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Blood Money: Incentives for Violence in NHL Hockey

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John P. Haisken-DeNew and Matthias Vorell*

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Abstract
The level of violence in the National Hockey League (NHL) reached its highest point in 1987 and has reduced somewhat since then, although to levels much larger than before the first team expansions in 1967. Using publicly available information from several databases 1996–2007, the incentives for violence in North American ice hockey are analyzed. We examine the role of penalty minutes and more specifically, fighting, during the regular season in determining wages for professional hockey players and team-level success indicators. There are substantial returns paid not only to goal scoring skills but also to fighting ability, helping teams move higher in the playoffs and showing up as positive wage premia for otherwise observed low-skill wing players. These estimated per-fight premia, depending on fight success ($10,000 to $18,000), are even higher than those for an additional point made. By introducing a "fight fine" of twice the maximum potential gain ($36,000) and adding this amount to salaries paid for the team salary cap (fines would be 6.7% of the team salary cap or the average wage of 2 players), then all involved would have either little or no incentives to allow fighting to continue.

JEL Classification: J31, J81, C23

Keywords: Compensating wage differentials, health risk, violence, subjective indicators

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1 Background

The economic literature concerning incentives in professional ice hockey is relatively sparse. There are some papers concerning salary determination and the role of discrimination between English and French speaking hockey players in Canada as found in Longley (1995) or with respect to strategic behavior (shirking) by players once having signed a long-term contract as in Grabowiecki (2008). However, once on the ice, hockey players may have incentives to break official ice hockey rules with the explicit aim of achieving specific performance goals, as shown in Jones, Nadeau, and Walsh (1997). Violence has always been an integral part of the game of ice hockey. However, what does violence in hockey really have to do with a modern multi-million dollar industry that relies on healthy players performing so that stadium tickets (see Jones, Ferguson, and Stewart (1993)) and television cable/pay-per-view/rebroadcast rights can be sold, player endorsed merchandise sold and hockey fans being entertained? Some limited violence is seen as "letting of steam" by fans, players and owners, whereas other spectacular incidents have seen career-ending injuries or even criminal charges being laid against the antagonists have been publicly condemned. Even the old Canadian adage as to "why the ice hockey rink surface is white"[1] gives a hint as to the role of violence in the professional sport.

Some suggest that as early as 1955 when Bill Warwick and his brothers Grant Warwick and Dick Warwick with their aggressive hockey style won the World Championship for Canada as the "Penticton Vees" against the Soviet Union, that tastes for rougher and more violent hockey were in general developing amongst hockey fans. This was not just hockey, this was the cold war (on ice). Similarly in Game 8 of the famous international match Canada-Russia in September 1972, violence even threatened to extend to the officiating staff, as Canadian player Jean-Paul Parisé threatened to assault a referee for his perceived bad calls during the game by skating toward a referee whilst carrying a raised hockey stick in a tomahawk manner and threatening to hit the referee over the head. Parisé aborted the assault ultimately but the assault would have resulted in severe cranial trauma for the referee had Parisé carried out his threat. This was probably an example of a response "in the heat of the moment", however there are other motives, such as enforcement, and protecting the teams' investment in human capital of prize (and expensive) players. In 1944 Bob "Killer" Dill was put on the ice with

[1] That is, of course, for a spectator to be able to see blood resulting from a fight even 30 rows up in the stands.

the purpose of attacking Maurice "Rocket" Richard, perhaps the best player in the game at the time, indicating that violence was being used strategically. Whilst the hockey legend (and highly paid) Wayne Gretzky played for the team Edmonton Oilers in the 1980's, his team-mate Marty McSorely effectively acted as his enforcer, protecting Gretzky from other teams' fouls (and potential injury) and allowing Gretzky to score many goals. Very rarely was Gretzky himself involved in penalties or violent behavior; however his teammate McSorely was all the more involved and was eventually suspended from the league.

According to Official Rules of the National Hockey League (2007), more than half of the rules deal with on-ice penalties, their severity and their types (physical, restraining, stick and other fouls). The severity of penalties typically reflects the potential harm done to the victim of the foul. The minimum assessment for on-ice penalties is two minutes. During such time, the offending player is required to leave the ice for this time period without another player taking his place. This is clearly a detriment to his team, as with one player fewer on the ice compared to the other team, the offending team is at a disadvantage and more likely to have a goal scored against them. More severe penalties, such as fighting, start with five minutes, with an even greater chance of having a goal scored against the offending side, but are open ended to include multiple match suspensions or even complete disbarment. In an attempt to curb bench-clearing brawls (in which all players leave the benches and fight each other), the penalties for fighting were increased to include game suspensions and fines in 2005 for fights taking part in the last 5 minutes of play. This is also reinforced with Rule 43 "Intent to Injure".

Levitt (2002) and Heckelman and Yates (2003) examine the role of additional referees in enforcing NHL rules. In the 1999-2000 hockey season, some games were officiated by two referees, rather than the usual one referee. It was thought that with the additional referee, there would be additional enforcement potential and an increased deterrent effect. However, using IV estimation, Heckelman and Yates (2003) show that the number of referees indeed does not affect the number of infractions committed. They conclude that most infractions (penalties) are "accidental or retaliatory in nature" and "more analogous to a crime of passion than a calculated benefit-cost analysis performed by a rational criminal". Levitt (2002) comes to a similar conclusion. Jones, Nadeau, and Walsh (1997) use only information from the 89-90 hockey season but do not have explicit information on fight behavior, but rather only penalty minutes in general. They attempt to cluster players into "enforcers" and "non-enforcers" using variables correlated with fighting,

whilst having no information on fighting itself. They conclude that "enforcers" have significantly different coefficients in a wage regression, and are paid lower than otherwise expected salaries, due to their lack of bargaining power.

At the player level, players who engage in violent behavior do so at risk to themselves. The player can "win" a fight in such a manner that the "fight winner" does more damage to the "fight loser" than is true in reverse. Fighting outcomes are not certain and there is a percentage of the time that even good fighters lose. Thus one might think of paid "enforcers" as having a role in protecting the very good players by fighting *and winning* in addition to taking on the risk of fighting *and losing*. The empirical question is whether fighting is rewarded at all, and if so, is winning the fight rewarded differently than losing. One might think of the potential wage premium for winning fights as simply a reward for doing what they are paid to do, with little personal costs to the fighter. However, when the fighters lose, it is often at great personal risk of injury, and must be compensated financially. The literature for compensating wage differentials is summarized, among others, by Hamermesh and Wolfe (1990) and Purse (2004). In a study analyzing work related accidents, Meng (1989) finds positive and significant wage premia for working in risky industries in Canada. While the risk of death on the job in ice hockey is extremely rare, the risk of personal injury in a fight is immediate. Also, do fights (won, lost or neither) improve the chances of the team in reaching the playoffs or winning the championship?

While most of previously done work on wage differentials focuses on fatal injuries, the situation for non-fatal injuries is different. Lucas (1977) and Olson (1981) find significant wage effects for working under extreme/dangerous conditions in cross-sectional analyses, which were moderated to some extent by personal and demographic characteristics. As workers choose their jobs not only because of monetary compensation but also according to their individual preferences. The paid wage premium is directly linked to the accident frequency and accident severity. Difference in risk premiums can occur because of (1) different worker characteristics lead to different risk-producing qualities, (2) different wage premiums for the same risk. To address these issues, we will control for individual player and team fixed effects. Additional work by Dorsey and Walzer (1983) shows that the amount of compensation depends on the extent to which the employer is liable for the workplace risk.

Using a unique data base of players in National Hockey League (NHL) teams 1996-2007, and a team level database for all NHL teams 1967-2005,

we examine the role of penalty minutes and more specifically, fighting, in determining wages for professional hockey players and team-level success indicators. As players' wages, personal attributes and success indicators in the NHL are effectively public knowledge, we can quite readily determine whether compensating differentials are paid for fighters, or whether the "bad boys" are effectively punished monetarily. Also we can analyze whether teams with high levels of penalty minutes of fighting behavior are more successful in reaching the championship. The aim of this is paper is to analyze the role of on-the-ice violence as a characteristic of the work environment in which professional hockey players are gainfully employed. There appears to be some new evidence to suggest that player behavior with respect to fouling and using violence at the team or player level is more strategic than otherwise previously thought.

2 Empirical Application

The data was gathered from a variety of online resources. The main resources were the "HockeyDB Project", "Drop Your Gloves" and "Hockey-Fights"[2] websites on the internet. These sites are supported by hockey fans and collect data from various sources, including the NHL Player's Association, newspapers and official league statistics.

Figure 1 shows the average level of total team penalty minutes per season and its development over time. Penalty minutes increase from around 750 in 1967 to about three times that figure at the peak of violent behavior in the the NHL in 1987. After which, the total penalty minutes has been effectively in decline to around 1200 in 2005. At the same time, there have been distribution changes in penalty minutes. As the number of teams steadily increased through several league expansions, penalty minute dispersion also increased as seen in Figure 2. Now examining the average number of fights that teams were involved with, as shown in Figure 3, and the respective distributions in Figure 4, we see the peak in 1987 with a maximal amount in variation, slowly reducing in 2005 to about half of the peak level of 1987 and a distinct tightening of the variance. It is difficult to identify the reason for the peak in 1987 and the substantial reduction ever since. However in January 1988, for the first time, a player had criminal charges pressed against

[2]See hockeydb.com, dropyourgloves.com and hockeyfights.com for more information. We would especially like to thank David M. Singer from hockeyfights.com for his help in the preliminary analysis.

him and was convicted, spending one day in jail and fined $1,000. The Minnesota player Dino Ciccarelli had taken his stick and hit the Toronto player Luke Richardson in the head repeatedly. This might have been a trigger, prompting players to reduce flagrant violence, as it was now seen to riskier with respect to criminal consequences.

The data is particularly interesting as, in addition to team success and salary information, it contains a collection of objective indicators, such as goals scored, assists made, an on-ice plus-minus real time indicator, number of fights and total penalty minutes and subjective success indicators such as whether one actually "clearly won" the fights that one was involved in. The informational content of subjective indicators is well documented in economics such as in Winkelmann and Winkelmann (1998), DiTella, MacCulloch, and Oswald (2001) and Frijters, Haisken-DeNew, and Shields (2004).

At the *team* level, the outcome variable is how successful the team was during each season by surviving at least to the: playoffs, quarter finals, semi finals, finals and having won the Stanley Cup championship. We have the regular season percentage of games won, number of points, number of fights, and number of fights "clearly won".

At the team level, we use a series of conditional logit models taking team fixed effects (α_j) and season fixed effects (δ_t) into account:

$$LEVEL_{jt} = \beta X_{jt} + \gamma V_{jt} + \delta_t + \alpha_j + \varepsilon_{jt} \tag{1}$$

where $LEVEL_{jt}$ is interpreted as the j'th team having in time t reached a certain playoff level or above: (a) having at least reached the playoffs, (b) having at least reached the quarter finals, (c) having at least reached the semi finals, (d) having at least reached the finals and (e) having won the championship. In total, we run 5 conditional (binary) logits (a)-(e), where X_{jt} consists of information coming from the regular seasons only: total team goals scored, total team goals allowed in, percentage of games won. V_{jt} contains a measure of violent behavior: one of total team penalty minutes, total team number of fights and total team number of fights won.

At the *player* level, we observe 2216 players (excluding goalkeepers), playing in 30 teams starting from the 1996/1997 season until 2007/2008. This amounts to a total of 9806 person-year observations. For 2056 observations salary data is missing/not available.

Our main model at the player level is a wage regression of the following form:

$$SALARY_{ijt} = \beta X_{ijt} + \gamma V_{ijt} + \alpha_i + \alpha_j + \delta_t + \varepsilon_{ijt} \quad (2)$$

The salary (US$) of a player i, playing for team j in season t is the dependent variable. We control for a vector of player specific variables X_{ijt} containing, the number of games played, the number of points scored in the previous seasons and his plus/minus-score of the previous season. The "Plus/Minus" statistic is a player statistic to measure the contribution of a single player to his team's performance. The score is increased by one if a team scores while a player is on the ice and the team is not in power play (the other team has a penalty). It is decreased by one if the player is on the ice and the team allows in a goal while it is not short-handed. Since 1968 the statistic is officially compiled by the NHL. V_{ijt} contains a measure of violent behavior. In different specifications we test whether penalty minutes, fights, "fights won" and "fights not won" have significant effects on a players' salary. We control for year-specific effects, using a season dummy variable δ_t. The specification includes an individual fixed effect (α_i) and a team fixed effect (α_j) to control for unobservable, time-constant characteristics of players and teams. The residual ε_{ijt} is assumed to have the usual properties. In contrast to Jones, Nadeau, and Walsh (1997), we can control for player and team-specific fixed effects in a panel setting and demonstrate that these matter for financial returns to fights.

3 Estimation Results

Table 1 displays the team-level summary statistics for the 30 NHL teams for the time period 1967-2005. On average each team has 73 fights and incurs 1431 penalty minutes per season. Games won is less than 50% as there is the possibility to tie. Table 2 summarizes the player level information. On average a player earns $1.5 million, has 2 fights and incurs 48 penalty minutes per season.

Table 4 displays the results for the conditional logit regression, estimating the level of team success while controlling for team penalty minutes. As expected, goals for a team during the regular season are positive and significant in determining playoff success, however only for "getting into the playoffs". After which, the number of goals scored is not important. Similarly goals

against is negative and significant up until the quarter finals and then becomes insignificant. Most important is the percentage of games actually won during the regular season, being positive and significant for all levels. The team penalty minutes is significant and positive for all levels at the quarter finals and above, indicating a strategic value for incurring penalties during the regular season.

We focus next on Table 4 which runs the same estimations this time controlling for total teams fights. An almost identical pattern is found with respect to all of the standard success indicators as well as with fight behavior. Additional numbers of fights help in increasing the probability of advancing all the way to the championship finals, but do not increase the chance of winning the championship itself. That is reserved for the percentage of games won during the regular season. Finally, we examine the same models with a control for the number of fights that were clearly won by a team in Table 5. At all team success levels (where significant), the coefficients are larger for "fights won" than simply for "fights". Not only does it improve the playoff chances of a team to fight, but also it pays to *win* these fights.

On a similar note, we analyze wage determinants for individual players, taking into account the standard success indicators as well as indicators for penalty minutes, number of fights, number of fights won, and number of fights lost. Table 6 summarizes the wage regression results from using controls for player position, individual and group performance, and penalty minutes. We see that in the first 4 OLS specifications, the number of goals scored and the number of assists (points) is positive and significant. Points remain significant even when controlling for player unobserved heterogeneity. The plus/minus indicator is no longer significant when controlling for position and/or player fixed effects. However, throughout all specifications, penalty minutes are positive and significant. In the base panel regression with fixed-effects, we find that players earn a premium of \$2,577 for each penalty minute they incur. When we disaggregate the effect by position in the last column, it appears that players who are centers (i.e. the key goal scorers) are the only ones to gain from penalty minutes with a wage premium of \$4,783 per additional incurred minute.

We extend the same model to examine the effects of fighting behavior on wages in Table 7. Here we see that in OLS fights are only significant once disaggregating by position. When controlling for player fixed effects, on average, the number of fights are positive but are insignificant ($t = 1.7$). However disaggregating by position, the wing players receive a wage premium

of $10,940 completely driving the result. The point to keep in mind here is that the wing player has a choice: he can either make an assist (1 point) and earn an additional $10,930 or half a goal and make the same (1 goal = 2 points), or have a fight and earn $10,940, which is even $10 more. Looking at the OLS results disaggregating by position, a wing player who fights has a wage penalty of $7,120. However controlling for his otherwise unobserved very poor characteristics (which he very likely exhibits, being an "enforcer") he in fact earns indeed a large positive wage premium of $10,940.

Entering into a fight is a risky proposition. One can "win", "tie" or "lose" a fight. We use the subjective information supplied by fans to control for skill and success in fighting. Table 8 displays the results for our standard player wage model when we control for "fights won". On average in OLS, a wing player who fights and wins the fights has an even larger wage penalty of $11,240. However, when controlling for fixed effects, a wing player who wins fights earns a wage premium of $18,135. This is almost as much as the wage premium for scoring another goal (2 points $\times$ $10,933). Here on average it clearly pays to fight and win, with the overall "fights won" effect being significant at $13,921 even when controlling for player fixed effects. What happens to players who do not achieve a "clean win"? In Table 9 we run the same wage regressions controlling for the number of fights either "tied" or "lost" as voted by hockey fans online. Under OLS, "fights not won" carries a premium of $15,077, however this is being driven by defense players. Wing players have a wage penalty of $8,978 if they fight and do not win. However when controlling for player fixed effects, these same wing players experience no longer a wage penalty but a wage premium of $11,993, completely driving the positive (yet not significant) overall result of $10,120. One must keep in mind that an additional fight (even not having won) for a wing player adds $11,993 to his annual wage, whereas an additional point in the form of an assist only fetches $10,925.

Clearly it is the case that there are enormous incentives for foul play and overt violence in the NHL at the team level, by increasing the chances of playoff success. At the individual player level, causing penalties (and thereby penalty minutes) are a strategic tool for centers. Fighting is a specialty of the wing players who earn substantial wage premia for this behavior. Not only is it important to fight in general, but also to win, with even higher wage premia for "winning" a fight. Perhaps one might argue that certain hockey players are trained especially to fight, and given the strategic incentive as a wing player to protect the star center player, this behavior can be explained. Thus these players are doing what they are trained to do, and presumably

gain some personal pleasure themselves doing this (by revealed preference). However, no wing player goes into a fight on the ice hoping to lose, even though the wing player still has to protect his star center player as best he can. Therefore there is still a substantial compensating wage differential for fighting and *not winning*. This is consistent with the wing player showing loyalty to his team and star player and for that, the wing player is compensated by his team in the form of a wage premium.

This analysis gives to rise to some interesting policy-relevant conclusions. If one is interested in reducing fight violence in ice hockey, then the incentives must be altered, so that it is no longer profitable for players in terms of additional wages and for teams in terms of increased success in the playoffs. On average, a team has 73 fights per year, corresponding to approximately 2 per player and year. If a "fight fine" were introduced which would would offset any possible gain to the player, i.e. the premium of \$18,135 he might gain by "winning" the fight, this would imply a total of player fines in the amount of \$1.3 million per team and year. At this point, even the best fighters would be indifferent to fighting. This is a substantial amount of money, as the average wage of a player during this time period is \$1.5 million. Nonetheless, there are still team incentives to allow fighting even if a player were indifferent, such as reaching higher levels in the playoffs, receiving larger tickets sales and broadcast transmission rights etc for winning. Thus teams would still have an incentive to collude with the violent players and simply cover their fines. The amount of the fine would have to be at least as great as the marginal benefit to the team (the expected gain equals the fight contribution to added success multiplied by all additional revenues associated with winning). For argument's sake, by setting the fine at twice the wage premium for winning a fight, this would correspond to \$2.6 million per team and year or \$36,000 per fight. However, since 2005 there is a fixed team salary cap of \$39 million.[3] For the fines to have their intended effect, the total fines assessed to violent players would have to be added to the salary cap, amounting to approximately 6.7% of total gross salaries, assuming the current level of fight behavior.

[3]See the 2005 collective bargain agreement from the National Hockey League Player's Association for more details at www.nhlpa.com/CBA/2005CBA.asp.

4 Conclusion

Violence and foul play are simply a fact of life in the National Hockey League, reflecting very much strategic considerations as opposed to merely "venting off steam". Using a unique data base of players in NHL teams 1996-2007, and a team level database for all NHL teams 1967-2005, we examine the role of penalty minutes and more specifically, fighting, during the regular season in determining wages for professional hockey players and team-level success indicators. There are substantial returns paid not only to goal scoring skills but also to fighting ability, helping teams move higher in the playoffs and showing up as positive wage premia for certain players.

We provide evidence for the proposition that observed low-ability wing players are paid a substantial wage premium to protect high-ability center players who can score goals. They do this by fighting with any other opposing player who threatens their star players, allowing the star player unfettered scoring possibilities. At the same time, they also try to intimidate the opposing center and wing players. For this the wing players are paid a premium of \$10,940 for each fight. For an additional point (i.e. an assist), they are only paid a premium of \$10,930. It pays not only to fight but to *win* the fight. The wage premium for the wing fighter who "clearly wins" the fight is almost double (\$18,135) than that for fighting but not winning (\$11,993), i.e. he is a "more effective" enforcer and more likely to protect the star player. However, both amounts are still greater than scoring another point (in the form of an assist) at around \$10,925.

As we have consistently found significant OLS wage penalties for wing players based only on observed indicators, coupled with positive and significant wage premia for the same players, controlling for unobserved individual player heterogeneity (massive comparative advantages in fighting), we conclude that the main mechanism behind fights is strategic. Wing players specialize in fighting skills and have comparative disadvantages in scoring goals. Their observable characteristics are (comparatively) poor on average. Yet they still provide valuable services to the star players by protecting them and harassing the opposing team star players, all of which are beneficial to the own team. Not only are they paid additionally for this, the respective teams experience higher probabilities in achieving higher standings in the playoff rounds. This is not to say that all wing players are "enforcers". However, given the monetary and success incentives for using violence in the NHL, it seems unlikely that this kind of violence will disappear on its own, even given the downward trend in fights since the 1987-88 season when the first hockey

fighter due to his own brutality had criminal charges laid against him and was convicted.

To reduce fight violence in ice hockey, then the incentives must be altered, so that it is no longer profitable for players to fight, in terms of additional wages and for teams in terms of increased success in the playoffs. By introducing a "fight fine" of twice the maximum potential gain (2 x \$18,000=\$36,000 per fight) that a fighting player might gain and adding this amount to salaries paid for the team salary cap introduced in 2005 (fines would be 6.7% of the team salary cap or the average wage of 2 players), then all involved would have either little or no incentive to allow fighting to continue. Presumably, this would also have the added benefit of avoiding career-ending injuries due to wanton violence and improve the quality of play as it would no longer to pay to employ players explicitly for their fighting skills as opposed to goal-scoring skills.

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Table 1: Team-Level Summary Statistics

Variable	Mean	(Std. Dev.)	Min.	Max.	N
PIM	1431.332	(407.756)	554	2713	780
Fights	73.017	(31.408)	6	198	780
Fights Won	36.701	(16.132)	3.8	102.96	758
Goals For	263.126	(49.369)	151	446	780
Goals Against	261.867	(52.183)	157	446	780
Games Won (Pct.)	0.435	(0.114)	0.1	0.756	780

Table 2: Player-Level Summary Statistics

Variable	Mean	(Std. Dev.)	Min.	Max.	N
Salary (US$)	1517677.102	(1590539.766)	99270	17000000	5571
Fights	1.969	(3.965)	0	40	5571
PIM	48.171	(41.844)	0	372	5571
Games Played	57.768	(23.569)	1	82	5571
+/-	0.507	(10.218)	-42	52	5571
Points	26.353	(22.079)	0	127	5571

Table 3: Conditional Logit: Penalty Minutes and Team Performance

	At Least Playoffs	At Least Quarters	At Least Semis	At Least Finals	Won Championship
Goals For	0.0373***	0.00698	0.00531	0.00249	-0.000211
	(3.28)	(1.06)	(0.69)	(0.26)	(-0.01)
Goals Against	-0.0354***	-0.0149**	-0.0125	-0.0120	-0.0145
	(-3.51)	(-2.37)	(-1.64)	(-1.15)	(-0.76)
% Games Won	22.42***	10.01***	10.49***	12.56***	22.00***
	(4.49)	(3.41)	(3.02)	(2.73)	(2.77)
Penalty Minutes	0.158	0.197*	0.356***	0.306*	0.560*
(standardized)	(0.95)	(1.81)	(2.70)	(1.76)	(1.78)
Season FE	Yes	Yes	Yes	Yes	Yes
Team FE	Yes	Yes	Yes	Yes	Yes
R^2	0.664	0.280	0.261	0.285	0.423
χ^2	533.3	232.1	148.2	106.4	82.61
N	769	762	737	670	439

t statistics in parentheses

All models contain seasons dummies (base year: 1967)

Season 1994-1995 not included

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Conditional Logit: Fights and Team Performance

	At Least Playoffs	At Least Quarters	At Least Semis	At Least Finals	Won Championship
Goals For	0.0388***	0.00704	0.00681	0.00466	0.00210
	(3.38)	(1.06)	(0.87)	(0.48)	(0.13)
Goals Against	-0.0367***	-0.0146**	-0.0123	-0.0115	-0.0122
	(-3.59)	(-2.30)	(-1.56)	(-1.09)	(-0.64)
% Games Won	22.20***	10.46***	10.41***	11.99***	20.59***
	(4.45)	(3.48)	(2.91)	(2.59)	(2.63)
Number of Fights	0.0193**	0.0230***	0.0288***	0.0168**	0.0107
	(2.16)	(4.37)	(4.62)	(2.13)	(0.81)
Season FE	Yes	Yes	Yes	Yes	Yes
Team FE	Yes	Yes	Yes	Yes	Yes
$PseudoR^2$	0.668	0.301	0.289	0.289	0.410
χ^2	537.2	249.2	163.8	107.8	80.03
N	769	762	737	670	439

t statistics in parentheses

All models contain seasons dummies (base year: 1967)

Season 1994-1995 not included

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Conditional Logit: Fights Won and Team Performance

	At Least Playoffs	At Least Quarters	At Least Semis	At Least Finals	Won Championship
Goals For	0.0436***	0.00778	0.00599	0.00352	0.00168
	(3.61)	(1.15)	(0.77)	(0.36)	(0.11)
Goals Against	-0.0447***	-0.0161**	-0.00972	-0.00826	-0.0119
	(-4.02)	(-2.49)	(-1.25)	(-0.77)	(-0.63)
% Games Won	20.51***	9.809***	10.45***	12.41***	20.25***
	(3.89)	(3.24)	(2.95)	(2.67)	(2.59)
Fights Won	0.0473***	0.0388***	0.0408***	0.0251*	0.00999
	(2.73)	(4.02)	(3.70)	(1.78)	(0.41)
Season FE	Yes	Yes	Yes	Yes	Yes
Team FE	Yes	Yes	Yes	Yes	Yes
R^2	0.683	0.304	0.271	0.282	0.405
χ^2	528.1	245.8	151.1	103.0	78.73
N	747	740	715	649	428

t statistics in parentheses

All models contain seasons dummies (base year: 1967)

Season 1994-1995 not included

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Player Wage Effects of Penalty Minutes

	OLS 1	OLS 2	OLS 3	OLS 4	XT 1	XT 2
Plus/Minus$_{t-1}$	8847.0***	6352.6**	3193.0	3968.0	-682.3	-535.8
	(2.89)	(2.58)	(1.33)	(1.60)	(-0.22)	(-0.18)
Points$_{t-1}$	44025.7***	43600.1***	47949.0***	46311.6***	10634.6***	10458.0***
	(21.59)	(21.71)	(22.09)	(22.54)	(5.26)	(5.13)
Games played	-595.4	-1021.1	-1925.8***	-2413.6***	-2208.3*	-2524.8*
	(-0.83)	(-1.67)	(-2.81)	(-3.32)	(-1.98)	(-2.03)
Penalty Minutes	2715.7***	3310.6***	3423.4***	–	2577.5***	–
	(4.98)	(7.02)	(5.97)		(3.08)	
Wing	–	–	-135197.5*	–	–	–
			(-2.02)			
Defence	–	–	496493.7***	–	–	–
			(10.47)			
Wing x PM	–	–	–	-7560.4***	–	1224.2
				(-9.56)		(0.85)
Center x PM	–	–	–	-5648.8***	–	4783.1**
				(-4.23)		(2.19)
Defence x PM	–	–	–	8624.8***	–	1412.8
				(8.50)		(1.00)
Season FE	No	Yes	Yes	Yes	Yes	Yes
Team FE	No	Yes	Yes	Yes	Yes	Yes
Player FE	No	No	No	No	Yes	Yes
R^2	0.392	0.441	0.470	0.460	0.265	0.267
Adj. R^2	0.392	0.437	0.465	0.455	0.263	0.265
N	5571	5571	5571	5571	5571	5571

t statistics in parentheses

Standard errors are robust and clustered on team level

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Player Wage Effects of Fights

	OLS 5	OLS 6	OLS 7	OLS 8	XT 3	XT 4
Plus/minus$_{t-1}$	8910.4***	6524.9**	3265.4	5777.3**	-679.5	-676.2
	(2.90)	(2.60)	(1.35)	(2.28)	(-0.22)	(-0.22)
Points$_{t-1}$	42940.3***	42374.9***	47547.3***	43213.5***	10925.0***	10930.3***
	(22.01)	(22.18)	(22.61)	(22.31)	(5.46)	(5.45)
Games played	1719.3***	1782.2***	525.1	1485.6**	-257.5	-250.3
	(2.94)	(2.97)	(0.84)	(2.55)	(-0.37)	(-0.36)
Fights (F)	-183.5	1605.8	13615.8***	–	8886.5	–
	(-0.06)	(0.57)	(4.10)		(1.70)	
Wing	–	–	-106551.5	–	–	–
			(-1.60)			
Defence	–	–	534660.7***	–	–	–
			(11.22)			
Wing x F	–	–	–	-7120.2***	–	10940.4**
				(-2.88)		(2.35)
Center x F	–	–	–	-31128.6*	–	9308.2
				(-1.80)		(0.42)
Defence x F	–	–	–	47726.1***	–	4229.9
				(7.11)		(0.43)
Season FE	No	Yes	Yes	Yes	Yes	Yes
Team FE	No	Yes	Yes	Yes	Yes	Yes
Player FE	No	No	No	No	Yes	Yes
R^2	0.388	0.435	0.465	0.440	0.263	0.263
Adj. R^2	0.388	0.431	0.460	0.436	0.261	0.261
N	5571	5571	5571	5571	5571	5571

t statistics in parentheses

Standard errors are robust and clustered on team level

All models except first contain season and team dummies

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Player Wage Effects of Fights Won

	OLS 9	OLS 10	OLS 11	OLS 12	XT 5	XT 6
Plus/Minus$_{t-1}$	8910.8***	6523.2**	3244.6	6201.7**	-707.4	-705.0
	(2.90)	(2.60)	(1.33)	(2.47)	(-0.23)	(-0.23)
Points$_{t-1}$	43072.8***	42381.4***	47323.3***	42747.3***	10920.9***	10933.6***
	(22.10)	(22.07)	(22.66)	(21.94)	(5.46)	(5.49)
Games played	1644.6**	1783.3***	697.2	1678.4**	-100.3	-91.25
	(2.75)	(2.85)	(1.07)	(2.70)	(-0.15)	(-0.13)
Fights Won (FW)	6488.4	5026.7	28097.1***	–	13921.5*	–
	(1.48)	(1.08)	(5.12)		(1.93)	
Wing	–	–	-103050.2	–	–	–
			(-1.58)			
Defence	–	–	536030.0***	–	–	–
			(11.27)			
Wing x FW	–	–	–	-11240.2*	–	18135.3***
				(-1.84)		(2.97)
Center x FW	–	–	–	-33504.3	–	-7068.2
				(-1.11)		(-0.13)
Defence x FW	–	–	–	88095.3***	–	7805.0
				(4.49)		(0.57)
Season FE	No	Yes	Yes	Yes	Yes	Yes
Team FE	No	Yes	Yes	Yes	Yes	Yes
Player FE	No	No	No	No	Yes	Yes
R^2	0.388	0.436	0.465	0.438	0.262	0.263
Adj. R^2	0.388	0.431	0.460	0.433	0.261	0.261
N	5571	5571	5571	5571	5571	5571

t statistics in parentheses

Standard errors are robust and clustered on team level

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Player Wage Effects of Fights Not Won

	OLS 13	OLS 14	OLS 15	OLS 16	XT 7	XT 8
Plus/Minus$_{t-1}$	8905.8***	6523.1**	3271.8	5813.2**	-666.1	-668.9
	(2.90)	(2.60)	(1.35)	(2.29)	(-0.22)	(-0.22)
Points$_{t-1}$	42856.1***	42335.4***	47500.9***	43148.7***	10928.0***	10925.6***
	(21.95)	(22.13)	(22.58)	(22.30)	(5.47)	(5.43)
Games played	1770.1***	1808.0***	563.2	1521.1**	-246.0	-248.5
	(3.02)	(3.02)	(0.90)	(2.63)	(-0.36)	(-0.36)
Fights Not Won (FNW)	-1981.8	1049.0	15077.2***	–	10120.1	–
	(-0.54)	(0.29)	(3.60)		(1.46)	
Wing	–	–	-104168.1	–	–	–
			(-1.56)			
Defence	–	–	534925.8***	–	–	–
			(11.24)			
Wing x FNW	–	–	–	-8978.2***	–	11993.5*
				(-3.16)		(1.96)
Center x FNW	–	–	–	-37711.2*	–	19671.5
				(-1.95)		(0.57)
Defence x FNW	–	–	–	53556.3***	–	3300.8
				(6.68)		(0.30)
Season FE	No	Yes	Yes	Yes	Yes	Yes
Team FE	No	Yes	Yes	Yes	Yes	Yes
Player FE	No	No	No	No	Yes	Yes
R^2	0.388	0.435	0.464	0.440	0.262	0.263
Adj. R^2	0.388	0.431	0.460	0.435	0.261	0.261
N	5571	5571	5571	5571	5571	5571

t statistics in parentheses

Standard errors are robust and clustered on team level

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Teams and Person-Year Obersvations

Team Name	**No.**	%
Anaheim Mighty Ducks	409	4.2
Atlanta Thrashers	242	2.5
Boston Bruins	438	4.5
Buffalo Sabres	407	4.2
Calgary Flames	451	4.6
Carolina Hurricanes	269	2.7
Chicago Blackhawks	435	4.4
Colorado Avalanche	304	3.1
Columbus Blue Jackets	229	2.3
Dallas Stars	314	3.2
Detroit Red Wings	288	2.9
Edmonton Oilers	325	3.3
Florida Panthers	330	3.4
Los Angeles Kings	340	3.5
Minnesota Wild	194	2.0
Montreal Canadiens	326	3.3
Nashville Predators	275	2.8
New Jersey Devils	303	3.1
New York Islanders	355	3.6
New York Rangers	341	3.5
Ottawa Senators	309	3.2
Philadelphia Flyers	346	3.5
Phoenix Coyotes	318	3.2
Pittsburgh Penguins	318	3.2
San Jose Sharks	301	3.1
St. Louis Blues	335	3.4
Tampa Bay Lightning	310	3.2
Toronto Maple Leafs	329	3.4
Vancouver Canucks	323	3.3
Washington Capitals	342	3.5
Total	9806	100.0

Table 11: Top 20 Enforcer

Fights	**Player**	**Position**
169	Tié Domi	Wing
160	Krzysztof Oliwa	Wing
159	Ian Laperriere	Center
154	Jeff Odgers	Wing
147	Donald Brashear	Wing
141	Peter Worrell	Wing
131	Matt Johnson	Wing
123	Paul Laus	Defence
122	Matthew Barnaby	Wing
120	Georges Laraque	Wing
119	Jody Shelley	Wing
113	Jim McKenzie	Wing
110	Denny Lambert	Wing
105	Darren Langdon	Wing
105	Rob Ray	Wing
99	Bob Boughner	Defence
98	Eric Cairns	Defence
96	Kelly Buchberger	Wing
94	Andrei Nazarov	Wing
92	Andre Roy	Wing

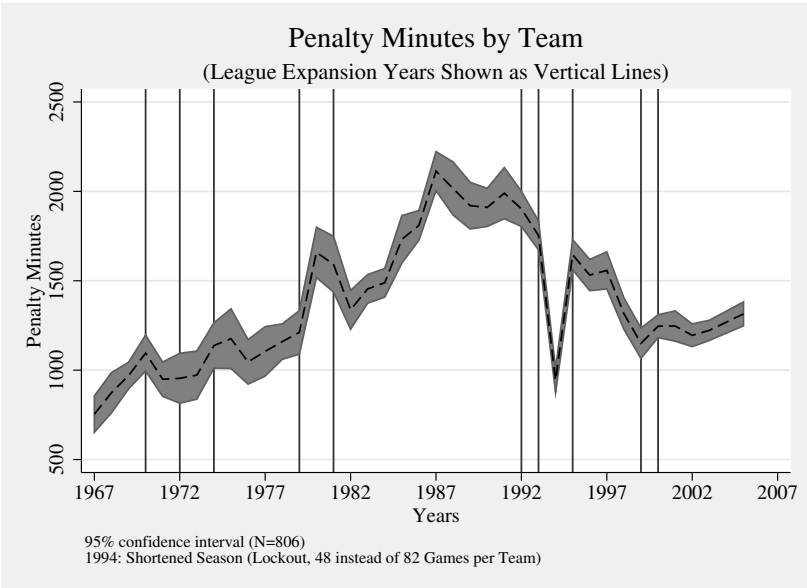

Figure 1: Development of Penalty Minutes on Team Level

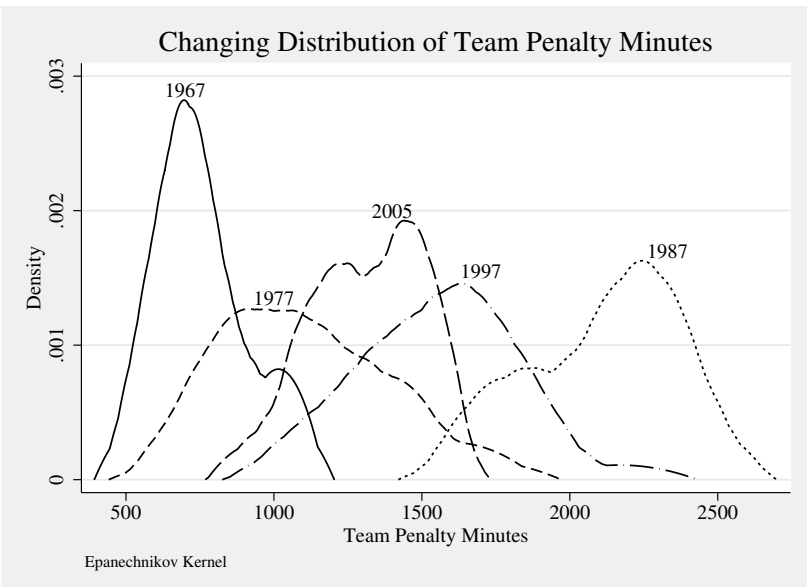

Figure 2: Distribution of Penalty Minutes

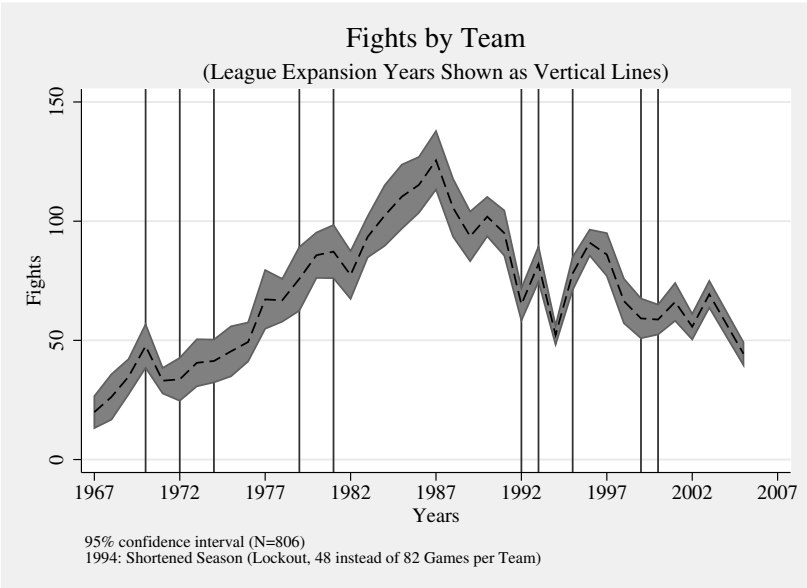

Figure 3: Development of Fights on Team Level

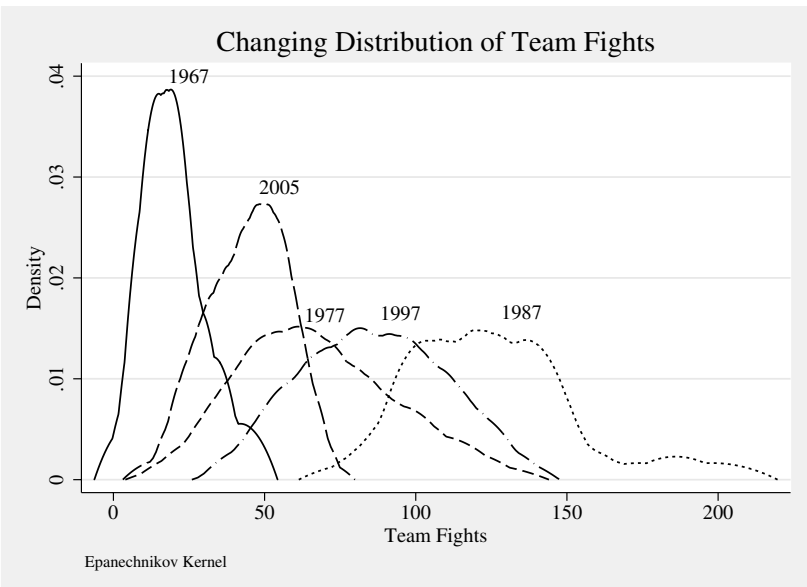

Figure 4: Distribution of Fights