CLAREMONT McKENNA COLLEGE

BLOOD MONEY: A STUDY OF THE EFFECT OF FIGHTING ON PLAYER SALARIES IN THE NATIONAL HOCKEY LEAGUE.

SUBMITTED TO

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Abstract

Fighting has been a centerpiece of the National Hockey League since it was formed in 1917. Although rules have been introduced regulating the physicality of play in the NHL, fighting is demanded—and encouraged—by fans and players alike. Fans have long been attracted to the violence of professional hockey; previous studies have documented that professional hockey is a "blood sport" that generates revenues with violence. This research investigates the effect of fighting on player salaries in the NHL, examining the way in which fighting has become a strategic element of the game, describing the way players enforce their own "Code" of hockey rules and police the ice in ways referees cannot, and comparing the salaries of fighters and skilled players to determine how players in different roles are valued.

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Table of Contents

1. Introduction

Despite taking three punches to the head and being thrown to the ice without so much as a swing at his opponent, Maxime Talbot of the Pittsburgh Penguins was satisfied. Finding his team down 3-0 against the Philadelphia Flyers, Talbot goaded Flyer Daniel Carcillo into a fight early in the second period of the teams' game six meeting on April 25, 2009 in the first best-of-seven round of the Stanley Cup Playoffs. After the fight, the Penguins scored five unanswered goals. The Penguins won the game 5-3, and eliminated the Flyers from the playoffs (ESPN NHL).

Talbot is what's known as an agitator in the National Hockey League (NHL)—a player whose role is to get under the skin of opposing players and draw penalties to give his team an edge. It also means engaging in fights. Win or lose, fighting has the potential to change the momentum of the game. Was Talbot's fight the main reason the Penguins won game six against the Flyers? Probably not. Did it jumpstart the Penguins' comeback? Undoubtedly.

The presence of fighting in hockey is often a polarizing topic. Some fans watch hockey solely for the violence; others condemn the sport for its unique leniency on the issue. What frequently goes overlooked, however, is the strategy surrounding fighting in the National Hockey League.

There are many instances in which the aggressive nature of hockey affects managerial decisions. By examining available data about player salaries (determined by owners and managers), we will analyze how central fighting is to the decision-making processes that occur off the ice in the NHL.

2. The Development and Strategy of Fighting in the NHL

2.1 The History and Development of Fighting in the NHL

The NHL was established in 1917, and was known from the beginning for its physical brutality. The original rules were significantly different from the rules today, and violence was actually more common and less regulated. Over the years, the NHL gradually introduced more and more rules designed to temper the brutality of the sport: the league's intent is to allow for the physical nature of the game, but not at the expense of player safety. The first key change occurred in 1918, when the two blue lines were introduced. These lines divided the ice into three sections: two defensive zones on each end and a neutral zone in the middle. Initially, passing the puck was only allowed in the neutral zone, which meant that when a player had the puck in either of the other zones, he had to skate through walls of fists, elbows, high sticks, and outstretched skates, rather than pass. This style of hockey was extremely dangerous and led to many injuries (Bernstein 2006, 3-4).

Rather than ban violence outright, the NHL tried to regulate it. In 1922, the league introduced Rule 56, punishing players who engaged in fights with a five-minute penalty. Owners, in the meantime, recognized that fans were attracted by violence, and encouraged the physical type of play that became engrained in hockey culture. Managers soon recognized the need to protect their most skilled players from the violence that was becoming dominant, and created the role of the enforcer to police the game and protect their star players (Bernstein 2006, 4).

What exactly did enforcers enforce? The Code. Hockey games were ruled not only by the official rules, but also by an unspoken code. This Code—which includes the principle that players have to answer for delivering big hits and taking cheap shots at opponents—became an integral part of hockey. Enforcers began to use fighting to intimidate opponents and deter them from hitting and checking (either legally or illegally) the team's stars. Marty McSorley, nicknamed "Wayne Gretzky's Bodyguard" for his role protecting Gretzky when both played for the Los Angeles Kings, described his task as one of the league's most feared enforcers: "As an enforcer, it was my job to make sure that my teammates had space out on the ice and could play the game honestly. If opposing players wanted to take liberties with my guys, then they would have to answer to me. That kept things honest, and that is the basis of the Code in its purest sense" (Bernstein 2006, x).

Enforcers have persisted in the league because of their success protecting teammates. Glen Sonmor summed up the effects of adhering to the Code, saying "When I was coaching the North Stars I also found it difficult to get my guys to even check Gretzky out there because they knew that as soon as they did they were going to have to turn around and face his bodyguards, McSorley or Semenko" (Bernstein 2006, 11).

It is worth noting that the NHL is the only major hockey league to allow—and to actually encourage—fighting. Fighting is prohibited in European hockey leagues and in Olympic ice hockey (International Ice Hockey Federation). While not prohibited in collegiate hockey in the US, it is strongly discouraged: fighting players are disqualified from the

game in which they fight and are suspended for the following number of games equal to their total number of fighting penalties that season. As a result, players tend not to take on the role of enforcer until they reach the NHL. George Parros, now an enforcer for the Anaheim Ducks, was a skilled forward when he played collegiate hockey at Princeton. He became an enforcer when he realized he wasn't talented enough to make it in the NHL as a goal-scorer; he led the league in fights in the 2010-2011 season with twenty-seven.

The lack of fighting in other leagues is part of the reason that enforcers need to establish themselves early on in the NHL. Much of an enforcer's success is due to his reputation, and a player cannot build a reputation as an enforcer until he reaches the NHL. The longevity of an enforcer's NHL career requires that he participate in fights early and often. This allows us to identify enforcers as players who fought frequently during the previous season for the purposes of this study.

2.2 Fighting Strategy: Profit Maximization for the Teams

Team owners typically have two goals: revenues and success (measured by wins and—in particular—by Stanley Cup appearances). Fighting has become engrained in the NHL because of its impact on both these goals. Essentially, the continued fighting helps team owners maximize profits. (Think of the way that new technology—although not directly related to a business's goal or output—often helps the business increase its profits by improving or accelerating the process the business uses to produce products, or by decreasing the costs of production.) Because a team's success increases revenues from

both ticket sales and merchandising, when fighting boosts a team's on-ice performance, it drives profits up as well. Below is a more detailed explanation of the way fighting impacts revenues, both directly (through sales and merchandising) and indirectly (through improving performance).

2.21 Fighting and Revenues

From the start, owners of NHL teams recognized that fans enjoyed the violence of hockey games. In fact, in the 1920s, when hockey came to New York City, Madison Square Garden promoter Tex Rickard recognized that people flocked to boxing events, and realized that he could use the public's delight in brutality to market hockey. He hired ambulances to drive through Manhattan with their sirens on, and pull up outside Madison Square Garden before a hockey game started, appearing to wait for the inevitable serious player injuries (Bernstein 2006, 4-5).

Though owners have long made the connection between fighting and ticket sales, two studies during the 1990s proved the connection statistically. These studies found that in the United States, "fighting" teams that played an aggressive style of hockey and commonly engaged in fights had significantly higher attendance rates than "skating" teams that tended to avoid on-ice violence. (These studies are explained in more detail in the following section.)

Besides increasing revenues through ticket sales, enforcers reduce costs by acting as insurance policies for more highly-paid skilled players. Because enforcers deter opponents from hitting star players, the stars suffer fewer injuries. Fighting is thus a cost-effective strategy: in addition to signing enforcers at lower salaries than those paid to stars, owners use enforcers to ensure that their highly-paid teammates suffer fewer injuries and have the time and the space to make the most of their abilities.

2.22 Fighting Strategies and Wins

The ability of enforcers to create time and space for skilled players leads to the strategy behind fighting in the NHL. As in any sport, hockey teams use different player roles to execute different strategies. In the NHL, teams can dress eighteen skaters each game: twelve forwards and six defensemen. Teams are allowed five skaters on the ice, and these are typically three forwards (right wing, center, and left wing) and two defenders. The eighteen skaters dressed for each game are organized accordingly. A team's defensemen form three defensive pairings, while forwards form four "lines" of three. The defensive pairings are typically ranked according to the skill of the players, but each of the forward lines has a significantly different role, based on strategies developed around fighting and physical play.

The first line usually includes the best offensive players on a team; it is responsible for the majority of a team's scoring. The second line contains the

second-tier offensive players; it supplements the first line's point generation. Coaches often move individual players between the first and second lines throughout the season, trying to find the best combinations of players with complementary abilities. For example, a playmaker (a player who excels at setting up goal-scoring opportunities for his teammates) needs to play with goal-scorers who can take advantage of the opportunities the playmaker supplies.

Physicality and fighting come into play on the third and fourth lines. The third line is commonly known as the checking line, and is usually composed of defensive-minded forwards; it plays against the opposing team's first and second lines to limit their scoring and wear them down physically. The fourth line is the "energy" line; energy-line players are usually older players whose scoring potential has diminished, but who play extremely physical and aggressive hockey. An energy line usually gets little ice time, but plays in bursts of high-octane aggression that often lead to fighting. Enforcers often appear on checking or energy lines.

Although enforcers are the primary participants in fights in the NHL, another player role is often responsible for fighting throughout the season: agitators. Agitators (also known as pests) are players who antagonize opponents either through physical play or verbal taunting—often both. They use legal, illegal, and questionable tactics to do this, frequently committing penalties when the refs are not watching. Their goal is to goad opponents into committing penalties; they

often try to lure opponents into fights and then back off so that only the opponent gets a penalty. As a result of their playing style, agitators are often required to answer for their tactics and uphold the Code by fighting. Agitators and enforcers thus have different roles, but both types of players commonly participate in fights.

The third and fourth lines use physical play to accomplish two key goals: invigorating their teammates and wearing down opponents. Their aggressive play (checking any and all of the opposing team they can) is often used to swing momentum and energize the rest of the team. The physical play livens up the fans in attendance, which—in turn—can give a boost to the home team's players. Fighting also tends to re-energize both the teams and the crowd. As a result, fighting has the potential to impact a game by changing its momentum. Even the prospect of having to fight a team's enforcer causes opponents to give the enforcer's teammates more time and space on the ice, making it easier to score goals and win games.

2.3 Choosing When to Fight

What affects a player's decision to fight? There are a few main reasons players challenge opponents to a fight. The first is justice. Enforcers are there to protect teammates: if a skilled player is checked hard (especially if it was an illegal, or questionable, hit), the enforcers on that player's team will challenge his attacker to a fight. Second, players fight to re-energize their team. Many players (sometimes skilled players) will fight when their team is playing poorly and is losing. The goal is to send a message to teammates to

work harder and get back in the game. Finally, many fights occur simply because of rivalries. Both individual and team rivalries lead to many fights, including some at the start of the game, simply to set the tone.

A typical fight in hockey involves a challenge from one player and an acceptance from his opponent, followed by both players "dropping the gloves." What causes a player to accept a fight? The Code. When a challenge is issued to uphold the Code, a player is expected to fight to answer for his earlier aggression. In other instances, a player might choose to accept the challenge, or might merely skate away. A major factor to consider before accepting a challenge is the state of the game. Because many fights are attempts to re-invigorate the losing team, a player on the winning team might skate away because he doesn't want to provide an opportunity for a shift in momentum. (The Talbot-Carcillo fight mentioned in the introduction to this paper was a fight of this nature. Carcillo's willingness to accept the fight and give Talbot and the Penguins a chance to swing the momentum was questioned by the game's commentators for this very reason.)

3. Literature Review

Though many view fighting in hockey merely as excessive violence, we will demonstrate the complex effect of fighting on financial decisions. Fighting in hockey in the United States has been studied before by Jones, Ferguson, and Stewart (1993, 1996), though these studies have focused on the relationship between fighting and attendance revenues, not specifically on the impact of a player's fighting role. We will bring together information from studies about the financial importance of fighting in the NHL, and information from studies of managerial and

coaching decision-making in *other* sports leagues (specifically the National Football League, the NFL) to examine the effect of fighting on player salaries in the NHL.

Two studies by Jones, Ferguson, and Stewart (1993, 1996) demonstrate the link between fighting and financial returns on hockey teams. These studies show the financial factors in the valuations managers place (or *should* place) on players such as agitators and enforcers. While the studies don't answer the questions we are asking, the results are pertinent to player salary determinations. Managers have two goals: 1) create a winning team, and 2) maximize profits. Players that help accomplish either of these goals (or both) become more valuable to the team. Jones, Ferguson, and Stewart (1993) focus on a number of variables believed to affect game attendance, including the price of tickets, the league ranking of the specific teams playing, the playoff drive of each team, and the "violence" of each team. Violence was incorporated as the average number of penalty minutes for each team prior to the game in question. The penalties were then broken into minor penalties, major penalties, and game misconducts. ("Fighting" is a five-minute major penalty in the NHL, and aggressors are sometimes given ten-minute game misconducts as well.) They also divided the study between games played in Canada and games played in the US. Jones, Ferguson, and Stewart regressed game attendance on these variables. The results categorized hockey in the US as a "blood sport:" as violence increases, so do ticket sales. In Canada, however, ticket sales actually decrease with a rise in extreme violence such as fighting.

Jones and Stewart (1996) single out fighting from other penalties. They also examine the playing styles of individual teams, categorizing each team as a "skating" or a "fighting" team,

based on its reputation for skilled or physical play. From this, they identify individual games as being between two skating teams, two fighting teams, or between one skating team and one fighting team. The results support their previous study which found that fighting has a significant, positive impact on ticket sales in the US, where games that include a fighting team are better attended than those between two skating teams. Canadian audiences still seemed to dislike violence.

Both prior studies highlight the financial value of enforcers and agitators for a professional hockey team. When choosing players for their teams, managers must consider the cost of their investment (player salary) and the return on their investment. The return on investment can be measured using both immediate financial returns (such as a change in ticket sales and merchandising revenue) and long-term financial gains based on performance (Will the team win the Stanley Cup, ultimately driving up ticket sales and merchandising revenue?). Jones and Stewart (1993, 1996) thus reveal that fighting should factor in the valuations managers place on different players.

The Jones and Stewart studies link hockey fighting and financial return but do not address managerial decisions at the draft, something that has not been studied in the NHL. However, managerial profit-based draft decisions have been studied extensively in the National Football League. Moskowitz and Wertheim (2011) focused on player value during professional sports drafts: they studied the trades teams conducted in order to get higher positioning in the draft, the salaries awarded to different draft picks, and the performances of draft picks during their NFL careers. They concluded that high draft picks are most often overvalued; the disparity in

performance between players chosen in different rounds of the draft was not proportional to their difference in salary. In fact, Moskowitz and Wertheim suggested that the risks facing a team with any given player (injury, team compatibility, and other factors affecting performance) make the high salaries paid to top draft picks unreasonable. Instead, teams should "trade down" with high draft picks to receive multiple players for a similar total salary (since the chances of one of two players becoming a star are greater than the chances of one of one). The similarities of the NFL and NHL drafts make the Moskowitz and Wertheim results pertinent. If the highly-touted goal scorers that dominate the first rounds of the NHL draft demand salaries many times those of their gritty teammates, skilled players might well be overvalued relative to enforcers.

What about the decisions facing coaches about when to play their enforcers? Again, coaching decisions have been studied in the NFL and not in the NHL. Moskowitz and Wertheim provide some insight into this issue through the NFL. Questioning the validity of the oft-used sports motto "There's no *I* in *team,*" they compared the success of teams composed of one superstar with "serviceable" support with that of teams composed entirely of "solid" players. They identified such teams by looking at salary disparities across individual teams. They found that teams with higher salary disparities across their starters are more likely to reach championships than those with more even salary distributions. In the NHL specifically, teams without a star goal-scorer or goalie dropped out of the playoffs quickly. What can we extrapolate about fighting from this? Enforcers are expected both to protect their own teammates and to intimidate their opponents. An enforcer's ability to keep his own team's goal scorers worry-free and to force opposing stars to play tentatively might be the deciding factor in a hockey game. However, an enforcer's abilities are not directly reflected in player statistics. As a result, we cannot simply

look at an enforcer's goal-scoring ability to determine his appropriate salary. Moskowitz's and Wertheim's results reveal the need to look at enforcers and skilled players separately when examining player statistics to determine an appropriate player valuation.

There are a few studies that have examined salary determinants in the NHL. Although these studies have focused on identifying potential discrimination affecting player salaries, the results offer a benchmark of comparison for this study—as well as an opportunity to expand upon prior research. Jones and Walsh (1988) looked at a number of factors affecting player salaries in the NHL, examining how different skill sets impacted player valuations, particularly across players in different positions. They used regression analysis to accomplish this, regressing player salaries on a number of standard statistics such as games played, games played squared (the coefficient of games played squared would reveal whether players could have too *much* experience; if they could be "over the hill"), penalty minutes, height, and weight. To assess whether salary discrimination existed against French-Canadian NHL players (because many former French-Canadian NHL-ers have complained of discrimination), Jones and Walsh also included a dummy variable for players born in the province of Quebec.

As a result of their study, Jones and Walsh posited two theories pertinent to the topic of our study. First, the positive coefficient for penalty minutes for forwards—compared to a negative coefficient for defenders—suggests that the NHL pays more for enforcers at a forward position. In the Jones and Walsh study, penalty minutes represented a player's level of aggression—aggressive players are more likely to incur penalty minutes, be it accidental or intentional. Second, Jones and Walsh returned a statistically-significant negative coefficient for the French-

Canadian dummy variable in their regressions for defensemen. They concluded that all other attributes being equal, French-Canadian defensemen had salaries ten percent lower than those of their peers. However, Jones and Walsh used data from the 1977-1978 season, so while their conclusion might indicate discrimination, it is possible that such discrimination is no longer seen in player salaries in the NHL. Additionally, as Jones and Walsh note, the plus-minus statistic was not recorded by the NHL prior to the 1977-1978 season. Since plus-minus has become a prevalent way of measuring a defender's ability, it is possible that the addition of the plus-minus variable to a regression analysis of player salaries will yield different results and have different implications about salary discrimination in the NHL.

The results presented in Jones' and Walsh's study raise additional questions. If enforcers at the forward position are paid a premium, what determines their salaries? Skilled players typically see higher salaries as their goals and assists increase, and lower salaries the more they are penalized. (Teams would rather their goal scorers spend time on the ice and not in the penalty box.) In addition, enforcers tend to score fewer goals than their teammates. To truly compare player salaries, it is necessary to look at the effect of different factors on the salaries of skilled players and enforcers to see which variables are more pertinent to each player's valuation. For example, height and weight might be more relevant in selecting an enforcer whose role is to intimidate and fight opponents than in choosing a skilled player, whose physical size might not have a profound impact on his ability to score goals. If we can examine the value of enforcers in more depth, the perceptions of discrimination become more interesting: if there does exist a premium for enforcers, is it possible that French-Canadian players tend not to be enforcers, thereby explaining—at least in part—the disparity in salaries for French Canadians?

Lavoie (2000) followed up Jones' and Walsh's study, trying to determine factors that explain the lower salaries of French-Canadian NHL players. Lavoie hypothesized that factors such as team location could explain such prejudice: the tensions between English Canada and French Canada could make English Canadian teams less interested in French Canadian players because managers fear that a heavily French Canadian team will attract fewer fans and lead to lower revenues. Lavoie's results were tentative (sometimes the signs of coefficients were opposite from what Lavoie expected or were not statistically significant), and suggested a different reason for the discrepancy. Lavoie's regression analysis suggested that management, potentially under the pressure of local fans, tends to pay a premium for local players. Since there are fewer teams located in French-Canadian cities and provinces than in the rest of Canada or in the US, French-Canadian players don't typically fall into the category of "local" talent and therefore miss out on the premium that managers pay for locals.

However, Lavoie (2003) expanded upon the results of his first paper, analyzing the merits that teams recognize in rookie players at the NHL draft. Lavoie (2003) found that European players typically do not suffer the same salary discrimination experienced by French-Canadian players, suggesting that his prior explanation of managers paying for local players does not explain the discrepancy. In addition, Lavoie added other variables to assess the playing style of individual players, incorporating height, weight, and penalty-minutes-per-game into his regression analysis. He also included a variable designed to identify the defensive ability of players (something typically underrepresented in player statistics) by creating a dummy variable for forwards who are often utilized on penalty kill units. (When a player commits a penalty, he spend two minutes

in the penalty box and his team remains down a player for that period of time. This period is called the "power play" for the team with the one-man advantage and the "penalty kill" for the perpetrator's team. Teams have designated power play and penalty kill units; forwards who appear on their team's penalty kill units are usually viewed as having strong defensive play.) The results of Lavoie's study suggested that defensive capabilities were not responsible for the salary discrimination against French-Canadian players; the players were simply undervalued by teams at the NHL draft. Like Jones and Walsh, Lavoie's results might be explained by the data he used: he looked at data up until 1994. It is worth exploring the possibility that discrimination has disappeared in the seventeen years since Lavoie's study.

To expand on the work of Jones, Walsh, and Lavoie, this study will specifically distinguish between enforcers and skilled players. An enforcer's defensive ability, for example, stems from intimidation: opposing skilled players tend to play more tentatively against aggressive enforcers, lowering their potential to score. However, since enforcers rarely have the skating ability and skill set to be considered defensive players, they do not appear on penalty kill units and would not have been recognized by Lavoie for their defensive contribution. Enforcers' strengths are typically intangible, and are therefore overlooked by standard regression analysis that groups all players together. To compensate for this, we will examine enforcers and skilled players as separate groups at the forward and defender positions. A direct comparison of the way different variables impact both enforcers and skilled players should explicitly reveal what factors have more weight in determining the salaries of both types of players. This, in turn, can be used to re-assess the possible reasons for the perceived discrimination towards French-Canadian players.

4. Methodology

Determining the effect of fighting on player valuations in the NHL requires a method for valuing players. The market value of hockey players can be measured different ways. How does a player impact a team's ticket sales and merchandising revenue? How many goals does a player score in a season? How does a player improve the performance of his teammates? Some of these impacts are measureable, but many of the values that enforcers and agitators bring to a hockey team are intangible. As a result, we need to pick a tangible way to measure a player's value. For the purposes of this study, we used two measures: salary and time on ice. Based on the availability of salary information for current players, we can create a direct numerical comparison between the value of enforcers and the value of skilled players. Jones, Walsh, and Lavoie also used player salaries to analyze potential discrimination in the NHL. This allows us to compare the results of our analysis with their results to look for commonalities, and to identify the most appropriate explanation for the perceptions of discrimination reported by Jones, Walsh, and Lavoie. Time on ice will give us insight into the strategic value of different variables on enforcers and skilled players. Time on ice data (a player's average total time on the ice per game) is available for all players from the previous season.

To assess what factors impact a player's salary and average time on ice, we will regress them on points-per-game, games played, penalty minutes, plus-minus (a measure of how many goals are scored *for* a player's team while he is on the ice minus the number scored *against* his team), height, and weight. The regressions will not only reveal whether certain factors are "statistically significant" (Is there a clear impact on a player's salary or playing time?), but will also quantify the impact of certain variables on player valuation. We can then compare the results between

enforcers and agitators and skilled players. (We will also divide players into two groups—forwards and defenders—as different skill sets are needed for these different positions.) If enforcers and agitators have different determinants for their salaries and ice times, we can identify ways teams measure the intangible value that physical play brings to hockey. In addition, some variables might be statistically significant for one group of players and not the other (or for salary determination, but not time on ice), demonstrating that certain variables have a different impact on a player's salary and ice time depending upon his role.

After determining the impact of fighting on player salaries, we hope to use our findings to expand upon the studies conducted by Jones and Walsh (1988) and Lavoie (2002, 2003). Jones, Walsh, and Lavoie concluded that French-Canadians in the NHL are discriminated against in salaries. If our results reveal that enforcers and agitators earn larger salaries relative to their goal-scoring and defensive abilities in order to compensate for their intangible "violence" value, we can examine the distribution of French-Canadian enforcers across the league. If French Canadians tend not to incorporate the physical aspects of hockey into their game, the value of fighters might account for the lower salaries paid to French Canadian players.

Moreover, we can follow up the studies of Jones, Ferguson, and Stewart (1993, 1996) suggesting that US audiences are more attracted to physical play than Canadian audiences. By comparing the salaries of enforcers playing for Canadian teams with those playing for American teams, we can see if the ability of enforcers to increase ticket sales through violence is reflected in a disparity in salaries for teams in different locations.

5. Data

5.1 Players

Hockey players included in this study were current players who have played at least 50 games in their NHL careers. Only current players were included for three reasons. First, salary data came from the National Hockey League's Players' Association (NHLPA), and player salaries were not available for older seasons. Second, salaries of NHL players have changed drastically over the years. Salaries have changed not only in response to inflation and changes in revenue streams, but also as a result of changes in salary regulations. The NHL enforces a salary cap for each team, limiting the amount of money teams can invest in players. Changes in the salary cap affect the maximum salaries that teams are allowed to offer their players, making comparisons between salaries from different years less significant. Finally, the NHL has been subject to many changes in playing style and rules since its inception. In particular, the NHL lockout that occurred during the 2004-2005 season sparked a number of changes designed to increase the popularity of hockey in the US. Rule changes—including smaller pads for goalies and bigger goals—were enacted to increase the number of goals scored, making it difficult to compare statistics effectively before and after such rule changes. As a result, only current players were included in the study.

Current players who have played fewer than fifty games in their careers were removed from the study for two reasons. First, the fewer games an individual has played, the less likely it is that his statistics accurately reflect his ability. As a player participates in more games, his statistics level out and it becomes easier to establish ratios such as points-per-

game over a long-term career. Eliminating players who have played fewer than fifty games removes all rookie players and players who have been in the NHL only sporadically (those called up from minor leagues to fill in for NHL affiliates because of injuries during the season). Rookies and sporadic players typically have lower salaries that vary little depending on their ability. As is true with most jobs, a player's salary ultimately becomes a reflection of his success and of the contribution he provides to his team, but this doesn't happen immediately. Coaches and managers must witness a player's ability at the professional level consistently before they offer him a salary reflective of his skill. For these reasons, players who have played in fewer than fifty games were eliminated from the sample.

5.2 Enforcers

Determining which players are enforcers can be difficult—many players are both talented goal scorers and aggressive checkers. However, skilled players are typically prevented from fighting by their own team, since the risk of losing a goal-scorer or playmaker to a broken hand from fighting is a major reason for having designated enforcers on each team. Since an enforcer's job necessitates fighting, we compiled a list of all the players who participated in at least one fight in the most recent season. (One season's data alone is sufficient because an enforcer must get in fights regularly to fulfill his role. Any enforcers in our sample set of current players with more than fifty games of experience would have been in a fight the previous season.) However, because establishing a cut-off number of fights to determine an enforcer is arbitrary, we chose two alternative cut-off points. By looking at these two different samples and comparing the regression results,

we can identify similarities and also see if the number of fights an enforcer engages in has a large impact on his salary.

We first chose players who had participated in at least four fights last season as enforcers. (Since skilled players can occasionally be goaded into fights or have to "answer the call" as part of the self-imposed hockey code for delivering a big hit to an opposing team's star player, many players participate in one or two fights a season without being enforcers.) This method weeds out most skilled players, but there are still some players whose high levels of aggression lead them to engage in more than four fights. As a result, we chose a second cut-off point of ten fights. A manual examination of the list of players who engaged in ten or more fights last season reveals only those players definitely known primarily as enforcers.

5.3 French Canadians

In order to follow-up the Jones and Walsh (1988) and Lavoie (2002, 2003) studies on discrimination against French-Canadian NHL players accurately, we used the same method to identify French-Canadian players: players born in the province of Quebec, Canada.

5.4 Statistics

Certain statistics carry more weight in determining the value of a player depending on his position either as a forward or as a defender. While we ran the same regressions for all players, we divided the sample into forwards and defenders, and compared enforcers and

skilled players in each of these groups. The variables used for the regressions are discussed below, with attention given to the effect of each variable on both forwards and defenders.

Charts 1a through 1h plot goals-per-game against penalty minutes-per-game for enforcer defenders, skilled player defenders, enforcer forwards, and skilled player forwards. The results demonstrate the key difference between skilled players and enforcers: skilled players—particularly at the forward position—consistently have higher goals-per-game ratios and lower penalty minutes-per-game ratios than enforcers. In addition, examination of the trendlines reveals slopes of different signs: forward enforcers see a drastic drop in their goals-per-game as penalty-minutes-per-game increases while skilled players see a positive correlation between the two. This relationship can be explained by the different implications of penalty minutes for enforcers and skilled players. Skilled players with more penalty minutes typically play a more aggressive and intense style of hockey; their intensity leads them to accrue more unintentional penalties, but also helps them create more scoring opportunities. For enforcers, penalty minutes typically represent a more aggressive playing style as well. However, aggressive enforcers focus more on fighting and checking opponents (therefore intentionally earning penalties), limiting their scoring chances and leading to fewer goals. The same difference can be seen in defenders, but to a lesser extent. The smaller disparity among defenders is not surprising: defenders score fewer goals than forwards regardless of their playing styles and defenders commonly commit minor penalties (such as hooking and slashing) intentionally to slow down opposing players on breakaways and deny goal-scoring

opportunities. The meaning of penalty minutes for different groups of players is elaborated on in section 5.44, where the relationship with a player's salary is examined in more depth.

Tables 1a through 1d and 2a through 2d summarize all the variables being examined, and divide up the sample groups for comparison. They also show the correlation between each variable and the salaries of players within that sample group. For the purposes of this study, it is important to note the differences in average salary for different player groups. When we use a cut-off of four fights the previous season to define an enforcer, the difference between the mean salaries of skilled players and enforcers is not significant at a ten percent level for either forwards or defenders. However, when we use ten fights as the cut-off for an enforcer, there is a statistically significant difference in the mean salaries for skilled players and enforcers. For forwards, the difference in mean salaries is significant at a five percent level. For defenders, it is significant at a one percent level. This suggests that enforcers who do an excessive amount of fighting are less valuable, possibly because their fighting ability comes at the expense of other skills—such as the ability to score goals. Because enforcers tend to spend much less time on the ice than skilled players, a comparison of this nature for time on ice as a dependent variable would not be an appropriate comparison for enforcers and skilled players. The regression analysis (examined under "Empirical Findings") provides a better comparison by assessing which variables have a statistically-significant impact on determining a player's time on ice. A more detailed explanation of the key variables that impact player salaries and ice time follows.

5.41 Games Played and Games Played Squared

Games played (GP) and games played squared (GPSQ) represent the NHL experience of each player. Because salaries are often based on experience, we must examine the effect of games played on salary. Games played squared is included to assess the "point of diminishing returns." In other words, can players be *too* experienced? We expect games played squared to have a negative coefficient for both salary and time on ice because players become less valuable as they pass a certain age and are no longer in their physical prime (this is true for time on ice in particular, as older players are less physically capable of playing for extended durations).

It is worth noting that the level of experience has more of an effect on the salaries of skilled players than on enforcers. Skilled players typically see their salaries increase steadily as they reach their prime, accruing more goals and assists each season. Because of the difficulty of transitioning to the NHL from minor leagues or colleges, salaries of many skilled players don't peak until they have played professionally for five or six years. In addition, the peak is short-lived: as players age, they become slower and more injury prone, lowering their scoring potential.

Enforcers, on the other hand, vary little in their performance ability over time. An enforcer's value stems from his grit and aggressiveness—traits which can be present when players first enter the league and which continue (and sometimes grow) as

players age. The most likely reason for an enforcer's NHL experience to affect his salary is the reputation he develops. Reputations precede players and a well-known enforcer might be able to deter opponents from hitting his teammates simply because of his reputation. As a result, we expect both games played and games played squared to have a larger impact on the salaries of skilled players.

5.42 Points

Points—an accumulation of both goals and assists for a player over his entire career—also has a profound effect on salary determination. The abilities of many players (particularly forwards) are often measured solely by their career points. For example, Wayne Gretzky is widely considered to be the best NHL player of all time, and is probably the only hockey player known by name to people who do not follow the sport. Gretzky has nearly one thousand points more than the second-place all-time leader, Mark Messier. The top ten all-time leaders in points are collectively considered some of the best players to ever play in the NHL[1]. Career points are therefore a large factor in determining a player's salary, as seen in charts 2a through 2d. All four groups of players have an upward-sloping trendline when we plot player salary against career points. Points should also have a significant impact on the playing time of both skilled players and enforcers: any player with a high ability to score will be given more ice time than his peers in order to maximize his opportunity to score goals.

[1] Wayne Gretzky (2,857), Mark Messier (1,887), Gordie Howe (1,850), Ron Francis (1,798), Marcel Dionne (1,771), Steve Yzerman (1,755), Mario Lemieux (1,723), Joe Sakic (1,641), Jaromir Jagr (1,612), and Phil Esposito (1,590) are the top ten all-points leaders in the NHL (The National Hockey League).

5.43 Plus-Minus

Plus-minus is a statistic typically used to measure the skill of defensive players. Since defensive players tend not to score as many goals, and record fewer assists than forwards, their point totals seem low in comparison to those of forwards. However, plus-minus reflects a defender's ability to protect his own goal and support his team's scoring ability by keeping his team on offense. We expect plus-minus to have more impact on the salaries of defenders than on the salaries of forwards. As with points however, enforcers' salaries will be less-effected by their plus-minus due to the way in which enforcers function on their teams.

We expect plus-minus to have a significant impact on the ice time of forwards in particular. Because plus-minus is used to measure a player's defensive ability, a high plus-minus for a forward may contribute to his selection for his team's penalty kill unit, contributing to his total ice time per game. As with salary, defenders are expected to have an average ice time dependent, in large part, on their plus-minus, as it is often indicative of which players are considered the best defensemen.

5.44 Penalty Minutes

A player's total for penalty minutes is often valued differently depending upon the player's role. For a skilled player, penalty minutes represent the player's aggression and intensity on the ice; playing with a higher intensity or levels of aggression often results in more accidental penalties (minor penalties such as hooking, tripping, and

slashing). For skilled players, we expect penalty minutes to have a positive correlation with salary, although skilled players who commit too many penalties and spend too much time in the penalty box limit their own scoring chances and become less valuable to the team. Despite this delicate balance, there is no clear "sweet spot" that identifies the value of a skilled player's penalty minutes, though we expect a positive coefficient for penalty minutes.

For enforcers, penalty minutes is perhaps the most important statistic. Just as career points are the key measure of a skilled player's ability, penalty minutes reveal whether an enforcer is doing his job: engaging in fights and checking opponents—the two major roles of enforcers—yield high penalty minute totals. One of the league's most famous enforcers, Marty McSorley, is fourth in all-time career penalty minutes[2]. Because of the importance of penalty minutes in assessing enforcers, we anticipate a positive coefficient for penalty minutes in the regressions of player salaries.

The effect of penalty minutes on ice time is much more complex. Although penalty minutes might reflect an enforcer's tenacity and result in more ice time, it is important to remember than penalty minutes are minutes spent *off* the ice. For every fight an enforcer is in, he spends at least five minutes in the penalty box. As a result, we expect penalty minutes to have a negative coefficient for players when examining time on ice, regardless of their position and playing style.

[2] Dave Williams (3,966), Dale Hunter (3,565), Tie Domie (3,515), Marty McSorley (3,381), and Bob Probert (3,300) are the top five all-time leaders in penalty minutes. All were feared as top enforcers in their day (The National Hockey League).

5.45 Height and Weight

Although height and weight do not directly correspond to a player's success in the NHL, they are relevant to NHL players because of the physical nature of the game. For enforcers in particular, height has a significant impact: in addition to intimidating other players, height typically means longer reach, which—in turn—makes enforcers better fighters. The better a fighter someone is, the more people fear fighting him, and the less his teammates are targeted by opposing teams. Weight has a similar effect. However, while height and weight are essential for enforcers, they are still beneficial attributes for skilled players: the bigger the player, the harder it is for opposing teams to push him around. As a result, we do not anticipate a large disparity in the effect of the height and weight variables on enforcers and skilled players.

Moreover, like games played, height and weight have a point of diminishing returns (taller players tend to be less talented skaters and heavier players are often slow skaters). To measure this, we included height squared (HTSQ) and weight squared (WTSQ) in our regressions. Because these attributes become harmful after a certain point, we expect a positive coefficient for height and weight, but a negative coefficient for height squared and weight squared.

6. Empirical Findings

6.1 Salary Determinants for Different Player Roles

Tables 3 and 4 contrast the Ordinary Least Squares (OLS) estimates for skilled players and enforcers (with enforcers defined as players participating in at least four fights in the 2010-2011 season and at least ten fights in the 2010-2011 season). These tables show the results of regressions for the four different groups of players, dividing both forwards and defenders into skilled players and enforcers. In Table 4, the OLS estimates for enforcers at the defender position are omitted because of collinearity: only four defenders participated in ten or more fights during that season, making our sample size too small to provide useable results. This does reveal a tendency for enforcers to exist at the forward position. Since NHL teams dress twelve forwards and six defensemen for each game, losing defensemen to penalties (and potential misconducts and game ejections) is more costly to a team than losing a forward.

There were a few commonalities across all the regressions. Points-per-game (PPG) is statistically significant at the one percent level in all seven regressions, and the high coefficients (ranging from 2.1 to 2.6) demonstrate the value of a player's ability to contribute goals and assists to the success of his team.

Games played (GP) and games played squared (GPSQ) are also significant across all the regressions, with two important results. First, as predicted, games played has a positive coefficient while games played squared has a negative coefficient. This supports the

hypothesis that players become more valuable as they gain NHL experience, but they do reach a peak after which experience (probably reflecting age) hinders their ability and contributes to their decreasing market value in the NHL. Second, games played and games played squared were less significant at the five and ten percent level, respectively, for enforcers engaging in ten or more fights than for all other player groups. This supports our prediction that the most active enforcers are valued more for their tenacity and willingness to fight than for their experience. However, experience still offers value by means of reputation, though (as with skilled players) too much experience reduces value.

There are a few important differences between forwards and defenders, so we'll examine the results for the two groups separately, starting with forwards. Defining enforcers as players who participated in at least four fights, the only additional variable that is statistically significant in determining the player's salary is plus-minus (+/-). It is not, however, statistically significant for skilled players. Since plus-minus is typically used to assess defenders, it could perhaps reflect a tendency for managers to view enforcers as defensive players, even when they play at the forward position. These results thus suggest that enforcers provide value without recording goals and assists; they have a defensive impact. This supports the findings of Moskowitz and Wertheim that an enforcer's ability to intimidate his opponents can mitigate the impact of opposing teams' star players, diminishing their ability to score goals.

While plus-minus is not significant for skilled forwards, weight and weight squared are both significant at the five percent level. Although we incorrectly predicted that physical attributes would not significantly affect players with different playing styles to the same degree, the importance of weight for skilled players *is* in line with our predictions. The positive coefficient of weight for skilled forwards demonstrates the need for muscle and bulk so that opposing players cannot easily push the forwards around. This, in turn, gives the forwards greater opportunity to capitalize on their scoring abilities. At the same time, the negative coefficient of weight squared reflects the importance of attributes like speed and skating ability for many goal-scorers—qualities that tend to diminish as players get heavier.

Interestingly, the significant variables among forwards differ when we define enforcers as players who participated in ten or more fights the previous season. In that case, penalty minutes (PIM), not plus-minus, is statistically significant. Perhaps this is the result of differences between agitators and energy lines and enforcers. Agitators and players playing on energy lines are characterized by aggressive play. Their willingness to check players—often opposing skilled players in an attempt to get them "off their game"—requires agitator and energy line players to accept opponents' challenges to fight based on the Code. This could cause many agitators and energy players to engage in just over four fights in a season; however, such a playing style would probably not lead these players to participate in ten or more fights in a season. The different cutoffs might capture players of slightly different playing styles as a result. Since agitators and players on energy lines tend to have more skilled attributes than enforcers, they might be valued

more based upon their plus-minus. When looking only at players engaging in ten or more fights, we examined only the most persistent enforcers in the league. These players' value stems more directly from their willingness to fight, and their career penalty minutes (which increases significantly for every five-minute fighting major) offer managers the best way to measure this willingness.

For defenders, the only statistically significant variable other than points-per-game, games played, and games played squared is penalty minutes. However, unlike for forward enforcers, the coefficient for penalty minutes is negative for defender enforcers. Since the higher number of forwards in a team's lineup makes forwards more disposable, managers would prefer that their forwards take penalties, not their defenders. Perhaps the value of enforcers at the defender position is reflected in the fact that plus-minus is not statistically significant at even the ten percent level for enforcers, but is significant at the one percent level for skilled players, suggesting that the traditional method of assessing a defender's ability by examining his plus-minus ratio does not adequately reflect the ability of enforcers.

Finally, we compared the salaries of enforcers on Canadian teams to those of enforcers on American Teams (see Table 5). For both thresholds—four fights and ten fights—of determining enforcers, there was no statistically-significant difference between the salaries of enforcers playing for teams in different locations above a ten percent level. Even though Jones, Ferguson, and Stewart (1993, 1996) might have found a stronger link

between physical play and ticket sales for teams located in the US, the relative ability of enforcers playing in different countries to attract fans is not reflected in a salary disparity.

6.2 Time on Ice Determinants for Different Player Roles

Tables 6 and 7 contrast the OLS estimates for skilled players and enforcers when using time on ice as the dependent variable for the regressions. (As with salaries, the OLS estimates for enforcers at the defender position are omitted when using ten fights as the threshold for enforcers because of collinearity.) Tables 6 and 7 reveal an interesting contrast between salary and time on ice for skilled forwards: while salary was not affected by the plus-minus statistics, the plus-minus statistic is statistically significant in determining a player's time on ice (at a ten percent level with a threshold of four fights, and a five percent level with a threshold of ten fights). However, the coefficient for plus-minus was negative, despite our prediction of a positive coefficient. This is perhaps attributable to the defensive role given to forwards with a high plus-minus. Since many forwards with a high plus-minus are valued for their defensive role, they play in specialized situations—such as the penalty kill—but are given less total ice time than other forwards who are more capable of scoring goals for the team. However, while plus-minus was statistically significant for the salaries of forward enforcers, it was not significant in determining the ice time of such players. In fact, only points-per-game was statistically significant at a one percent level for forward enforcers. (Games played and games played squared were significant at a ten percent level using the four-fight threshold, but were not significant when using ten fights as a threshold.) This suggests that an enforcer's time on ice is affected primarily but his capacity to score goals in

addition to his traditional role as a fighter. However, ice time for forward enforcers—unlike salary—is virtually unaffected by other variables.

Plus-minus also had a smaller impact on the ice time of defenders—both skilled players and enforcers—than on their salaries. Plus-minus was statistically significant for skilled defenders at a ten percent level using the four-fight threshold for enforcers, but was not significant at the ten-fight threshold and was not significant for enforcers at either threshold. These results—in combination with the regression analysis for player salaries—suggest that plus-minus has become a standard measure of a defender's *economic* value to a team, but that it has a limited effect on a player's time on ice per game. It is possible that the smaller numbers of defenders on a team (typically six dressed defenders compared to twelve dressed forwards) necessitates more playing time for each defensive pair, and that each pair has a similar strategic role. This is in line with the traditional division of forward lines into two scoring lines, one checking line, and one energy line, a distinction that necessitates different average ice times for players on the different lines.

6.3 No Discrimination Against French-Canadian Players

The results of the regressions also reveal an interesting result about discrimination towards French Canadian players. Only one regression—forward enforcers—had a statistically significant coefficient for the French Canadian dummy variable. However, since there was only one French Canadian forward in the sample who had engaged in four or more fights, we cannot accept the result as universally true. (It merits noting that

the coefficient for this player was positive, suggesting that even if we did accept the results, there certainly isn't discrimination *against* French Canadian players.) Although our results did not support our hypothesis that differences in the determinants of salaries for skilled players and enforcers could explain the disparity in French-Canadian player salaries, we were correct in predicting that using more recent player data would produce different results from those reported by Jones, Walsh, and Lavoie.

To follow up Jones, Walsh, and Lavoie's studies, however, we examined data for French Canadian defensemen. In our study, there was never a statistically significant coefficient for the French Canadian dummy variable among defensemen, suggesting that salary discrimination does not exist. This can probably be attributed to two factors. First, the previous studies used data that was too old to include the plus-minus variable. Since our data from the 2010-2011 season looked at plus-minus (and found it to be statistically significant at the one percent level), plus-minus might provide a better way to assess a defenseman's ability. The prevalence of the plus-minus to evaluate defensemen in the NHL today might make it easier to evaluate players on an equal scale, minimizing salary discrimination. As a result, the previous studies would have suffered from omitted variable bias, skewing the results. Second, it is possible that salary discrimination towards French Canadian players has disappeared from the NHL over time. Lavoie's study was the most recent to examine discrimination, and his most recent data was from 1994. Changes in the game and in the way discrimination is tolerated and perceived likely occurred during the last sixteen years, leading to the disappearance of any salary discrimination against French Canadian's that might have existed in the past.

7. Conclusion

The objective of this research was to investigate the effect of fighting on player salaries and ice time in the National Hockey League and to use the results to expand upon previous studies that indicated salary discrimination against French Canadian players. To do this, we analyzed the impact of different variables on the salaries and ice times of skilled players and enforcers in the NHL. We collected salary information of current NHL players from the National Hockey League Players Association and ice times from the National Hockey League and regressed the data on career statistics of those players provided by the NHL's website.

The results of the regressions supported our hypothesis that enforcers are valued differently from skilled players. Although total points were a significant determinant of salary and ice time for all players, different variables suggested that NHL managers recognize the way different playing styles provide value to teams and measure the abilities of different types of players accordingly.

Perhaps most interesting was our conclusion about the absence of salary discrimination against French Canadian players. Our regressions did not find statistically significant coefficients for the French Canadian dummy variable, contradicting the findings of previous studies and suggesting that discrimination does not exist. This was likely due to our addition of the plus-minus statistic that is now used to assess the ability of defensemen, though it might merely reflect a change in discrimination within the NHL in the sixteen years since Lavoie's study.

The results of this study raise a few questions for future consideration. In regards to discrimination, it would be interesting to find historical data for player salaries over the past sixteen years and run regressions for each year. This might reveal a gradual change in discrimination, measured either by changes in the coefficients or by changes in statistical significance. This would support the premise that NHL salary discrimination against French Canadian defensemen—although prevalent in the 1980s and 1990s—has gradually faded. The absence of such a result suggests that the change might be due to the introduction of the plus-minus statistic just after Jones and Walsh's study, giving NHL managers a more consistent way of valuing defensemen.

It would also be interesting to study teams' breakdowns of player salaries to examine each team's resource allocation towards different player types. Looking for commonalities across the NHL would highlight the importance teams place on having a variety of roles filled, rather than accumulating a star-studded roster. This would be an additional extension of the analysis in Moskowitz and Wertheim's second study, suggesting that teams perform better with one star player and a number of merely good players in different supporting roles.

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Appendix

Chart 1a:
Relationship of goals-per-game and penalty minutes for enforcers at the defender position.

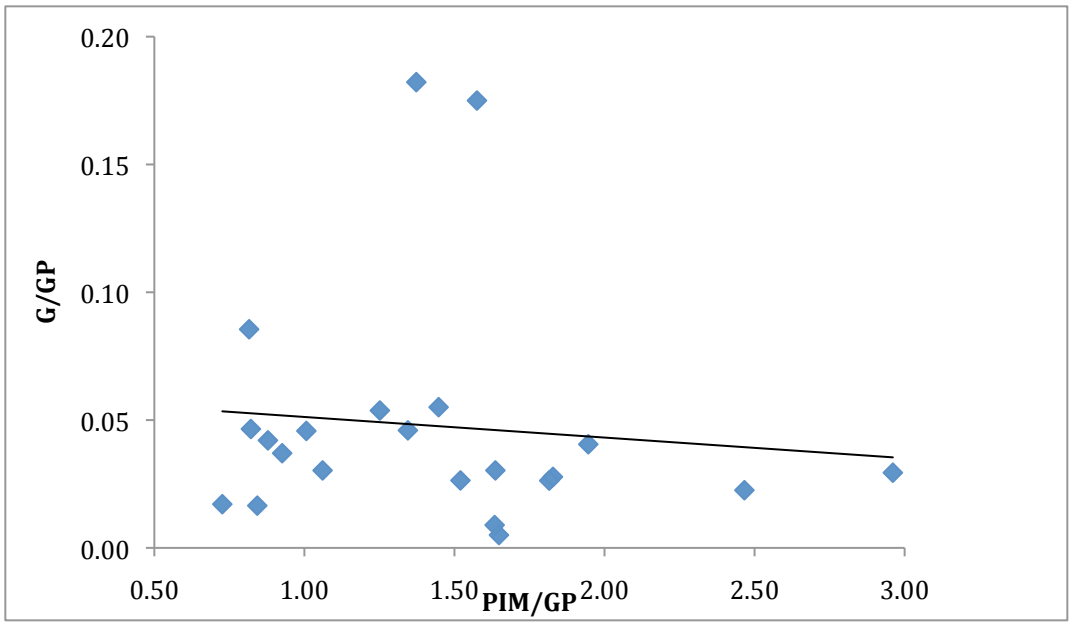


Chart 1b:
Relationship of goals-per-game and penalty minutes for skilled players at the defender position.

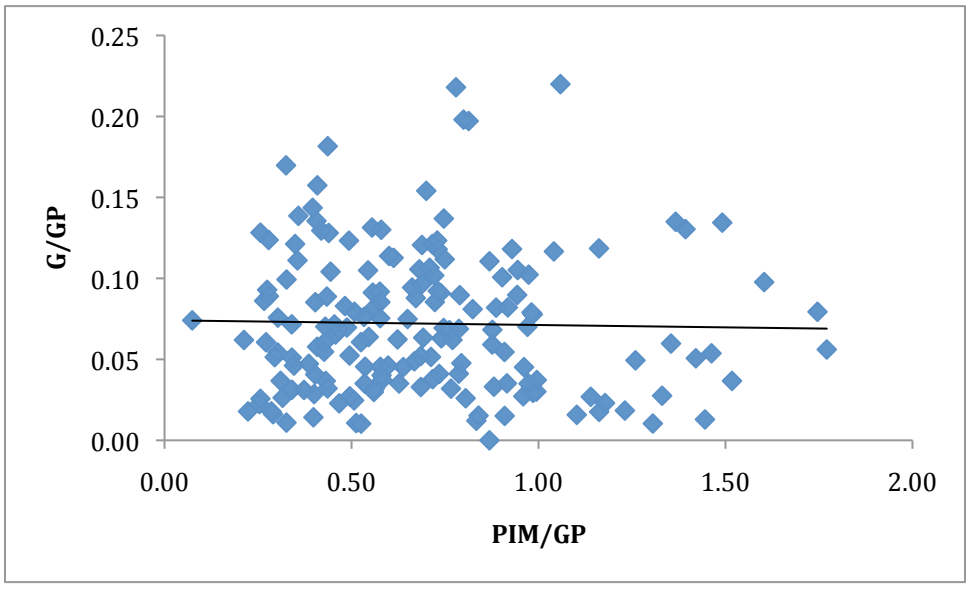


Chart 1c:
Relationship of goals-per-game and penalty minutes for enforcers at the forward position.

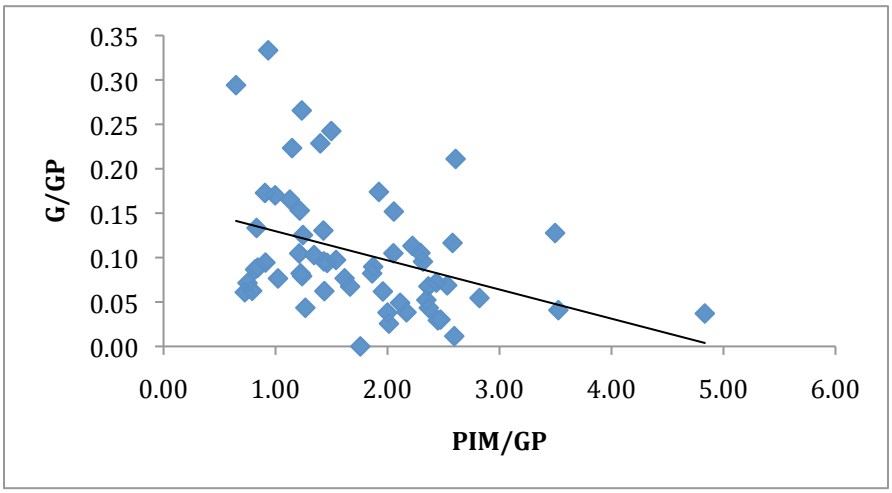


Chart 1d:
Relationship of goals-per-game and penalty minutes for skilled players at the forward position.

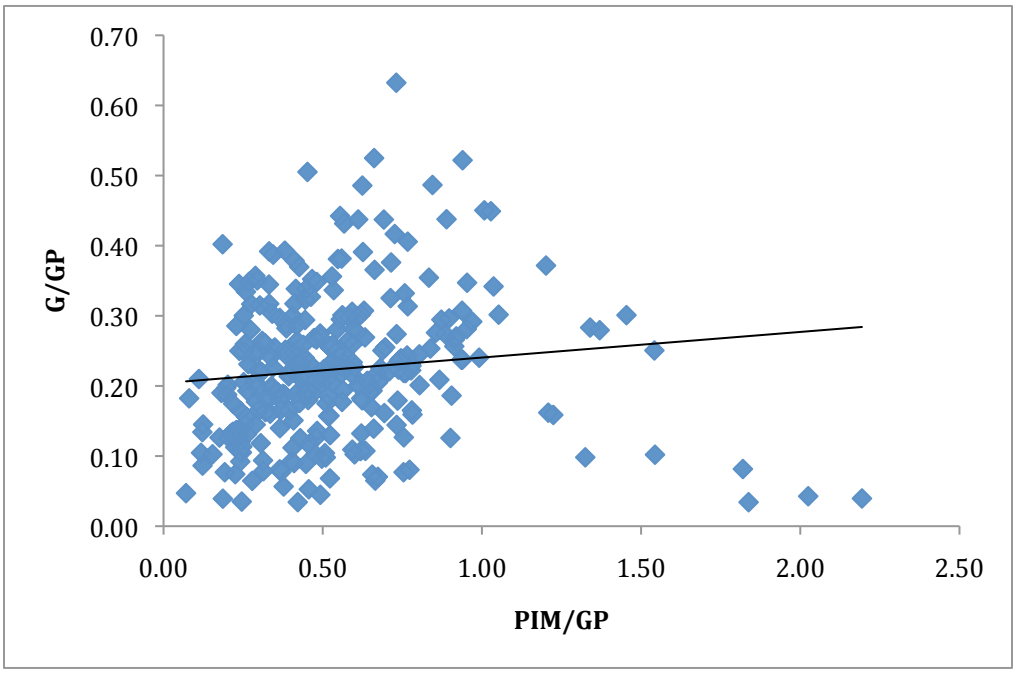


Chart 1e:
Relationship of goals-per-game and penalty minutes for enforcers at the defender position (threshold of ten fights for enforcers).

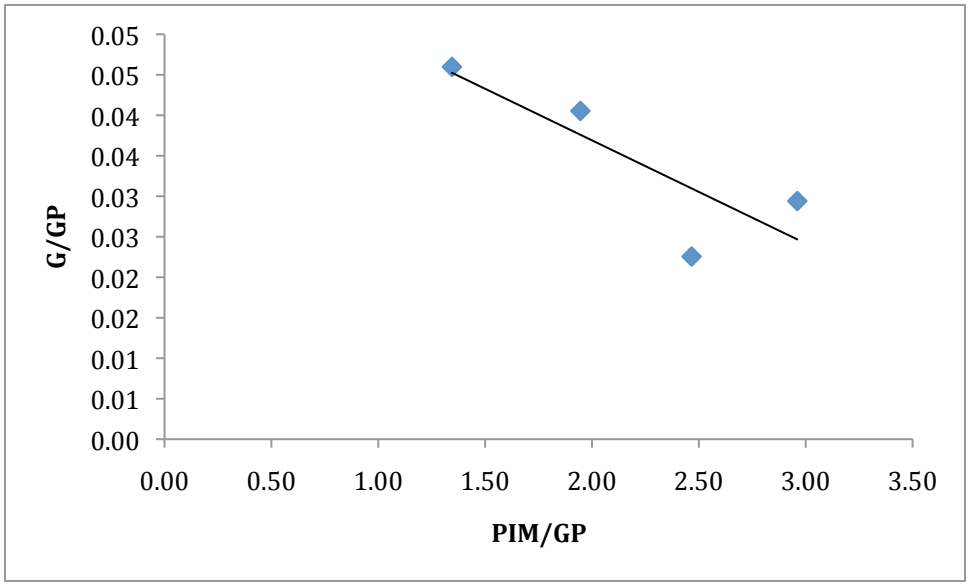


Chart 1f:
Relationship of goals-per-game and penalty minutes for skilled players at the defender position (threshold of ten fights for enforcers).

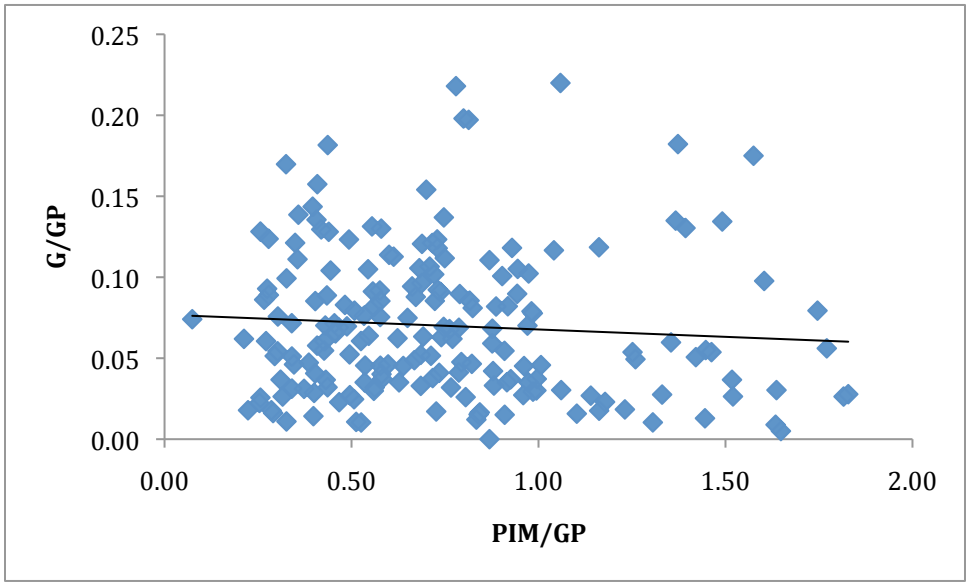


Chart 1g:
Relationship of goals-per-game and penalty minutes for enforcers at the forward position (threshold of ten fights for enforcers).

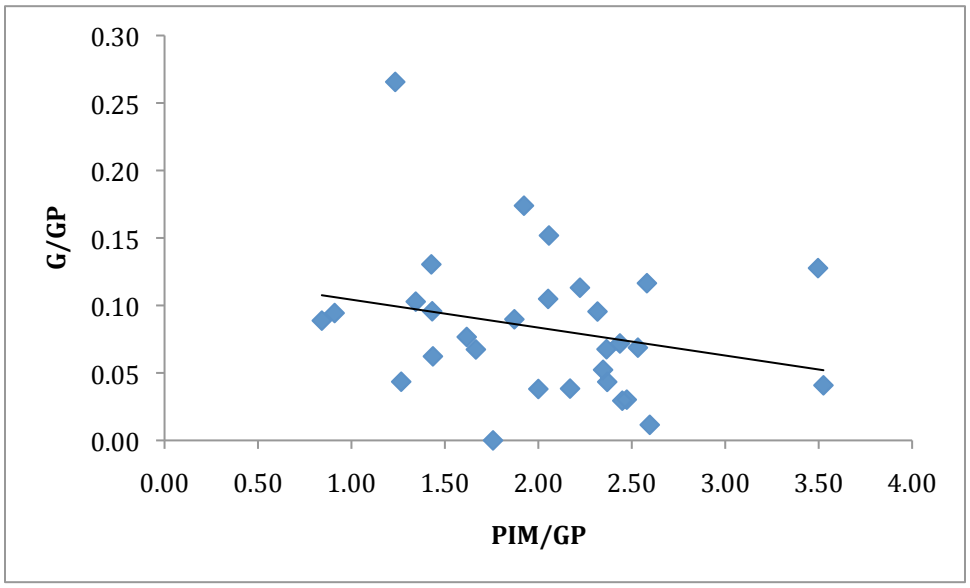


Chart 1h:
Relationship of goals-per-game and penalty minutes for skilled players at the forward position (threshold of ten fights for enforcers).

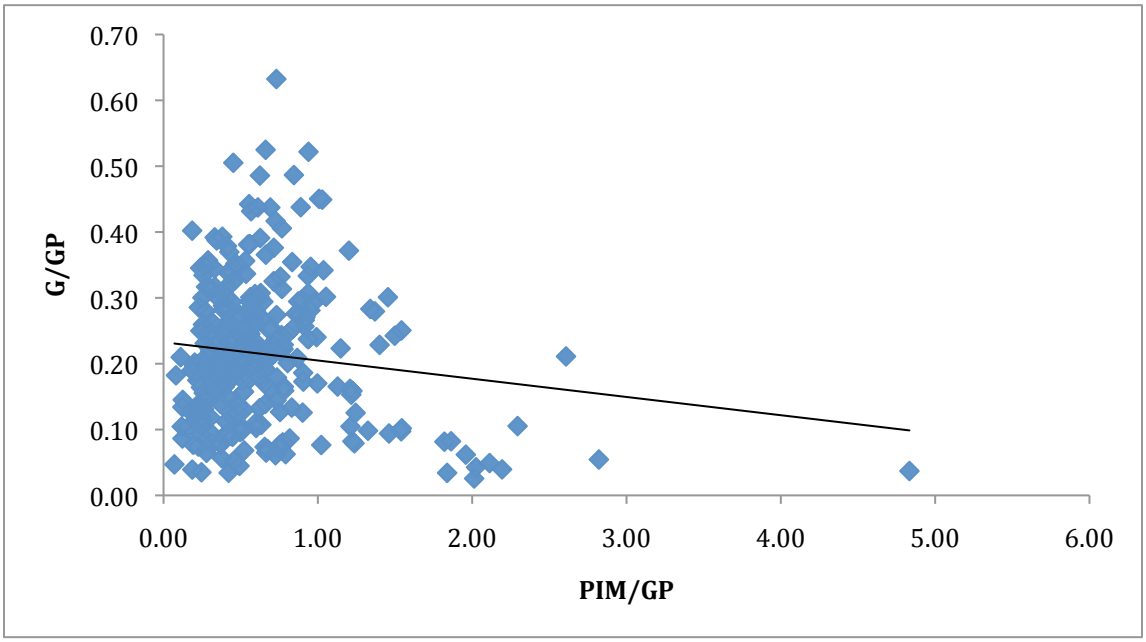


Chart 2a:
The effect of points on player salary for enforcers at the defender position.

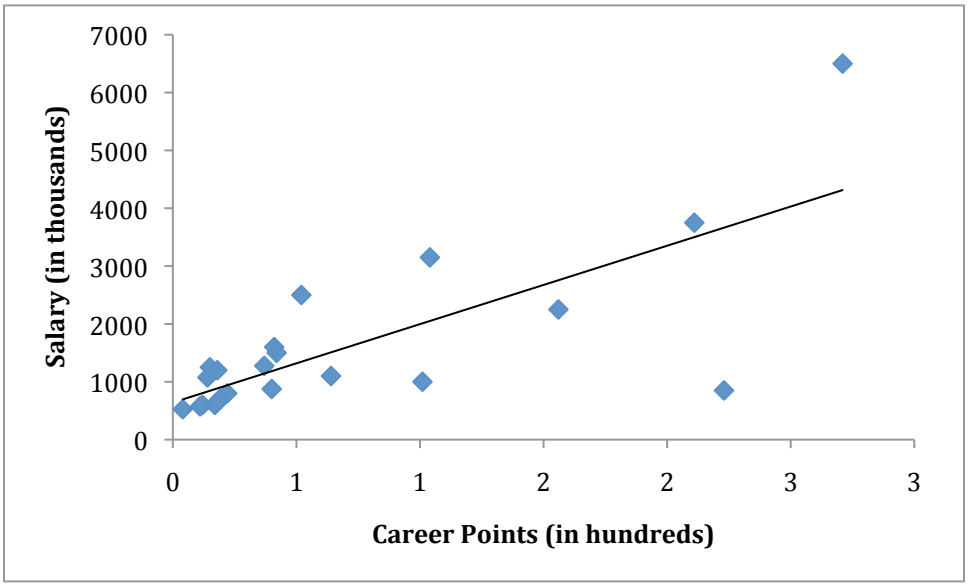


Chart 2b:
The effect of points on player salary for skilled players at the defender position.

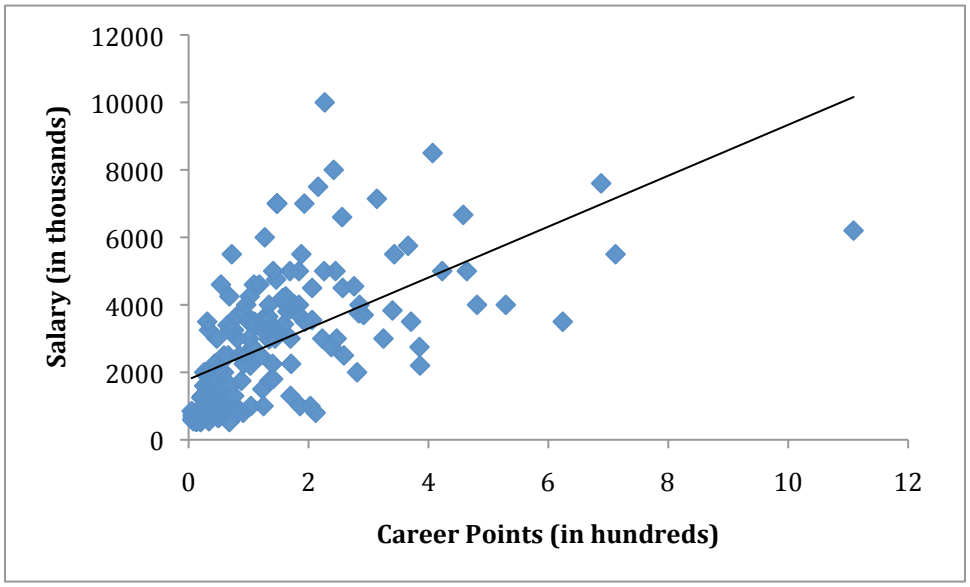


Chart 2c:
The effect of points on player salary for enforcers at the forward position.

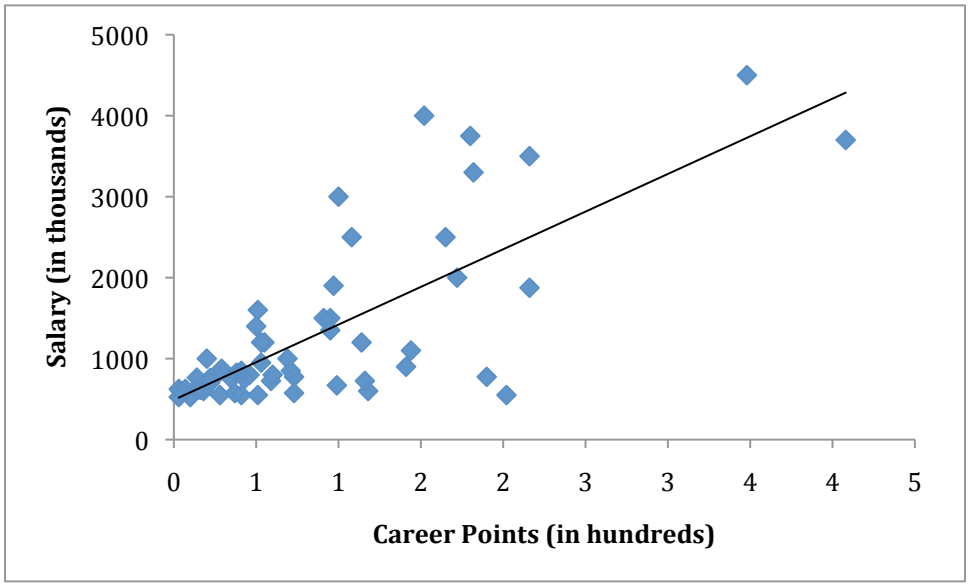


Chart 2d:
The effect of points on player salary for skilled players at the forward position.

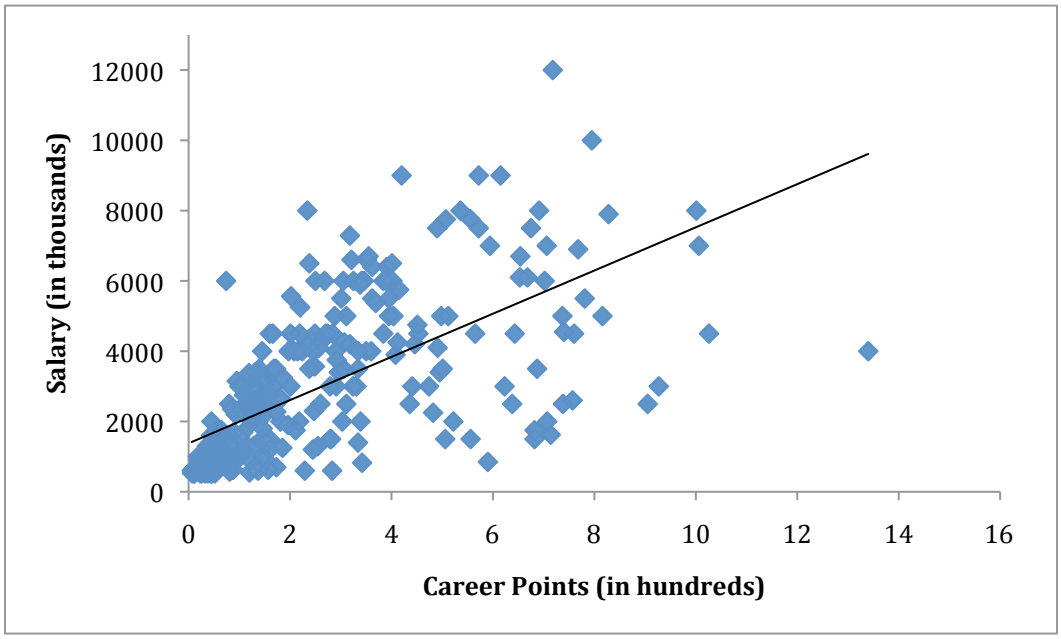
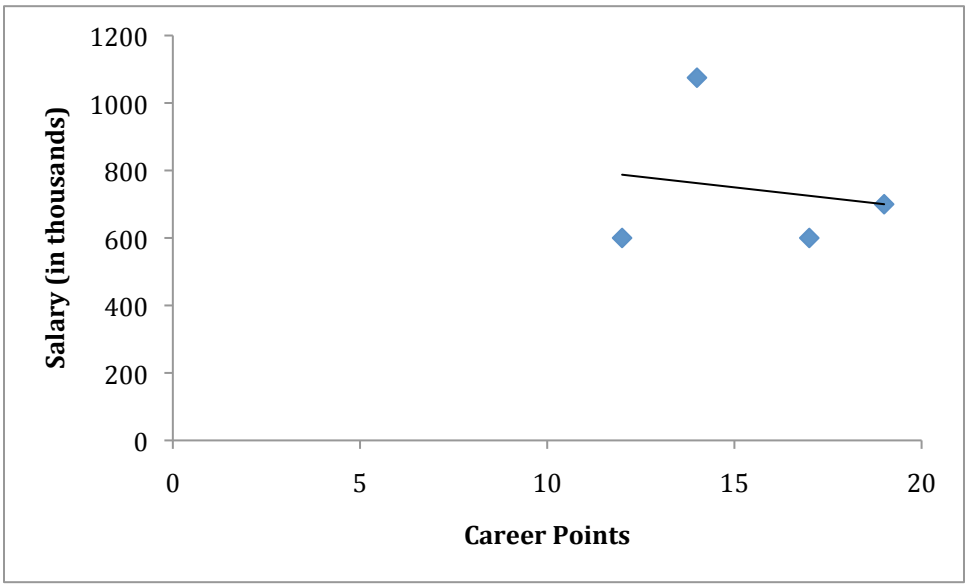


Chart 2e:
The effect of points on player salary for enforcers at the defender position (threshold of ten fights for enforcers).



Note that* Career Points *is not scaled here; Charts 2a-d and 2f-g measure* Career Points *in hundreds.

Chart 2f:
The effect of points on player salary for skilled players at the defender position (threshold of ten fights for enforcers).

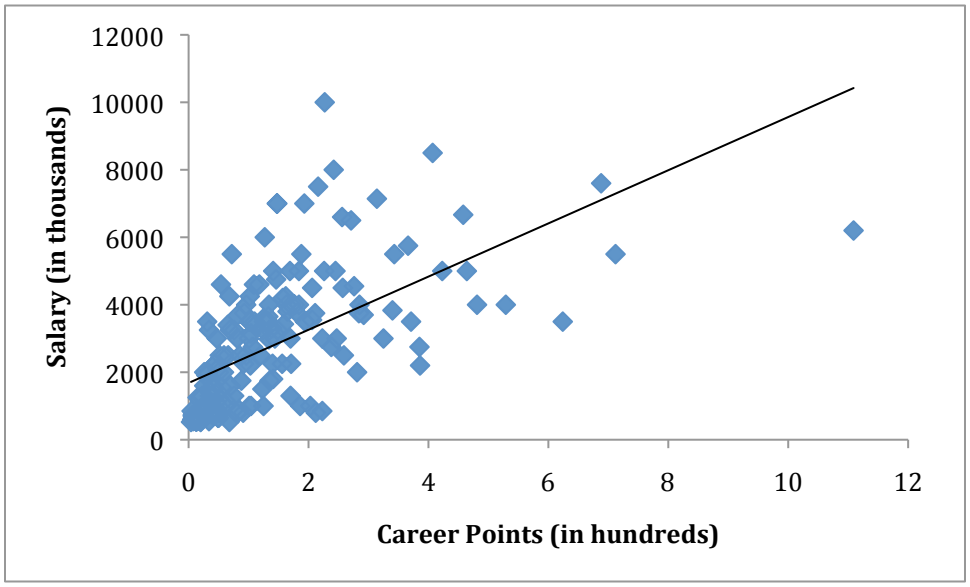


Chart 2g:
The effect of points on player salary for enforcers at the forward position (threshold of ten fights for enforcers).

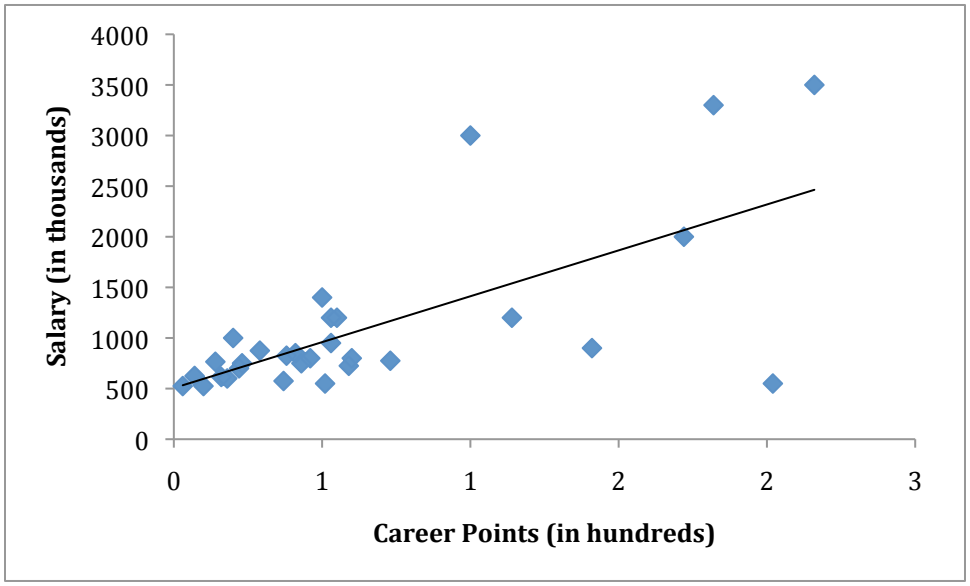


Chart 2h:
The effect of points on player salary for skilled players at the forward position (threshold of ten fights for enforcers).

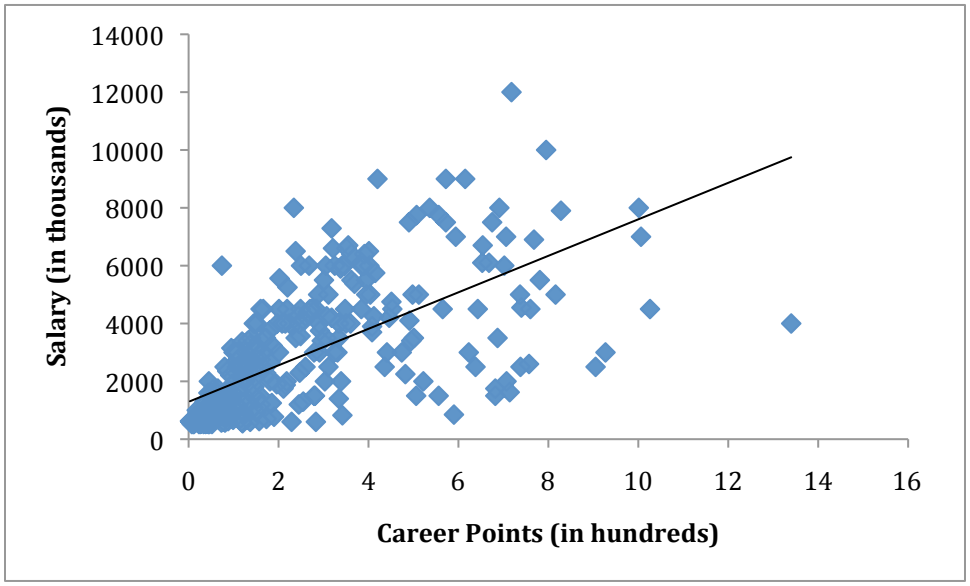


Table 1a. Summary of Key Variables in the Determination of Player Salaries in the NHL.

(Enforcers defined as players who engaged in four or more fights in the 2010-2011 season.)

Independent Variables	*No. of Observations*	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*	*Correlation to Salary*
Skilled Forwards						
SALARY	302	2.92 M	2.22 M	525,000	12 M	1.00
TOI/GAME	302	16:02	3:09	5:13	22:33	0.7099
GP	302	414.11	284.52	51	1,261	0.4745
GPSQ	302	2,521.71	3,184.10	26.01	15,901.21	0.3586
POINTS	302	250.75	236.52	6	1,340	0.6541
PPG	302	0.53	0.23	0.06	1.39	0.7999
+/-	302	9.59	44.14	-111	193	0.3172
PIM	302	243.37	228.57	6	1,372	0.3820
PIMPG	302	0.54	0.31	0.07	2.19	0.1703
HT	302	72.75	1.95	65	78	0.1287
SQHT	302	529.71	28.40	422.50	608.40	0.1289
WT	302	200.89	14.72	157	245	0.1057
SQWT	302	405.73	59.86	246.49	600.25	0.1018

In order to keep the numbers reasonable, *Games Played Squared* and *Square Weight* were scaled by 100 ($GPSQ=GP^2/100$, $SQWT=WT^2/100$) and *Square Height* was scaled by 10, ($SQHT=HT^2/10$).

Table 1b. Summary of Key Variables in the Determination of Player Salaries in the NHL.

(Enforcers defined as players who engaged in four or more fights in the 2010-2011 season.)

Independent Variables	*No. of Observations*	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*	*Correlation to Salary*
Enforcer Forwards						
SALARY	59	1.28 M	1.00 M	525,000	4.50 M	1.00
TOI/GAME	59	11:01	3:52	3:04	20:13	0.6979
GP	59	329.9	192.50	54	817	0.2915
GPSQ	59	1,452.62	1,556.80	29.16	6,674.89	0.2203
POINTS	59	85.54	81.15	3	408	0.7493
PPG	59	0.24	0.16	0.04	0.69	0.7756
+/-	59	-11.37	23.40	-85	55	0.5197
PIM	59	543.47	350.46	85	1,706	0.1281
PIMPG	59	1.76	0.80	0.65	4.83	-0.2425
HT	59	73.61	1.91	69	79	0.0575
SQHT	59	542.21	28.21	476.10	624.10	0.0569
WT	59	211.73	14.94	180	250	-0.0236
SQWT	59	450.48	63.77	324.00	625.00	-0.0251

In order to keep the numbers reasonable, *Games Played Squared* and *Square Weight* were scaled by 100 ($GPSQ=GP^2/100$, $SQWT=WT^2/100$) and *Square Height* was scaled by 10, ($SQHT=HT^2/10$).

Table 1c. Summary of Key Variables in the Determination of Player Salaries in the NHL.

(Enforcers defined as players who engaged in four or more fights in the 2010-2011 season.)

Independent Variables	*No. of Observations*	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*	*Correlation to Salary*
Skilled Defenders						
SALARY	172	2.88 M	1.93 M	525,000	10 M	1.00
TOI/GAME	172	20:12	3:24	6:59	26:53	0.6147
GP	172	412.09	279.16	53	1,496	0.5084
GPSQ	172	2,473.00	3,278.63	28.09	22,380.16	0.3934
POINTS	172	144.62	149.75	5	1,109	0.5850
PPG	172	0.32	0.14	0.14	0.74	0.5291
+/-	172	8.91	48.59	-101	431	0.3146
PIM	172	310.48	300.93	4	1,580	0.4140
PIMPG	172	0.69	0.33	0.07	1.77	0.2192
HT	172	73.80	2.19	68	81	-0.0217
SQHT	172	545.16	32.50	462.40	656.10	-0.0204
WT	172	210.05	15.72	172	265	0.0680
SQWT	172	443.68	67.61	295.84	702.25	0.0702

In order to keep the numbers reasonable, *Games Played Squared* and *Square Weight* were scaled by 100 ($GPSQ=GP^2/100$, $SQWT=WT^2/100$) and *Square Height* was scaled by 10, ($SQHT=HT^2/10$).

Table 1d. Summary of Key Variables in the Determination of Player Salaries in the NHL.

(Enforcers defined as players who engaged in four or more fights in the 2010-2011 season.)

Independent Variables	*No. of Observations*	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*	*Correlation to Salary*
Enforcer Defenders						
SALARY	22	1.56 M	1.40 M	525,000	6.50 M	1.00
TOI/GAME	22	17:01	3:49	6:15	25:18	0.6710
GP	22	307.41	281.21	66	1,175	0.4128
GPSQ	22	1,699.86	3,092.28	43.56	13,806.25	0.2127
POINTS	22	67.82	77.94	4	271	0.7546
PPG	22	0.20	0.12	0.04	0.57	0.6174
+/-	22	2.68	34.44	-102	94	-0.1595
PIM	22	407.77	384.93	75	1,786	0.2455
PIMPG	22	1.43	0.56	0.56	2.96	-0.2998
HT	22	74.68	1.86	71	80	0.0036
SQHT	22	558.07	28.03	504.10	640.00	0.0004
WT	22	218.73	18.06	189	270	-0.0601
SQWT	22	481.53	82.08	357.21	729.00	-0.0724

In order to keep the numbers reasonable, *Games Played Squared* and *Square Weight* were scaled by 100 ($GPSQ=GP^2/100$, $SQWT=WT^2/100$) and *Square Height* was scaled by 10, ($SQHT=HT^2/10$).

Table 2a. Summary of Key Variables in the Determination of Player Salaries in the NHL.

(Enforcers defined as players who engaged in ten or more fights in the 2010-2011 season.)

Independent Variables	*No. of Observations*	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*	*Correlation to Salary*
Skilled Forwards						
SALARY	331	2.80 M*	2.19 M	525,000	12 M	1.00
TOI/GAME	331	15:42	3:24	3:04	22:33	0.7056
GP	331	408.02	278.72	51	1,261	0.4718
GPSQ	331	2,439.24	3,087.96	26.01	15,901.21	0.3644
POINTS	331	238.14	231.19	3	1,340	0.6670
PPG	331	0.51	0.24	0.05	1.39	0.8038
+/-	331	8.23	43.04	-111	193	0.3372
PIM	331	262.94	243.09	6	1,372	0.2924
PIMPG	331	0.63	0.47	0.07	4.83	-0.0210
HT	331	72.83	1.99	65	79	0.1048
SQHT	331	530.70	29.05	422.50	624.10	0.1045
WT	331	201.72	15.22	157	250	0.0665
SQWT	331	409.21	62.36	246.49	625.00	0.0611

* Statistically-significant difference from the salary of enforcer forwards at the 5% level

In order to keep the numbers reasonable, *Games Played Squared* and *Square Weight* were scaled by 100 ($GPSQ=GP^2/100$, $SQWT=WT^2/100$) and *Square Height* was scaled by 10, ($SQHT=HT^2/10$).

Table 2b. Summary of Key Variables in the Determination of Player Salaries in the NHL.

(Enforcers defined as players who engaged in ten or more fights in the 2010-2011 season.)

Independent Variables	*No. of Observations*	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*	*Correlation to Salary*
Enforcer Forwards						
SALARY	30	1.09 M*	0.80 M	525,000	3.50 M	1.00
TOI/GAME	30	9:53	3:30	4:52	17:57	0.6770
GP	30	315.73	185.39	66	817	0.2626
GPSQ	30	1,329.12	1,533.08	43.56	6,674.89	0.1640
POINTS	30	64.93	59.99	3	216	0.6791
PPG	30	0.20	0.13	0.04	0.68	0.7517
+/-	30	-16.63	19.97	-85	22	0.2752
PIM	30	617.53	386.57	116	1,706	0.2324
PIMPG	30	2.02	0.65	0.84	3.53	-0.1559
HT	30	73.70	1.47	72	77	-0.1281
SQHT	30	543.38	21.73	518.4	592.90	-0.1293
WT	30	213.07	11.76	190	234	-0.1980
SQWT	30	455.31	49.75	361.00	547.56	-0.1915

* Statistically-significant difference from the salary of skilled forwards at the 5% level

In order to keep the numbers reasonable, *Games Played Squared* and *Square Weight* were scaled by 100 ($GPSQ=GP^2/100$, $SQWT=WT^2/100$) and *Square Height* was scaled by 10, ($SQHT=HT^2/10$).

Table 2c. Summary of Key Variables in the Determination of Player Salaries in the NHL.

(Enforcers defined as players who engaged in ten or more fights in the 2010-2011 season.)

Independent Variables	*No. of Observations*	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*	*Correlation to Salary*
Skilled Defenders						
SALARY	190	2.77 M**	1.92 M	525,000	10 M	1.00
TOI/GAME	190	19:56	3:33	6:15	26:53	0.6284
GP	190	406.56	280.10	53	1,496	0.4971
GPSQ	190	2433.37	3,276.78	28.09	22,380.16	0.3757
POINTS	190	138.45	145.81	4	1,109	0.5985
PPG	190	0.31	0.15	0.04	0.74	0.5507
+/-	190	8.35	47.60	-102	431	0.2894
PIM	190	323.59	314.61	4	1,786	0.3553
PIMPG	190	0.74	0.38	0.07	1.83	0.0800
HT	190	73.88	2.18	68	81	-0.0365
SQHT	190	546.28	32.40	462.40	656.10	-0.0354
WT	190	210.89	16.11	172	270	0.0243
SQWT	190	447.35	69.85	295.84	729.00	0.0242

**Statistically-significant difference from the salary of enforcer defenders at the 1% level.
In order to keep the numbers reasonable, *Games Played Squared* and *Square Weight* were scaled by 100 ($GPSQ=GP^2/100$, $SQWT=WT^2/100$) and *Square Height* was scaled by 10, ($SQHT=HT^2/10$).

Table 2d. Summary of Key Variables in the Determination of Player Salaries in the NHL.

(Enforcers defined as players who engaged in ten or more fights in the 2010-2011 season.)

Independent Variables	*No. of Observations*	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*	*Correlation to Salary*
Enforcer Defenders						
SALARY	4	0.74 M**	0.23 M	600,000	1.08 M	1.00
TOI/GAME	4	15:25	2:14	13:20	18:35	0.2805
GP	4	99.00	25.39	74	133	0.2805
GPSQ	4	102.85	53.33	54.76	176.89	0.2207
POINTS	4	15.50	3.12	12	19	-0.1721
PPG	4	0.16	0.03	0.14	0.20	-0.6002
+/-	4	1.25	17.46	-14	26	-0.6229
PIM	4	222.75	107.61	117	328	0.6607
PIMPG	4	2.18	0.70	1.34	2.96	0.8480
HT	4	75.00	1.15	74	76	-0.4794
SQHT	4	562.60	17.32	547.60	577.60	-0.4794
WT	4	217.75	21.19	197	237	0.7050
SQWT	4	477.52	92.19	388.09	561.69	0.7032

**Statistically-significant difference from the salary of skilled defenders at the 1% level.
In order to keep the numbers reasonable, *Games Played Squared* and *Square Weight* were scaled by 100 ($GPSQ=GP^2/100$, $SQWT=WT^2/100$) and *Square Height* was scaled by 10, ($SQHT=HT^2/10$).

Table 3. Determinants of NHL Player Salaries (lnsal): OLS Estimates by Playing Style and Position. Enforcers defined as players engaging in four or more fights during the 2010-2011 season. (t statistics in parentheses)

Independent	*Forwards*		*Defenders*	
Variables	*Skilled*	*Enforcers*	*Skilled*	*Enforcers*[1]
PPG	2.22123 (16.77)***	2.21966 (5.37)***	2.1242 (7.34)***	2.2303 (2.99)***
GP	.0036994 (10.32)***	.002969 (2.63)***	.004454 (9.59)***	.0062763 (5.82)***
GPSQ	-.000283 (-9.76)***	-.000301 (-2.45)**	-.000342 (-9.09)***	-.0003323 (-3.78)***
PIM	-.000027 (-0.14)	.000234 (1.01)	.0003202 (1.28)	-.00153 (-2.29) **
+/-	-.0000121 (-0.02)	.005985 (2.24)**	.0038576 (4.10)***	.0017238 (0.61)
HT	**-**.127679 (-0.19)	-.3082 (-0.22)	2.02614 (2.32)**	3.77882 (0.69)
HTSQ	.010043 (0.21)	.02405 (0.25)	-.138842 (-2.35)**	-.250934 (-0.68)
WT	.087065 (2.29)**	.01851 (0.23)	-.009542 (-0.20)	.016072 (0.08)
WTSQ	-.0208788 (-2.24)**	-.004443 (-0.24)	.004112 (0.38)	-.00187 (-0.04)
FRCAN	.038831 (0.41)	.9097991 (2.41)**	-.201817 (-1.06)	--- ---
CONSTANT	7.53701 (0.33)	20.4314 (0.42)	-60.8445 (-1.99)**	-131.981 (-0.72)
R^2	0.7320	0.6624	0.6090	0.7286
F	83.22	12.38	27.64	7.26
N	302	59	172	22

*Significant at the 10% level; **significant at the 5% level; ***significant at the 1% level

[1]There are no enforcers at the defender position who were born in Quebec; FRCAN was thus omitted from the regression.

Table 4. Determinants of NHL Player Salaries (lnsal): OLS Estimates by Playing Style and Position. Enforcers defined as players engaging in ten or more fights during the 2010-2011 season. (t statistics in parentheses)

Independent	*Forwards*		*Defenders*	
Variables	*Skilled*	*Enforcers*[1]	*Skilled*	*Enforcers*[2]
PPG	2.26394	2.62329	2.20793	---
	(18.01)***	(4.62)***	(8.15)***	---
GP	.0036221	.002424	.0048457	---
	(10.42)***	(1.68)*	(11.29)***	---
GPSQ	-.0002703	-.0003158	-.0003474	---
	(-9.65)***	(-2.08)**	(-9.74)***	---
PIM	-.0002151	.0005597	-.0000462	---
	(-1.36)	(1.98)**	(-0.21)	---
+/-	.0002264	.0045333	.0031221	---
	(0.37)	(1.28)	(3.54)***	---
HT	-.264315	6.42184	1.7285	---
	(-0.42)	(1.49)	(2.03)**	---
HTSQ	.019686	-.427736	-.117155	---
	(0.45)	(-1.47)	(-2.04)**	---
WT	.066356	-.130506	-.000924	---
	(1.94)*	(-0.66)	(-0.02)	---
WTSQ	-.015519	.028498	.0016682	---
	(-1.86)*	(0.61)	(0.17)	---
FRCAN	.076498	---	-.202576	---
	(0.83)	---	(-1.07)	---
CONSTANT	14.3704	-213.424	-51.4936	---
	(0.67)	(-1.43)	(-1.75)*	---
R^2	0.7345	0.6444	0.6167	---
F	92.29	6.84	31.41	---
N	331	30	190	---

*Significant at the 10% level; **significant at the 5% level; ***significant at the 1% level

[1]There are no enforcers at the forward position who were born in Quebec; FRCAN was thus omitted from the regression.

[2]Only four defenders participated in ten or more fights during the 2010-2011 season. Results were omitted because of collinearity.

Table 5a. Mean Salaries for Enforcers Playing on Canadian Team and US Teams.

(Enforcers defined as players who engaged in four or more fights in the 2010-2011 season.)

Player Group	*Observations*	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*
Defenders					
Canadian Teams	5	2.15 M	2.45 M	700,000	6.5 M
American Teams	17	1.39 M	0.96 M	525,000	3.75 M
Forwards					
Canadian Teams	12	0.97 M	0.41 M	550,000	2.0 M
American Teams	47	1.37 M	1.1 M	525,000	4.5 M

Table 5b. Mean Salaries for Enforcers Playing on Canadian Team and US Teams.

(Enforcers defined as players who engaged in ten or more fights in the 2010-2011 season.)

Player Group	*Observations*	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*
Defenders					
Canadian Teams	2	0.89 M	0.27 M	700,000	1.08 M
American Teams	2	0.60 M	---	600,000	600,000
Forwards					
Canadian Teams	6	0.97 M	0.53 M	550,000	2.0 M
American Teams	24	1.13 M	0.86 M	525,000	3.5 M

Table 6. Determinants of NHL Players' Time on Ice (in seconds): OLS Estimates by Playing Style and Position. Enforcers defined as players engaging in four or more fights during the 2010-2011 season. (t statistics in parentheses)

Independent	*Forwards*		*Defenders*	
Variables	*Skilled*	*Enforcers*	*Skilled*	*Enforcers*
PPG	639.5833 (18.85)***	1,232.67 (8.75)***	818.116 (9.11)***	1,236.31 (8.65)***
GP	.389701 (4.27)***	.686823 (1.81)*	.801919 (5.57)***	.87846 (4.25)***
GPSQ	-.030343 (-4.11)***	-.073634 (-1.78)*	-.060344 (-5.18)***	-.032263 (-1.91)*
PIM	-.053944 (-1.09)	-.090029 (-1.15)	-.071157 (-0.92)	-.41785 (-3.27)***
+/-	-.28936 (-1.82)*	-1.14026 (-1.26)	.53634 (1.84)*	.015564 (0.03)
HT	104.322 (0.60)	-414.997 (-0.85)	415.362 (1.54)	1,081.24 (1.03)
HTSQ	-6.6318 (-0.56)	28.7892 (0.87)	-27.9966 (-1.53)	-74.5074 (-1.06)
WT	15.4443 (1.59)	1.86744 (0.07)	-2.08726 (-0.14)	63.4859 (1.57)
WTSQ	-3.98207 (-1.67)*	-1.07477 (-0.17)	.452536 (0.13)	-13.2974 (-1.46)
CONSTANT	-5,008.37 (-0.85)	15,306.9 (0.92)	-14,367.6 (-1.52)	-45,928.1 (-1.30)
R^2	0.6657	0.7315	0.4627	0.9147
F	67.61	18.55	17.36	26.01
N	302	59	172	22

*Significant at the 10% level; **significant at the 5% level; ***significant at the 1% level

Table 7. Determinants of NHL Players' Time on Ice (in seconds): OLS Estimates by Playing Style and Position. Enforcers defined as players engaging in ten or more fights during the 2010-2011 season. (t statistics in parentheses)

Independent	*Forwards*		*Defenders*	
Variables	*Skilled*	*Enforcers*	*Skilled*	*Enforcers*[1]
PPG	679.0844	1,265.51	886.6521	---
	(20.42)***	(6.64)***	(10.67)***	---
GP	.431089	.199365	.8122209	---
	(4.72)***	(0.41)	(6.18)***	---
GPSQ	-.031163	-.024891	-.059216	---
	(-4.23)***	(-0.49)	(-5.44)***	---
PIM	-.115967	-.020155	-.093345	---
	(-2.77)***	(-0.21)	(-1.40)	---
+/-	-.323958	.056214	.4325151	---
	(-2.00)**	(0.05)	(1.60)	---
HT	10.92227	55.4026	462.1157	---
	(0.07)	(0.04)	(1.77)*	---
HTSQ	-.157392	-2.81202	-31.22762	---
	(-0.01)	(-0.03)	(-1.78)*	---
WT	20.49779	-81.7583	12.2673	---
	(2.27)**	(-1.23)	(0.93)	---
WTSQ	-5.228748	17.83711	-2.89059	---
	(-2.38)**	(1.13)	(-0.96)	---
CONSTANT	-2,175.96	7,072.66	-17,613.3	---
	(-0.39)	(0.14)	(-1.95)*	---
R^2	0.6929	0.7481	0.5243	---
F	83.74	10.57	24.14	---
N	331	30	190	---

*Significant at the 10% level; **significant at the 5% level; ***significant at the 1% level
[1]Only four defenders participated in ten or more fights during the 2010-2011 season. Results were omitted because of collinearity.