presented in the figure. After the 2005 salary cap, all the diagrams seem to approach each other. Again after 2008 they seem to diverge and gaps between the graphs stay pretty constant. The average of playoff teams' payrolls are greater than the average payrolls of all teams during the whole examination period. Excluding the Stanley Cup winners' payroll graph before the 2005 salary cap, all graphs have an upward sloping trend. The 2005 salary cap lowered the level of average salaries but did not change the upward sloping trends. 2013 CBA does not have any influence on graphs presented in Figure 5.

8.1.1.2 Is there a difference in the standard deviations of successful and non-successful teams?

Figure 6 shows changes in payroll average standard deviations. Black line illustrates all league teams' average and blue line illustrates playoff teams' average. Teams that get to play playoff games are considered successful in this study. Playoff entry is the only ways to give your team a possibility to compete for the Stanley Cup.

Figure 6: Teams average payrolls' standard deviation



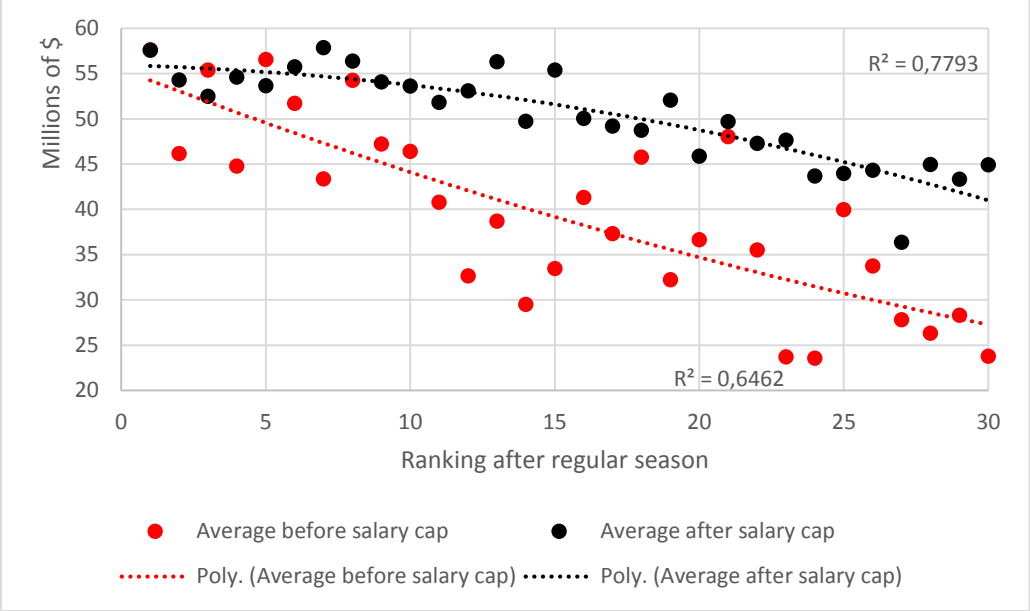
Team payrolls approached each other as 2005 salary cap was implemented. Accordingly, there is a notable drop in standard deviations after the introduction of 2005 salary cap as we can see from Figure 6. Both, before and after 2005 curves are upward sloping meaning that differences between team salaries are increasing. From 2001 to 2014 playoff teams have greater payroll standard deviation compared with the average of all teams' payroll standard deviation. As expected, the gap between two averages is smaller after the 2005 salary cap. This is an expected result when a salary cap includes maximum and minimum limits for spending.

The difference between the payrolls of successful and non-successful teams decreased after the salary cap. This is shown in Figure 5 as clearly both types of teams' payrolls approached each other. Figure 6 supports this finding as average standard deviations decreased and approached each other.

8.1.1.3 What is the relation of an average payroll and ranking after the regular season?

In Figure 7 vertical axis presents the average payroll and horizontal axis presents teams' standing after the regular season. For example, an average payroll of xth team on the horizontal axis is calculated as the average of the payrolls of xth teams during the seasons in question.

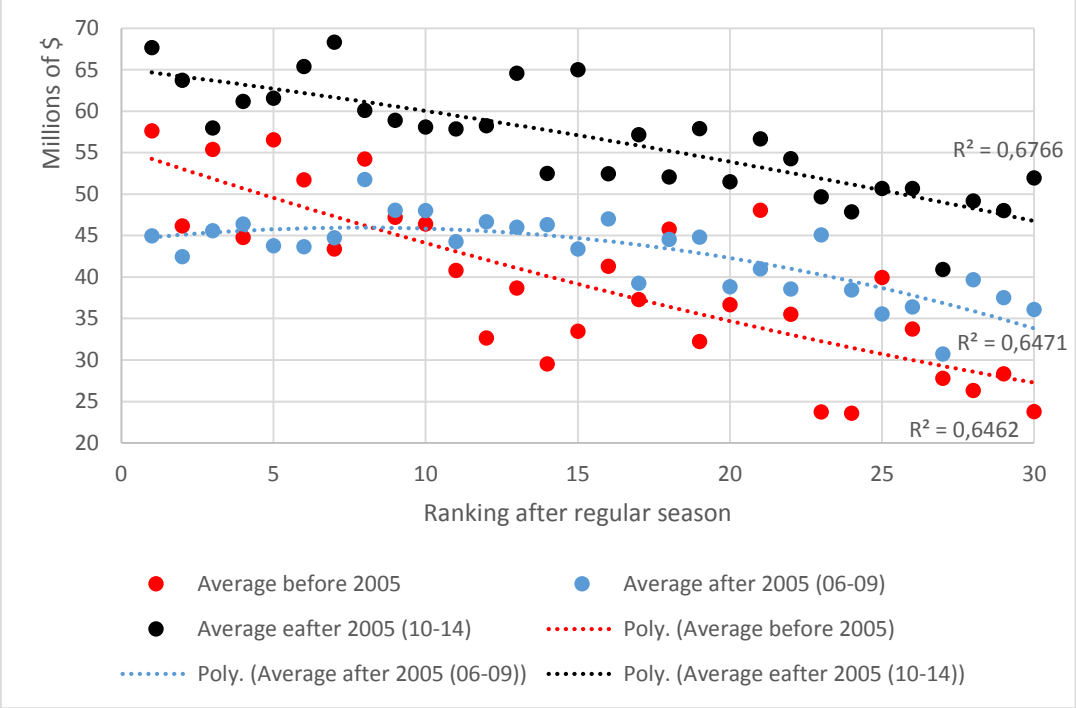
Figure 7: Teams' average payroll and ranking after regular season



As we can see from Figure 7 average salaries before the 2005 salary cap are more diffused than after 2005. Polynomial trendlines are both downward sloping which illustrates that there is a negative relation between ranking after the regular season and team payroll. Lower goodness-of-fit (0.6462) for trendline before 2005 is due to the greater diffusion of averages. After the salary cap, there is a smaller negative relation between a payroll and ranking after regular season according to Figure 7. Team payrolls are greater but especially on top 16 (playoff teams) negative relation seems to be less of importance after the 2005 salary cap.

Figure 8 shows the same relation as Figure 7. In Figure 8 data is divided in three sets and most of all after the 2005 salary cap observations are divided in two based on a year of observation. Data set and trendline marked as red is the same as in Figure 7. Data set marked as black in Figure 7 is now divided to present two different data sets and trendlines in Figure 8, black and blue. The blue set presents average payrolls during seasons 2006-2009 and black set presents average payrolls during seasons 2010-2014.

Figure 8: Teams' average payroll and ranking after regular season, three periods

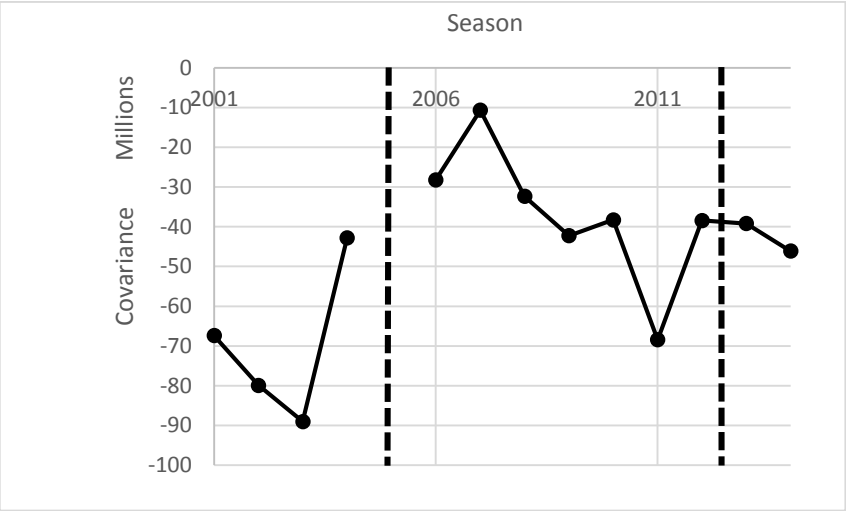


Blue set in Figure 8 clearly shows the balancing effect of the 2005 salary cap on payrolls. The trendline is not as steep as other two trendlines. As we can see from the figure, average payrolls of top positions dropped notably and the payrolls of lower rankings increased. Accordingly, NHL can be said to be more balanced after the introduction of 2005 salary cap in terms of average payrolls. The black set illustrates later years in the data set. It shows that as the salary cap has increased and widened, the trendline has turned steeper again. Average payrolls in the black data set are notably higher than in other two sets and payrolls are less balanced than in the blue data set. Arguably there is a negative relation between teams' average payroll and ranking after the regular season as presented in Figure 8.

8.1.1.4 How much does payroll and standing after regular season change together?

Payroll and standing after regular season are expected to have negative relation because in previous figures a bigger payroll is shown to have a relation with smaller ranking. Figure 10 shows the covariance of ranking after the regular season and payroll. The smaller the value the greater negative relation payroll and ranking have during the regular season.

Figure 9: Ranking after regular season and payroll covariance

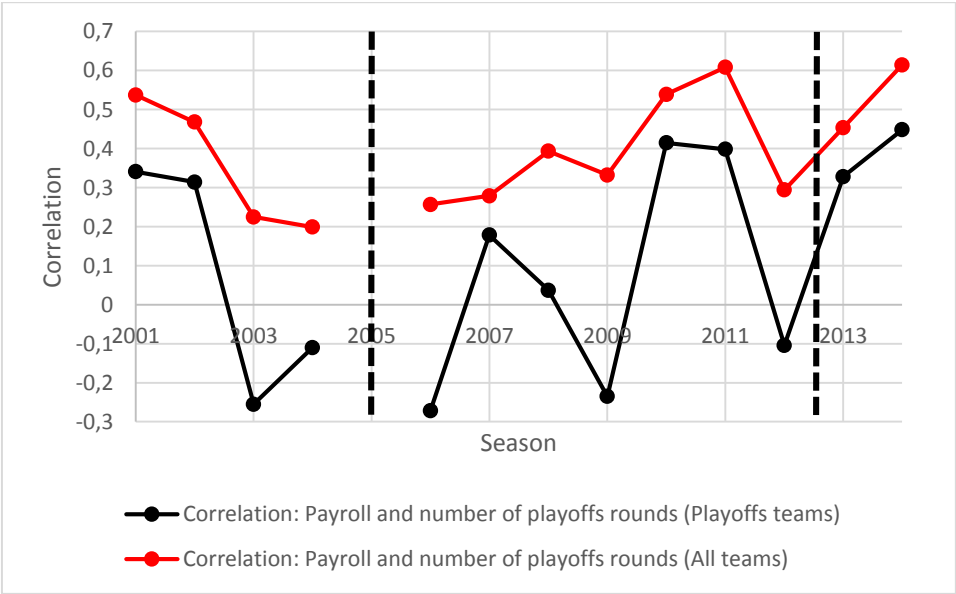


As Figure 9 shows covariance approached zero after the 2005 salary cap meaning that negative relation of payroll and ranking decreased. After 2005 covariance has slowly diverged from zero again. Figure 9 supports previous findings about the balancing effect of NHL salary cap on payrolls. Balancing effect was notable when the salary cap was introduced but it has become less meaningful ever since. 2013 CBA has not showed any notable changes on the findings presented so far.

8.1.1.5 Has the correlation between a number of playoff rounds and payroll changed?

Figure 10 presents two correlations: black line is the correlation between a payroll and number of playoff rounds for playoff teams and red line is the same correlation for all teams that attended the season.

Figure 10: Payroll and number of playoff rounds correlations



As we can see from Figure 10, payroll correlates positively with a number of playoff rounds when we consider the league-wide correlation. At its minimum, the correlation is 0.2 and at its maximum it is 0.6. Before the 2005 salary cap correlation is decreasing but after the salary cap correlation has had an increasing trend.

Playoff teams' correlation of payroll and number of playoff rounds is more unstable. What is interesting is that several years' the correlation is negative. This also has an increasing trend after the salary cap but as it is bumpier than in the case of all teams too much conclusions cannot be made.

Figure 10 suggests that payroll has greater relation with a number of playoff rounds among all NHL teams than among playoff teams. The decreasing trends of both correlations before the salary cap propose that greater investments do not correlate with success in a same way that they used to during previous seasons. This might be one of the reasons why team owners insisted on a salary cap. Overall, the relation of payroll and success in the NHL during the regular season decreased after the 2005 salary cap as shown in previous figures.

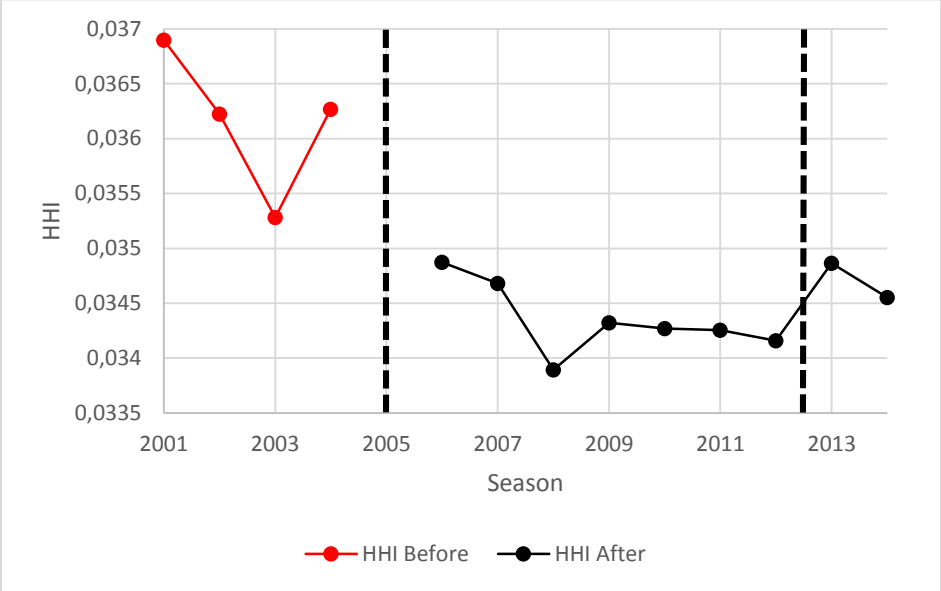
8.1.2 Regular season competition

In this chapter, I show that the competition has balanced after the 2005 salary cap during regular season. Analysis is based on HHI, Lorenz curves and Gini coefficients which all represent equality measures of a different kind.

8.1.2.1 Did the Herfindahl-Hirschman Index change after the 2005 salary cap?

Figure 11 reflects the distribution of wins during the regular season. Herfindahl-Hirshman Index (HHI) is illustrated on the vertical axis and season is shown on the horizontal axis. The most equal distribution is 1/N which in the case of the NHL is equal to 1/30 = 0.03333.

Figure 11: NHL teams' wins Herfindahl-Hirschman Index



As we can see from Figure 11 there is a drop in the values of the HHI after the 2005 salary cap. We can see that the red, before the salary cap, series is above the level of the black, after the salary cap, series. During the period before the salary cap HHI is more than 0.035 and after the salary cap every season HHI is less than 0.035. Table 3 below shows the average values of HHIs before and after the salary cap.

Table 3: Average Herfindahl-Hirshman Indexes of wins

Time period	Average HHI
Before the 2005 salary cap	0.03617
After the 2005 salary cap	0.03443

After the salary cap HHI is closer to the most equal distribution of wins in the NHL (1/N). Accordingly, the distribution of wins has become more equal after the salary cap. The conclusion that the NHL is a more balanced league in terms of wins during the regular season after the 2005 salary cap can be drawn from the change in HHI.

8.1.2.2 Are points after the regular season more evenly distributed after the 2005 salary cap?

During regular seasons, points are relatively evenly distributed between the teams playing in the NHL (see Appendix 1). After the 2005 salary cap cumulative distribution of points has become slightly more even. Gini coefficients are gathered to Table 4 and it will be referred to in the future chapters of this thesis. The Gini coefficients of distribution of points after the

regular season during three time periods in Table 4 column 2 illustrate the changes in the distribution of points.

Table 4: Gini coefficients

	Question 1 Is the competition more balanced after the salary cap?				**Question 2** What is the effect of limited player costs?	
	Regular season competition		Playoff competition		Effect on teams	Effect on players
Time period	Distribution of points	Distribution of standings	Distribution of playoff rounds (all teams)	Distribution of playoff rounds (playoff teams)	Team payrolls	Player salaries
Before the salary cap (01-04)	0.0816	0.2476	0.4039	0.3122	0.2140	0.4736
After the salary cap (06-09)	0.0602	0.2282	0.4228	0.3340	0.1199	0.4565
After the salary cap (10-14)	0.0586	0.2421	0.4622	0.3795	0.1010	0.4478

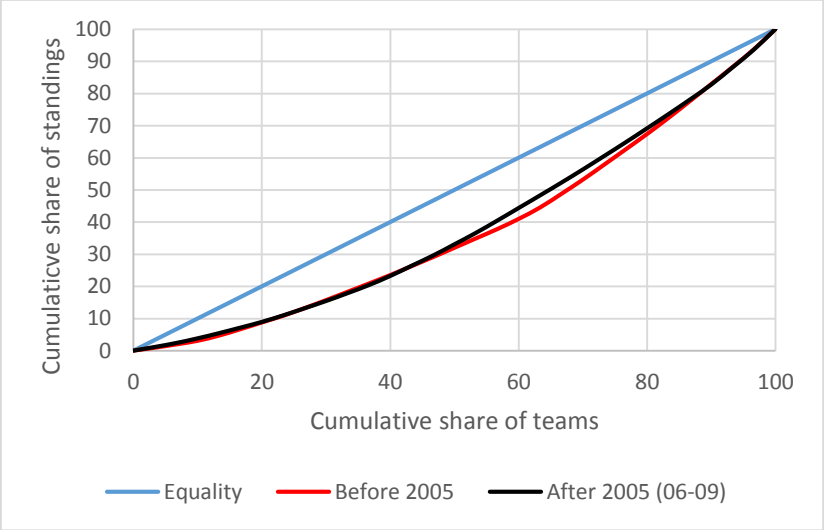
As we can see from the table above, the Gini coefficients of point distribution are relatively low. This means that during regular seasons the point distribution is comparatively equal. Table 4 shows that the Gini coefficient of point distribution decreases after the 2005 salary cap and continues to decrease. Distribution of points becomes more equal after the salary cap. The difference is arguably low as the Gini coefficient is already before the salary cap less than 0.1.

8.1.2.3 Are standings after regular season more evenly distributed after the 2005 salary cap?

Figure 12 shows the distribution of standings after regular season. Red curve illustrates seasons 2000-2004 and black curve illustrates seasons 2005-2009. Blue line is the 45-degree line

showing the most even distribution. Naturally first position is preferable for teams after regular season. Thus, standings are presented in opposite order so that cumulative distribution fits Lorenz curve illustration.

Figure 12: Standing after regular season



As we can see from Figure 12 distribution of positions after regular season is more balanced after 2005. The balancing effect is the most notable within teams that collect 50 to 80 percent of the cumulative standings. This is in line with previous findings in this chapter. The Gini coefficients of distribution of standings are presented in Table 4 in column 3.

Drop in Gini coefficient tells that standings are more evenly distributed after the salary cap. On the other hand, Gini coefficient during seasons from 2009-2010 to 2013-2014 increased close to the value before the salary cap. Accordingly, during seasons 2010-2014 Lorenz curve moves closer to the before 2005 curve and thus competition during regular season can be said to become less balanced again (see Appendix 2).

In this chapter, I have empirically shown that the regular season competition did become more balanced after the introduction of the 2005 salary cap. This change is proved by the more equal distribution of wins during regular season, points after regular season, and standings after regular season. In the following chapter, I analyze the competitive balance during playoffs and the changes in it.

8.1.3 Playoff competition

In a competitively balanced league playoff rounds should be distributed equally. Playoff rounds correlate strongly with success. With zero playoff rounds in the NHL, the team has had zero competitive success as reaching the playoff stage is the minimum target when competing for the Stanley Cup. Economically playoff rounds are important as tickets can be sold with a higher price and most games are sold out. Playoff games also bring coverage and fans are more enthusiastic about the games during playoff season. Overall, a team cannot be totally satisfied with its season if it has not reached the playoff stage.

Every season there are a total of 30 playoff rounds. In the calculation method of this thesis, every team that is eliminated at the first round gets value one. Teams that are eliminated at the second playoff round get value two. As there are 16 teams every season that reach the playoff stage it means total of four rounds: at first round there are 16 teams that make 8 pairs and accordingly 8 teams are eliminated at the first round. At the second round 4 teams get eliminated and at the third round 2 teams get eliminated. Accordingly there are 2 teams left at the fourth round and another will be the Stanley Cup winner. Thus, the total of playoff rounds is calculated as follows: 8*1 + 4*2 + 2*3 + 2*4 = 30. There are 30 teams in the NHL and thus on average every team should get one playoff round per season in a competitively balanced league.

8.1.3.1 How are playoff rounds distributed among NHL teams?

Gini coefficients presented in Table 4 column 4 illustrate the changes in the competitive balance during playoffs among all teams. The Gini coefficient has steadily increased during the three time periods presented in Table 4 column 4. Consequently, the distribution of playoff rounds has become less even. The Gini coefficients of the distribution of playoff rounds among playoff teams in Table 4 column 5 also suggest that the competition during playoffs has become less balanced after the 2005 salary cap. Supportive Lonrenz curves are presented in Appendix 3 and 4.

Gini coefficients in Table 4 column 5 are smaller than in column 4. This is logical as teams with zero playoff rounds are excluded from the data set. The Gini coefficient has increased during three time periods. Distribution of playoff rounds among all teams and playoff teams both have increased. Thus, empirical evidence supports the conclusion of less balanced playoff competition.

8.1.3.2 Is there any change in distribution of wins during playoffs?

Figure 13 shows the distribution of wins during playoffs. A Gini coefficient in theory can get any value from 0 to 1. In this case 0 and 1 are not possible as each team needs 4 wins to get to the next round. Hence, both teams playing in the Stanley Cup finals have collected 12 wins and the Stanley Cup winner has 16 wins at the end of the playoffs. The Stanley cup winner has 0 to 12 losses depending on the equality of series'. The Gini coefficient is still varying as every playoff series has 4 to 7 games depending on the distribution of wins in that series. In theory, a salary cap should even the distribution of talent and thus playoff series' should be more equal. Consequently, more playoff games should be played as it takes more games for a team to win 4 games in one series.

Figure 13: Wins during playoffs Gini coefficients

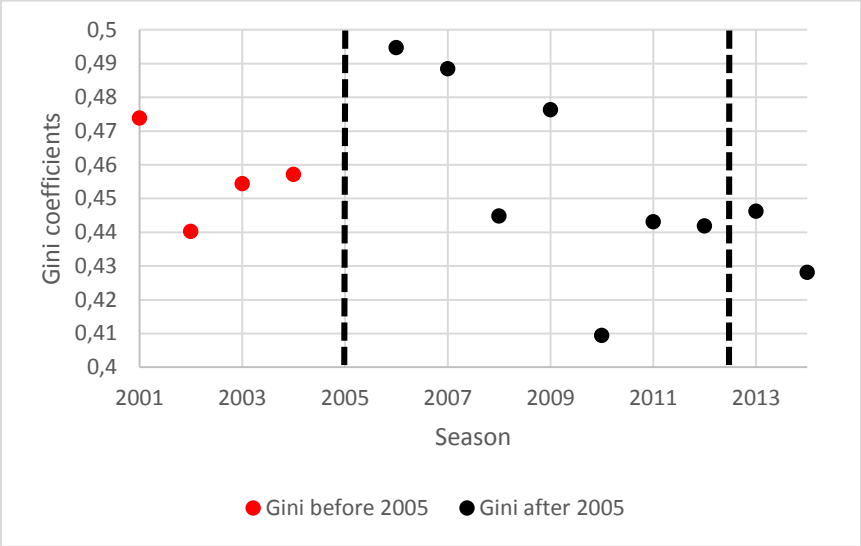


Figure 13 shows that there is not much difference in the distribution of wins during playoffs before and after the 2005 salary cap. Distribution seems to become less equal shortly after the salary cap and later slowly turn into more equal. Accordingly there is a decreasing trend after the salary cap. The period averages of Gini coefficients (see Appendix 3) support this finding. Altogether, differences are so small that not much conclusions can be made. Based on Figure 13 I conclude that the distribution of wins during playoffs has not changed.

8.1.4 Discussion and recommendations

According to the empirical evidence presented earlier the relation of a payroll and success in the NHL has decreased after the 2005 salary cap. All empirical evidence in Chapter 8.1.1 supports this result. A decrease in the relation is a logical result as the salary cap forced team

payrolls to be more equal. The increase in league wide revenues resulted as a wider salary cap in the NHL and team payrolls started to diverge again. As empirically shown, the increase in league revenues increased team payrolls and relation of payroll and regular season success.

Following the findings I argue that setting a narrow salary cap with upper and lower limits on team payrolls is a way to decrease the relation of payroll and success. If the target is to maintain a low relation, the salary cap needs to be readjusted when the league-wide sales increase. In the case of the NHL, when targeting for a smaller relation between payroll and success there are two options. First option is to lower the players' share which results in lower payrolls. Second option is to narrow the gap between minimum payroll and maximum payroll. The first option is harmful for player salaries and thus would face resistance by the NHLPA. The second option forces small teams to spend more and large teams to spend less than they would be willing to (see Figure 4, the NHL salary cap system). Thus, option two is not in the favor of team owners and the NHL will not propose it. Also, a hybrid model with lower players' share and narrower gap between the caps is possible. Arguably, then the harms and the benefits of a salary cap would be experienced by the owners and the players.

Academic literature suggests that regular season competition is more balanced after a salary cap. Empirical evidence from the NHL supports this suggestion as presented earlier. Wins are divided more equally during regular season after the salary cap as shown by the HHI in Figure 11. Regular season points are also distributed more equally as shown by decreased Gini coefficients. Additionally, standings after regular season are distributed more equally. Only empirical finding that is not supporting the balancing effect of the NHL salary cap is that Gini coefficient of standings after the regular season increased when moving form seasons 06-09 to seasons 10-14. Altogether, I found that there is empirical evidence to support the balancing effect of the 2005 salary cap. Thus, I conclude that the 2005 salary cap had a balancing effect on the regular season competition in the NHL.

Distribution of playoff rounds suggests that competition in playoffs is less balanced after the 2005 salary cap. The same result is found with all teams and playoff teams. Additionally, the distribution of wins in playoffs has not become more balanced after the salary cap. Comparison between these results and the correlation of a payroll and number of playoff rounds of playoff teams (Figure 10) support each other. Figure 10 suggests that pay and performance during playoffs are not as strongly correlated as they are during regular season. Empirical evidence

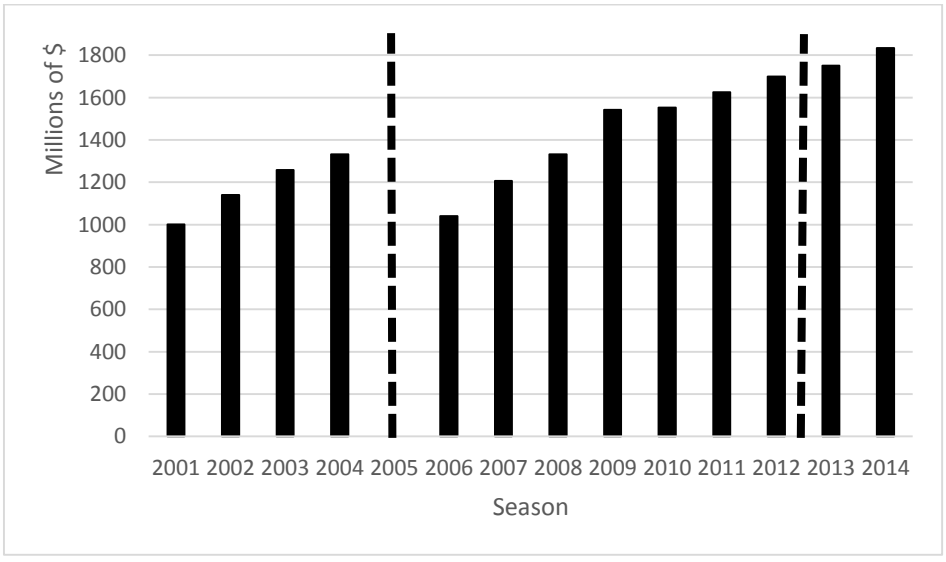
about the playoff competition supports the suggestion as the salary cap did not make the playoff competition more equal.

I have now comprehensively analyzed and discussed the relation of payroll and success, competitive balance during regular season, and competitive balance during playoffs. The theoretical results of the 2005 NHL salary cap on a competitive balance have empirical support during the regular season. There is no empirical evidence that the salary cap did balance the competition during playoffs. In the following chapter, I analyze and discuss if the NHL salary cap limited player costs in the NHL and what are the consequences to the NHL team owners and to the NHL players.

8.2 Has the salary cap limited the overall player costs of the teams in the NHL?

In the 21st century the increase of player salaries has been rapid as we can see from Figure 14. The salary cap was set to decrease this phenomenon as it expresses limits to the team spending on players. It also limits the maximum amount that can be paid to one player and sets a lower limit on personal salaries. The figure shows that the salary cap set at 2005 decreased combined team salaries to almost the same level where they were in 2001. On the other hand yearly increase in salaries has been comparable to the time before the salary cap.

Figure 14: Combined team salaries in the NHL



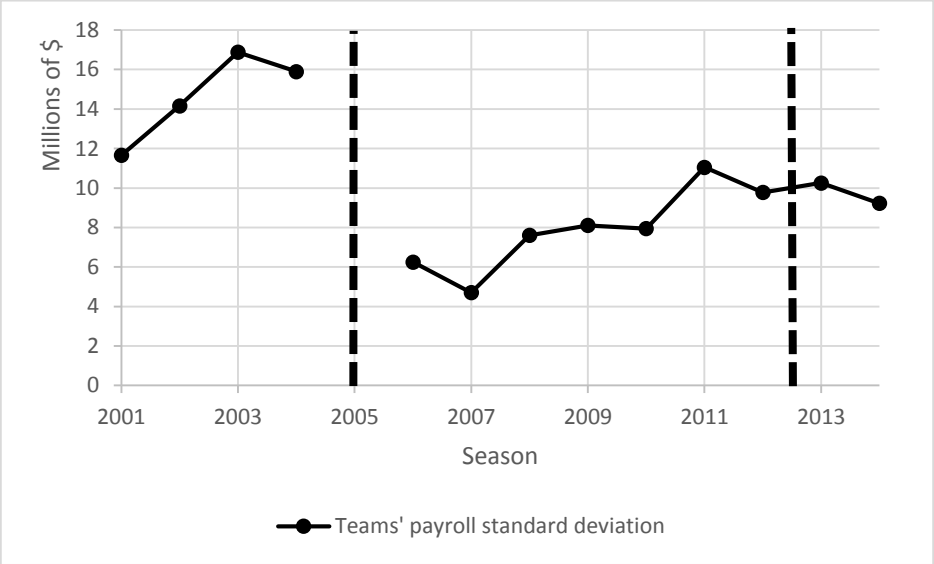
The general impact of a salary cap is considered positive. A salary cap improves competitive balance which should make the league more attractive, levels player salary distribution, and guarantees a reasonable profit rate for all the clubs as costs decrease. Clearly superstar players

who have had the biggest salaries do not prefer salary caps as their salaries will decrease the most. Also, introduction of a salary cap will lead to a departure from Pareto-optimal point. (Késenne 2000.)

Arguably owners' profits increased since the player costs decreased due to the salary cap. The 2005 salary cut was about 22% of the players' salaries suggesting that owner's incomes increased by 22% of the players combined salaries. This finding is in line with Staudohar's (2005) statement that NHL spent 76 percent of its revenue on player salaries before the 2005 salary cap. 76 percent is notably higher than in other professional sports in North America. For example in the NBA players' share that time was about 58 percent of revenue (Staudohar 2005). Clearly, the 2005 salary cap decreased the overall player costs of the teams in the NHL. Percentage and total amount of payrolls both decreased as shown above. Combined team salaries increased rapidly after the 2005 salary cap as shown in Figure 14. Even though combined team salaries rapidly exceeded the 2004 level percentage remained at 54-57% as agreed in the 2005 CBA. Thus, the decrease in players' share meant an increase in team owners' profits.

Figure 15 illustrates the NHL teams' payroll standard deviation. Bigger the deviation the bigger the differences between team payrolls. A salary cap is expected to decrease standard deviation.

Figure 15: Teams' payroll standard deviation



Standard deviation notably dropped after the introduction of the 2005 salary cap. The drop was about ten million in numbers which corresponds to about 62%. The trend of teams' payroll standard deviation was rapidly increasing before 2005 as we can see from Figure 15. After 2005 trend is also increasing but not as fast as before 2005. Teams in the NHL seem to have

balanced their spending after the introduction of the 2005 salary. More even salary distribution between teams is expected as clear limits to teams' payrolls are introduced. Too much conclusions cannot be made about the trend after the 2013 CBA but the standard deviation seems to be stagnant or even decreasing.

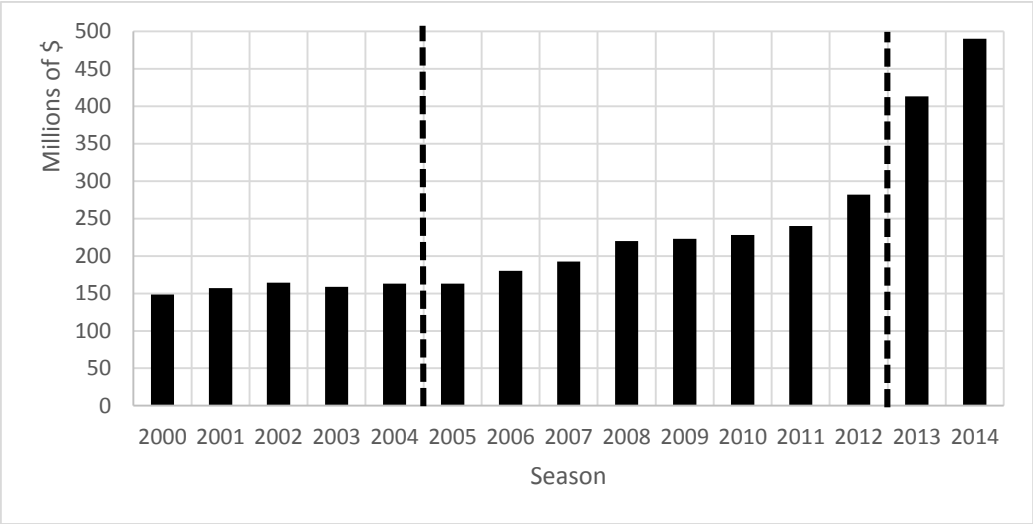
The Gini coefficients of team payrolls' are presented in Table 4 column 6. The decrease from 0.2140 to 0.1010 illustrate the balancing effect of a salary cap on team payrolls. The decrease was more notable right after the 2005 salary cap supporting that the decrease is caused by the salary cap. Decreasing Gini coefficient support the notion of increasingly evenly distributed payrolls in the NHL. Supportive Lorenz curve is presented in Appendix 5.

According to the evidence presented in this chapter I conclude that the NHL salary cap has lowered the player costs. It lowered the total costs for a few season but increase in league wide revenues revoked this decrease in no more than four season. Players' share of league wide revenues has remained at the level which is agreed in the 2005 and 2013 CBAs. This means that owners' profits and players' salaries grow together as revenues grow. In the following chapters, I analyze the consequences of limiting the player costs in two different chapters. First I analyze the consequences to the NHL team owners and second I analyze the consequences to the NHL players.

8.2.1 What are the consequences to the NHL team owners?

Figure 16 shows the development of the average franchise value of NHL teams. Values are collected from forbes.com which annually lists NHL team franchise values. The data on Figure 16 encompasses seasons from 1999-2000 to 2013-2014.

Figure 16: Average franchise value of NHL teams (data from www.forbes.com)



The average franchise value was stagnant during the period presented before the 2005 salary cap. This might be due to rapidly increasing player salaries which lowered the owners' share of revenues. After the 2005 salary cap, the average franchise value moderately increased until 2012 when the 2005 CBA came to its end. During this period players' share was tied to league wide revenues and increased as revenues increased. Maximum players' share during the 2005 CBA was 57% and it guaranteed the rest of the revenue to the team owners'. After the 2013 CBA, the average franchise value has increased rapidly as illustrated in Figure 16. In 2013 CBA players' share is fixed at 50% and this possibly correlates with the rapidly increasing average franchise value.

According to the average franchise value presented in Figure 16 team owners' seem to be the biggest winners after the salary cap was introduced in the NHL. Most probably a fixed salary cap positively affects the valuation of NHL franchises but there might be several additional reasons to the increase in franchise values. Estimating the exact impact of a fixed salary cap is left for future studies. On the scope of this study I settle for concluding that the salary cap and teams' average franchise value which is illustrated in Figure 16 are related.

8.2.2 What are the consequences to the NHL players?

In this chapter, I analyze the consequences of limiting player salaries to the NHL players. The most probable outcome is that player salaries are lower on average. My main interest is to find out if all player positions experience the same changes in the same way and depth. Also, I examine if the relation of positional investments and success has changed due to the 2005 salary cap.

8.2.2.1 Has the distribution of player salaries leveled after the 2005 salary cap?

Cumulative salary distribution has leveled since the 2005 salary cap through the whole examination period. The most notable change has happened in the salaries of the highest paid players (see Appendix 6). This finding supports the findings of Kaijalainen (2013). The Gini coefficients of player salaries are presented in Table 4 column 7. Player salaries' Gini coefficients presented decrease during the whole examination period. Supporting Kaijalainen (2013) I conclude that the salary distribution between the NHL players has become more even after the 2005 salary cap.

Positional Gini coefficients are presented in Table 10. As we can see from the table below, Gini coefficients have decreased in all three player positions.

Table 5: Positional Gini coefficients of salary

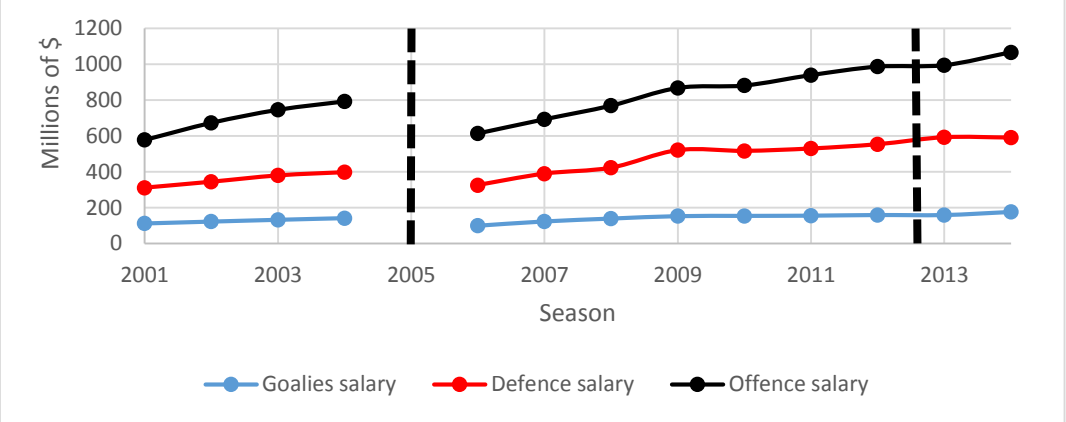
	Before 2005	After 2005
All	0.473566	0. 457905
Defence	0.43742	0.434629
Offence	0.488113	0.468267
Goalies	0.47865	0.464238

The most notable drop is in the Gini coefficient of offensive players as it has dropped almost 0.02 units. Overall changes are relatively small as 0.02 is the biggest change. Important in this finding is that wage equality has decreased rather than increased during the examination period. The development of wages in the NHL shows the opposite behavior before the 2005 salary cap. Accordingly, the salary cap has balanced the development of salaries among the NHL players as wage disparity has not increased after the 2005 salary cap.

8.2.2.2 Did the 2005 salary cap have an influence on all player positions?

Figure 17 illustrates the development of accumulated positional salaries in the NHL. Blue line is the accumulated seasonal salaries of goalies, the red line is the accumulated seasonal salaries of defence, and the black line is the accumulated seasonal salaries of offence. As we can see from the figure all player positions experienced a decrease after the 2005 salary cap.

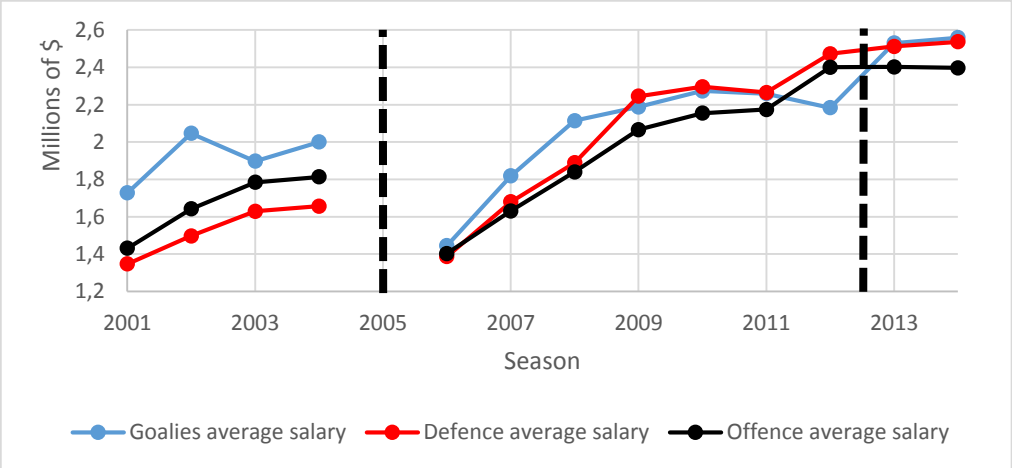
Figure 17: Accumulated positional salaries



When considered in absolute numbers, the drop in salaries is the greatest among offence players. As there are more offence players than defence players or goalkeepers, I considered it reasonable to calculate the drops in percentages. The drop in salaries is the most notable among goalkeepers when considering percentage drops. Decrease in accumulated salaries among goalkeepers is about 29.8 percent when the corresponding value for defence is approximately 18.0 percent and for offence it is approximately 22.5 percent. Hence, the influence of the 2005 salary cap is the most notable for goalkeepers.

Figure 18 shows the development of three positional average salaries. The positions and colors of lines are as in Figure 17. The difference between figures is that Figure 17 illustrates accumulated salaries and Figure 18 illustrates average salaries.

Figure 18: Positional average salaries



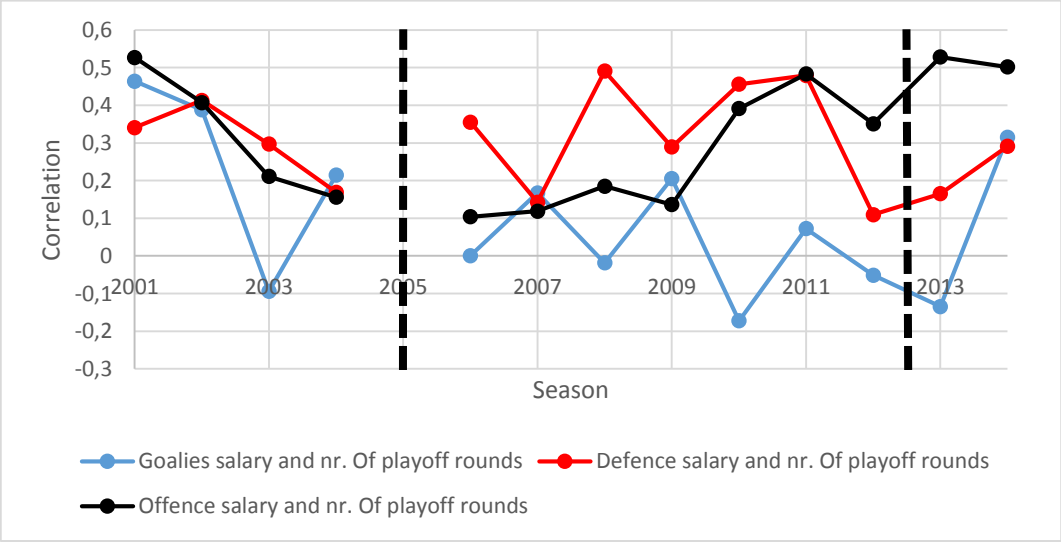
Goalkeepers had the highest average salary before the 2005 salary cap. The second highest average salary was among offence players and the lowest average salary among defence players. There were no changes in this order during the 2001-2004 seasons. As shown in figure 18 positional average salaries are more balanced after the 2005 salary cap. Accordingly, goalies

experience the greatest drop in average salaries, offence players the second greatest and defense players the smallest. The drop in goalies' average salary after the 2005 salary cap was 27.8 percent. For offence the corresponding percent was 22.7 and for defence it was 16.3 percent. The order from the greatest to the smallest has varied after the salary cap as we can see from Figure 18.

Altogether, before the salary cap goalies had the highest average salary fallowed by offence and then defence. After the salary cap positional average salaries have been more balanced and the order from the greatest to the smallest has varied.

8.2.2.3 Has the correlations of positional investments and number of playoff rounds changed?
Figure 19 shows the correlations of investments in different player positions and number of playoff rounds of all teams in the NHL. The positions and colors of the lines are as in two previous figures.

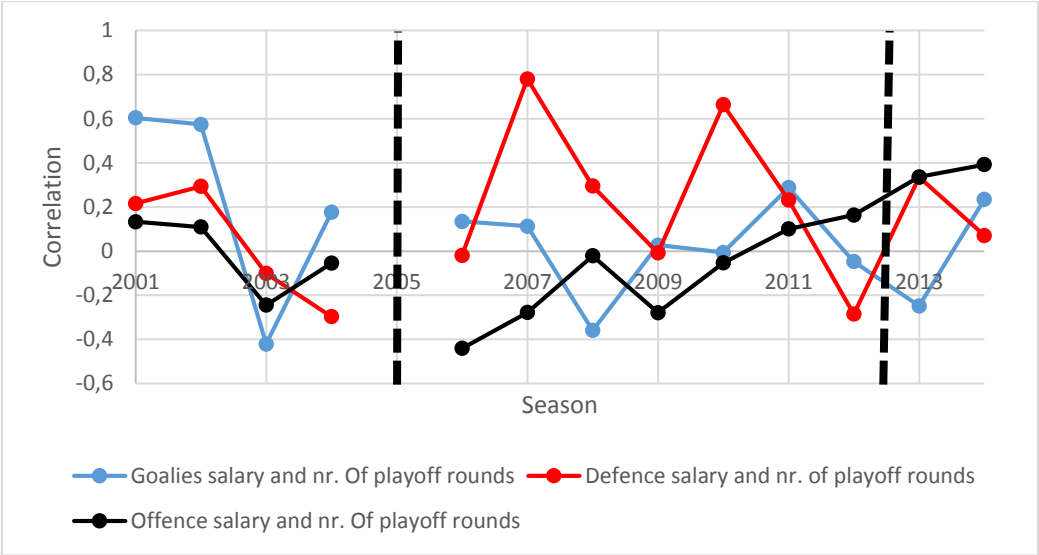
Figure 19: Correlation of positional investments and playoff rounds (All teams)



All three correlations seem to have a decreasing trend before the 2005 salary cap. After the salary cap, correlation between defence and number of playoff rounds is notably positive. Correlation between offence and number of playoff rounds has an increasing trend after the salary cap and during the 2013 and 2014 seasons the correlation is more than 0.5. Correlation between investments in goalkeepers and number of playoff rounds is varying and having negative values during some seasons. Hence, it is hard to find positive relation between investments in goalkeepers and number of playoff rounds after the 2005 salary cap. Figure 19 suggests that after the salary cap, investments in offence have an increasing importance among all NHL teams when determining the number of playoff rounds.

Figure 20 shows the same relation as does Figure 19. The difference between figures is that teams that did not make their way to the playoffs during the season in question are dropped from the data set in Figure 20. Hence, Figure 20 makes possible the analysis of the relation of positional investments and playoff success.

Figure 20: Correlation of positional investments and playoff rounds (Playoff teams)



As we can see from Figure 19 and Figure 20, correlations between positional investments and number of playoff rounds are lower among playoff teams than among all teams. This supports the previous finding that the relation of a payroll and a number of playoff rounds is greater among all teams than among playoff teams. Also in Figure 20 correlation of investments in offence and the number of playoff rounds has an increasing trend (from about -0.4 to 0.4) after the salary cap. Difference in Figure 20 is that correlation is negative shortly after the salary cap but as time elapses correlation turns positive and increases. Correlation between investments in defence and number of playoff rounds differs yearly and fluctuates between -0.3 and 0.8. The average is positive but the trend is decreasing. Consequently, there are not many conclusions to be made from this correlation or about its development. Correlation between investments in goalkeepers and number of playoff rounds varies around 0 before and after the 2005 salary cap and no conclusions can be drawn.

The most important findings in Figures 19 and 20 are that all correlations between positional investments and number of playoff rounds were decreasing before the 2005 salary cap. After the salary cap correlation between investments in offence and number of playoff rounds has been increasing among both, all teams and playoff teams. Trends of other positional

correlations have remained stagnant suggesting that the relation of investments in offence and success has increased.

8.2.2.4 *Has the correlation of positional payroll shares and number of playoff rounds changed?*

Figure 21 shows the correlations of all NHL teams' positional salary shares and number of playoff rounds. Colors and lines are as in previous figures. The difference is that team investments are calculated as percentages, not as absolute sums. This figure eliminates the fact that some teams' payrolls are greater than others'.

Figure 21: Correlation of positional payroll shares and playoffs rounds (All teams)

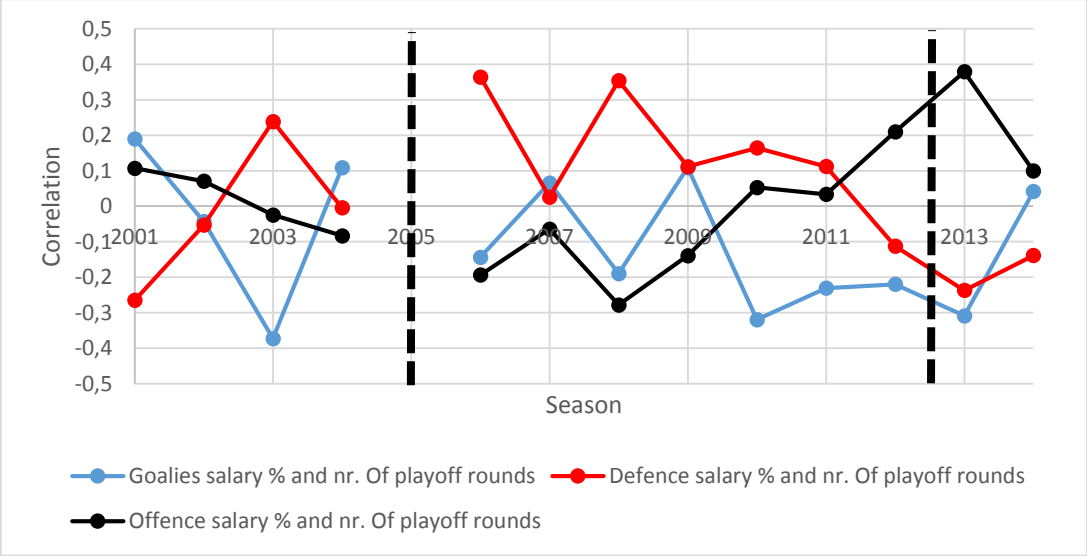
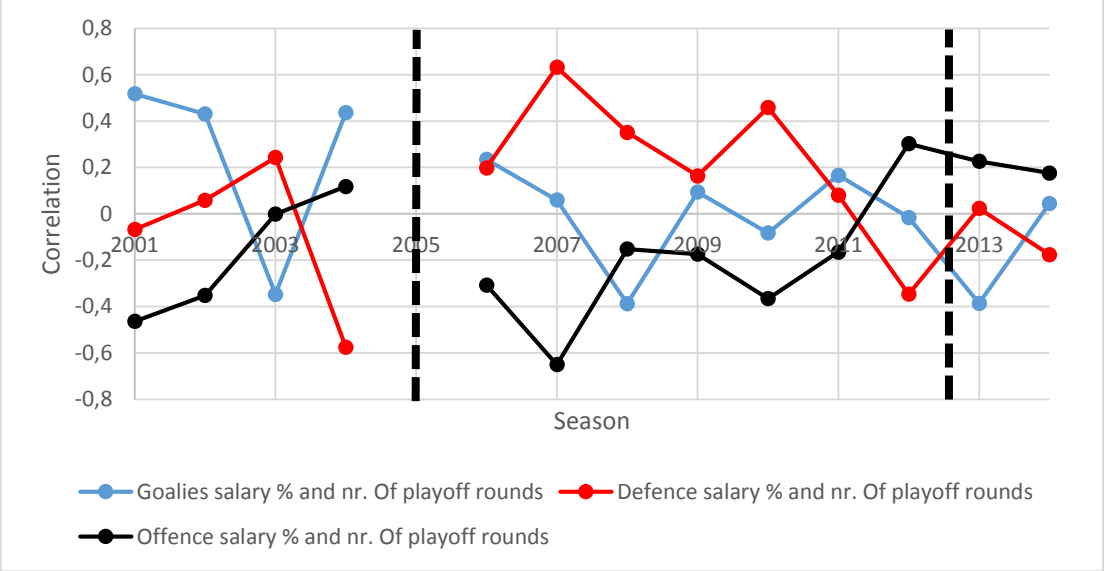


Figure 21 shows the same increasing trend of investments in offence and number of playoff rounds supporting the previous findings. Interestingly the correlation of percent investments in defense and number of playoff rounds seem to have decreasing relation in Figure 21. Correlation of percent investments in goalkeepers and number of playoff rounds is the same as in previous figures, around zero. Figure 21 highlights the increasing positive relation between investments in offence and number of playoff rounds after the 2005 salary cap. Also, it suggests that investments in defense have a decreasing correlation with playoff rounds after the salary cap.

Figure 22 shows the same correlation as Figure 21 but the non-playoff teams are excluded from the data set.

Figure 22: Correlation of positional payroll shares and playoffs rounds (Playoff teams)



Trends in Figure 22 have some same features as in Figure 21. Trends are not as steep as in Figure 21 and end up closer to the zero level correlation. Again, this supports the finding of a payroll being more important during the regular season than in the playoffs. Notable in Figure 22 is that again the correlation of investments in offence and number of playoff rounds has an increasing trend and the correlation of investments in defence and number of playoff rounds has a decreasing trend.

8.2.3 Discussion on limited player costs

Empirical evidence shows that the 2005 NHL salary cap did decrease NHL teams' player costs. Figure 14 shows the decrease in accumulated salaries which is about 22% of total player costs. According to previous studies on salary caps, this is an expected result as one of the motivations of a salary cap is to limit teams' costs. Small teams increased spending and large teams decreased spending after the NHL salary cap. Consequently, standard deviations between teams' payrolls decreased. The distribution of payrolls is empirically shown to be more balanced on the team level (Figure 15). Theory suggests that this should result in a more balanced competition in addition to lower costs.

Economically team owners' seem to be the biggest winners as shown by the increase in the average team franchise value (Figure 16). The average franchise value more than tripled in ten years after the 2005 salary cap. The average value remained stagnant before the salary cap and started to increase after. Most likely the NHL team owners and investors gain more trust on the economic wealth of the teams as a greater share of the income was guaranteed to the teams.

More analysis on the topic of why franchise values started to increase is left for future studies. In terms of this study I conclude that the NHL team owners have gained significant benefits after the introduction of the 2005 salary cap.

As stated before, player salaries decreased after the salary cap. Supporting Kaijalainen (2013) I found that the decrease in salaries was the greatest among the top players. On the other hand, players were guaranteed the minimum salary that meant an increase for the lowest paid players. All player positions experienced a decrease in accumulated and average salaries. The decrease was the most notable for goalkeepers for which the cut was almost one third of their average salaries. Before the salary cap goalkeepers enjoyed the highest average salary, offensive players the second highest average salary, and defensive players had the lowest average salary. The salary cap balanced the salary distribution between the positions. The pay distribution familiar before the salary cap ceased to exist after the salary cap as all positions started to receive a more equal pay. Empirical analysis suggests that the relation of success and offensive salaries has increased after the salary cap. Figures 19-22 show that correlation between offensive salaries and success has increased after the salary cap. Correlations of pay and success of other two positions remain stagnant or decrease. This might be due to increase in the valuation of defensive offensive players. They count as an offensive player due to their position but their task is to be also defensive players. Also, offensive players that have defensive responsibilities can act as substitutes for defensive investments. Further research on this topic is required. In this study I settle for concluding that the relation of pay and team performance for offensive players has increased since the 2005 salary cap.

This study has empirically shown that the 2005 salary cap did decrease teams' player costs. Additionally, the average franchise value of the NHL teams started to increase. Empirically presented average franchise value provide support for the argument that the NHL team owners are economically the biggest winners after the salary cap. Empirical analysis also shows that all three player positions analyzed in this study experienced a decrease in salaries. The increase was the greatest among goalkeepers. Offensive players' relation of pay and success is shown to be increasing. This is a possible topic for future studies. In the next chapter, I conclude the study and analyze the results with the findings of other studies.

9. Conclusions

Four North American major sports leagues are considered to behave as profit maximizers. One possible way for cutting costs and thus increasing profits is to set a salary cap on player salaries. This thesis introduces theoretical results of setting a salary cap in professional team sports and shows if these results are found in the NHL after the 2005 salary cap. According to previous literature (Késenne 2000, Larsen et al. 2006, Dietl et al. 2012) salary caps have two main motivations: more balanced competition and lower player costs.

The 2005 NHL salary cap is a hard salary cap that is calculated as a percentage of revenue of league wide sales. It sets upper and lower limits to teams' player costs. A percentage of revenue players' share gives an incentive for players and owners with joint effort to increase league wide revenues. As shown in the empirical part, players' salaries after the salary cap rapidly exceeded the level before the salary cap. Accordingly, league wide revenues increased and players' share grew in terms of dollars. If the NHL aims for competitively more balanced league, in theory, it has two ways to reach this in terms of a salary cap. Revenue sharing is not included in this study. One option is to lower players' share and the other is to narrow the gap between upper and lower limits of spending giving less leeway for teams' player budgets. A profit maximizing league aims for lower player costs and thus the league prefers lowering the players' share rather than narrowing the salary cap gap.

If limiting teams' payroll by a salary cap is expected to balance competition, then player cost is expected to be related to success. In the NHL, player cost and team success have a relation as shown in the empirical part of the thesis. After the 2005 salary cap, this relation decreased for a while but as salaries increased again the relation grew. Correlation of pay and performance is positive among all NHL teams but among playoff teams the correlation is close to zero. Empirical analysis shows that competitive balance increased during the regular season but did not change during playoffs. The results support each other as the relation of player costs and success is greater during regular season than playoffs. Accordingly, the balancing effect of the salary cap is greater during the regular season than playoffs.

The 2005 salary cap did reduce player costs in the NHL. The players' share dropped from about 76% to 54% due to the salary cap. The average franchise value of NHL teams started to increase after the salary cap and after the 2013 CBA the growth accelerated as players' share was dropped to 50%. The average franchise value more than tripled in ten years and accordingly the owners have had significant benefits from the setting of the salary cap.

Traditionally, goalkeepers are thought to contribute most to the team performance fallowed by forwards and then defensemen (Chan, Cho and Novati, 2012). Positional average salaries before the salary cap followed this belief; goalies had the highest average salary and defensemen the lowest. After the salary cap positional differences in terms of salaries leveled and accordingly goalies suffered the greatest loss in terms of salaries by position. Supporting Kaijalainen (2013) I find that highest paid players experienced the greatest cut in salaries after the 2005 salary cap. Additionally, the lowest paid players experienced an increase in salaries due to the minimum per player salary set by the salary cap.

Research shows that in the case of the NHL there is empirical evidence to support the suggestions of theoretical models presented earlier. Firstly, competition is more balanced during the regular season. Secondly, player costs decreased when the 2005 salary cap was introduced. Success during playoffs is not as significantly related to a payroll as success during regular season. Thus, the expected result of more balanced competition is not found during playoffs after the salary cap. The challenge for the NHL and the NHLPA is to find an optimal level for the salary cap in order to maximize the balancing effect and simultaneously satisfy both parties.

Present player costs have long exceeded the level before the 2005 salary cap. Additionally, regular season competition has become more related to a payroll again. Both, decreasing the players' share and narrowing the gap between the upper and lower limits of spending would decrease the relation of a payroll and success. As shown by the 2005 salary cap these actions resulted in a more competitively balanced regular season competition.

Both parties, the NHL and the NHLPA, are profit maximizers. Arguably, team owners have gained more benefits than players after the salary cap as franchise values have increased and player salaries decreased immediately after the salary cap. The two organizations have agreed the terms of the 2013 CBA and at soonest new negotiations can be expected at or just before 2022 when the 2013 CBA comes to its end. If recent trends hold, then we will most probably see a decrease in players' share as league wide sales have increased meaning that player costs have increased in terms of dollars. Additionally, a possible outcome is that the payroll gap becomes narrower than in the 2013 CBA. This would result in a lower relation of a payroll and success as payrolls are forced to be more uniform. The experiences after the 2005 salary cap have shown that forcing payrolls to be more convergent results in a more competitively balanced regular season competition.

My recommendation in order to achieve economic benefits, a competitively balanced league, and lower player costs is to start negotiations about the future CBA before the year 2022. History shows that the negotiations tend to result in a lockout that can cancel a whole season. The NHLPA should highlight the fact that team franchise values have increased rapidly since the first salary cap in the NHL to point out the benefits that the owners have gained. The NHL should highlight the increase in player salaries after the salary cap to point out the benefits that the players have gained. As historically shown, the league usually has the higher ground when negotiation new CBAs. To maximize profits new CBA should be formed before the start of the 2022-2023 season. It remains to be seen if the outcome is a lower players' share and a narrower gap between upper and lower payroll limits. A narrower gap would guarantee a lower relation between player costs and success even if the league-wide sales increase.

Throughout the paper, I assume that the NHL acts as a profit maximizer. This assumption is based on previous analysis by Ferguson et al. (1991) with the data from the 1980s NHL ticket sales but there is no clear consensus on this topic. In this paper profit maximization is the only reasonable assumption and my analysis on the development of the NHL teams' average franchise value supports the assumption. Testing the assumption of profit maximization with more recent NHL data is a possible topic for future research.

In this thesis I have settled for stating that there is a relation between the setting of the salary cap and the increase in the average NHL teams' franchise value. Also, after the 2013 CBA the growth in franchise values accelerated, suggesting that there might be one-way causality between the two. Further research testing the possible causality between a salary cap and team franchise values and on the determinants of team franchise values is needed to make more conclusions about the topic. If causality is found, it would support and explain the findings in this study that team owners gain economic benefits after the setting of a salary cap.

I have shown that the relation of offensive players and success has increased since the setting of the 2005 salary cap. The thesis does not include any analysis on this phenomenon. I have settled for stating that the relation has gown. A possible topic for further research is an analysis on why the relation of salaries paid to offensive players in the NHL and success have grown after the 2005 salary cap. Possibly the defensive characteristics of traditionally low paid offensive players have increased their importance. Ample room for further research on this topic.

This study is useful for leagues that are considering whether to put a salary cap in operation or not. Currently, the Kontinental Hockey League (KHL) is going through economic struggles as some teams have left the league due to financial problems and some teams have struggled with salary payments. Based on the findings made during my research, I argue that a salary cap could help the KHL to overcome its problems. The future of the KHL is unsure and thus the teams and the league should recommend a salary cap to be implemented as soon as possible. Arguably, the major differences between the KHL and the NHL are that the KHL is facing competition by the NHL and so far the KHL has not acted as a profit maximizing league. To bolster its future, the KHL should introduce a binding salary cap. Surely, this would mean backing down competition with the NHL as the number one league. Some exceptions in a hard salary cap could be made to hold on some superstar players meaning that a soft salary cap might be a suitable option for the KHL. However, the KHL provides an interesting arena for implementing a salary cap and the economic situations demands it or at least some other changes to be made as soon as possible.

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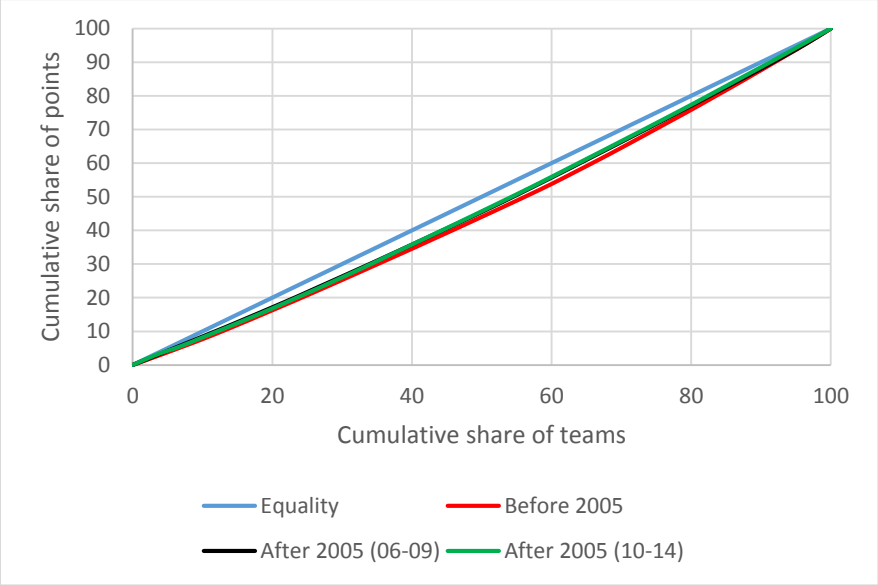
Appendixes

Appendix 1



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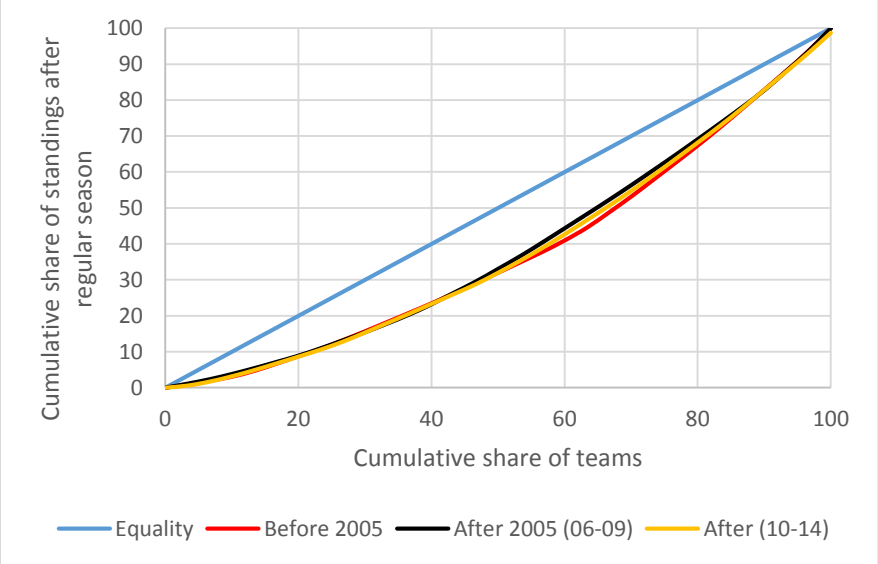

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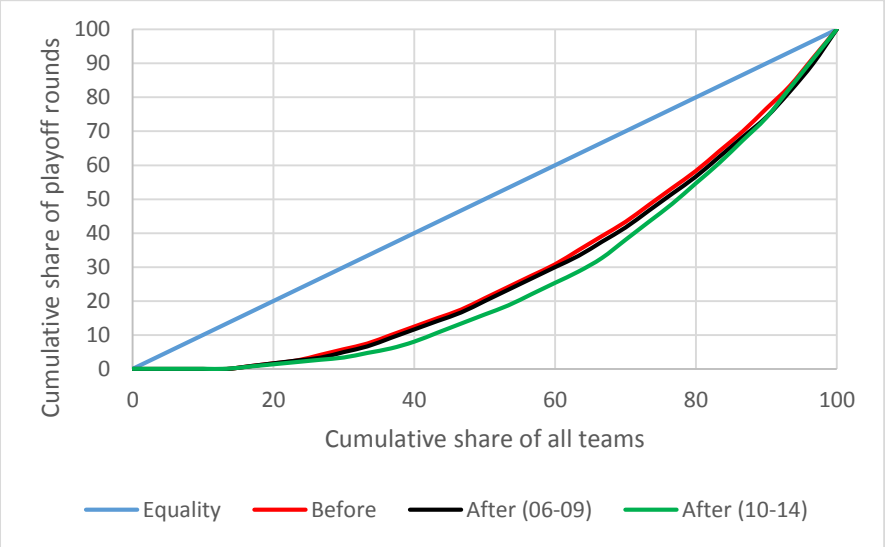

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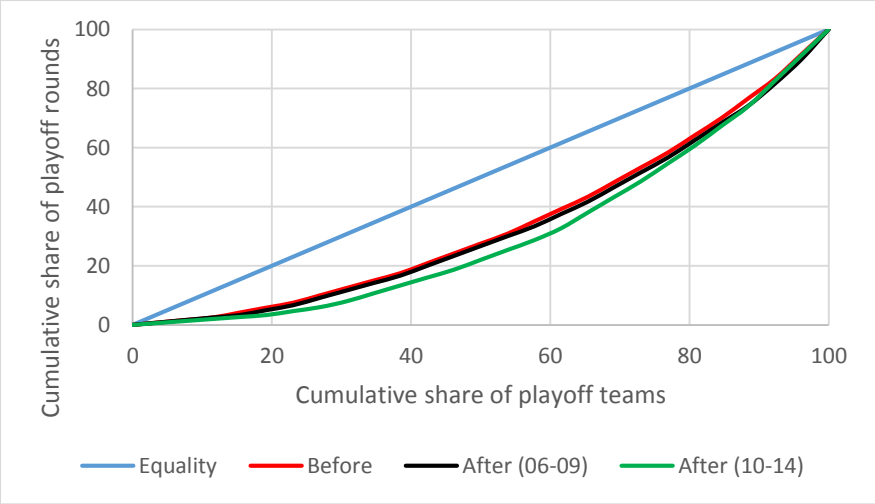

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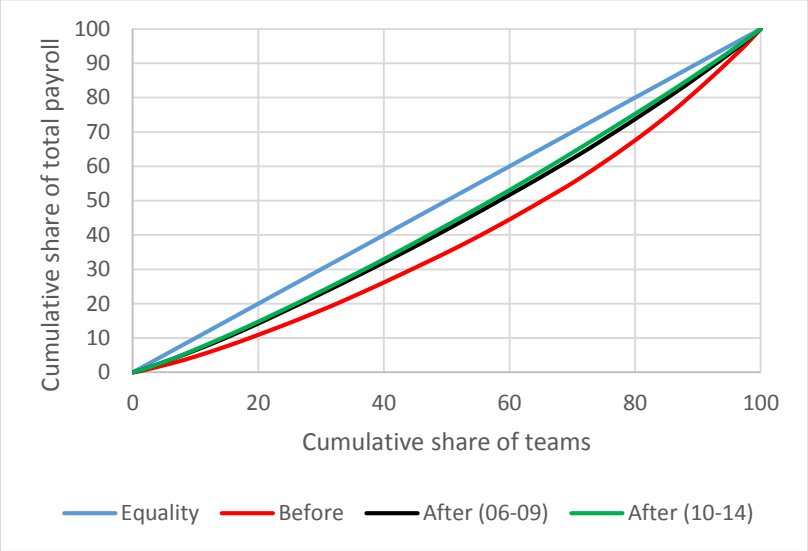

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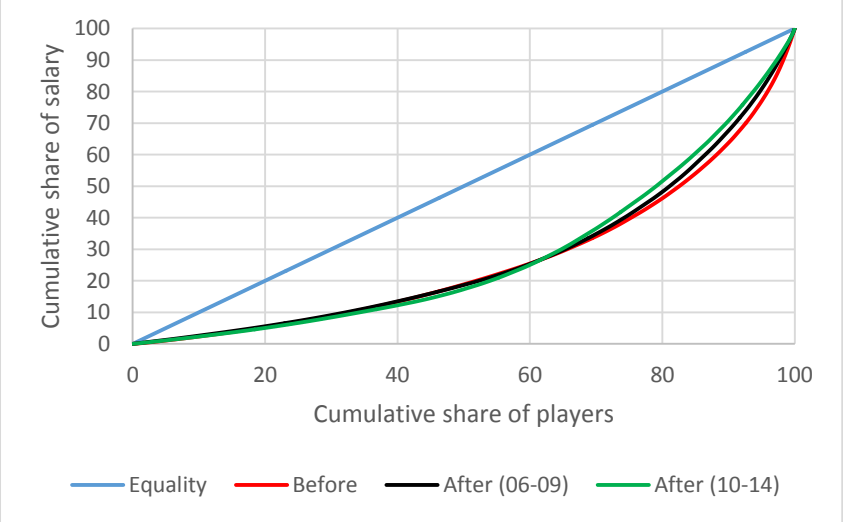
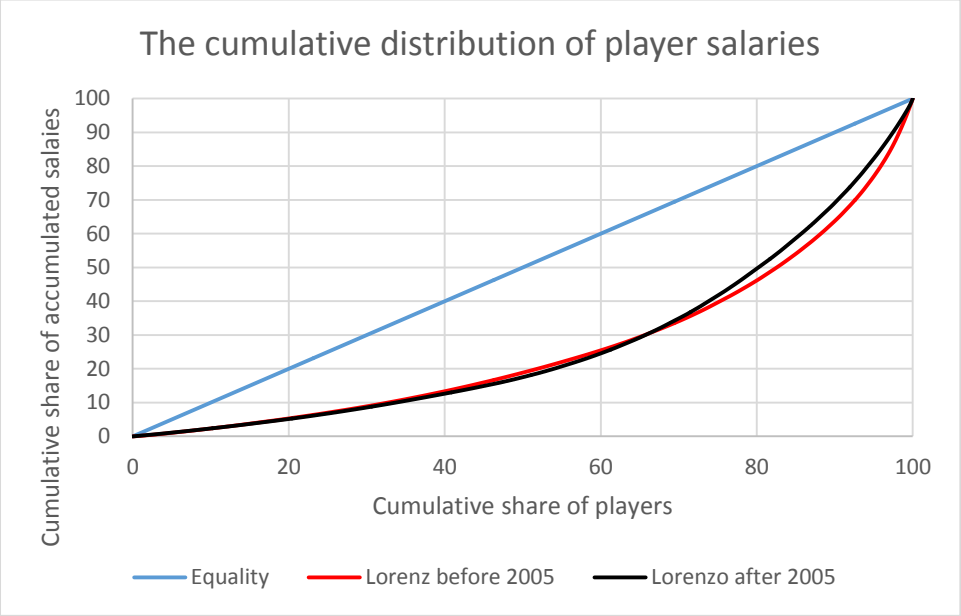


Appendix 7

Time period	Gini coefficient
Before the 2005 salary cap	0.484357872
After the 2005 salary cap (06-09)	0.504353234
After the 2005 salary cap (10-13)	0.462857143

Appendix 8


The cumulative distribution of player salaries
Cumulative share of accumulated salaies
100
90
80
70
60
50
40
30
20
10
0
0
20
40
60
80
100
Cumulative share of players
Equality
Lorenz before 2005
Lorenzo after 2005