COMPETITIVE BALANCE IN THE NATIONAL HOCKEY LEAGUE SINCE THE 2004-2005 LOCKOUT

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Abstract

Previous sports studies on competitive balance have used many different economic tools to determine whether a league is balanced or not. In this paper the Herfindahl- Hirschman index is used to measure competitive balance in the National Hockey League. This study was done using the year before the lockout (2003-2004) as well as every year post lockout up to last year (2010-2011) in hopes of seeing whether competitive balance in the National Hockey League has increased since the 2004-2005 lockout. The numbers show that since the lockout competitive balance has increased in the National Hockey League with the major factors being offensive talent, defensive talent, and the lockout.

KEYWORDS: (Competitive balance, National Hockey League, Herfindahl- Hirschman Index)
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CHAPTER I
INTRODUCTION

Throughout the years the National Hockey League has shown a great disparity in competitive balance. Since the NHL assumed control of the cup in 1926, there have only been 19 different winners of the prestigious trophy and 5 teams have only won the trophy once, while the Montreal Canadiens have won the trophy 22 times, with one pre-NHL win.¹ There was a major problem with competitive balance throughout the league as well as too much of total revenue being spent on player’s salaries. In 2004-2005 the National Hockey league was locked out for an entire season due to labor disputes between the National Hockey League Players Association and owners of National Hockey League teams. The shutdown lasted 310 days, which was the longest of any professional sport, which resulted in the loss of 1230 games throughout the league.² The National Hockey League made salary restrictions both on the maximum and the minimum of what teams were able to spend on revenue after the lockout. The salary cap increased every year of the, which is determined by a share of the total revenue brought in by the league, collective bargaining agreement (CBA), but with the current CBA coming to an end in

¹ NHL.com/cup/champs.html.

2011-2012, was the NHL successful in making the league more competitively balanced? It is important to measure the effectiveness of the lockout in making the league more competitively balanced to determine what worked and what was ineffective. Along with the salary cap the NHL also implemented different rule changes into league play to make the game more fan friendly and increase speed and goal scoring. One of the rule changes the league put in place is increase the speed of the game pertained to obstructive penalties such as hooking, holding, and interference. The NHL came up with a much stricter template of what each of these penalties entails. Another major change the league put in place was the structure of overtime. Similar to before the lockout if a game is tied at the end of regulation a five minute overtime follows. However, if a goal is not scored in overtime the league decided to go to a 3 man shootout instead of ending in a tie. This allows three members from each team to go one on one against the opposing team’s goaltender. The NHL also made stricter regulations on the size of leg pads, glove and blocker, and jersey size of goaltenders. Similar to the other rule changes, these regulations were put in place to optimize goal scoring by reducing how much of the net a goaltender occupies by just standing in the net.3

Motivation of this Study

The current collective bargaining agreement in the National Hockey League expires at the end of the 2011-2012 season and the NHL must avoid another lockout. It is important for the NHL to determine whether the measures put in place after the lockout

3nhl.com/nhlhq/cba/rules_changes.
in 2003-2004 were successful and what needs to be amended and what new measures need to be put in place to continue to strive for competitive balance while making the game profitable and exciting for the fans? Since the 2003-2004 the National Hockey League has seen five consecutive years of record total revenue and in the 2010-2011 season brought in more than $2.9 billion by the end of the Stanley Cup Playoffs. This is due to the increased sponsorship sales and gross sales increasing by 33 percent during the 2010-2011 season. The NHL was able to do this by the regulations put in place after the last lockout, which makes avoiding another lockout important. Therefore it is important to explore whether the league was successful in increasing competitive balance or whether the rule changes alone were the reason for the increase in revenue. The information determined in this study could also help the other major professional sports in North America, two of which has labor stoppages in 2011. This study can show the National Football League and the National Basketball Association whether striving for competitive balance helps increase total revenue within the respective leagues. This study will also show how trying to increase competitive balance in any industry will affect total revenue. Every business wants to increase revenue and this study will show how instituting industry wide rule changes affect revenue throughout that industry.

Overview of the Paper

This paper will attempt to explore the determinants of competitive balance in the National Hockey League after the 2003-2004 lockout using the Herfindahl- Hirschman

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4 nhl.com/ice/news.
Index (HHI) through Ordinary Least Squares regressions (OLS). The main goal behind this paper will be to answer the question: Since the 2004-2005 National Hockey League lockout has competitive balance improved in the league? The hypothesis of this study will be that competitive balance in the National Hockey League has increased since the 2004-2005 lockout. Chapter two will be a review of the literature on competitive balance. The literature includes Major League Baseball, the National Football League, the National Basketball Association, Soccer leagues in Europe, and finally the National Hockey League and what factors affect competitive balance. Chapter three will lay out a theoretical model of the determinants for competitive balance in the National Hockey League, as well as boundaries for the HHI pertaining to hockey. Chapter four will describe the data and the methodology used to test the theoretical implications of the third chapter. Lastly, Chapter five will discuss and draw conclusions from the results of the study, examine extended research topics, and discuss possible downfalls of the study.
Chapter II

Literature Review

Sports have always been a major topic of discussion around the world and over the last couple decades more and more studies have been done on the economics of sports. This chapter will focus on the literature written by experts in the field of economics pertaining to competitive balance in sports. The literature review provides a background on competitive balance, allowing the reader to better understand the idea behind competitive balance in the NHL, and the ideas put in place after the 2003-2004 lockout and what the National Hockey League needs to do to continue to make the league competitively balanced.

Previously, most of the studies done on competitive balance consisted of Major League Baseball (MLB). However, this section will also cover studies done on competitive balance in the National Football League (NFL), National Basketball Association (NBA), the National Hockey League (NHL), as well as other professional sports outside North America.

The first person to use the idea of competitive balance in professional sports was Simon Rottenberg (1956). Simon considered the baseball labor market and looked at it as a business.\(^1\) He described how leagues became unbalanced, and used Major League

Baseball as his example. At the time of Rottenberg’s (1958) study, team revenue was almost completely based on gate revenue; therefore, a team with higher attendance continued to have money to spend on players. His argument was that this would cause the league to become unbalanced over time because the teams with lower attendance would not be able to pay as much money for their players, and be less likely to attract the high caliber players. The lack of talent distribution would cause the outcomes of the games to become far less uncertain, and through time make the product less appealing.\textsuperscript{2} A.G. Mills came up with a reserve rule which put a limitation on freedom in the baseball market. Rottenburg (1956) performed a simple study, using Mills reserve rule, which looked at the number of league pennants each baseball program had won from 1920-1951 and found an unequal distribution of pennants in that time period.\textsuperscript{3} In order to fix the problem of competitive balance in Major League Baseball, Rottenburg proposed a few solutions, including revenue sharing and a salary cap.\textsuperscript{4}

In 2002, an article written by Andrew Zimbalist, “Competitive Balance in Sports Leagues: An Introduction,” begins with a great line, “Competitive balance is like wealth, everyone agrees it’s a good thing to have, but no one knows how much one needs.”\textsuperscript{5} Zimbalist’s study focused on the four major professional sports leagues. He agrees with Rottenberg’s beliefs that teams with more fans, a large population in the base city, and

\begin{itemize}
\item \textsuperscript{3} Ibid, 247.
\item \textsuperscript{4} Ibid, 256.
\end{itemize}
larger attendance creates more success for the team. In the article he shows effective ways of measuring competitive balance. By using the standard deviation of win percentages, a ratio of the top and bottom win percentages, the Gini coefficient, and the Herfindahl- Hirschman Index, he is able to come to conclusions on how competitively balanced each sports league is. All of these common measures will be discussed later in this chapter. Also, Zimbalist cited the complexity of factors affecting competitive balance as a cautionary statement about studies on the subject. Factors like technology, playing conditions, and playing rules are all influential on competitive balance, yet almost impossible to quantify. He then breaks down the four major professional sports, showing what each league does well and what needs to be amended to help improve competitive balance. Revenue sharing should not be the first solution because it encourages bottom half teams to lowball payrolls and continue to reduce talent accumulation. Revenue sharing allows the low market teams to continue to receive more money from other team’s revenues. Higher pay creates better teams, but better teams create higher pay.

An article written by Szymanski and Kesenne shows under reasonable conditions increasing gate revenue sharing among teams in a specific sports league actually decreases competitive balance. The authors state that gate revenue sharing will not only decrease total investment in talent by teams in a league but also reduce the degree of competitive balance. They state that if the major sports in America adopted a prize-like

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6 Ibid, 119.


element like the ones in place in Europe, the prizes can, in principle, create balanced contests by evening up the ex ante incentives to invest.\footnote{Ibid., 173.}

Competitive balance is not merely an economic issue. Economics does play a major role in professional sports, but professional sports are becoming unbalanced due to technological advances.\footnote{Sanderson, Allen. “The Many Dimensions of Competitive Balance,” \emph{Journal of Sports Economics}, Vol. 3, No.2 (May 2002): 225.} Technological advances include better equipment and performance enhancing drugs, which are not distributed evenly among professional sports teams. Restrictions have been put in place throughout many of the four major sports as well as other sports to decrease the amount of technology allowed to influence the game. Advances in medicine have allowed players to play entire seasons with health issues such as broken bones, torn ligaments, as well as other injuries. Many of these advances put the player’s health in serious jeopardy, and at the time the players do not think of the long term affects but instead will do whatever it takes to get back to work. With the new advances in technology training in the offseason as well as staying healthy during the season has become an arms race for substances, both legal and illegal. This has bred a new way of looking at competitive balance in sports which is based on the integrity of the game and falls on the players and the individual organizations.

\textit{Competitive Balance in Major League Baseball}

Over the last couple decades more studies have been done looking at the empirical data involving competitive balance in Major League Baseball. Balfour and

\begin{quote}
\textit{\ldots}
\end{quote}
Porter (1991) looked at the variability of winning percentages before and after free agency were implemented into the league. The two were looking to see if the reserve clause was necessary in achieving competitive balance in sports. The study showed that during free agency, the variance in winning percentage was actually lower than before free agency. Therefore rejecting the hypothesis that “the dispersion of winning percentage is higher with free agency,” and concluded that it “is indeed lower (that divisional races are closer) during the period of free agency. It appears free agency promotes competitive balance.” Zimbalist argued that the reason for an increase of competitive balance was not because of free agency but rather from the compression of talent. Stating the overall variance in talent from top to bottom today is less than it was a few decades ago. The compression of talent causes competitive balance to increase because of the difficulty for teams to select dominant or potentially dominant players.

In response to articles looking at competitive balance in Major League Baseball, Michael Butler used a regression equation to look at competitiveness within a season, by looking at the standard deviation of winning percentage, and the season to season correlation of team winning percentage from 1946-1992. He wanted to find the cause of the increase in competitive balance looking at free agency, narrowing of team market sizes, and a compression of baseball talent. He found that looking at competitive

12 Ibid., 16.
14 Ibid.
balance within a season only the rookie draft to be statistically significant.\textsuperscript{16} However looking at the season-to-season data all three of the factors he examined proved to be statistically significant.\textsuperscript{17}

Hadley and Krautmann chose to do a similar study in 2006. They looked at the impact of competitive balance on attendance in Major League Baseball. They included both intra-seasonal balance (how much dispersion exists in teams’ winning percentages within a season?) and inter-seasonal balance (how much turnover exists in playoff-bound teams over a number of seasons?)\textsuperscript{18} For intra-seasonal they used the standard deviation of season win percentage divided by the ideal standard deviation of winning percentage, and the inter-seasonal balance was calibrated with the Markov transitional probabilities of teams making the playoffs in consecutive seasons. Their results showed that intra-seasonal imbalance has no adverse effect on attendance. They note that close pennant races may impact end of the season attendance for the teams in the tight race but the insignificance of the regression coefficient suggest the spread of winning percentage throughout the entire season is not a determinant of attendance.\textsuperscript{19} As far as inter-seasonal attendance goes, Krautmann and Hadley concluded that their results indicated significant but small impacts on attendance only in the American League.\textsuperscript{20}


\textsuperscript{16} Ibid., 49.

\textsuperscript{17} Ibid.


\textsuperscript{19} Ibid., 291.
In 2002 Brad Humphreys’ looked at competitive balance in baseball using the Competitive Balance Ratio (CBR). He stated that although other measures of competitive balance (like the standard deviation of yearly win-loss records) are fine to use for specific years, the CBR is a more proficient indicator of competitive balance. This is due to the fact that the CBR is able to account for variations over time. Humphrey used a ratio of average team-specific variation in won-loss ratio during a number of seasons over the average within-season variation in winning percentage during the same period. The ratio was a number between zero and one, with one being completely competitively balanced and zero being no competitive balance over time.21 Humphreys also found that variations in the CBR offer a better explanation than previous models of the variation in the attendance for Major League Baseball. 22

In “Testing the Causality Between Team Performance and Payroll”, Stephen Hall, Stefan Szymanski and Andrew Zimbalist tried to determine a link between team payroll and team success in both Major League Baseball and English Premier League Soccer.23 They used regular season team winning percentage as a base for performance.24 The authors had two purposes of this study. First they wanted to find a correlation between winning and high payrolls, saying “Clearly, a positive correlation between payrolls and

20 Ibid.


22 Ibid.


24 Ibid., 149.
playing success is absolute for establishing that revenue disparities play any role in determining competitive balance.”

Secondly, the determined the strength of the correlation between winning and payroll. They also used Granger Causality Tests to see if the association went from payroll to high performance or vice-versa. A casual link was found to exist in the 1995 Major League Baseball season in both directions. Statistical evidence also proved that teams with higher payrolls perform better in professional soccer. The authors determined the difference between the two leagues was attributed to the different governing rules of each sport. They stated the lack of financial restrictions in the English Premier League make it easier for teams to buy success.

Schmidt and Berri examine the relationship between competitive balance and aggregate league attendance. Previous research done by these two men has shown improvements on competitive balance have had a positive impact on league attendance. However, their research done on the aggregate level showed did not show a relationship between competitive balance and league attendance. Schmidt and Berri found that changes in competitive balance were a significant determinant of attendance, although, the change in attendance per game was small and depended on the time period. An interesting discovery showed that fans respond negatively to an increase in competitive

25 Ibid., 150.

26 Ibid., 166.
27 Ibid., 167.


29 Ibid., 158.
balance in a single-year but over a three to five year period fan satisfaction grew significantly.

In the article “The Baseball Player’s Labor Market Reconsidered,” John Vrooman (1996) conceded that there has been an increase in competitive balance over time, but believes it is at the expense of the quality of the game.\(^{30}\) He agreed that there is a trend for free agents to gravitate from smaller to larger market teams, it did not necessarily equate to larger market domination. Vrooman backed his statement by saying:

> There is little support in the literature that the uncertainty of a games’ or seasons’ outcome, achieved at the expense of a total league output, is preferred by fans. Equally bad teams beating one another is an uncertain outcome derived from an inferior league product... this is the flawed result of the current limitations placed on free-agent eligibility.\(^{31}\)

Vrooman also presented ideas to abolish the problem of the decreased quality of play he observed. One of the suggestions was that there should be an increase in revenue sharing among the “winning-inelastic” revenues, or the income that is not heavily affected by a team winning or losing. Another suggestion was that there should be less restriction on player movement, stating that players should become free agents after four years instead of six.\(^{32}\)

In another article in 2000 to further his 1996 article Vrooman stated that, with the MLB’s current setup, neither free agency, a salary cap, or revenue sharing would actually

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\(^{31}\) Ibid.

\(^{32}\) Ibid.
help improve competitive balance.\textsuperscript{33} Vrooman also found that a salary cap does not work because it actually lowers team revenue. Economically, with a salary cap the overall league profits would decrease, because profit maximization could only be as high as revenue maximization.\textsuperscript{34} Vrooman states that the way revenue sharing works, it pays to win at home and lose on the road, because of the gate and television revenues work. Revenue sharing will effectively increase the exploitation of players, but it will not affect competitive balance.

Danielle Carbonneau and Paul Sommers use the Gini Index, normally used for income and wealth distributions, to look at competitive balance in baseball.\textsuperscript{35} The Gini Index is found by plotting the cumulative percentage of teams on the x-axis versus the cumulative percentage of games won in a season by the teams on the y-axis. Their findings agreed with the majority of other baseball studies in that “the absence of restrictions in baseball such as the reserve clause (does not) have a disruptive effect on the evenness of the competition in Major League Baseball.”\textsuperscript{36} Martin Schmidt also used the Gini Index while looking at competitive balance in Major League Baseball. In contrast to a majority of the other studies on baseball, which have examined factors like the reserve clause, free agency, or the rookie draft, Schmidt chose to see if expansion


\textsuperscript{34} Ibid., 395.


\textsuperscript{36} Ibid., 165.
affected competitive balance in the league. He concluded that the rise in competitive balance in baseball came when the league decided to expand.  

One of the more relevant journal articles for this paper was written by Craig A. Depken. He used the deviation of the Herfindahl-Hirschman Index (HHI) to look at competitive balance in Major League Baseball. The HHI has previously been used to find the market share of a firm in an industry, to account for competitive balance. The Herfindahl-Hirschman Index is calculated as

$$HHI = \sum_{i=1}^{N} s_i^2$$  \hspace{1cm} (2.1)

In the equation the $s$ is the market share of the $i^{th}$ firm (with $s$ being a number between zero and one). In baseball, market share can be determined by a team’s percentage of total wins in the industry. If the HHI measures $1/N$ (where $N$ is the number of firms) then it can be assumed the league is perfectly competitive. On the other hand, if the HHI equals one, it can be assumed there is no competitive balance in the league. In Depken’s article it is pointed out that the number of firms in the industry can skew the actual HHI. In other words as the number of firms in the market grows, the HHI will decline. To fix

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this problem Depken uses the dHHI.\textsuperscript{41} Depken looks at statistics from 1920-1996. He found the variation in parity has decreased over time. Depken also found that free agency in baseball has reduced the equality in the American League, while having no significance in the National League.\textsuperscript{42}

\textit{Competitive Balance in the National Hockey League}

An article found on the National Hockey League; written by David Richardson, offered ways to improve balance in the league.\textsuperscript{43} Before the lockout the NHL had no salary cap, no gate revenue sharing, and very little television revenue sharing. Even though these items are vital at insuring competitive balance, the main focus of the article was limiting free agency and the reverse-order draft. The reverse-order draft proves to be an effective system because it allows the worst team from the year before to have the first choice at the top end talent under the age of 19.\textsuperscript{44} Of all the ideas aimed at competitive balance the reverse-order draft may be the most easily identifiable and measureable. Limiting free agency could also have an effect on competitive balance by limiting the teams a top free agent is available to after their contract terms.\textsuperscript{45}

\textsuperscript{41} dHHI= \text{HHI}-1/N, where N is the number of firms in the industry.


\textsuperscript{44} Ibid.

\textsuperscript{45} Ibid., 395.
David Richardson was the first to use the National Hockey League as a focus for looking at competitive balance. He chose to look at competitive balance not only as dispersal of regular season winning percentage, but also as the number of playoff games over time. He found the long-term trend leaned towards more competitive balance in the National Hockey League when looking at winning percentages, and found no significant patterns for playoff games. While looking at the entry draft on competitive balance, Richardson found some support that the draft helps maintain competitive balance in the league.

An article that is important for this paper uses HHI to look at competitive balance in sports was written by Aju Fenn, Peter Von Allmen, Stacey Brook, and Thomas Preissing. Their article “The Influence of Structural Changes and International Players on Competitive Balance in the NHL,” uses the dHHI to examine competitive balance in the National Hockey League. They investigated the impact of changes in league structure and size, as well as the effect of imported and rookie players. They concluded the changes in the pool of imported talent (rookies) do not have an effect on competitive balance, but the changes in the pool of imported players, does alter competitive balance.

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47 Ibid., 405.

Competitive Balance in the National Football League

Kevin Grier and Robert Tollison looked at the effect of the rookie draft on the National Football League. The used the winning percentage and draft position for all the NFL teams over a time period to see if having an earlier draft choice actually helped a team perform better over time. The two men found that having a higher draft choice raises winning percentage significantly over time, and concluded that the rookie draft in professional football helps advocate competitive balance. Another article done on the National Football League was written by Atkinson, Stanley and Tschirhart. The authors used the NFL as an example of how all professional sports leagues could increase competitive balance with the implementation of a revenue sharing program. They concluded that owners are not necessarily profit-maximizers, but instead utility maximizers that value winning. They found that even if owners act in a utility maximizing fashion, the league still tends to move to optimal distribution of talent with the existence of revenue sharing. With an optimal distribution of talent the league would likely become more balanced.

Competitive Balance in All Major Sports Leagues


50 Ibid., 298.


52 Ibid., 41.
An article written in 2000 discusses the differences between competitive balance and incentives to win. Palomino and Rigotti agree with most other authors, saying that a salary cap and gate, as well as television, revenue sharing are good systems that could increase competitive balance. A performance based reward system may be the optimal way to create balance among sports teams. Every player would like to increase their income and this type of system allows them the opportunity to make more money by playing well and competing in every game. Along with a salary cap this type of system has a chance to become the optimal solution.

In their article, “The Impact of Free Agency on Competitive Balance in North American Professional Team Sports Leagues”, Joel Marxy and Michael Mondello state when free agency was reintroduced to professional sports leagues in the 1970s sports


54 Ibid.
enthusiasts expressed concern that competitive balance would suffer. The article empirically examines the effects of changes in free agent rules on competitive balance in the National Basketball Association (NBA), the National Football League (NFL), and the National Hockey League (NHL). They used the standard deviation of winning percentage as well as Spearman’s rank correlation coefficient to determine whether competitive balance has been positively or negatively affected by competitive balance. The study showed that in the NFL and the NHL competitive balance has increased with the implementation of free agency. For the NFL results showed improved balance since unrestricted free agency was introduced in 1993 and the NHL showed improved balance since 1994. However, results from the NBA indicated that competitive balance has decreased since the introduction of free agency. The ambiguous results indicated the effects are not independent but rather depend on the interaction of free agent rights with other labor market and league rules.

In the article “The Impact of Salary Caps in Professional Team Sports,” Stefan Kesenne agreed with Vrooman’s statement that salary caps decrease total league revenues. However, Kesenne believes that a salary cap would increase competitive balance within the respective leagues. He argues a salary cap would hold down top player

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56 Ibid., 356.

57 Ibid., 362.

salaries, allowing owners of big and small market teams a reasonable profit rate, allowing new investments (mostly in players) to be encouraged.\textsuperscript{59}

Another article written by Kesenne looks at the impact of revenue sharing on competitive balance in professional sports.\textsuperscript{60} He relied on the assumption that professional sports organizations are profit maximizing firms. Because of this he states it would be in a team’s best interest to only have as many superstars as needed to be highly competitive. Kesenne argued that this gives smaller market clubs the opportunity to bid on the other superstars, which would create a more competitively balanced league.\textsuperscript{61}

Daniel R. Marburger had a similar finding to Kesenne in his article “Gate Revenue Sharing and Luxury taxes in Professional Sports”. Marburger concluded that revenue sharing can have a positive effect on competitive balance because it gives smaller market teams more money. He did, however, point out the disincentive problem, which pertains to smaller market teams having no incentive to spend money on players due to the fact that they receive money from the large market teams.\textsuperscript{62} The teams have less incentive to win because their revenue will not change through wins or loses. Disincentives help lead to competitive imbalance in leagues. Marburger also looked at luxury taxes as a way to increase competitive balance in leagues. A luxury tax works by the league imposing a tax on teams if their salaries exceed a certain point. The league

\textsuperscript{59} Ibid., 63.


\textsuperscript{61} Ibid., 63.

then either keeps the tax or distributes it to the other teams throughout the league.
Marburger found the best way to redistribute the tax would be to do so evenly throughout
the league, avoiding the disincentive problems discussed earlier.\textsuperscript{63} This is opposed to the
idea of distributing the tax by team quality which could lead to a disincentive for teams to
spend money on players. He stated the problem with a luxury tax is the potential for both
clubs and players to find loopholes to avoid or alleviate the tax which “will tend to
mitigate the impact of the tax on competitive balance.”\textsuperscript{64}

Along with his other works John Vrooman created a general theory for Major
League Baseball, the National Basketball Association, and the National Football League
with concerns to free agency, revenue sharing, and the salary cap; all of which are viewed
as ways to increase competitive balance.\textsuperscript{65} For the MLB, Vrooman stated that even
through the era of free agency, the league had remained relatively competitive balance
but there was a clear revenue advantage for the larger market teams. Vrooman showed
the baseball had the lowest player exploitation of the three leagues with only moderate
competitive balance, while revenue sharing in football increases competitive balance at
the cost of exploiting player salaries.\textsuperscript{66} The salary cap showed to be least effective in the
NBA, in increasing competitive balance. Vrooman suggested that the cap is a “unique

\textsuperscript{63} Ibid., 114-124.
\textsuperscript{64} Ibid., 121.
\textsuperscript{66} Ibid., 988.
form of cost-sharing collusion which causes the NBA to be a cartel of teams acting as a single firm”, 67 thus reducing competitive balance.

“Cross-Subsidization, Incentives, and Outcomes in Professional Team Sports Leagues, was written by Fort and Quirk and discusses the effect of revenue distribution, the reserve clause, salary caps, and the rookie draft on competitive balance for different professional sports leagues.68 The authors concluded that revenue sharing; gate revenues and television revenues, reverse-order draft, franchise locations, and league expansion do not help competitive balance but actually harm it. They state that an enforceable salary cap is the only one of the cross-subsidization schemes currently in use that can be expected to accomplish competitive balance in a league.69 Along with Kesenne, Fort and Quirk argue that the problem with a salary cap is proper enforcement because teams are not allowed to maximize revenues with a salary cap. This discrepancy would naturally cause management to look for loopholes, like deferred payment, in the cap.70

*English Soccer*

Another article looked at competitive balance using a Lorenz curve. A Lorenz curve usually examines the distribution of income in the bounds of a specific economy. However, Paul Downward and Alistair Dawson used the curve to plot cumulative

67 Ibid., 989.


69 Ibid., 1282.

70 Ibid., 1266.
percentages of teams in a sports league versus the cumulative percentage of championship won.\textsuperscript{71} In a perfectly competitive world, the line would be a 45-degree angle. The two admitted possible problems with the Lorenz curve. Mainly its inability to observe closely contested seasons, and its capacity to account for the amount of time that teams have in their respective leagues.\textsuperscript{72} The two compare English soccer to professional sports leagues in North America. They concluded that English soccer is more competitively balanced than the professional leagues in North America. They believe North American leagues should implement regulations from English soccer. They also stated that American fans do not necessarily need to have an uncertainty of outcome, which goes against almost all other authors on the subject.

Stefan Szymanski looked at competitive balance and fan interest in English Premier League Soccer.\textsuperscript{73} He found weak evidence that widening the distribution of the income gap had caused a decrease in competitive balance, there was no evidence of the income gap affecting interest in English soccer in a negative manner. He acknowledges the flaws of his study stating that there are other factors (beyond income) the altered the relative attractiveness of attending soccer matches throughout the league.\textsuperscript{74}

\textsuperscript{71} Downward, Paul and Alistair Dawson, \textit{The Economics of Professional Sports Teams} (London: Routledge, 2000), 53.

\textsuperscript{72} Ibid., 54.

\textsuperscript{73} Szymanski, Stefan. “Income Inequality, Competitive Balance and the Attractiveness of Team Sports: Some Evidence and a Natural Experiment from English Soccer,” \textit{Economic Journal} 111, No. 469 (February 2001): F669-F84.

\textsuperscript{74} Ibid., F82.
Conclusions

In the studies on competitive balance in professional sports, the findings have no consistent solution on how to increase the balance of a league. The inconsistent conclusions probably stems from the variety of methods used to measure competitive balance as well as the lack of a universal method of measuring the balance. Although there was no definite solution in finding what exactly helps increase competitive balance the literature has proved helpful base for the research done in this study. The next chapter will explain the theory involved in calculating competitive balance pertaining to the National Hockey League after the 2004-2005 lockout.
Previous research on competitive balance in professional sports is rather abundant. In addition, there are many ways to measure competitive balance and no one is one hundred percent sure on how to maximize competitive balance throughout a professional sports league. This chapter will start by reviewing some of the different methods used to measure the competitiveness of a certain league. The chapter will then theoretically examine possible variables affecting competitive balance of the National Hockey League. Finally, the chapter will examine the boundaries of the Herfindahl-Hirschman Index as well as the Ordinary Least Squares (OLS) regression.

Dispersion of Win/ Loss Percentage

Dispersion of win/ loss percentage among teams is one of the more common measures of competitive balance. This can be done for a single year or over a time period of many years. An easy way of finding the dispersion of win/ loss percentages in the league is by finding the range of winning percentages. In other words, the dispersion of win/loss percentages finds the difference between the highest and lowest winning percentages in a league for any given season.
Standard Deviation of the Distribution of Win/ Loss Percentages

Like finding the dispersion of win/ loss percentages throughout a league the standard deviation of the distribution of win/ loss percentages is a common way of measuring competitive balance in professional sports. This measure is easily calculated, which makes it convenient, but it is not the most accurate. However, the standard deviation can be instructive, because if the win loss percentages for a league are normally distributed, approximately 99% of the win/ loss percentages will lie within three standard deviations of the league average.1 The idealized standard deviation for win/loss percentage in any year of the National Hockey League assuming every team wins half its games is 0.0552.

\[
0.5/ \sqrt{n} = 0.5/ \sqrt{82}, \text{ where } n= \text{number of games played} \tag{3.1}
\]

The standard deviation of win/ loss percentage is not as sensitive of a measure of the parity as the Herfindahl- Hirschman Index because it does not take into account other factors of winning and losing,

Lorenz Curve

Another popular way of looking at competitive balance is through league championships. Downward and Dawson chose to look the dispersion of league

championships using a Lorenz curve.\(^2\) A Lorenz curve can be plotted by having the cumulative percentage of championships along the vertical axis, against the cumulative percentage of team years in the league along the y axis. The curve examines the concentration or frequency of team championships and compares it to a normal frequency of team championships.

**Gini Coefficients**

A final way to observe competitive balance in professional sports is to look at the Gini Coefficient. Traditionally, Gini coefficients have been used to measure inequality in the outcomes of league playoffs. However, Carbanneau and Sommers in 1997 and Schmidt in 2001 used the Gini coefficient to measure within-season competitive balance. The Gini coefficient has one main advantage which pertains to its inherent simplicity in understanding it. It has a defined range between zero and one, and the closer the coefficient is to one, the less balance there is in the league.\(^3\) The Gini Index is found using the Lorenz Curve. The index is the area between the actual Lorenz curve and the perfect balance curve.

**Determinants of Competitive Balance**

In professional hockey there are many factors that have the ability to have an influence affecting competitive balance. The National Hockey League was locked out in

---


2004-2005 and during the lockout the league had to address many issues. Most of the issues pertaining to a large amount of total league revenue being paid to player’s salaries but also the National Hockey League were competitively unbalanced and small market teams were unable to compete with the larger market teams. After the lockout the NHL put restrictions in throughout the league to provide the opportunity for small market teams to compete for top end talent as well as compete for a championship. The major question is after the lockout has the National Hockey League become more competitive.

A couple of the rule changes were: the installation of a salary cap, stricter penalties on the ice (to influence a faster and more fan friendly game while offering more power play opportunities for teams\textsuperscript{4}, deciding tied games with a 3 man shootout (instead of ending in a tie), as well as decreasing the size of goalie pads to help promote goal scoring. Now the factors affecting competitive balance can be generalized by offensive talent, defensive talent, shootout wins, shootout loses, power play goals for, power play goals against, penalty minutes, and the salary cap hit each team incurs. Figure 3.1 is a representation of these factors.

\textsuperscript{4} A team is granted a powerplay when the other team commits an infraction of the rules, therefore, granting the other team a one man advantage for either two minutes, four minutes, or five minutes, depending on the severity of the infraction.
FIGURE 3.1

DETERMINANTS OF COMPETITIVE BALANCE IN THE NHL

Competitive Balance

- Offensive Talent
- Defensive Talent
- Penalty Minutes
- Salary Cap Hit
- Power Play Goals For
- Power Play Goals Against
- Shootout Wins
- Shootout Loses
Competitive Balance

As referred to in the introduction, the theory of competitive balance is what is referred to as the uncertainty of outcome. The more uncertain a league’s outcomes are the greater competitive balance the league is considered to have. Competitive balance has also been linked to attendance by Schmidt and Berri. Their study showed a connection between teams that finish low in the standing and low attendance. These two concepts usually go hand in hand with lower revenue streams. Therefore if teams and leagues want to increase revenue flow throughout the league, a good place to start is looking at competitive balance within the league.

As the primary model, this study uses the Herfindahl-Hirschman Index of points (HHIp) to look at the competitiveness of the National Hockey League. There is no need to use the dHHI which measures a firms market share taking into account the amount of firms in the industry because during the time period in which this study took place the number of teams was constant at 30 teams. Equations (3.2-3.3) show the theoretical model for the HHIp.

\[ HHIp = \sum_{i=1}^{n} (MSi)^2 \]  \hspace{1cm} (3.2)

\[ MSi = POINTS \text{ OF TEAM } i/ \text{ TOTAL LEAGUE POINTS} \]  \hspace{1cm} (3.3)

---

Since every team in the National Hockey League plays an 82 game regular season schedule no team can have more than 82 wins, therefore, the HHIp will be less than one. If all the teams HHIs are close this will signal that the league has succeeded in making the NHL more competitively balanced since the 2004-2005 lockout, but if there is a large discrepancy in the HHIp, this means the NHL has continued to be an unbalance league.

**Offensive Talent**

Offensive talent within a league can be a good indicator of competitive balance within a league. Especially since the NHL has tried to increase goal scoring since the lockout by opening up the game due to stricter penalty calls, as well as reducing the size of goalie equipment. One study that looked at offensive talent in baseball used the Herfindahl-Hirschman Index (HHI) for runs scored in a season in Major League Baseball. In order to look at offensive talent in the National Hockey League this study will use goals for. The model for HHIgf can be found in equation (3.5).

\[
HHI_{gf} = \sum_{i=1}^{n}(MSi)^2 \tag{3.5}
\]

\[
MSi = \text{GOALS SCORED BY TEAM } i \div \text{TOTAL LEAGUE GOALS} \tag{3.6}
\]

The closer this number is to 1, the more goals that individual team scored and the greater there offensive talent is. Since a team with a high degree of offensive talent can be

---

expected to score more goals than a team with little offensive talent, the HHIgf seems to be the best indicator of the distribution of offensive talent.

**Defensive Talent**

The examination and concentration of defensive talent is another indicator of competitive balance throughout a league. In Depken’s study he used runs allowed to look at defensive talent in Major League Baseball. For hockey the measure of defensive talent would be goals against. A model of the Herfindahl- Hirschman Index for goals allowed is given below in equations (3.7) and (3.8).

\[
HHI_{ga} = \sum_{i=1}^{n} (MS_i)^2 
\]
(3.7)

\[
MS_i = \frac{GOALS ALLOWED BY TEAM i}{TOTAL LEAGUE GOALS} 
\]
(3.8)

The closer the HHIga is to 1, the worse the team’s defensive talent is because they allowed more goals throughout the course of the season. A team with a higher level of defensive talent would be more likely to allow fewer goals than a team with little defensive talent; therefore, the HHIgf seems to be the best method for measuring the concentration of defensive talent.

The HHI for points and both offensive and defensive talent will help provide a conclusion to whether the National Hockey League has become more competitively balance since the lockout. If the data shows what the study expects, the best teams will have a high HHI for points and the HHI for goals for will be high and the HHI for goals

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8 Ibid.
against will be low. However, the HHI statistics could show a HHI for defensive talent and a high HHI for offensive talent and still be effective. This would mean a team allowed a larger number of goals throughout the season but also scored a large number of goals.

The HHI is an acceptable approach because it gives one number that ranks the league’s competitive balance as well as a number for offensive and defensive talent. By producing only one number per year it is very simple to see how much competitive balance the NHL has possessed since the lockout.

**Summary of Theoretical Model**

In determining a model for competitive balance the following should hold true. First offensive and defensive talent will have a positive relationship with the dependent variable. Second the OLS regression will show positive correlation between shoot out wins and power play goals and points captured in a season. While shoot out loses and power play goals against with have a negative correlation with points captured in a season. This chapter has reviewed a few of the most popular ways of measuring competitive balance in sports. It has also laid out a generalized concept of six major areas affecting competitive balance. Finally, this chapter showed the HHI equations that will be used to come to a conclusion on whether or not the National Hockey League has became more competitively balance since the 2004-2005 lockout. The next chapter will go into more detail for each of the variables and their possible implications.
CHAPTER IV
DATA/ METHODOLOGY

The purpose of this chapter is to familiarize the reader with the empirical methodology and reasoning used to test the theoretical implications of the Chapter III. The model presented in the previous chapter uses the Herfindahl- Hirschman index of team points captured in the National Hockey League as the measure of competitive balance. Before the NHL lockout of 2004-2005 the NHL was unbalanced and in a bind, but has competitive balance since the lockout increased? Do small market teams now have a better chance at making the playoffs and competing for a championship? The data in this chapter will help provide and answer for these questions.

This chapter will start by reviewing the Herfindahl- Hirschman Index for point (HHIp) and its subsequent independent variables. In other studies measuring competitive balance using the Herfindahl- Hirschman index the dHHI has been used. In this study there is no reason to use the dHHI, which is the deviation of the HHI, and as a measure of concentration the HHI will always decrease as the number of firms in the market increases. However, because the number of firms in this study has remained constant at 30 there is no need to measure using the dHHIp.
MODEL EQUATION (HERFINDAHL-HIRSCHMAN INDEX FOR POINTS\(HHIp\))

\[ HHIp = f(\text{Offensive Talent, Defensive Talent, Power Play Goals for, Power Play Goals Against, Penalty Minutes, Shoot out Wins, Shoot out Loses, and Salary}) \]

In this equation \(HHIp\) is the difference of team points from the ideal distribution of points in any given season. Equations (4.2-4.3) are a mathematical representation of the \(HHIp\).

\[ HHIp = \sum_{i=1}^{n} (MSi)^2 \]  \hspace{1cm} (4.2)

\[ MSi = \text{POINTS OF TEAM } i / \text{TOTAL LEAGUE POINTS} \]  \hspace{1cm} (4.3)
### Independent Variables

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFFTAL</td>
<td>Offensive talent= HHIgf</td>
</tr>
<tr>
<td>DEFTAL</td>
<td>Defensive talent= HHIga</td>
</tr>
<tr>
<td>PPGF</td>
<td>Power play goals for</td>
</tr>
<tr>
<td>PPGA</td>
<td>Power play goals against</td>
</tr>
<tr>
<td>PIMS</td>
<td>Penalty minutes</td>
</tr>
<tr>
<td>SOW</td>
<td>Shoot out wins</td>
</tr>
<tr>
<td>SOL</td>
<td>Shoot out loses</td>
</tr>
<tr>
<td>Salary</td>
<td>Salary cap hit each team pays out</td>
</tr>
</tbody>
</table>
Offensive Talent (OFFTAL)

Offensive Talent was measured by the HHI of goals scored by a team in a given season, or the distribution of goals scored. Offensive talent is measured in this way because the HHI will show how goals are distributed throughout the league and what affect scoring more goals has on competitive balance. Equations (4.4-4.5) are a mathematical representation of offensive talent.

\[
HHI_{gf} = \sum_{i=1}^{n} (MSi)^2
\]  

(4.4)

\[
MSi = \text{GOALS SCORED BY TEAM } i / \text{TOTAL LEAGUE GOALS}
\]  

(4.5)

One would expect the more concentrated goals scored is throughout the league, hence the more distributed offensive talent in the league becomes, the lower the HHI for goals for should be. It is expected then that offensive, which is measured by the HHI of goals for, would decrease. In other words the predicted sign of the coefficient for offensive talent would be positive.

Defensive Talent (DEFTAL)

Similar to offensive talent it is also important for an NHL team to be strong defensively. Defensive talent was measured using the HHI for goals against, and the effect of goals against on how competitive a team is in the National Hockey League. Equations (4.6-4.7) are a mathematical representation of defensive talent.

\[
HHI_{ga} = \sum_{i=1}^{n} (MSi)^2
\]  

(4.6)
It is expected that defensive talent, which is measured by the HHI of goals against by a given team, would increase and the predicted sign of the coefficient for defensive talent would be negative.

*Power Play Goals for (PPGF)/ Power Play Goals Against (PPGA)*

During the 2004-2005 lockout the National Hockey League needed to think of ways to increase attendance by increasing fan satisfaction. One way to do that is by creating the opportunity for more goals to be scored. The NHL decided to make the game faster and more up tempo by restricting the infractions players are allowed to commit against each other, thus creating more power play opportunities for the teams. Because of the league putting an emphasis on penalties and trying to create more opportunities on the power play it is expected that since the lockout goal scoring has increased. Therefore, it is expected that more power play opportunities would increase competitive balance in the National Hockey league. On the other hand, it would be expected that power play goals against would also have a significant role in increasing competitive balance.

*Penalty Minutes (PIMS)*

Since the league tightened the noose on penalties after the lockout creating more power play opportunities for teams, the number of penalty minutes a team incurs throughout the course of a year has extreme importance. If a team commits a high

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1 A power play occurs when one team commits an infraction and is forced to play one man down for 2 minutes, 4 minutes, or 5 minutes depending on the severity of the infraction.
number of infractions and allows the other team to continually be on the power play that team would struggle to compete. Because of this the coefficient of penalty minutes is expected to be negative meaning the higher number of penalty minutes the less competitive balance there would be in the league.

*Shoot Out Wins (SOW)/ Shoot Out Loses (SOL)*

A three man shoot out was put in place after the lockout to decide games if a game is still tied after regulation and a five minute overtime period is played. The main goal of this rule was to increase excitement for fans. The league awards two points to the winner of the shootout (the same amount as a regulation win) and awards the losing team one point (the same as an overtime loss). The shoot out has increased fan satisfaction but how does it affect competitive balance. The shoot out could both increase and decrease competitive balance. It gives the top offensive talent on each team the opportunity to show case their skills while allowing the goaltenders (part of defensive talent) to showcase their talents. So teams with a high degree of offensive talent would be expected to have more shootout wins, therefore having a negative effect on competitive balance while teams with a high degree of defensive talent (mainly goaltending) would also have a higher probability of winning a shootout causing a negative effect on competitive balance as well. The shoot out will prove to have a slightly negative effect on competitive balance.

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2 A shoot out is when a player goes one on one with the opposing team’s goalie. This continues for 3 men each side and if the shoot out is still tied after three men the shoot out goes into sudden death, meaning the first team to score wins.
Salary Cap

After the 2004-2005 lockout, the NHL instituted a salary cap and a salary floor making teams spend somewhere between the two numbers. Both numbers increased with each year of the collective bargaining agreement. The purpose of the salary cap was to enforce teams to spend money on top end talent while avoiding a small handful of teams buying all the top end offensive and defensive talent available. Because of installment of this rule it is expected the salary cap with have a negative coefficient, therefore increasing competitive balance throughout the league. As previous studies have shown, a salary cap can sometimes be an effective rule in increasing the competitive balance in a professional sports league.

Dummy Variables

Lockout (LOCKOUT)

To see whether the National Hockey League was successful in creating a more competitively balanced league after the lockout a dummy variable for the lockout was created. For the data before the lockout a value of 0 was given. For every year after the lockout a value of 1 was given.

\[
\text{Lockout} = \begin{cases} 
1 & \text{if } year > 2004 - 2005 \\
0 & \text{if } year < 2004 - 2005
\end{cases}
\] (4.8)
Measuring the lockout’s effectiveness on competitive balance should create a negative coefficient when compared to the HHIp meaning that the lockout helped increase competitive balance in the National Hockey League.

*Offensive and Defensive Talent with Regards to the Lockout (OFFTAL\_Lockout/DEFTAL\_Lockout)*

These variables are used to show the effect the lockout had on team’s offensive and defensive talent. Special consideration should be put on these variables, as the lockout was expected to redistribute talent throughout the league because of the salary cap. The dummy variable is equal to zero if the year is before the 2004-2005 lockout, and equal to one if the year is after the lockout. Similar to the dummy variable of the lockout the redistribution of offensive and defensive talent is expected to have the same effect on parity. It is predicted that the redistribution of talent will cause a positive coefficient for offensive talent meaning it has lead to an increase in competitive balance as well as a negative coefficient for defensive talent causing a increase in competitive balance with regards to the lockout.

\[
\text{OFFTAL\_Lockout/DEFTAL\_Lockout} = \begin{cases} 
1 & \text{if } year > 2004 - 2005 \\
0 & \text{if } year < 2004 - 2005 
\end{cases}
\]

*Ordinary Least Squares Estimator*

In order to calculate the model regression equation, ordinary least squares (OLS) has been used. Ordinary least squares was chosen because it minimizes the squared
distances between the actual data points, and the regression line. By squaring the error terms (points that do not fall directly on the regression line), ordinary least squares puts more of an emphasis on error terms far from the line.\(^3\) Because of this OLS fits our assumption that a line with several small misses fits the data better than a line with a few very large misses.

This chapter has detailed the empirical methodology and reasoning used to test the theoretical implications laid down in Chapter III. The chapter started by examining the Herfindahl- Hirschman Index for points captured by each team throughout the course of a season, as well as, offensive and defensive talent. The independent variables were chosen to estimate the effectiveness of the rule changes, put in place after the lockout, on competitive balance in the National Hockey League. Then, the chapter analyzes the dummy variables: lockout as well as the lockout’s effectiveness on offensive and defensive talent redistribution throughout the league. Lastly, the chapter explains why and ordinary least squares (OLS) regression was used as a measure for the competitive balance in the National Hockey League before and after the lockout. The next chapter will look at the results of the regression equations that have been detailed in the last two chapters.

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CHAPTER V
RESULTS AND CONCLUSIONS

This chapter will present the regression results based on data explained in Chapter IV. The data have been analyzed using Herfindahl- Hirschman Index, as a measure for competitive balance in the National Hockey League, before and after the 2004-2005 lockout to see if the measures put in place during the lockout were effective at increasing competitive balance in the league.

This chapter will begin by discussing the results of the ordinary least squares regressions ran with respect to the HHIp. The next part of this chapter will present and analyze the HHIp values for the National Hockey League for the given years. The final section of this chapter will present conclusions based on the regressions, consider possible limitations of the research, and explore ideas for future research on competitive balance in the National Hockey League.
Model Results

Herfindahl- Hirschman Index for Points Captured in a Given Season

Table (5.1) is a summary of the OLS regression results for various regression runs. The name of the variable is followed by a brief definition of it. The value of the coefficient of the variable and its standard error (in parenthesis) are next. The asterisks indicate the level of the t statistic with: * = 5%, ** = 10% and *** = 15%. Anything higher than 15% is determined as insignificant. A dash through the cell indicates a variable that has been left out of a particular equation.
### TABLE 5.1

MODEL REGRESSION RESULTS

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Equation 1</th>
<th>Equation 2</th>
<th>Equation 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Constant</td>
<td>.03728 * (.00282)</td>
<td>.03563 * (.00628)</td>
<td>.03084 * (.00227)</td>
</tr>
<tr>
<td>OFFTAL</td>
<td>HHI goals for</td>
<td>.71299 * (.05958)</td>
<td>.70237 * (.12872)</td>
<td>-</td>
</tr>
<tr>
<td>DEFTAL</td>
<td>HHI goals against</td>
<td>-8.7146 * (.05701)</td>
<td>-8.1047 * (.10049)</td>
<td>-</td>
</tr>
<tr>
<td>PPGF</td>
<td>Power play goals for</td>
<td>.00004 *** (.00017)</td>
<td>.00004 * (.00002)</td>
<td>.00009 * (.00002)</td>
</tr>
<tr>
<td>PGA</td>
<td>Power play goals against</td>
<td>9.43e-06 (.00019)</td>
<td>.00001 (.00002)</td>
<td>-0.00005 ** (.00002)</td>
</tr>
<tr>
<td>PIMS</td>
<td>Penalty minutes</td>
<td>-2.34e-06 * (1.07e-06)</td>
<td>-2.37e-06 * (1.08e-06)</td>
<td>-2.29e-06 ** (1.42e-06)</td>
</tr>
<tr>
<td>SOW</td>
<td>Shoot out wins</td>
<td>.000254 * (.00007)</td>
<td>.00025 * (.00007)</td>
<td>.00025 * (.00009)</td>
</tr>
<tr>
<td>SOL</td>
<td>Shoot out loses</td>
<td>.00006 (.00008)</td>
<td>.00006 (.00008)</td>
<td>.00005 (.00001)</td>
</tr>
<tr>
<td>LCKOUT</td>
<td>Dummy variable for before and after lockout</td>
<td>-.00228 * (.00081)</td>
<td>-.00108 (.00687)</td>
<td>-.00169 (.00391)</td>
</tr>
<tr>
<td>Salary</td>
<td>Salary cap hit</td>
<td>2.93e-11 ** (1.80e-11)</td>
<td>2.96e-11 ** (1.81 e-11)</td>
<td>5.81e-11 * (2.33e-11)</td>
</tr>
<tr>
<td>Offtal_lckout</td>
<td>Dummy for offensive talent before and after lockout</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Deftal_lckout</td>
<td>Dummy variable for defensive talent before and after lockout</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

|             | **R- Squared** | .8253 | .8260 | .6980 |
|             | Adjusted R-squared | .8174 | .8163 | .6844 |
|             | **F- Statistic** | 104.95 | 85.45 | 51.35 |
**TABLE 5.1 (cont.)**

**MODEL REGRESSION RESULTS**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Equation 4</th>
<th>Equation 5</th>
<th>Equation 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Constant</td>
<td>.03532* (.00637)</td>
<td>.03443* (.00649)</td>
<td>.03777* (.00276)</td>
</tr>
<tr>
<td>OFFTAL</td>
<td>HHI goals for</td>
<td>.77007* (.12738)</td>
<td>.70051* (.13357)</td>
<td>.74391* (.05792)</td>
</tr>
<tr>
<td>DEFTAL</td>
<td>HHI goals against</td>
<td>-.79834* (.10011)</td>
<td>-.81195* (.10432)</td>
<td>-.86894* (.05802)</td>
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<tr>
<td>PPGF</td>
<td>Power play goals for</td>
<td>-</td>
<td>.00003 *** (.00002)</td>
<td>.00003 ** (.00002)</td>
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<tr>
<td>PGA</td>
<td>Power play goals against</td>
<td>-</td>
<td>-4.96e-06 (.00002)</td>
<td>-6.61e-06 (.00002)</td>
</tr>
<tr>
<td>PIMS</td>
<td>Penalty minutes</td>
<td>-1.09e-06 (9.35e-07)</td>
<td>-</td>
<td>-1.81e-06 ** (1.07e-06)</td>
</tr>
<tr>
<td>SOW</td>
<td>Shoot out wins</td>
<td>.000238* (.00007)</td>
<td>-</td>
<td>.00016* (.00006)</td>
</tr>
<tr>
<td>SOL</td>
<td>Shoot out loses</td>
<td>.00005 (.00008)</td>
<td>-</td>
<td>-.00008 (.00007)</td>
</tr>
<tr>
<td>LCKOUT</td>
<td>Dummy variable for before and after lockout</td>
<td>.00038 (.00694)</td>
<td>-.00153 (.00703)</td>
<td>-</td>
</tr>
<tr>
<td>Salary</td>
<td>Salary cap hit</td>
<td>6.40e-12 (1.61e-11)</td>
<td>2.86e-11 ** (1.87 e-11)</td>
<td>-</td>
</tr>
<tr>
<td>Offtal_lckout</td>
<td>Dummy for offensive talent before and after lockout</td>
<td>.05016 (.11099)</td>
<td>.05177 (.14062)</td>
<td>-</td>
</tr>
<tr>
<td>Deftal_lckout</td>
<td>Dummy variable for defensive talent before and after lockout</td>
<td>-.10899 (.11099)</td>
<td>-.10366 (.11523)</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>R- Squared</th>
<th>Adjusted R-squared</th>
<th>F- Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.8188</td>
<td>.8107</td>
<td>100.44</td>
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<td></td>
<td>.8095</td>
<td>.8163</td>
<td>106.77</td>
</tr>
<tr>
<td></td>
<td>.8171</td>
<td>.8108</td>
<td>128.95</td>
</tr>
</tbody>
</table>
Offensive Talent

In the model equations, to account for the distribution of offensive talent, the Herfindahl- Hirschman Index for goals scored is looked at. In his research for Major League Baseball, Depken found the Herfindahl- Hirschman Index for runs scored to be insignificant 5%.\textsuperscript{1} Hence for Depken’s model, the concentration of runs scored does not seem to matter in determining the balance for Major League Baseball.

In all the equations the Herfindahl- Hirschman Index for goals for has a positive effect on competitive balance except for the one equation offensive talent was not included. Offensive talent also proved to be significant at the 95% confidence interval as well, in all of the equations. The regression coefficient for equation one is .71299. This means as the concentration of goals scored increases by 1 the HHIp increases by .71299. This result is expected and goes along with the predicted result with a positive correlation between the distribution of offensive talent and competitive balance in the National Hockey League. Also, when offensive talent was multiplied with the dummy variable of the lockout the coefficient remain positive showing an increase in the distribution of talent after the 2004- 2005 NHL lockout. However, when offensive talent is multiplied by the dummy variable of the lockout none of the equations came out with a significant t-statistic. These findings show that the concentration of offensive talent in the National Hockey League has an effect on parity.

Defensive Talent

In his model, Depken found the Herfindahl- Hirschman Index for runs allowed to be insignificant at the 95% confidence interval.\(^2\) Therefore, Depken’s model suggests that the concentration of runs allowed does not affect parity in Major League Baseball at the 95% confidence interval.

In all the model equations, in which defensive talent was measured, the Herfindahl Hirschman Index of goals allowed had a negative relationship with the HHIp. As the HHI for goals against decreases it means the concentration of goals allowed is decreasing. In other words, there is more parity or equality in goals allowed, from team to team. This would cause the league to be more competitively balanced. Using equation one as an example, the regression coefficient for offensive talent is -.87146. This shows that as the concentration of goals allowed increases by 1 it causes the HHIp to decrease by .87146. Defensive talent showed to be significant in all the equations it was used in at 5 %. These results contradict Depken’s results in his study for Major League Baseball showing that in the National Hockey League the distribution of goals against is a significant factor for competitive balance in the league. These findings imply that the concentration of defensive talent has an effect on parity in the National Hockey League.

In addition, when defensive talent was multiplied by the dummy variable for the lockout it continued to be a negative number. This shows that since the lockout, the concentration of defensive talent has decreased and as a result has increased competitive balance in the NHL. However, since none of the regression results proved to be

\(^2\) Ibid.
significant for defensive talent with regard to the lockout it is impossible to make this assertion.

*Power Play Goals For*

After the 2004-2005 lockout rule changes were put in place to open up the game and promote speed. Some of these changes were to put limits on the amount of obstruction a player can cause to his opponent. Because of this more penalties have been called throughout the league presenting more power plays for teams. When on the power play the chances of scoring increase, but have more power play opportunities created a more competitively balanced league?

As with the HHI for goals a positive coefficient for power play goals shows an increase in competitive balance in the National Hockey League since the lockout. In all the equations in which power play goals were measured they showed a positive coefficient and all were significant at least the 85% confidence interval, which is a weak significance level. For instance, in equation one the regression coefficient for power play goals was .00004. A small number but it shows that with an increase of 1 power play goal for, HHIp increases by .00004. A small increase but the number shows that power play goals for has a negative impact on competitive balance in the National Hockey League.

*Power Play Goals Against*

Because of the rule changes put in place after the lockout it is important to look at power play goals against as well as power play goals for. Power play goals against is
another measure for defensive talent but it measures of different aspect of defense. If a team is able to avoid getting scored on in 80% of the other team’s power play opportunities they are considered to have an efficient penalty kill. This is why it is important to measure power play goals against. In regression 1, the coefficient is positive at 9.43e-06. This coefficient means for every power play goal scored against HHIp increases by 9.43e-06. None of the equations were significant at the 95% confidence interval showing that unlike power play goals for, power play goals against are insignificant in determining competitive balance in the National Hockey League.

The finding on power play goals against were surprising because it is hard to imagine that power play goals for would have an impact on competitive balance, but power play goals against show to be insignificant. This is because both of the variables are measuring the same thing but just different quantities for different teams. It was expected that like defensive talent a negative coefficient would be produced and be significant at effecting competitive balance.

Penalty Minutes

Similar to power play goals for and goals against penalty minutes (PIMS) were measured to see if there was a correlation between penalty minutes taken by a team and the team’s point totals. The idea being the more penalty minutes taken by a team the lower the team’s point totals would be. This is because the team would have to spend more time shorthanded and less time on the attack. In the model equations, penalty minutes showed to have a negative relationship with HHIp and were statistically significant in all but equation 4. In equation one the coefficient for penalty minutes was
-2.34e-06 with a standard error of 1.07e-06. The coefficient for penalty minutes means that for every increase of one penalty minute the HHIp decreases by 2.34e-06. The results showed to be significant in some of the equations but not in others. This could have been caused by the other variables used in the regressions as well as the variables left out. The coefficient is the expected result meaning that an increase in penalty minutes has a positive effect on parity in the National Hockey League.

**Shoot out**

The data for shoot out wins proved to be significant in all the regression equations while the data for shoot out loses was insignificant in all the equations. For shoot out wins the coefficient in the first equation was .000254, meaning that for every shoot out win, HHIp increases .000254. This has a negative effect on parity showing that the implementation of the shoot out after the 2004-2005 lockout actually decreased competitive balance in the National Hockey League. Shootout loses on the other hand did not have a significant impact on competitive balance in the National Hockey League. This is not a surprising result since the shoot out favor teams with higher levels of offensive talent. With each team given the opportunity to go one on one with the opposing team’s goaltender it is obviously the more highly skilled offensive team would win the majority of the time.

**Salary Cap**

In this study, all the coefficients were positive meaning that the salary cap has actually decreased parity in the National Hockey League. In the first regression equation
the coefficient for salary was 2.93e-11. This coefficient means that for every increase in salary the HHIp increased 2.93e-11. The positive relationship shows that the placement of a salary cap in the National Hockey League was not a successful tool in increasing competitive balance and in fact lessened parity in the National Hockey League. The positive coefficient shows that as the variable increases the HHIp increases which decreases competitive balance in the NHL. This result is puzzling because with a salary cap as well as a salary floor, teams are forced to spend money on top end players but are not able to buy all the top offensive and defensive talent in the market. In all of the equations in which salary was used the data produced significant coefficients.

**Lockout**

To account for the 2004-2005 NHL lockout a dummy variable was used. The main purpose of this study was to see if competitive balance in the NHL has improved since the lockout which makes this variable of great importance. Even with all the rules changes put in place after the lockout it was important to see if the league became more competitively balanced or if the increase in attendance could be attributed to some other aspect of the game. In the regression equations the coefficients were both positive and negative. In equation one, two and five the coefficients were negative and in equations three and four the coefficients were positive. However, only in equation one was the coefficient for the lockout significant. In equation one the coefficient for the lockout was -.00228 and was significant at the 95% confidence interval, which could be caused by the interaction of the terms used. This means that for every year after the lockout the HHIp has decreased by .00228. The decrease in the HHIp shows that the lockout did in fact
have a positive effect on parity in the National Hockey League. The National Hockey League was successful at increasing competitive balance in the league after the lockout.

*Offensive talent_lockout and Defensive talent_lockout*

The dummy variables used for measuring the distribution of offensive and defensive talent before and after the lockout proved to be insignificant at the confidence levels used. However, the coefficients ended up being similar to offensive and defensive talent. The coefficients were positive for offensive talent and negative for defensive talent showing an increase in parity for both of them with respect to HHIp because like offensive and defensive talent a positive coefficient for offensive talent with regards to the lockout means that since the lockout goals scored have been more evenly distributed thus increasing the parity in the National Hockey League. The opposite goes for defensive talent with regards to the lockout. The negative coefficient in respect to the HHIp means that goals against since the lockout has become less concentrated and therefore goals against are more evenly distributed in the post lockout era.

*Fit of the Model*

The fit of each of the six model equations appear to be quality. Equation one has a coefficient of determination (R-squared) of .8253 and equation two has an R-squared of .8260. This shows that the two equations explain 82.53% and 82.60% of the variation in the HHIp, respectively. After taking into account the degrees of freedom, the adjusted R-squared for equation one is .8174, while for equation two it is .8163. This means that 81.74% and 81.63% of the variation in the dependent variable can be explained by the
independent variables. Equation three proved to have the smallest $R^2$ and adjusted $R^2$ values which were .698 and .6844 respectively. Equations four through six all exhibit relatively similar $R^2$ and adjusted $R^2$ values of. All three have $R^2$ and adjusted $R^2$ values around 81%.

**Conclusions for Results of the Model**

After analyzing the regression equations pertaining to the Herfindahl- Hirschman Index, some conclusions can be made. In observing the regression equations, it is very apparent that the three variables affecting the HHIp are offensive talent, defensive talent and in regression one the lockout had a significant impact on HHIp. Offensive and defensive talent distributions are major factors in determining competitive balance. This is an obvious assumption because few would argue that offense and defense are the two most important facets of the game. Hence, by creating more evenly distributed offense and more evenly distributed defense, the league would create better parity.

The salary cap also proved to have a significant impact on HHIp. This is no surprised because most of the literature agrees that a salary cap can be an important tool in increasing competitive balance. In this study, salary cap did in fact help the National Hockey League become more competitively balanced.

The dummy variable for the lockout also showed to have an impact on the HHIp. Because of the rules changes put into place after the lockout the National Hockey League was able to increase parity throughout the league.

Overall, this study showed that since the 2004-2005 lockout the National Hockey League has in fact become more competitively balanced. This is a result of the
implementation of the new rules and as well as the amendments of the old rules. Even the rules changes that had a negative impact on competitive balance, for instance the shootout, brought more excitement to the game. As tough as the 2004-2005 lockout was for hockey fans to take, it proved vital in reviving the game in North America as well as creating a more competitively balanced league.

Possible Limitations of this Study

There are certain limitations of this study that deserve to be mentioned in order to help explain some of the results, as well as to help future research regarding competitive balance in the National Hockey League. Although the years before and after the lockout were measured, this study only took into account the two years before the lockout as well as every year since the lockout. A more in depth look at the years before the lockout and then comparing them to the post lockout years might have shown different results. Also, this study focused solely on competitive balance in the regular season of the National Hockey League. If the HHIp could be tweaked in order to see competitive balance in the playoffs or the number of championships won by a team, could be an effective way of measuring competitive balance.

Different studies have shown different results on parity based on the measure used. Competitive balance is a subjective topic, and therefore has no perfect way to measure it. Because of this, it is extremely difficult to prove which method of testing for competitive balance is the best.
Final Discussion

In order to help determine factors in competitive balance within the National Hockey League the following should be analyzed; the offensive and defensive talent distribution, the implementation of the salary cap, as well as pre and post lockout data.

The National Hockey League and the National Hockey League Players’ Association would both benefit greatly if they were able to continue to make the league more competitively balanced. With the current collective bargaining agreement coming to an end this year, the league as well as the players association will have to come to terms again on what is best for the league. Competitive balance would not only help the overall product of the game but also spark more interest in National Hockey League cities that have losing teams. A more balanced league would also help generate more revenue for NHL teams and, in turn, its players.

This research helps quantify the determinants of competitive balance in the National Hockey League. Along with the studies done before this on the National Hockey League this study shows what proves to be useful and what is insignificant in determining competitive balance in the NHL. This study will hopefully act as a stepping-stone for future, possibly more in depth studies of the determinants of competitive balance in the National Hockey League. Going into a new CBA and knowing how to improve parity, the league and its players could potentially create a more balanced National Hockey League product.
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