The Determinants of Team Success in the NHL

An examination: Pre and Post-Lockout

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Abstract

In this paper I examine the determinants of team success in the National Hockey League (NHL), and whether they changed with the introduction of the new Collective Bargaining Agreement (CBA) in 2005. Team success is defined in two ways: first, whether a team makes the playoff (or not), and second, how far a team goes into the playoffs. This paper uses team-level data that covers 10 hockey seasons, five of which follow the introduction of the new CBA. The analysis shows that the new CBA did not have a significant effect on the determinants of team success. Goals for and against are two key determinants, and this holds for both measures of team success. Finally, I find that accounting for invariant heterogeneity does not materially affect the findings.

Acknowledgement

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1 Introduction

The presence of a union in sports can have significant financial impacts for both players and owners as well as on the way the game is played. The relationship between these parties is governed by a Collective Bargaining Agreement (CBA). Should negotiations over a new CBA fail, players can opt to use a strike as a bargaining method while owners can use a lockout. A lengthy strike or lockout can in turn force both sides to come back to the bargaining table as both sides accumulate costs and the relationship suffers. This paper analyzes the impact of the CBA signed following the 2004-2005 lockout and the determinants of team success in the National Hockey League (NHL). This CBA includes new measures such as the salary cap, revenue sharing, buyouts etc. and may have an impact on team success. Team success is defined in two ways, the first is whether a team makes the playoffs or not and the second is whether they make it into further rounds of the playoffs.

In 2004-2005, the NHL season was wiped out due to a lockout. This marked the first time in history that an entire season in any sport was abolished due to a work stoppage (Schmidt and Berri, 2004) and the Stanley Cup was not awarded.[1] However, this was not the first labour disagreement in NHL history. In 1992, the NHL and its players association had their first labour disagreement that lasted only 10 days. Consequently, the players received more compensation for playoff games, the player's union got the right to choose the arbitrator in negotiations, and the age for unrestricted free agency was dropped from 31 to 30. The owner's benefitted by an increase in

[1]The only other time the Stanley Cup was not awarded was in 1919 due to a flu epidemic. http://www.greatesthockeylegends.com/2009/04/flu-epidemic-cancelled-stanley-cup-in.html

scheduled games from 82 to 84. In the 1994-1995 NHL season, there was a more lengthy lockout lasting 104 days over the issue of the salary cap proposed by the NHL and the owners. The lockout ended January 4th 1995, reducing the NHL season to 48 games, and the playoffs occurred as scheduled. The outcome led to the imposition of a partial salary cap which was applied solely to rookie salaries. Furthermore, penalties were applied to teams which attempted to sign players that were restricted free agents with their respective clubs. The age limit for unrestricted free agency (a player who is free to sign a contract with any team), was decreased from 32 to 30 from the previous agreement. In addition, the season schedule reverted back to the original 82 games. The lockout of 2004-2005 lead to the signing of the 2005 CBA which to some extent has changed the way the game is played. For example, these rule changes resulted in greater advantage to forwards and defencemen with speed, skill resulting in more goals. These changes are explained in section 3 which provides highlights on the new CBA.

There are three main conclusions to be drawn from my analysis. First, there are some minor differences between the pre and post-lockout results. For example, the marginal effect between goals for (the amount of goals a team scores) and goals against (the amount of goals a team allows) in the post-lockout is half as much when compared to the pre-lockout period. Second, only goals for and goals against are the variables that are both economically and statistically significant in my analysis and are robust to the choice of specification. Finally, controlling for unobserved time-invariant heterogeneity (by including fixed effects) does not affect my findings.

This paper is organized as follows: in the next section, I provide a literature review of papers that analyzed sports, labour agreements and the notion of a team success. Section 3 provides highlights of the collective bargaining agreement and how it has changed after the lockout. The data is provided in Section 4. In Section 5, I describe the model and methodology, which includes a dual model approach. Key results are reported in Section 6. A discussion of the robustness of the results is included in Section 7. Section 8 concludes.

2 Literature Review

This section puts into perspective what we should be accounting for when evaluating the determinants of team success. These papers explore a number of different topics concerning unions, player's salaries and team success/performance in professional sports. From the review it is clear that these topics have been analyzed individually but not together.

a) Impact of Strikes on Consumer Demand in Sports

Schmidt and Berri (2004) attempt to answer the following: Is consumer demand permanently impacted during a work stoppage? The authors explore this thesis using data from the professional sports industry. Consumers may threaten to withdraw all future demand by abstaining from going to future games, if a strike is not resolved quickly. Consequently, industry insiders assert that labour strikes have the potential of destroying the professional sports league.[2] Schmidt and Berri (2004) uses panel data over the past 30 years for MLB (1981, 1994-1995), National Football League (NFL) (1982,

[2] Schmidt and Berri (2004) pg. 1

1987) and NHL (1994) to investigate whether league attendance rebounds from output loss. The years indicated represents the years for the strikes. Their findings suggests that there are no permanent effects from labour-management conflicts in professional sports and consumer demand is re-established instantly. The authors believe that consumer's threat of rejecting the industry is not credible. Furthermore, since there was no permanent repercussions on attendance in these three sports, they believe that labour conflicts in all 3 professional sports are likely to occur again.

b) Salary Determinants

Jones and Walsh (1988) examine three characteristics that need to be taken into account to determine a player's salary in the NHL. The characteristics include skill differences, special bargaining abilities of NHL forwards, and the possible salary discrimination against French Canadian hockey players. Their goal is to determine the degree to which player's salaries are affected by these characteristics. In their econometric model they use 1977-1978 NHL data encompassing some 300 NHL players. To determine a player's salary, Jones and Walsh (1988) use a quantile regression model with the following explanatory variables: Points per Game, Games Played, Penalties, Awards, as well as player attributes such as height, weight and ethnicity. Jones and Walsh (1988) conclude that skills measured by goals and assists by a player and goals against average for the goaltender are the primary determinant of a player's salary. They conclude that "forwards" are somewhat like a monopoly as they have an advantage in bargaining power over other positions. They also found that there was no evidence to support the claim of salary discrimination against French Canadian players.

c) Salary Discrimination

Discrimination in hockey regarding certain ethnicities may occur in different forms: 1) different wages for the same relative productivity 2) segregation and 3) reserving certain positions to certain ethnicities. Lavoie et al. (1987) explore whether discrimination exists in the NHL and if it results in performance differentials. Performance differential can arise by giving a player from English Canadian origin more ice-time than a player from French Canadian origin, all else being equal. The authors differentiate players by their place of origin (English Canadian, French Canadian, American and European).[3] These players are then separated in terms of their respective positions: forwards, defencemen and goaltenders. The analysis uses player's attributes (age, height, weight, draft choice, seasons, games played, goals, assists, points) from the 1982-1983, and 1983-1984 seasons. Of the three positions mentioned, defence is the most difficult to evaluate contribution to team performance differentials. The authors conclude that there is evidence of hiring discrimination against francophone hockey players entering the NHL. French Canadian born players, out-performed their english born counterparts yet got paid less. Also the higher the uncertainty in measuring a player's expected contribution to their team, the greater the degree of discrimination. As one is better able to assess how well a player can perform for a team, discrimination of this kind may be eliminated.

Longley (1995) also explores the notion of salary discrimination in the NHL on French Canadians. His analysis is a critique of Jones and Walsh (1988) reviewed above.

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[3] For the goaltenders, the analysis is restricted solely to French and English Canadian goaltenders since there were no American and European born goaltenders in the NHL during that time.

The author applies regression analysis to 1989-1990 data for 300 NHL forwards. Longley's (1995) model goes further than Jones and Walsh (1988) in that a dummy variable is added to capture the interaction effect between a player's origin and a team's location. Longley (1995) looks at the performance of an individual player along with the potential generating revenue within a team. He concludes that French Canadian born players suffer discrimination only when these players play for English Canadian teams. Also, it is shown that English born Canadian players do not suffer the same type of discrimination when playing for French Canadian teams, or for United States based teams.

McLean and Veall (1992) is an extension of Lavoie et al. (1987) on discrimination and performance differentials in the NHL. The analysis is extended to incorporate more recent data. Their results differ in smaller performance differentials than predicted by Lavoie et al. (1987), and their findings proved to be no longer statistically significant at the 5% level. They claim this is due to enhanced market pressure in the NHL, where more francophone coaches and general managers are coming into the league, eliminating the bias against French Canadian born players. They use a regression based approach similar to Lavoie et al. (1987) using more recent data from the 1990-1991 NHL season. McLean and Veall (1992) conclude that there is no evidence of salary discrimination when using more recent data.

d) Player's Contributions to Team's Revenues in Major League Baseball

Sommers and Quinton (1982) claim that the average baseball free agent (a player without a signed contract) is greatly underpaid contrary to what fans and media believe.

They look at 14 major league baseball free agents from the 1977 season labelled as 'the first family of free agents'. They use two regression equations. The first involves an analysis of team's winning percentage versus team's statistics as explanatory variables. The second examines revenues incorporating the first equation as an explanatory variable along with the addition of team location, percentage of African American players per team and a city's population. Their results are further examined through a player's net benefit and net cost analysis on their respective team. Sommers and Quinton (1982) conclude that the average baseball free agent is greatly underpaid as opposed to a player with a signed contract who is paid according to their contribution towards team's revenue.

e) Variations in NHL Attendance

Paul's (2003) paper sets out to demonstrate that variations in NHL attendance is governed by the direction of the economy, a city's population, the timing of the NHL game and most importantly team success. He focuses on the factors that determine attendance for each individual NHL game. The author defines success in three ways; through team scoring, an increase in fights (provides a psychological advantage), and more games played against regional rivals. The author uses 1999-2000 panel data in order to examine the above mentioned variables on 1,148 games to account for team success. Paul (2003) states that out-scoring another team leads to more wins and may subsequently lead to further advancement in the playoffs. However, he indicates that this has a negative effect on attendance. He concludes that scoring by a large margin does not have an effect on team revenue in the long-run. He also claims that more fighting tends

to drive up attendance for all NHL teams which is a form of financial success. Paul (2003) believes that the increase in regional rivalries in the United States and Canada creates a more exciting atmosphere for the average fan, and subsequently creates a larger fan base.

f) Impact of Fighting in the National Hockey League

Fighting in hockey can be used by a player who wants to energize a team, protect a star player or a strategic move by the coach to change the momentum of a game. Haisken-Denew and Vorell (2008) analyze the effect of winning, losing and a draw on the fight towards wage determination along with its impact on team success. The authors measure team success as reaching the playoffs, the quarter-finals, the semi-finals, the finals and having won the Stanley Cup. They use individual players data from 1996-2007 along with team-level data from 1967-2005 for all NHL teams. They use both logistic regression and ordinary least squares method controlling for individual and team fixed effects. Haisken-Denew and Vorell (2008) conclude that there are high returns from fighting both financially and psychologically contributing to team success. They also found that fighting has a positive effect on other player's performance.

g) Effect of Earlier Born Players in the Minor League Hockey

Before a player is drafted into the NHL he must be successful in the minor league just to be considered. Barnsley and Thompson (1988) examine data for 7,313 minor hockey league players from the Edmonton Hockey League Association for the 1983-1984 season. Their aim is to analyze the effect of a minor league hockey player who is born earlier in the year (January-June) on his future potential. The authors claim that these

players are somewhat older and therefore have an advantage on players born later in the year due to more practice and size differentials. They label success as playing for "top tier" teams in future years and subsequently making the NHL. The authors analyse their performance by grouping the players into four quartiles. The authors also separate the age threshold and examine the participation rate in minor hockey for the monthly quartiles. Barnsley and Thompson (1988) conduct a simple regression analysis and conclude that players born in the months between January and June tend to play the sport longer and possess a higher probability of making the "top-tier" teams and the NHL over their (July-December) counterparts.

h) Impact of Second Referee on Game Outcome

Levitt (2002) considers the impact of how the addition of a second referee affects the end result of a hockey game. In sports, a referee is akin to a police officer. Their role is to call penalties on athletes when infractions are committed, and are subsequently disciplined. A penalty can have an impact on the outcome of a game. In hockey, players can commit either minor or major penalties. With minor penalties they are sent to the penalty box for two minutes, giving the non-penalized team a "Power-Play" (man advantage). With major penalties, the player is sent to the penalty box for a minimum of five minutes, or in some instances, depending on the severity may be required to leave the game. When a goal is scored during a major penalty, the player does not return on the ice which is contrary to a minor penalty. Levitt (2002) examines whether the rate of offending changes substantially with the addition of a second referee. He uses a quasi-experimental setting in order to analyze the economic model of crime. For the

1998-1999 NHL season, games were randomly selected and were used strictly as experimentation. Levitt (2002) concludes that if the number of referees are doubled, the probability of detection increases only slightly.

i) The Economics of Sports and the NHL Lockout

The key focus of Lavoie's (2007) paper is the 2004-2005 lockout which he claims is the biggest event in sport's economics. His analysis uses descriptive statistics of the MLB, National Basketball Association (NBA), NFL and the NHL on a variety of economic factors without using regression analysis. Other types of statistics examined include average attendance in the Canadian Football League (CFL) and the NHL, average player's salary in MLB, NBA, NFL and NHL, revenues from broadcasting television contracts for each sport and hockey market ticket prices. While descriptive statistics are used to illustrate an evolution of the factors described above, the data are from different time periods and establishing correlations is not possible. He concludes that the salary cap and appreciation of the Canadian dollar improves the chances of survival for smaller market Canadian teams.

The literature review illustrates that there are many different characteristics and/or variables that can be used to analyze sports data. There appears to be little literature that makes a correlation between unions and sports more specifically with respect to the National Hockey League's Players Association (NHLPA) and the NHL's owners. Much of the literature deals with a number of variables that impact on team success, whether it be; increased attendance, regular season or playoff performance or any number of

combinations of other variables. However, there is no literature that explores the impact that unions have had on team salaries relative to their success.

3 Collective Bargaining Agreement Highlights

The 2005 CBA brought about significant changes to the NHL and to understand its impact it is important to highlight key aspects of the agreement. This CBA includes new measures such as salary cap (imposed on total payroll), long term injury reserve (LTIR), revenue sharing, buyouts, bonus cushions, rollback, escrow tax. In my view the first four are among the measures that affect a team financially on a continuous basis. The salary cap in particular caused a salary compression amongst teams. To put into perspective the changes governed by the 2005 CBA, I discuss these concepts in relation to pre-lockout regulations.

The CBA had expired in June 2004 and was reinstated 300 days later for six years with a one year option for the 2011-2012 NHL season. In 2004, the player's union and the owner's of the NHL could not agree on a new CBA resulting in a lockout for the 2004-2005 season. The new CBA came into effect in the 2005-2006 season.[4]

The CBA is the regulation governing the relationship between players and owners. The current agreement was signed for 6 years through to the 2010-2011 NHL season with a one year extension option which has been exercised. The previous

[4] The main point of contention was the imposition of the salary cap in which the owner's were in favor of and the player's were against. The NHL was not the first league to address this issue. The NBA currently has a soft cap which was instituted in the 1984-1985 season. The difference between the NBA's and the NHL's salary cap is that NHL teams cannot exceed the league established cap with the two exceptions of Long Term Injury Reserve (LTIR) and bonus cushions. The NBA salary cap on the other hand, allows teams to exceed the cap with several exceptions; mid-level, bi-annual, rookie, Larry Bird and disability. Owner's prefer a soft cap as it allows them to retain their star players and allows their team to stay competitive. The conditions for soft cap in the NBA will not be elaborated on in this paper. However since this paper's focus is largely on the NHL, the two conditions for exceeding the salary cap, LTIR and bonus cushions will be discussed later.

agreement expired after the 2003-2004 season and an impasse in negotiations between NHL commissioner Gary Bettman and NHLPA commissioner Bob Goodenow resulted in the lockout. Bettman along with the owners, proposed a salary cap in order to increase smaller market team's chances of surviving.

Prior to the current 2005 CBA, Goodenow and the NHLPA succeeded in disclosing players salaries as public information to improve player's bargaining position. At the time, the best players in the league such as Wayne Gretzky were not paid the most. Goodenow, also negotiated a new three year $7.3M contract for Brett Hull, a large increase from his previous $125,000 yearly salary (Staudohar, 2005). In addition, draft picks in the early 1990's, e.g Eric Lindros and Alexandre Daigle, walked away with multi-million dollar deals before even playing through their first NHL season. There were also some general managers that would pay any price to acquire the best talent even if the best talent did not fit in with the team's chemistry. This had an escalating effect, where player's salaries increased significantly. As a result, smaller market teams could not keep up and some had to file for bankruptcy protection such as the Ottawa Senators, Buffalo Sabres and Pittsburgh Penguins. These are among some of the contributing factors to the NHL lockout.

NHL teams pre-lockout were not subject to any payroll constraints thus placing pressure on team finances. Smaller market teams had smaller payrolls and had less leverage in player contract negotiations. While bigger market teams with larger revenues could afford paying any price for talented players. In order to accommodate smaller

payrolls, smaller market teams had difficulties competing for quality players with their larger market counterparts.

Post-lockout NHL franchises are subject to two constraints: the *salary cap* (a maximum level of salary a team can attain) and the *salary floor* (a minimum level of salary a team can attain). A team must be above the floor and below the cap at all times. In order to stay within the cap floor and ceiling, teams have the following tools at their disposal: trades, waivers, claiming players via free agency, buying-out contracts. General Managers now have to be much more cautious to the terms and payment of future contracts. One of the major drawbacks of the salary cap is signing a player to a large long-term contract, hindering future potential moves. Should a team spend above the salary cap post-lockout, the league would levy fines. These fines may be waived due to LTIR or bonus cushions. This clearly changes the dynamics of how a team is assembled and ultimately may impact team success and performance.

Another factor that affects team finances is the value of the American dollar vis a vis the Canadian dollar. When the American and Canadian dollars are at par both Canadian and American teams are on a level playing field. When the Canadian dollar was lower, Canadian teams were at a significant disadvantage in trading players making it more difficult to obtain the right mix of players for a team to succeed.

The following provides greater detail on the workings of the NHL's salary cap. A players cap hit is dependent on the number of days in a season which varies from year to year. The 2009-2010 NHL season started October 1, 2009 and ended April 11, 2010 for a total of 193 active playing days. If a player is on the active roster his cap number is

multiplied by total days divided by the maximum total days (193). If a player is bought out his salary counts against the cap. Players that are on injury reserve and LTIR do not count against the cap since this violates the condition mentioned above. Teams can exceed the cap if they are replacing an injured player or a player on the LTIR. If a player is above the age of 35 with an existing contract and decides to retire before his contract expires, his salary will count towards his team's salary cap for the remainder of the contract duration. The *bonus cushion,* the other exception to the salary cap allows a team to exceed the cap by a maximum of 7.5%. If players do not attain their targets stated in their individual contracts, bonuses are not paid out, essentially lowering the teams predicted cap hit.

In the 2009-2010 NHL season, the Chicago Blackhawks won the Stanley Cup, and had to pay performance bonuses to their players. This performance bonus will go towards their cap hit for the next season. While they were successful in winning the Stanley Cup, this aspect of the new CBA essentially penalizes the club financially. In order to minimize this financial burden, certain players may be dealt via buyouts, trades and/or free agency and certain free-agents would not be resigned. This measure was designed to reduce the chances of creating dynasties in the NHL.

The 2005 CBA has increased players salaries in general while placing a cap on the maximum salary a player can obtain. A player's maximum salary cannot exceed 20% of the league's salary cap.[5]

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[5] For example, if the cap is established at $45M a player cannot earn more than $9M for that particular season.

The CBA also applied a one time 24% *rollback* (or reduction in salary) on all existing player's contracts for the 2005-2006 season in order to level the playing field. This measure was designed to compensate teams for fixed costs incurred during the lockout. While this rollback helped all teams, it was intended more for smaller market teams to retain their star players for a few more seasons. Larger market teams such as the New York Rangers, Detroit Red Wings, Philadelphia Flyers, Toronto Maple Leafs and the Dallas Stars all had to shed payroll parting ways with their high priced talent.

The new CBA also proposed an enhanced feature to salary arbitration. Now arbitration has become a double edged sword, where owners have the right to take overpaid players to salary arbitration and walk away from awarded contracts something that, previously only the players could do. This provides owners and general managers with greater leverage when negotiating players salaries.

Revenue sharing is another measure designed to ensure that all teams compete on an even footing. It effectively discourages owners from competing with each other to acquire the best talent by allowing the top ten teams to help finance the bottom ten. As team revenues increase, so does the salary cap. Proponents of revenue sharing argue for placing impediments to labour movements and that salary determination be imposed for the future of the sport. At the same time, the union feels that players should be free to move from one team to another and that their salaries be freely determined by the market (Lavoie, 2007). Another condition of the CBA is that a player cannot earn more than 54% of the teams revenue. An *escrow tax* is a method of withholding a certain percentage of a player's salary in case the ceiling has been exceeded. Once NHL

revenues at the end of the year have been calculated, the escrow amount is divided among the players and the owners.

Rookie salaries also have caps with the new CBA. All 18-19 year old players start with a rookie contract move to restricted free agency at the end of their contract. For a rookie coming into the league, his age and number of games played during the regular season plays a factor in his contract. If such a player signs his first NHL contract, but plays less than 10 NHL games in his first season, his contract will automatically be extended by one year. Table 1 illustrates that if a rookie at age 18 plays less than 10 games in the NHL, one additional year will be added to his contract. If he has played more than 10 games he is allowed to become a restricted free agent (RFA) after the third year.

Restricted free agency means that the players rights are still owned by his team. If an RFA has received an offer from another team and if his current team decides not to match the offer, the current team is compensated with a draft pick[6]. The level of draft picks will depend on the amount of compensation being offered to the player. For example, after the 2006-2007 season Dustin Penner became a restricted free agent finishing off his rookie contract with the Anaheim Ducks. The Edmonton Oilers signed him to an offer sheet of $21.25M over 5 years. Anaheim had declined to match it and this resulted in the Ducks receiving a 1st, 2nd and 3rd round draft pick as compensation due to the amount of the offer. Table 2 displays the compensation if a restricted free

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[6] A sports draft is a process by which professional sports teams select players not contracted to any team, often from colleges or amateur ranks.
http://www.wordiq.com/definition/Draft_pick

agent does not have his salary matched by his current team and is signed by another team through an offer sheet.[7]

A rookie player's contract is considered as a two-way deal and throughout the duration a player can go from the American Hockey League (AHL) to the NHL and vice-versa without having to clear waivers. Entry level deals are automatically considered as two-way deals unless otherwise specified. Illustration of the compensation to a rookie playing in the AHL and the NHL is shown in Tables 3 and 4. As one can see in Table 3, as a team's salary rises, a rookie's salary increases marginally.

Buyouts is a new feature introduced in the 2005 CBA. During the 6 day period of July 23 to July 29, 2005 buyouts did not count against the cap. This was considered a one-shot deal. Any buyouts past that deadline count towards the salary cap. The following is an example of how a buyout works. If a player is aged 26 and under, he will be bought out at 1/3 his salary. If he is aged 26 and above, he will be bought out at 2/3 of his salary.[8] Teams need to be very careful in their buyout process, since this could hurt them in the long-run because they are paying a wage to a player that is no longer on their active roster, which represents a sunk cost.

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[7] The offer sheet amounts are courtesy of the (2005) NHL Collective Bargaining Agreement and are subject to change in the future, i.e. if a team's salaries increases by a certain percentage these figures will increase by the same percentage.

[8] Take for example if the Vancouver Canucks decide to buy out 29 year old Alexandre Burrows's contract. Burrows has signed a contract at $8M for 4 years which averages out to $2M a season, during the 2008-2009 NHL regular season, thus his contract is deemed to be effective for the following season. Suppose that the Vancouver Canucks are dissatisfied with his performance in the 2009-2010 NHL season and that they decide to buy him out at season's end. Due to his age being above 26 years, Burrows will get bought out at 2/3 of his salary. He has $6M spread over the next 3 seasons and since he is bought out, an extra 3 year term is imposed on the contract. The buyout would thus amount to $4M over the next 6 seasons. Vancouver would pay Burrows $666,666 for the 2010-2011 NHL season up to the 2015-2016 season.

The measures put forth in the 2005 CBA were designed to level the playing field among teams. Larger market teams with higher revenues can no longer pay outrageous salaries to attract talented players thus making teams more competitive. The CBA also sought to create incentives for younger players by increasing the base salary entering the NHL. How these changes impact the determinants of team success is the object of this analysis.

4 Data

In this section, I present the data and provide summary statistics. I describe team-level data that covers the 1999-2000 season through to the 2009-2010 season. These dates were selected to establish five year intervals before and after the 2004-2005 lockout. There are 30 teams in each season except for the 1999-2000 in which there were 28 teams. The Minnesota and Columbus expansion teams had not entered the league until the 2000-2001 season.

Data sources for team salaries were gathered from USA Today, a National American newspaper. The team's salaries, were deflated using the Consumer Price Index (CPI) which was obtained from the United States Bureau of Labor Statistics. Data for average attendance was found from the website NHLNUMBERS that provides player's salaries and team data for several seasons. Average attendance was calculated using total fan attendance throughout the whole season divided by the number of home games which is 41. Data for the lot of players in each of the categories: Star Forwards, Star Defencemen and Star Goaltenders was extracted from each of the team's respective websites. Goals For and Goals Against were taken from the NHL website. Finally,

Average Ticket Prices were found in Andrew's Dallas Star's Page, a website devoted to the latest hockey news and statistics. Proportion of attendance to capacity is defined as the ratio of the average attendance for a team divided by the capacity of the NHL arena.

Table 5 shows summary statistics for the full sample period, and also for the pre and post-lockout separately. As one can see in post-lockout, the goals scored increased has by 20, which automatically holds true for goals against. This is most likely the result of the rule changes after the NHL lockout, which discourages the "clutch and grab" style of game, promoting more speed, skill and goals among forwards and defencemen to some extent. It seems as though post-lockout, star players have increased in all three categories; since goals scored have increased it should come as no surprise that these categories have increased as well. For the goaltender category post-lockout, the mean is 0.293. Thus from the definition of a star mentioned in this paper, almost 1 in every 3.4 teams has a goaltender that has posted 35 wins and above compared to the approximate 1 in 6.5 teams pre-lockout.

According to Table 5, average attendance has increased post-lockout overall. Attendance relates to the "crowd" factor and may provide a psychological boost to a team. The opposite may also be true. At the same time average ticket price (AVG$TICK) has increased slightly by about $3 a ticket. This slight increase is likely due to the lockout, where teams initially offered lower ticket prices in order to re-establish interest in certain hockey markets and promote attendance. Initially we observe a decrease in the ticket prices, and then the ticket prices are gradually increasing. This would explain the higher variance in ticket prices.

The proportion of attendance to capacity has increased by almost 3 percentage points from 89.9% capacity pre-lockout to 92.8% in the post-lockout. This variable goes hand in hand with attendance, and thus higher average attendance leads to a higher probability of arenas selling out. Attendance for an NHL team varies from team to team. Some stadiums have larger capacities than others, some teams have a larger fan base. In order to measure how full a stadium is, the variable of interest used is a proportion of average attendance to capacity which I will represent as AVGATTEN/CAPACITY. Certain teams have made modifications to their arenas, pre-lockout, post-lockout and some during the lockout and this is taken into account indirectly.

Team salary is another variable to consider when determining team success. For teams salaries there is an increase in the post-lockout when compared to the pre-lockout by about $7M. As one can see in Table 5. the variance post-lockout is lower, indicating that there is less dispersion between the team salaries. The data in Table 5. shows that there is salary compression due to measures implemented through the new CBA. The regression analysis will be used to assess whether average attendance, average ticket prices, proportion of attendance to capacity and teams salaries have any barring on teams success.

Tables 6 and 7 depicts team salaries pre and post-lockout respectively, while Tables 8 and 9 illustrate the NHL's average attendance for the respective periods. In order to simplify the presentation I present both Tables 6 and 7 into Figures 1 to 6 organized by division.[9] The salary cap and salary floor are represented by the dashed

[9] Since 30 lines representing each team in a figure would be too cumbersome.

lines. For table 8 and 9 only the average NHL attendance during the 10 year period is presented in Figure 7.

Figure 1 shows team salaries for the Northeast Division. All teams are above the salary floor, which is reasonable. Although starting in the 2008-2009 season, Montreal and Ottawa are both above the cap. Since teams are allowed to exceed the cap only through LTIR and bonus cushions. Teams above the cap that do no qualify for the exception, have to pay a fine, although since the lockout no teams have had to pay any fines. Thus even if a team is slightly above the salary cap it still has some leverage. Montreal seems to trail off, while Ottawa continues its trend at spending above the salary cap. The Toronto Maple Leafs who were once considered a high payroll market pre-lockout seemed to have trailed off compared to their divisional counterparts post-lockout. This decrease in player salaries has left smaller market teams such as Ottawa and Montreal leading their respective division in payroll.

The team salaries for the Atlantic Division are displayed in Figure 2. New York City is the largest city in the United States, so it should not come as a surprise that it exhibits the largest payroll in the league. Both pre and post-lockout the Ranger's are leading their divisional counterparts in payroll. On the opposite end of the spectrum the lowly Islanders, have not met the salary floor for the past two seasons due to the condition of LTIR. This can be explained in part by the fact that recurring injuries to goaltender Rick DiPietro who makes $4.5M a season was on the LTIR. Pre-lockout the Pittsburgh Penguins had very low player salaries, which can be attributed to the fact that they were a weak team. Once they obtained Sidney Crosby and Evgeni Malkin in the

post-lockout drafts, Pittsburgh became more competitive and increased both in revenues through ticket sales and payroll. With the exclusion of the two New York franchises, there appears to be salary parity amongst Philadelphia, New Jersey and Pittsburgh.

Figure 3 depicts team salaries for the Southeast Division. The interesting situation exists with the Washington Capitals, who took a significant drop in salary from the 2003-2004 to the 2005-2006 season. The salary cap affected this team the most requiring it to shed about $30 million in payroll. In the post-lockout, one can see that Washington shows an increasing trend in its salaries due to having to pay their high priced talent. This includes the resigning of Alexander Ovechkin, Alexander Semin and Mike Green to new lucrative contracts as well as the signing of other free agents via free agency in order to stay competitive. The other four teams in this division seem to trend together and all show similar salary levels, thus exhibiting parity in this division.

The team salaries for the Pacific Division are shown in Figure 4. Pre-lockout it was the Dallas Stars that were considered to be the high payroll team of the division with a $15M gap ahead of the group. Los Angeles and Anaheim occupy the middle of the pack, San Jose and Phoenix are at the lower end of the salary scale. Post-lockout, all five teams in this division are within the salary floor and salary cap interval. The Pacific Division is a prime example of parity in the league, all five teams in the division are all relatively similar in salary. This illustrates that the intent of the salary cap has succeeded in this respect. Pre-lockout, with the exception of the Dallas Stars all of the team salaries in this division were all similar.

Figure 5 illustrates the team salaries for the Northwest Division. There seems to be no comparison between Colorado and there divisional counterparts pre-lockout. While there seems to be parity amongst the smaller market teams (Minnesota, Vancouver, Calgary and Edmonton) pre-lockout, Colorado continues to show an increase in player salaries on a year to year basis. Post-lockout Colorado's salaries were not as high, with the exception of the 2007-2008 season. There seems to be less deviation between the maximum salary and minimum salary of this division, suggesting that there is a greater degree of parity like the pacific division.

Figure 6 shows team salaries for the Central Division. Pre-lockout the Detroit Red Wings exhibit the most salary, followed by St Louis. It should be noted that the Detroit Red Wings have won 2 cups and have been to 3 cup finals during this period. After Detroit and St Louis, there is a big discrepancy in salaries versus the other teams. Nashville, Chicago and Columbus's payrolls were all similar to each other, but all 3 of these teams could not compete with Detroit and St Louis. Post-lockout Detroit had to shed a lot of salary and were among the teams most affected by the new CBA. There has been an improvement in parity among the five teams in this division.

Since all teams pay players in American dollars the figures do not need to be adjusted for parity. The figures clearly show the differences in salary gaps pre and post-lockout. Pre-lockout, there was usually one team in every division that was higher than the rest by a large margin. Also, there was a large gap between the highest paying team and the lowest paying team not only in a respective division but in the league as a whole. Post-lockout, the salary deviations were reduced through the implementation of the salary

cap and salary floor. While there are still some deviations between the larger market teams and smaller market teams, it is not to the same magnitude. The figures show an increase in parity in the NHL which was the intent of the new CBA. Due to greater parity, smaller market teams can now compete on a more even footing with their larger market counterparts.

Figure 7 shows the average attendance during the 10 year period. As each respective season represents a point on the figure, the 2004-2005 season represents a break in the data due to the lockout. In the pre-lockout, there is a peak in attendance in the 2001-2002 season, then a drop in the two subsequent years. Contrary to expectations, fans returned in full force in the 2005-2006 season with higher attendance figures than pre-lockout. When looking at the Post-lockout there is an upward trend in attendance, except in the 2009-2010 season. The drop in attendance in 2009-2010 could be attributed to the recession in the American and Canadian economies, where consumers had less available income to spend on entertainment in general.

5 Model and Methodology

In this section I examine the determinants of team success using two different measures of success requiring two different econometric approaches. The first measure (model 1) accounts for a team making the playoffs or not. The second measure accounts for a team making the next round in the playoffs (model 2).

Model 1

The model takes the following form:

$$Success_{it} = \beta_0 + \beta_1 GF_{it} + \beta_2 GA_{it} + Z1_{it}\gamma + Z2_{it}\psi + \varepsilon_{it} \quad (1)$$

Where *Success*$_{it}$ equals 1 if team i makes the playoffs in season t and 0 otherwise. *GF*$_{it}$, is the amount of goals scored by a team during the regular season, *GA*$_{it}$ is the goals against a team has given up during the regular season.

$Z1_{it}$ is an explanatory variable vector composed of average attendance during the course of the regular season. This attendance encompasses over 41 home games during the regular season, the average ticket price at the box-office and the proportion of attendance to a stadiums capacity.

$Z2_{it}$ is also composed of an explanatory variable vector divided into three categories: Star Forwards which represents the amount of stars that play the left wing, right wing and center positions on a team, Star Defencemen which represents both left and right defence positions, and Star Goaltenders. Further refinement for each category includes the following: for Star Forwards, a forward must produce on average 3 points every 4 games or (0.75pts/gp), for defencemen they must produce at least 1 point every 2 games or (0.50pts/gp) and lastly for goaltenders they must achieve 35 wins during the regular season to achieve star status. It is impossible for a team to have 2 star goaltenders due to the constraint of an 82 game schedule. I introduce team salaries in an extension in Table 18. which is not part of my original model thus the variable is not included.

The error term, ε_{it}, can be presented as:

$$\varepsilon_{it} = \eta_i + \omega_{it} \quad (2)$$

where the first term, η_i, is the unobserved time invariant heterogeneity (i.e fixed effects) and the second term ω_{it} is the remaining unobserved factors that affect a team success. These fixed effects will account for something that is team specific and does not change over time. For example, some teams may have consistently better management than others. The fact that the Detroit Red Wings have consistently better management than the Atlanta Thrashers cannot be observed in the data. If we omit such time invariant heterogeneity, and better management affects team success and its correlated with any of the explanatory variables then an endogeneity problem exists.

I will be approaching this analysis in a four step sequential manner. In step 1, I only include Goals For (GF) and Goals Against (GA) as explanatory variables. In step 2, I add the $Z1_{it}$ vector, while step 3 includes all the explanatory variables including $Z2_{it}$.[10] In the last step, I include team-level fixed effects.

Given that the dependent variable is binary, equation (1) is a linear probability model (LPM). Equation (1) will be used to obtain the population parameters of interest, $\beta_1, \beta_2, \beta_3, \gamma, \Psi$ which represents the marginal effects, i.e. how a change in the explanatory variable affects the probability of a team making the playoffs. For example GF if β_1=0.01 then the interpretation is that an increase in 1 goal scored during the regular season increases the probability of making the playoffs by 1%, i.e.

$$\frac{\delta \Pr[Success = 1 \mid GF_{it}, GA_{it}]}{\delta GF_{it}} = \beta_1 \quad (3)$$

[10] I will use the same four step approach for all subsequent empirical analysis.

There are advantages and disadvantages to using a LPM (as opposed to a probit model). The key advantage is that one can include the fixed effects and still have interpretable marginal effects. If one includes fixed effect in a probit/logit model, one can recover the parameters, i.e. $\beta_1, \beta_2, \beta_3$, but not the marginal effects. I believe that accounting for unobserved time-invariant heterogeneity (with fixed-effects) is critical in this paper.[11] I further address these issues in Section 7.

Model 2

The definition of team success used in model 1 can be expanded to a team making it into further rounds of the playoffs. This linear model is constructed to examine the data in this light. It is important to do so as some teams may just make it into the playoffs by chance. Therefore this is not a true measure of success. How deep a team goes into the playoffs is a better measure of team success. This regression equation is the same as (1). The only difference is where the dependent variable $Success_{it}$ equals 0 if the team *i* misses the playoffs, 1 if team *i* makes the playoffs, equals 2 if team *i* makes round 2, equals 3 if team *i* makes round 3, equals 4 if team *i* makes the finals, equals 5 if team *i* wins the Stanley Cup. We are no longer dealing with a binary dependent variable. An alternative approach would have been to use an ordered probit model. However, I believe one must account for unobserved time-invariant heterogeneity. As with the probit, the ordered probit cannot account for such fixed effects.

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[11] There are many factors that are team specific that are not observed, i.e. more advanced scouting, better management and coaching are one of many.

6 Results

In this section I discuss the results of the overall sample where model 1 represents making the playoffs or not and model 2 represents making the next round. Furthermore, I assess the impact the new CBA has had on team success and whether there are significant differences in the determinants of success pre and post-lockout.

Model 1 Results - Overall Sample

The marginal effects for teams making the playoffs or not is shown in Table 10. The variable GF, is positively correlated with team success and as we add controls this variable remains similar and robust. This result is not surprising, as a team that scores more goals has a higher chance of making the playoffs. An increase in one extra goal results in an increase in probability of a team making the playoffs by 0.009 or 0.9 percentage point increase. The variable exhibits both statistical and economic significance, which is what I would expect.

For GA there is a negative correlation with respect to team success. As a team gives up one additional goal during the regular season it's chances of making the playoffs decreases by 0.9 percentage points. A higher GA goes hand in hand with losing games, and thus reduces team success. The results depicted in Table 10 for GA are both similar and robust to the different specifications. GA is both economically and statistically significant, which is to be expected.

The analysis shows that average attendance (AVGATTEN) has a negative effect on team success. This is counter-intuitive possibly because average attendance figures

can be skewed because it is impossible to distinguish supporters of the home team from the road team. Generally, teams with a larger fan base attract higher average attendance. Although this does not guarantee that a team will make the playoffs. When adjusting the AVGATTEN variable using controls, the results do not change much. As we control for fixed effects there is a negative correlation, which is surprising. Since AVGATTEN is measured in thousands, as we add 1000 fans the probability of making the playoffs decreases by 2%. When adjusting for fixed effects this probability decreases to 10%. This variable is not statistically or economically significant which is surprising.

The variable, average ticket price (AVG$TICK), exhibits a positive correlation with a team making the playoffs. If a team has clinched a playoff spot, owners may increase ticket prices. It is not significant economically or statistically even when we added controls. As ticket prices increase by $1, team success increases by 0.02%. This is not surprising since one would expect ticket prices to rise when a team makes the playoffs.

Proportion of Attendance to Capacity (Prop Capacity) is positively correlated with team success. This variable is a ratio from 0 to 100. It is statistically significant at the 10% level only when applying fixed effects. However, it is not economically significant as a one unit increase in Prop Capacity increases team success by 0.33%. An arena with a large number of empty seats can affect the outcome of a game. Thus this variable relates to team morale influencing team success.

As we look at the importance of star players in a hockey game, all three categories positively correlate with team success. When adjusting for fixed effects the sign for SF changes to negative while it remains the same for SD and SG. The results for these variables are not significant economically and statistically.

Model 1 Pre and Post-Lockout Comparison

When analyzing the effect of the lockout, it is necessary to compare the differences between pre and post-lockout. Table 12 and Table 14 demonstrate the marginal effects for making the playoffs in both periods. One can interpret the variable Goals For pre-lockout as follows; an increase in one extra goal results in an increase in a team's probability of making the playoffs by 0.01 or 1 percentage point. When comparing the value to post-lockout a team's probability of making the playoffs is 0.008 or 0.8 percentage points. As we control for fixed effects values pre and post are stable, it does not come as a surprise that Goals For is less significant post-lockout. Table 9 shows that Goals For has increased post-lockout. Thus the effect of one individual goal on team performance is less significant post-lockout than pre-lockout. Since goals for and against are higher post-lockout, the marginal effect of one extra should mean less than pre-lockout.[12] Both values are statistically and economically significant which is to be expected.

For Goals Against, when examining the coefficients pre and post-lockout one can see that as a team gives up 1 more goal, it decreases the probability of making the

[12] In the analysis pre-lockout goals for was 218.77 thus one extra goal scored represents 1/218.77, post-lockout there were 238.89 goals scored which represents 1/238.89 at the margin. Since the value at the margin pre-lockout is greater than post-lockout, it makes sense to conclude that the effect of one individual goal on team performance is less significant post-lockout than pre-lockout.

playoffs by 0.007 which translates to 0.7 percentage points in the pre-lockout and 1 percentage point post-lockout. When this variable is subject to other variables and fixed effects enter into the model, goals against remains stable. It is interesting to note that GF has a greater effect pre-lockout while GA has a greater effect post-lockout. This is interesting since we would expect them to move together in the same time period. GA in both pre and post-lockout has economic and statistical significance which is to be expected.

When examining Table 12 pre-lockout, the coefficient for average attendance is negative even when we add controls and fixed effects, while for post-lockout in Table 14 the coefficient is positive. This could be due to the fact that the league has stimulated interest in smaller market teams, which contributed to this change. However, this change is not economically or statistically significant in both cases. All other results in these tables are quite negligible. There does not appear to be any significant differences between the explanatory variables pre and post-lockout in making the playoffs or not.

Model 2 Results - Overall Sample

Marginal effects for making the next round are presented in Table 11. In this table the dependent variable of team success is adjusted to 0 if the team has missed the playoffs, 1, 2 or 3 for each successive round, 4 if the team makes the finals and 5 if they win the Stanley Cup. For Goals For, there is an increase from Table 10 in all 4 columns. One can interpret this variable as follows, an increase in one extra goal results in an increase in a team's probability of making the playoffs by 0.02. This can be re-written more formally as an increase in 1 goal results in a 2.1 percentage point increase in the

next round. This value in Table 11 appears to have more than doubled than that in Table 10. It is definitely statistically and economically significant. The more goals a team scores the higher the probability of the team advancing in the playoffs.

For GA, the results are similar to GF. All values tend to hover around the same value even when we add controls. The one difference between the two variables is the sign of the coefficient, GF is positive and GA is negative. The analysis shows that the more goals a team scores and the fewer goals scored upon them are determinants for team success.

For average attendance, the sign of the coefficient is now positive, thus as teams succeed further in the playoffs, average attendance goes up. This is to be expected since fans will attend more games if their team wins. When adding fixed effects one can interpret that an extra 1000 fans increases a team's chances of making the next round by 19.6% which is economically significant. This value is not statistically significant though. As we look at the other explanatory variables in the table, one can see that the sign of the coefficient for Prop Capacity has been reversed. The variables AVG$TICK, PROPCAP, SF, SD and SG do not have economical nor statistical significance as demonstrated in Table 10.

Model 2 Pre and Post-Lockout Comparison

The marginal effects of a team making the next round pre and post-lockout are examined in Tables 13 and 15. Both GF and GA exhibit similar values for both periods and remain consistent as we add new variables and control for fixed effects. Where the

significant change lies is within the AVGATTEN variable. When controlling for fixed effects we obtain 1.32 for post-lockout. One can interpret this as for every increase in 1000 fans, team success increases by 132%. When compared to pre-lockout team success would decrease by 67.1% for every 1000 fans. These results seem extremely significant economically and as shown through the p-value post-lockout this variable is significant with 95% confidence. The variable AVG$TICK exhibits a positive correlation in the pre-lockout period even when adding more variables and controlling for fixed effects. In the second step in the estimation AVG$TICK is significant with 90% confidence. In the post-lockout the opposite occurs where the correlation between the variables are all negative. This is surprising since as teams advance to the next round, they are able to raise their ticket prices in order to make more profit. The variables Prop Capacity, SF, SD and SG all have no economic and statistical significance.

7 Robustness Check

In this section, I examine how sensitive my results are with the econometric models. Instead of using the linear probability and linear models one could have used a probit and ordered probit technique. I will be comparing the strengths and weaknesses of both models and examining if there is a difference empirically.

The problem with using the LPM is that it does not guarantee that the probabilities will be between zero and one. A probability model however, ensures that the probability is bounded. The probit model can be written as the following:

$$\Pr[Success = 1 \mid X] = \phi(X\beta) \quad (4)$$

where X is the same vector of controls as equation (1), and $\phi(.)$ is the cumulative normal probability distribution. The probit model differs from the LPM in that when calculating the marginal effects the following is obtained:

$$\frac{\delta \Pr[Success_{it} = 1 \mid GF_{it}, GA_{it}]}{\partial GF_{it}} = \phi(\beta_0 + \beta_1 GF_{it} + \beta_2 GA_{it})\beta_1 \quad (5)$$

Table 16 compares the results of using a LPM and a probit model using the specification that has all explanatory variables (except for the fixed effects). Although GF and GA both double in magnitude, the significance is the same. The other explanatory variables do not exhibit much more significance when compared to the LPM.

A disadvantage of the probit model, is that it is not straightforward to include fixed effects, it makes the marginal effects of these results very difficult to interpret. This is particularly the case when we proceed to the richer model. The reason why we use the LPM, is because there is something specific amongst the NHL teams, that differentiates one from the other. We therefore cannot introduce fixed effects which is the reason why I am not using the probit as my main specification.

As a robustness check I estimate an ordered probit for the model where the dependent variable can take 6 possible outcomes. An advantage of the ordered probit (as was the case for the probit model) is that the probability is bounded between zero and one. It also allows the thresholds to be at irregular intervals which the linear model does

not. Assuming regular intervals is not a very strict assumption for my analysis; because we are talking about making it to one more round.[13]

A key disadvantage of the ordered probit as with the probit model is that it makes the results difficult to interpret when using fixed effects. One can recover the $\beta_1, \beta_2, \beta_3$ but not the marginal effect which is the object of interest in this paper. Table 17 compares the results using the linear model and the ordered probit model. The same analysis is conducted with the linear model and the ordered probit, and the results are quite similar to each other. Both the probit and the ordered probit were examined pre and post-lockout, and since there wasn't much difference between the linear probability and the linear model, a collection of the whole sample was sufficient.

8 Conclusion

There are three main conclusions to be drawn from this analysis. First, there are some differences between the pre and post-lockout results. For example, the goals for and goals against effect is half the size in the post-lockout period. The implementation of the 2005 CBA set the stage for rule changes that affect the way the game is played. These rule changes resulted in greater advantage to forwards and defencemen with speed, skill resulting in more goals. However, there is very little difference when looking at star categories and proportion of attendance to capacity. Second, goals for and goals against are the only variables that are systematically important (both economically and

[13] Unlike for example in job security literature, where there are questions on the level of job security where 0, represents you are not worried about losing your job, 1 you are worried a little bit, and 2 you are very worried about losing your job. There is a small gap between 0 and 1 but when comparing 1 and 2 there is a significant gap.

statistically) throughout the regression analysis; goals for has a positive effect on team success, while goals against has a negative effect. These results are robust to the choice of specification, i.e. when I add such variable as: average attendance, average ticket price, proportion of attendance to capacity, star forwards, star defencemen and star goaltenders. Finally, controlling for unobserved time-invariant heterogeneity (by including fixed effects) does not materially affect my findings.

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Table 1. A Draft Pick's First NHL Contract with Conditions For Games Played

	1	2	3	4
Age	18	19	20	21
Games Played	<10	Signed	Signed	Signed
	≥10	Signed	Signed	RFA

Table 2. Compensation and Offer Sheet Amounts

Offer Sheet	Compensation
< $660,000	None
[$660,000-$1,000,000)	3rd Round Pick
[$1,000,000-$2,000,000)	2nd Round Pick
[$2,000,000-$3,000,000)	1st and 3rd Round Picks
[$3,000,000-$4,000,000)	1st, 2nd and 3rd Round Picks
[$4,000,000-$5,000,000)	(2) 1st, 2nd and 3rd Round Picks
>$5,000,000	(4) 1st Round Picks

Table 3. The Minimum Salary Evolution For a Rookie Playing in the NHL

Draft Year	Compensation
2005	$850,000
2006	$850,000
2007	$875,000
2008	$875,000
2009	$900,000
2010	$900,000
2011	$925,000
2012	$925,000

Table 4. Rookie Compensation on a 2-way Contract

Year	Compensation
2005	$62,500
2006	$62,500
2007	$65,000
2008	$65,000
2009	$67,500
2010	$67,500
2011	$70,000
2012	$70,000

Table 5. Summary Statistics of Means and Standard Deviations for both Pre and Post-Lockout

	Pre-lockout (1)	Post-lockout (2)	Both (3)
Goals For	218.77	238.89	228.90
	(26.21)	(25.48)	(27.70)
Goals Against	219.45	239.28	229.43
	(30.70)	(27.67)	(30.81)
Star Forwards	2.24	2.74	2.49
	(1.39)	(1.40)	(1.42)
Star Defencemen	0.78	1.09	0.94
	(0.75)	(0.87)	(0.83)
Star Goaltender	0.16	0.29	0.26
	(0.36)	(0.46)	(0.42)
AVGATTEN (in thousands)	16.58	17.16	16.87
	(2.17)	(2.16)	(2.18)
AVG$TICK (in dollars)	44.05	46.81	45.45
	(8.74)	(12.01)	(10.59)
PROPCAP	89.98	92.79	91.40
	(11.12)	(9.51)	(10.42)
Team Salaries	37.95	44.42	41.21
	(14.64)	(9.65)	(12.78)
N (observations)	148	150	298

Note: The standard deviations are in parentheses. Pre-lockout data is based on the years 1999-2004. Data for 2004-2005 is not included since it was the year of the lockout, post-lockout is based on the years 2005-2010.

Table 6. National Hockey League Team Salaries Pre-Lockout

Teams	Salaries ($Millions)				
	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004
Anaheim	35.1	28.4	35.0	**45.5**	53.3
Atlanta	16.7	17.8	15.2	23.0	28.5
Boston	24.5	31.9	41.9	44.1	46.6
Buffalo	30.9	38.7	28.9	28.3	33.0
Calgary	21.6	26.5	26.9	32.2	**36.4**
Carolina	27.1	32.5	**32.0**	33.1	35.9
Chicago	32.4	29.7	41.5	35.3	30.9
Colorado	41.5	♦**51.7**	59.5	62.9	63.4
Columbus	-	18.3	20.0	26.7	34
Dallas	**42.3**	50.1	48.7	69.6	68.6
Detroit	43.4	55.1	♦**66.6**	68.4	77.9
Edmonton	24.0	25.1	24.3	27.9	33.4
Florida	33.3	32.5	29.9	21.5	26.1
Los Angeles	34.6	34.6	39.7	37.4	53.8
Minnesota	-	11.7	16.8	20.7	27.2
Montreal	33.8	26.5	41.3	42.0	38.9
Nashville	16.6	18.4	18.7	23.9	21.9
New Jersey	♦**31.3**	**39.2**	43.1	♦**56.1**	48.9
New York I	18.1	23.4	33.7	37.0	40.9
New York R	59.4	56.9	64.8	76.5	76.5
Ottawa	21.7	29.1	27.2	34.3	39.6
Philadelphia	50.3	40.9	56.4	65.2	68.2
Phoenix	31.0	34.6	31.9	35.9	39.3
Pittsburgh	30.3	33.7	34.1	24.4	23.4
San Jose	37.6	42.1	48.6	37.5	34.5
St Louis	32.6	47.1	57.4	68.7	61.7
Tampa Bay	19.0	18.0	27.4	29.5	♦**34.1**
Toronto	34.0	41.0	51.6	65.1	62.5
Vancouver	34.0	24.7	30.0	34.1	42.1
Washington	28.3	41.3	47.4	51.4	50.9

Note: The bold entry represents a team making the Stanley Cup finals, while the additional symbol ♦ represents the Stanley Cup winner. There are no data for Minnesota and Columbus for the 1999-2000 season because they only joined the league as expansion franchises in the 2000-2001 season.

Table 7. National Hockey League Teams Salaries Post-Lockout

Teams	Salaries ($Millions)				
	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010
Anaheim	32.1	**♦40.5**	50.8	49.8	55.2
Atlanta	37.2	37.6	36.6	34.3	41.8
Boston	36.7	43.7	49.5	51.5	53.3
Buffalo	28.5	40.0	46.0	52.2	54.5
Calgary	36.6	45.8	50.9	63.1	60.4
Carolina	**♦35.3**	39.0	50.0	49.1	40.1
Chicago	30.1	38.5	34.8	51.6	61.0
Colorado	41.0	38.0	61.3	51.9	**♦46.7**
Columbus	30.1	36.9	28.0	52.3	43.9
Dallas	40.7	43.9	49.4	55.6	45.5
Detroit	39.6	39.9	**♦44.6**	**56.4**	61.7
Edmonton	**38.5**	42.3	46.9	54.1	50.8
Florida	26.5	37.6	39.7	51.4	42.3
Los Angeles	37.9	40.7	40.5	36.1	53.3
Minnesota	25.2	39.5	46.2	52.9	44.5
Montreal	33.0	43.6	42.3	58.9	55.1
Nashville	31.7	43.0	30.3	44.2	47.8
New Jersey	44.9	49.6	47.6	55.7	57.7
New York I	31.5	37.8	39.0	33.3	31.6
New York R	41.5	45.1	56.7	66.1	63.9
Ottawa	36.9	**43.6**	50.0	59.8	63.0
Philadelphia	42.6	43.8	57.0	60.5	**58.2**
Phoenix	30.4	37.0	35.7	39.1	49.0
Pittsburgh	23.1	26.3	**41.4**	**♦56.6**	56.9
San Jose	31.0	43.9	41.5	55.8	56.3
St Louis	28.5	33.7	39.0	45.5	46.5
Tampa Bay	39.2	41.9	39.0	43.5	42.9
Toronto	36.8	43.3	46.5	48.8	51.2
Vancouver	43.7	42.9	45.7	53.1	60.8
Washington	18.9	29.7	44.3	58.5	56.1

Note: The bold entry represents a team making the Stanley Cup finals, while the additional symbol ♦ represents the Stanley Cup winner. There are no data for Minnesota and Columbus for the 1999-2000 season because they only joined the league as expansion franchises in the 2000-2001 season.

Table 8. Average NHL Attendance per Team Pre-Lockout

Teams	Average Attendance				
	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004
Anaheim	14,460	13,499	12,002	13,988	14,987
Atlanta	17,206	15,262	13,668	13,476	15,121
Boston	16,322	15,432	15,403	15,029	15,133
Buffalo	17,955	17,839	17,206	13,776	15,290
Calgary	15,320	16,622	15,718	16,239	16,579
Carolina	12,400	13,355	15,508	15,682	12,330
Chicago	16,274	14,996	15,568	14,794	13,253
Colorado	17,889	18,007	18,007	18,007	18,007
Columbus	-	17,457	18,136	17,744	17,369
Dallas	17,001	17,001	18,532	20,058	18,355
Detroit	19,983	19,995	20,058	20,058	20,066
Edmonton	15,800	15,611	16,592	16,657	17,677
Florida	15,981	14,679	16,074	15,428	15,936
Los Angeles	16,518	16,057	16,756	17,569	17,889
Minnesota	-	18,328	18,455	18,500	18,530
Montreal	20,205	20,105	20,027	20,672	20,555
Nashville	16,599	15,767	14,788	13,228	13,157
New Jersey	15,206	15,642	15,925	14,858	15,059
New York I	9,748	11,332	14,548	14,930	13,693
New York R	18,200	18,200	18,038	18,148	18,080
Ottawa	17,508	17,793	16,919	17,198	17,758
Philadelphia	19,634	19,575	19,569	19,325	19,375
Phoenix	14,991	14,224	13,165	13,229	15,467
Pittsburgh	15,443	16,277	15,649	14,750	11,877
San Jose	17,290	17,468	17,422	17,350	15,835
St Louis	18,590	19,519	18,968	18,570	18,560
Tampa Bay	13,600	14,906	15,722	16,545	17,820
Toronto	19,158	19,257	19,279	19,240	19,376
Vancouver	14,641	17,026	17,712	18,396	18,630
Washington	14,485	15,534	17,341	15,787	14,720

Note: There are no data for Minnesota and Columbus for the 1999-2000 season because they only joined the league as expansion franchises in the 2000-2001 season.

Table 9. Average NHL Attendance per Team Post-Lockout

Teams	Average Attendance				
	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010
Anaheim	15,131	16,389	17,193	16,990	15,168
Atlanta	15,550	16,240	15,831	14,626	13,607
Boston	16,211	14,764	15,384	17,039	17,388
Buffalo	16,886	18,690	19,950	18,531	18,529
Calgary	19,289	19,289	19,289	19,289	19,289
Carolina	15,596	17,386	16,633	16,572	15,240
Chicago	13,318	12,727	16,814	22,247	21,536
Colorado	18,007	17,612	16,842	15,429	13,947
Columbus	16,796	16,401	14,823	15,543	15,416
Dallas	17,828	17,914	18,038	17,680	17,215
Detroit	20,064	20,066	18,870	19,865	19,546
Edmonton	16,832	16,839	16,839	16,839	16,839
Florida	16,014	15,370	15,436	15,621	15,146
Los Angeles	17,839	16,859	16,606	16,488	17,313
Minnesota	18,575	18,543	18,568	18,568	18,415
Montreal	21,273	21,273	21,273	21,273	21,273
Nashville	14,428	15,259	14,910	15,010	14,979
New Jersey	14,230	14,176	15,564	15,790	15,546
New York I	12,609	12,886	13,640	13,773	12,735
New York R	18,142	18,200	18,200	18,172	18,076
Ottawa	19,474	19,372	19,821	18,949	18,269
Philadelphia	19,653	19,282	19,556	19,545	19,535
Phoenix	15,582	14,988	14,820	14,875	11,989
Pittsburgh	15,804	16,424	17,076	16,975	17,078
San Jose	16,831	17,422	17,411	17,488	17,558
St Louis	14,213	12,520	17,610	18,554	18,883
Tampa Bay	20,509	19,876	18,692	16,497	15,497
Toronto	19,408	19,487	19,434	19,312	19,260
Vancouver	18,630	18,630	18,630	18,630	18,810
Washington	13,905	13,929	15,472	18,097	18,277

Note: There are no data for Minnesota and Columbus for the 1999-2000 season because they only joined the league as expansion franchises in the 2000-2001 season.

Table 10. Marginal Effects for Making the Playoffs or Not

	[1]	[2]	[3]	[4]
GF	0.0088*** (0.0007)	0.0089*** (0.0007)	0.0081*** (0.0010)	0.0078*** (.0012)
GA	-0.0090*** (0.0006)	-0.0091*** (0.0006)	-0.0087*** (0.0007)	-0.0089*** (0.0008)
AVGATTEN	-	-0.0215 (0.0182)	-0.0192 (0.0183)	-0.1067 (0.0655)
AVG$TICK	-	0.0030 (0.0019)	0.0026 (0.0019)	0.0011 (0.0025)
PROPCAP	-	0.0033 (0.0038)	0.0031 (0.0038)	0.0208* (0.0120)
SF	-	-	0.0041 (0.0182)	-0.0003 (0.0200)
SD	-	-	0.0245 (0.0266)	0.0193 (0.0290)
SG	-	-	0.0716 (0.0500)	0.0845 (0.0551)
Constant	0.5894*** (0.2184)	0.5089* (0.2715)	0.5461* (0.3006)	0.9652** (0.4515)
Fixed Effects	No	No	No	Yes
R2	0.5719	0.5772	0.5819	0.6276
N	298	298	298	298

Note: The standard errors are in parentheses. *10% significance, **5% significance and ***1% significance.

Table 11. Marginal Effects for Making the Next Round

	[1]	[2]	[3]	[4]
GF	0.0207*** (0.0021)	0.0209*** (0.0023)	0.0192*** (0.0032)	0.0198*** (0.0036)
GA	-0.0196*** (0.0019)	-0.0198*** (0.0019)	-0.0196*** (.0021)	-0.0204*** (0.0024)
AVGATTEN	-	0.0303 (0.0554)	0.0322 (0.0558)	0.1965 (0.1972)
AVG$TICK	-	0.0031 (0.0057)	0.0029 (0.0058)	0.0027 (0.0075)
PROPCAP	-	-0.0088 (0.0115)	-0.0095 (0.0116)	-0.0304 (0.0361)
SF	-	-	0.0336 (0.0556)	-0.0126 (0.0600)
SD	-	-	0.0383 (0.0812)	0.0040 (0.0872)
SG	-	-	0.0261 (0.1529)	-0.0943 (0.1659)
Constant	0.8187 (0.6608)	0.9428 (0.8257)	1.2092 (0.9183)	0.0539 (1.3597)
Fixed Effects	No	No	No	Yes
R2	0.4276	0.4292	0.4305	0.5068
N	298	298	298	298

Note: The standard errors are in parentheses. *10% significance, **5% significance and ***1% significance.

Table 12. Marginal Effects for Making the Playoffs or Not, Pre-Lockout

	[1]	[2]	[3]	[4]
GF	0.0101*** (0.0010)	0.0097*** (0.0011)	0.0096*** (0.0015)	0.0089*** (0.0021)
GA	-0.0070*** (0.0009)	-0.0072*** (0.0009)	-0.0066*** (0.0010)	-0.0071*** (0.0015)
AVGATTEN	-	-0.0329 (0.0245)	-0.0284 (0.0248)	-0.0547 (0.1814)
AVG$TICK	-	0.0052* (0.0031)	0.0044 (0.0031)	0.0013 (0.0052)
PROPCAP	-	0.0054 (0.0048)	0.0054 (0.0048)	0.0124 (0.0330)
SF	-	-	-0.0159 (0.0262)	-0.0158 (0.0327)
SD	-	-	0.0342 (0.0405)	0.0398 (0.0481)
SG	-	-	0.0838 (0.0819)	0.0943 (0.0991)
Constant	-0.1230 (0.3434)	-0.1730 (0.4179)	-0.3097 (0.4782)	-0.0361 (1.0102)
Fixed Effects	No	No	No	Yes
R2	0.6058	0.6187	0.6248	0.6721
N	148	148	148	148

Note: The standard errors are in parentheses. *10% significance, **5% significance and ***1% significance.

Table 13. Marginal Effects for Making the Next Round, Pre-Lockout

	[1]	[2]	[3]	[4]
GF	0.0198*** (0.0033)	0.0195*** (0.0035)	0.0177*** (0.0048)	0.0232*** (0.0061)
GA	-0.0183*** (0.0028)	-0.0187*** (0.0029)	-0.0186*** (0.0032)	-0.0189*** (0.0043)
AVGATTEN	-	0.0311 (0.0766)	0.0277 (0.0780)	-0.6710 (0.5342)
AVG$TICK	-	0.0166* (0.0096)	0.01601 (0.0098)	0.0110 (0.0153)
PROPCAP	-	-0.0125 (0.0149)	-0.0114 (0.0152)	0.1248 (0.0973)
SF	-	-	0.0468 (0.0823)	-0.0206 (0.0963)
SD	-	-	-0.0484 (0.1274)	-0.0836 (0.1417)
SG	-	-	0.1711 (0.2576)	-0.1058 (0.2919)
Constant	0.7290 (1.0707)	0.7466 (1.3083)	1.0219 (1.5045)	1.4349 (2.9755)
Fixed Effects	No	No	No	Yes
R2	0.4424	0.4564	0.4598	0.5861
N	148	148	148	148

Note: The standard errors are in parentheses. *10% significance, **5% significance and ***1% significance.

Table 14. Marginal Effects for Making the Playoffs or Not, Post-Lockout

	[1]	[2]	[3]	[4]
GF	0.0080*** (0.0011)	0.0081*** (0.0012)	0.0075*** (0.0016)	0.0076*** (0.0019)
GA	-0.0109*** (0.0010)	-0.0108*** (0.0010)	-0.0105*** (0.0012)	-0.0108*** (0.0015)
AVGATTEN	-	0.0020 (0.0279)	0.0030 (.0282)	0.1326 (0.2112)
AVG$TICK	-	0.0010 (0.0026)	0.0009 (0.0030)	0.0009 (0.0043)
PROPCAP	-	-0.0003 (0.0062)	-0.0007 (0.0063)	-0.0266 (0.0392)
SF	-	-	0.0078 (0.0261)	0.0020 (0.0303)
SD	-	-	0.0231 (0.0359)	-0.0117 (0.0451)
SG	-	-	.03822 (0.0687)	0.0322 (0.0842)
Constant	1.2205*** (0.3620)	1.1489*** (0.4629)	1.1731** (0.5176)	1.3342 (0.9372)
Fixed Effects	No	No	No	Yes
R2	0.5642	0.5648	0.5674	0.6745
N	150	150	150	150

Note: The standard errors are in parentheses. *10% significance, **5% significance and ***1% significance.

Table 15. Marginal Effects for Making the Next Round, Post-Lockout

	[1]	[2]	[3]	[4]
GF	0.0226*** (0.0032)	0.0214*** (0.0037)	0.0201*** (0.0048)	0.0192*** (0.0056)
GA	-0.0209*** (0.0030)	-0.0206*** (0.0031)	-0.0210*** (0.0035)	-0.0249*** (0.0044)
AVGATTEN	-	0.0299 (0.0843)	0.0300 (0.0851)	1.3296** (0.6357)
AVG$TICK	-	-0.0043 (0.0077)	-0.0050 (0.0079)	-0.0018 (0.0131)
PROPCAP	-	-0.0009 (0.0187)	-0.0018 (0.0189)	-0.2507** (0.1180)
SF	-	-	0.0098 (0.0789)	-0.0158 (0.0910)
SD	-	-	0.0862 (0.1083)	-0.1278 (0.1356)
SG	-	-	-0.0900 (0.2075)	-0.2208 (0.2533)
Constant	0.6455 (1.0936)	0.6028 (1.3973)	1.0517 (1.5627)	-0.1583 (2.8210)
Fixed Effects	No	No	No	Yes
R2	0.4173	0.4191	0.4223	0.5681
N	150	150	150	150

Note: The standard errors are in parentheses. *10% significance, **5% significance and ***1% significance.

Table 16. Linear Probability and Probit Comparisons

	[1]	[2]
GF	0.0081*** (0.0010)	0.0208*** (0.0033)
GA	-0.0087*** (0.0007)	-0.0217*** (0.0027)
AVGATTEN	-0.0192 (0.0183)	-0.0375 (0.0411)
AVG$TICK	0.0026 (0.0019)	0.0047 (0.0048)
PROPCAP	0.0031 (0.0038)	0.0072 (0.0084)
SF	0.0041 (0.0182)	0.0258 (0.0452)
SD	0.0245 (0.0266)	0.1011 (0.0596)
SG	0.0716 (0.0500)	0.0380 (0.1193)
R2	0.5819	0.6363
N	298	298

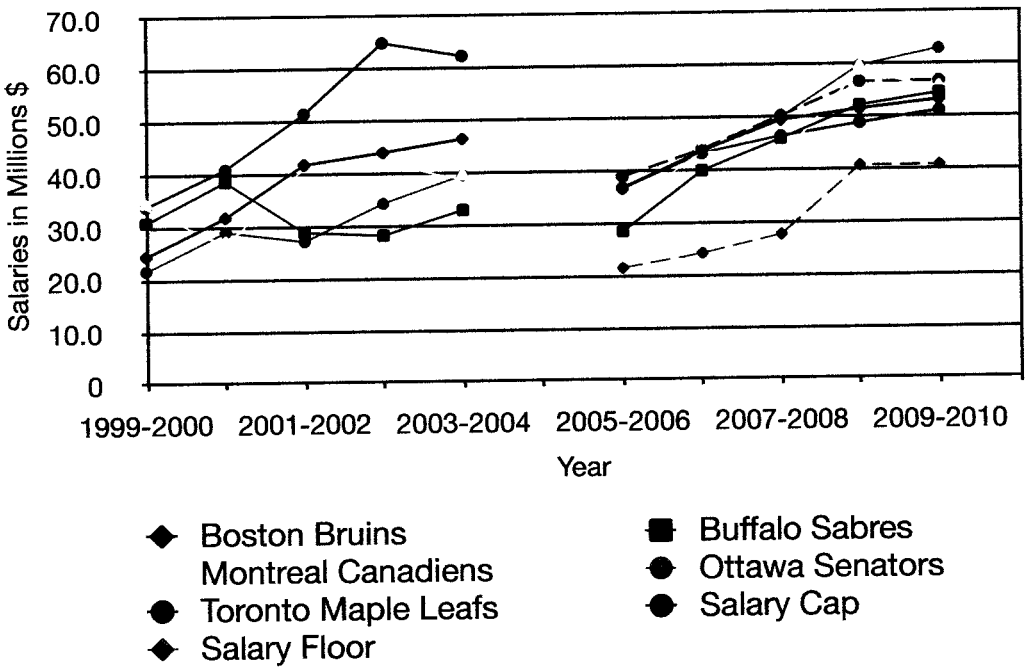
Table 17. Linear and Ordered Probit Comparisons

	[1]	[2]
GF	0.0192*** (0.0032)	0.0293*** (0.0041)
GA	-0.0196*** (.0021)	-0.0344*** (0.0034)
AVGATTEN	0.0322 (0.0558)	-0.0096 (0.0674)
AVG$TICK	0.0029 (0.0058)	0.0033 (0.0077)
PROPCAP	-0.0095 (0.0116)	0.0053 (0.0144)
SF	0.0336 (0.0556)	0.0527 (0.0669)
SD	0.0383 (0.0812)	0.0287 (0.0972)
SG	0.0261 (0.1529)	-0.0002 (0.1684)
R2	0.4305	0.2902
N	298	298

Table 18. A Comparison Between Fixed Effects and Not
-An extension of the model with team salaries adjusted with CPI

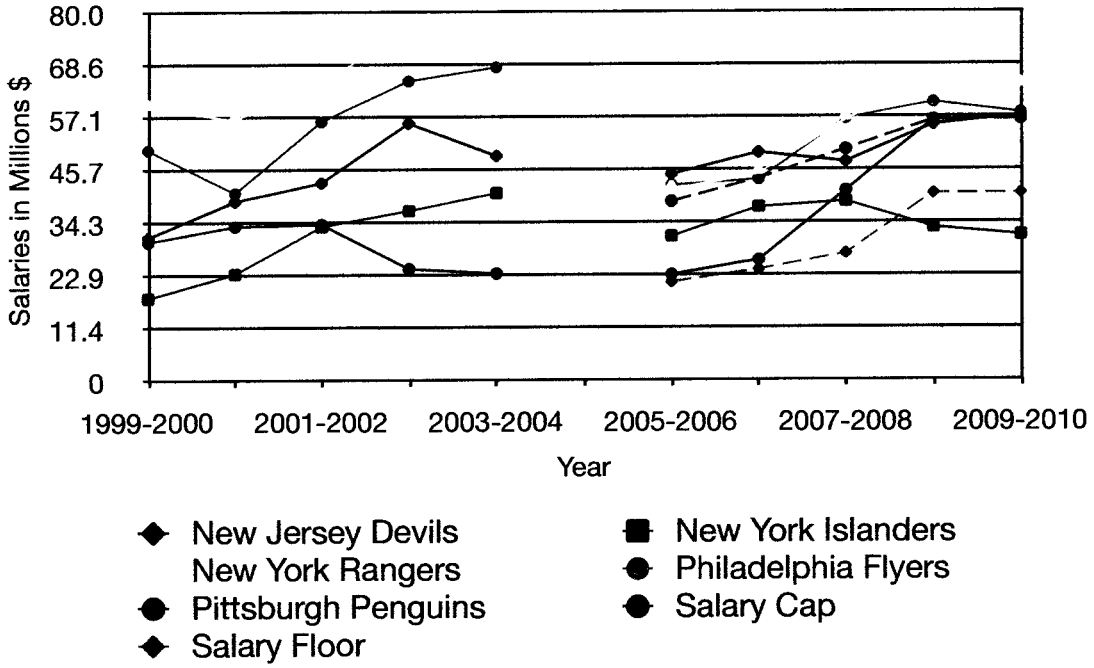
	[1]	[2]	[3]	[4]
GF	0.0081*** (0.0010)	0.0192*** (0.0032)	0.0078*** (.0012)	0.0196*** (0.0036)
GA	-0.0087*** (0.0007)	-0.0193*** (0.0022)	-0.0089*** (0.0008)	-0.0208*** (0.0025)
AVGATTEN	-0.0192 (0.0183)	0.0302 (0.0560)	-0.1067 (0.0655)	0.1957 (0.1975)
AVG$TICK	0.0026 (0.0019)	0.0024 (0.0059)	0.0011 (0.0025)	0.0037 (0.0078)
PROPCAP	0.0031 (0.0038)	-0.0102 (0.0117)	0.0208* (0.0120)	-0.0289 (0.0362)
SF	0.0041 (0.0182)	0.0297 (0.0562)	-0.0003 (0.0200)	-0.0094 (0.0604)
SD	0.0245 (0.0266)	0.0366 (0.0814)	0.0193 (0.0290)	0.0055 (0.0873)
SG	0.0716 (0.0500)	0.0219 (0.1533)	0.0845 (0.0551)	-0.0988 (0.1663)
Team Salaries	-	0.0059 (0.0112)	-	-0.0071 (0.0142)
Constant	0.5461* (0.3006)	1.1381 (0.9295)	0.9652** (0.4515)	0.1215* (1.3684)
Fixed Effects	No	No	Yes	Yes
R2	0.5819	0.4310	0.6276	0.5073
N	298	298	298	298

Figure 1. Team Salaries for the Northeast Division



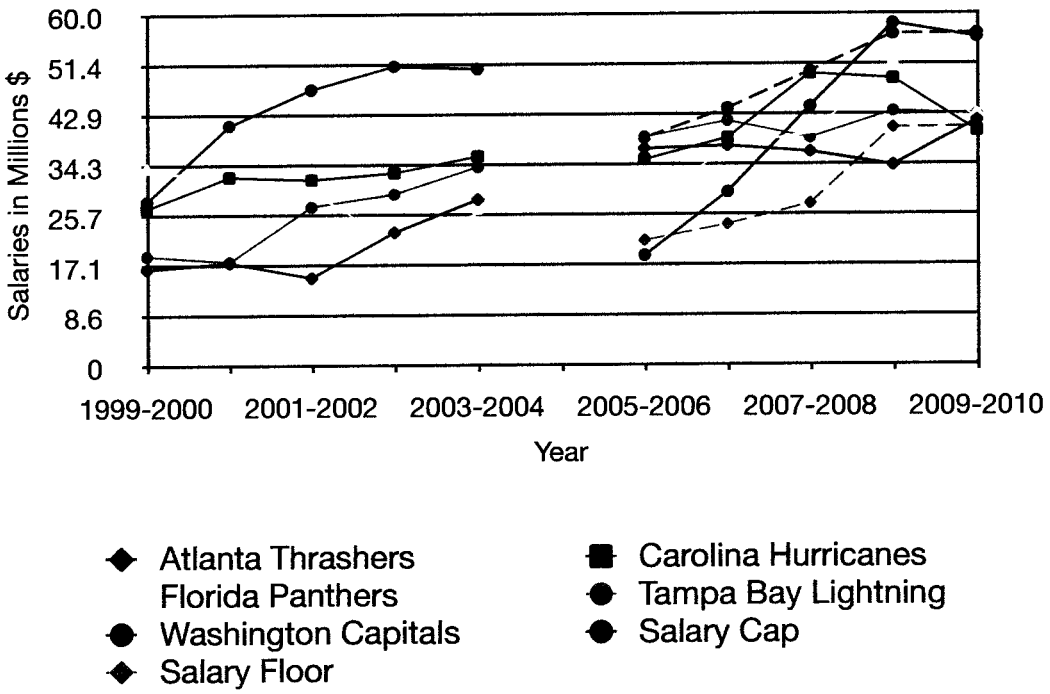
Note: The salary cap and salary floor were implemented after the lockout, thus pre-lockout there is no salary cap or salary floor. There is no data in the 2004-2005 season due to the lockout.

Figure 2. Team Salaries for the Atlantic Division



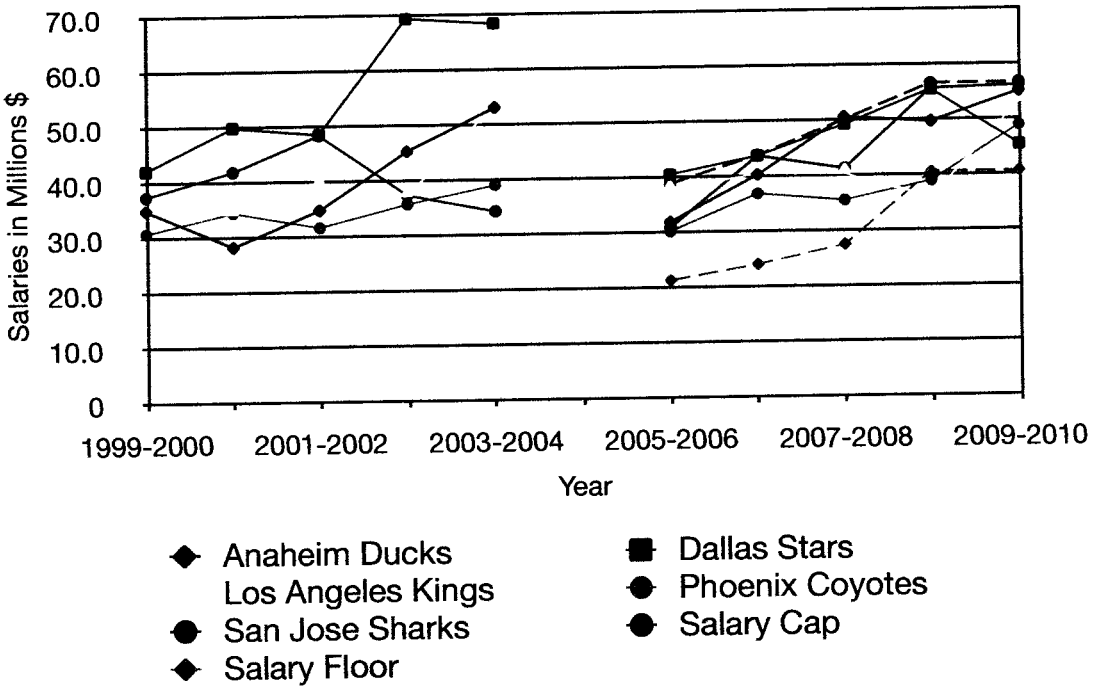
Note: The salary cap and salary floor were implemented after the lockout, thus pre-lockout there is no salary cap or salary floor. There is no data in the 2004-2005 season due to the lockout. New York has two NHL franchises.

Figure 3. Team Salaries for the Southeast Division



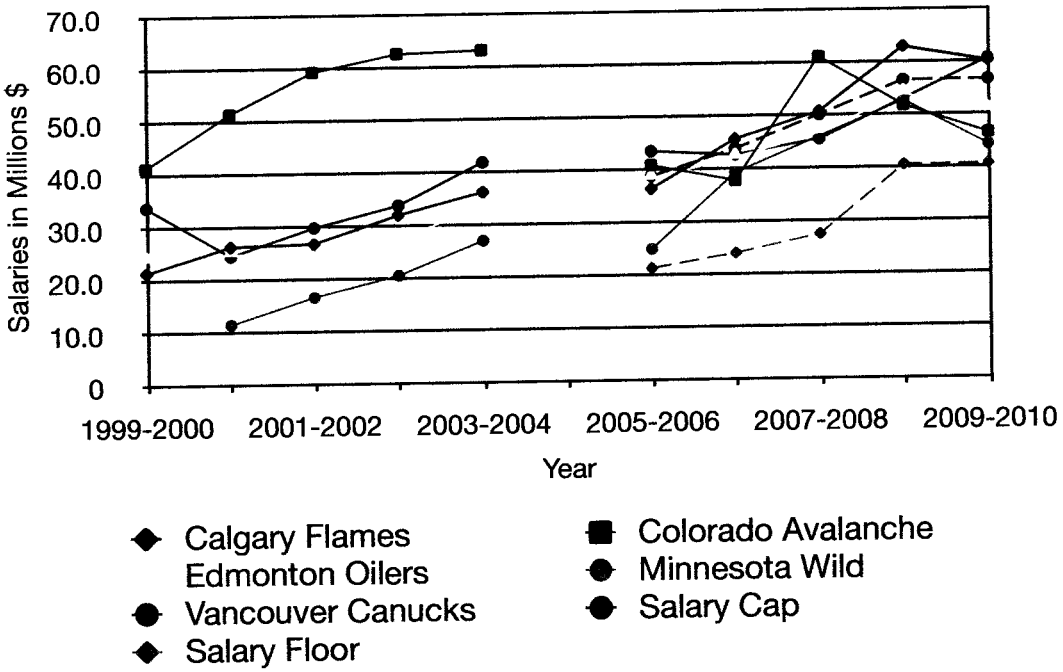
Note: The salary cap and salary floor were implemented after the lockout, thus pre-lockout there is no salary cap or salary floor. There is no data in the 2004-2005 season due to the lockout.

Figure 4. Team Salaries for the Pacific Division



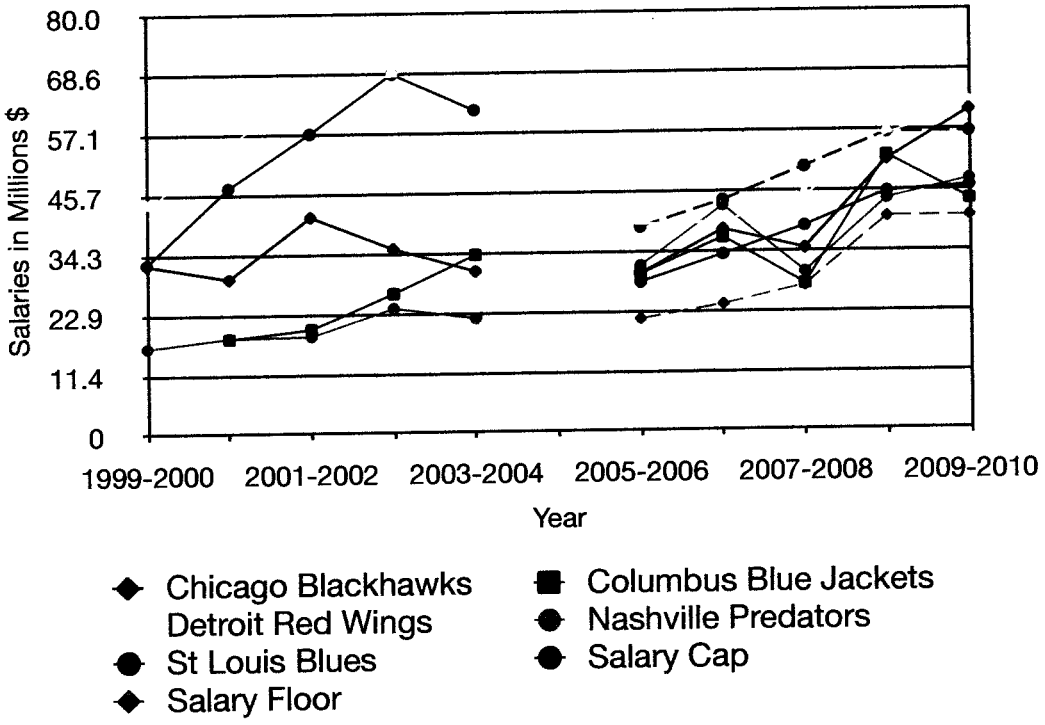
Note: The salary cap and salary floor were implemented after the lockout, thus pre-lockout there is no salary cap or salary floor. There is no data in the 2004-2005 season due to the lockout.

Figure 5. Team Salaries for the Northwest Division



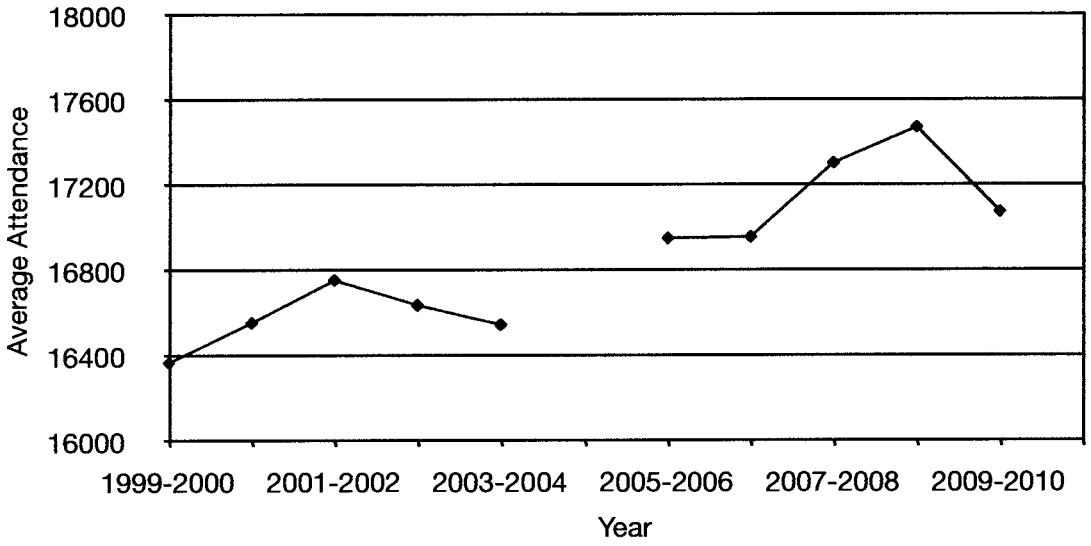
Note: The salary cap and salary floor were implemented after the lockout, thus pre-lockout there is no salary cap or salary floor. There is no data in the 2004-2005 season due to the lockout.

Figure 6. Team Salaries for the Central Division



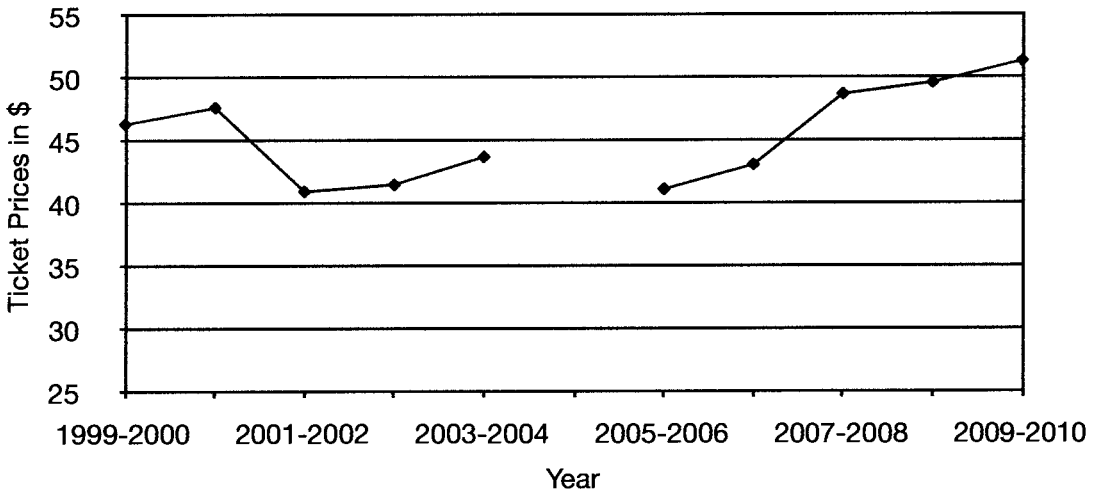
Note: The salary cap and salary floor were implemented after the lockout, thus pre-lockout there is no salary cap or salary floor. There is no data in the 2004-2005 season due to the lockout.

Figure 7. NHL Average Attendance during the 10 year Period



Note: There is no data in the 2004-2005 season due to the lockout.

Figure 8. NHL Average Ticket Prices



Note: There is no data in the 2004-2005 season due to the lockout.