No I In Team: Contract, Teammate and Team Quality Effects in the NHL

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Abstract

This paper analyzes contract, teammate and team quality effects in the NHL using data from the 2008-09 to 2011-12 seasons. This study takes a unique approach by looking at how team quality impacts contract effects. The results show that performance improves in the year before signing a new contract but declines when a player is signed to a multi-year contract. This decline may be due to diminished opportunities and selfless play rather than shirking. Performance of contract year players declines with wins, as the incentive to win a championship overrides the incentive to increase personal statistics.

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I. Introduction

In the National Hockey League, winning is everything. In Canada, players fight to end a two decade long championship drought for the seven Canadian teams. For many American hockey teams, they are one of many professional teams in their market, and winning is essential to bringing in sorely needed revenue. The 82 game regular season culminates in the 16 team Stanley Cup playoffs, with fiercely competitive games deciding who will hoist the Stanley Cup trophy in June. Due to revenue sharing, a salary cap and the nature of hockey, all 16 playoff teams can believe they have a realistic chance at winning a trophy. As a result, a single contract can truly make or break a team's season, meaning the optimization of salary usage is essential. General managers know that they must have players who are not only talented, but have an incentive to work hard and play selflessly as well.

The theory that underlies the player market in the NHL is the principal-agent model. The hockey team (principal), tries to get the player (agent) to work on behalf of the team's interests, rather than their own. As with most employees, hockey players are primarily motivated by money. NHL teams provide their players with contracts that incentivize them to exert maximum work effort. However, long-term contracts can cause players to vary work effort throughout the length of their contract. If a player has multiple years left where he knows he has guaranteed wages regardless of performance, he has a strong incentive to shirk and underperform. However, if he is in the final year of his contract and will be a free agent demanding a new salary after the season, there is a strong incentive to play as hard as possible to get noticed by teams around the league. This variation of work effort can be classified under two potential effects, *ex ante*, when

they increase effort before receiving a new contract, and *ex post*, when they diminish effort due to guaranteed future wages. These multi-year contracts are often referred to as a "double-edged sword" as they provide both positive and negative benefits to the principal.

Strategic behavior throughout a contract cycle is applicable throughout the sports world and beyond. Many employers provide long-term contracts in an effort to both keep and incentivize their workers. The conditions for the opportunistic behavior that may be occurring in the NHL were outlined by Krautmann and Donley (2009): When the agent and principal are linked by compensation, when the principal's success is in part dependent upon the agent's level of effort and when the principal can not directly monitor agent effort. It is clear that the first two conditions are met in hockey, as the teams provide monetary incentives for players to perform and increase their chances to win. The third condition may seem to not be applicable, as sports statistics are easily measured and widely available. However, unlike most jobs, athletes have others who are actively attempting to make their performance worse. A player might be getting older, dealing with an injury or could be on a better team that provides more scoring opportunities. Statistics can often be considered a measure of both ability and effort, making effort hard to monitor directly. Therefore it is not easy for the team to tell exactly when a player is shirking. Additionally, hockey is a fast paced game where players can easily get injured, making shirking on the ice a difficult proposition. As a result, there are two potential ways for a player to improve their statistical performance: working harder during the offseason and between games, and taking scoring opportunities away from teammates by playing selfishly. The question that this research tries to answer is if hockey players

increase their effort in the final year of a contract and decrease their effort the more years they have left on their contract. Additionally, if they are increasing their effort are they doing so by playing more selfishly?

Hockey more than just about any other sport revolves around teamwork. Forwards tend to play with the same two line-mates and defenders always play with the same partner. Due to the fast paced and team-oriented nature of the game, it is difficult to imagine that players with long contracts would simply stop trying. Therefore, improved statistical performance by players might occur due to selfish behavior that is exacerbated by teammates playing selflessly to help a line-mate get a new contract. The NHL presents a great opportunity to study contract effects and strategic behavior in a work setting. Performance is easily monitored and the multi-million dollar contracts provide an enormous monetary incentive to work hard. This research was done with data from the 2008-09 to the 2011-12 season. The samples were restricted to skaters (forward and defensemen) who played at least 41 games in the season monitored, leading to a total of 1,934 observations. Goalies are far more dependent on their teammates than other positions and have an entirely different set of statistics. Restricting the sample to players who played at least half of the total games allows for a more comprehensive measure of true productivity. Unlike most other sports, playing time is very evenly distributed to each player, giving each player a finite time to perform. Data on player performance was gathered in accordance with contract information and team performance from the same year.

Most literature on contract effects and the principal-agent relationship in the sports world has been done on baseball and basketball. One of the main contributions of

this paper will be to expand this analysis to hockey, a sport that has seen very little economic research. Having the opportunity to conduct research and analysis in a sport that has seen little was a primary motivation for this paper. Previous research on other sports has shown a substantial increase in performance in the final year of a contract, and a minor decrease in performance in the year after receiving a new contract. This paper will look to confirm whether or not these *ex ante* and *ex post* effects occur in the NHL. Similar to Werber (2012), this paper will also look at teammate effects in the NHL. Using a variable similar to Werber's that calculates the percentage of a team's players in the final year of their contract, three different models will be examined. First, the effect of the number of contract year players on team performance will be calculated, followed by a determination of teammate effects, to see if player's who are not in a "contract year," act selflessly to their teammates seeking a new deal, by providing more passes and taking fewer shots. Finally, a model estimating the relationship between player performance and contract status, age, team quality, team, position and year dummies and player fixed effects will be examined. One different approach that this paper will take is to look not just at the *ex post* effects in the year immediately after a contract is signed, but to examine the relationship between the length of the contract and performance. One unique approach that this paper will take on strategic behavior in sports is to interplay the effect of team quality and contract status on performance. This will show whether or not players in the final year of their contract see the effect of their contract status mitigated by being on a good team. It is possible that the incentives to perform selfishly are not as strong as the desire to win a championship. Players also receive bonuses for advancing in the

playoffs and increased media attention, providing a further monetary incentive to play for the team instead of the individual.

This paper studies the effect of contract status, teammate contract status and team quality on player performance in the NHL. It is predicted that player performance will improve in the final year of their contract as they attempt to increase their statistics and receive a larger contract in the future. This effect will be captured in their selfish play, as it is predicted they will be taking more shots at a lower success rate. This selfish play will cause a negative effect on their teammates, who may also be passing up on shots to improve their co-workers performance. Finally, it is predicted that the coefficient on the interaction term between contract year and wins will be negative, as players will be more selfless the greater the chance of winning a championship. One of the first papers to comprehensively examine contract effects in the NHL, this paper has important implications for how management make decisions in the labor market. If *ex ante* effects occur, it is important for general managers to look beyond simple statistics to see if a player is getting better or is behaving opportunistically. If players on winning teams forego individual success for the team, there could be value in trying to sign lesser name players on championship teams. The remaining sections of this paper are as follows: Section II reviews relevant literature. Section III discusses the data used and the motivation behind this study. Section IV presents the models and results of this research. Section V concludes the paper and discusses implications, limitations and the potential for future study.

II. Literature Review

Whether or not players exhibit opportunistic behavior and perform strategically is a question that has important implications for the world of sports. Recently, the effect of contract incentives in sports, especially in Major League Baseball and the National Basketball Association has been receiving more attention in literature. Many have studied the interplay between individual incentives and firm-wide compensation as well as individual pay vs. firm performance, but until recently there was little on the effect of individual pay on individual performance. The effect of a player's contract on their own performance is especially applicable to professional sports. Woolway (1997) found strong evidence for strategic performance in baseball but Maxcy et al. (2002) rejected the notion. While Maxcy et al. (2002) did not find evidence for opportunistic behavior, they did introduce the idea of *ex ante* and *ex post* behavior that is used in this paper. This theory addresses the improvement of performance at the end of a contract and a decline in performance after a new contract is received (Maxcy et al, 2002). If player's performance varies based upon their contract status, it is necessary to ensure that the value of a contract is based upon performance. Looking at North American sports leagues, Krautmann and Berri (2009) found free agent salaries to be largely based upon player performance, the size of their team's market and the position that they play. Because player performance is largely responsible for the size and length of a contract, there is an incentive for athletes to vary their effort based upon their contract status. In basketball, Berri et al. (2007) found that the amount of points a player scores dictates the money they receive. This demonstrates a clear rationale for players taking bad shots and playing selfishly to the detriment of their team.

Two papers, Stiroh (2007) and Werber (2012) were especially valuable to this paper. Stiroh (2007) looked at contract-related incentive effects on firm performance in the NBA. He looked at what he called the double-edged nature of long-term contracts, specifically the positive *ex ante* and negative *ex post* effects on individual performance. Stiroh found that players are heavily rewarded for improvements in their contract year and there was a significant improvement in performance in the final year of a contract. Because teams may interpret a player getting better in a given year as the beginning of a long-term trend rather than an anomaly, players can be over-valued. While Stiroh (2007) found a small decrease in performance after a long-term contract was received, it is hard to find evidence of post contract shirking due to a selection effect. This selection effect occurs because better players are often the ones that receive big contracts, so players with many years left on their contract are often innately better than those with short ones. Stiroh also found that teams with many players in the final year of their contract are better, demonstrating the asymmetric effects that occur because of contract status. This shows how workers can alter their effort levels to maximize personal gains, which can ultimately affect team performance.

To examine contract effects in the NBA, Stiroh first runs the following regression to look at the relationship between wages and individual performance:

$$Z_{i,t} = \beta_1 P_{i,t-N,T-2} + \beta_2 \Delta P_{i,t-1} + \beta_3 NAGE_{i,t} + \beta_3 Age + \alpha_P + \alpha_J + \alpha_t + \varepsilon_{i,t}$$

where Z is contract features such as length of contract, annual salary and total value, $P_{i,t-N,T-2}$ is historical performance, $\Delta P_{i,t-1}$ is the contract year change in performance, and the alphas are dummy variables for position, team and year respectively. Stiroh then goes on to model the relationship between contract status and individual performance:

$$P_{i,t} = \beta_{pre} PRE_{i,t} + \beta_{post} POST_{i,t} + \beta_{Age} NAGE_{i,t} + \alpha_P + \alpha_J + \alpha_t + \alpha_i + \varepsilon_{i,t}$$

where $P_{i,t}$ is a performance metric that factors in variables including points, assists, blocks, steals, rebounds, minutes played and more. PRE is a contract year dummy variable, POST is a dummy variable for the year after receiving a contract, and the alphas are dummy variables for position, team, year and an individual fixed effect. His prediction of a positive β_{pre} and a negative β_{post} was confirmed, with the coefficient on the PRE dummy variable especially significant. This confirms improved performance in the final year of a contract. Rather than examine just the year before and after a new contract, this paper will look at the total number of years remaining. Stiroh (2007) discusses how players could be altering their effort. While it is difficult for effort to vary on the court, how hard players work in the off-season and between games could affect their play. Stiroh asks why there are not more short-term incentive contracts. This is likely because a long-term deal ensures retention of star players as well as the powerful negotiating ability of the players association.

Werber (2012) builds off of Stiroh's research to study contract-related effects in the NBA through teammate effects. Using data from 2006-2011 he took a unique approach by using player efficiency rating as his performance metric. On top of looking at whether or not players in their contract year become more selfish, he examined the sacrifices other players make to help contract year teammates perform. Because having a new contract allows a player to have a diminished monetary incentive to score, they may be more likely to play selflessly. Werber (2012) estimates the following fixed effects model:

$$P_{i,t} = \beta_1 CY + \beta_2 PERCENTCY + \varepsilon_{i,t}$$

where $P_{i,t}$ is a performance variable, CY is a dummy variable for contract year and PERCENTCY is the percent of players on a team in the final year of their contract. If *ex*

ante contract effects are true, Werber predicts a positive coefficient on CY, and if teammate effects occur, Werber predicts a negative coefficient on PERCENTCY. Werber (2012) does find that players exhibit strategic behavior and improve their performance in the final year of their contract. While not as significant as predicted, he finds a negative coefficient on PERCENTCY, indicating that players may not be shirking after receiving a new contract but instead not having the same opportunities due to selfish teammates. Similar to Stiroh, Werber discusses the selection effect of better players having longer contracts, which will also be addressed in this paper.

A review of recent literature shows conflicting notions of strategic performance in sports, although most believe that it is occurring. To this point, there has been little to no studies looking specifically at contract incentives and teammate effects in the NHL. Hockey is an ideal sport to study contract incentives as there is a great degree of variation in contract length and many players receive incentive-based deals. In order to examine the role that an individual and their teammate's contract statuses play on their performance, it is necessary to discuss papers that addressed salaries in the NHL. Jones (1988) found skills and the statistics created by those abilities to be the principal determinant of salaries in the NHL. Richardson (2000) found substantial growth in the average salary and dispersion from 1990 to 1996 and Vincent (2009) found significant differences in the return to performance based on earnings.

Clearly, salaries are getting larger and the return to those big deals is becoming more varied, making the efficient use of payroll essential to success. So far, teams have been fairly good at identifying talent, with Chan et al. (2012) finding that players are compensated similarly to their value, with goalies contributing the most to team

performance followed by forwards. In a diverse league where team unity is crucial, teammate effects are under examination. Kahane, Longley and Simmons (2013) found that the presence of foreign workers, especially Europeans improves firm performance in the NHL. However, assimilation costs can override diversity benefits if those foreign workers are from different countries (Kahane, Longley and Simmons, 2013). The location and quality of a player's team also plays a role in the compensation they receive. Kahane and Idson (2000) found that teammate effects directly increase salary and Kahane (2001) found a significant difference in salaries across teams that are partially explained by revenue. This paper will build off of Stiroh and Weber to apply the study of contract and teammate effects on performance to the National Hockey League, while taking a unique look at the effect of team quality on those contract effects.

III. Motivation and Data

The first of two primary motivations for this paper is to apply a study of contract and teammate effects on performance similar to that of Stiroh and Werber to the NHL. The second motivation is to expand on their models to incorporate the effect of team quality on contract effects and player performance. The "Moneyball" revolution of professional sports teams has spread like wildfire to MLB and the NBA, as teams have sought advantages through statistical analysis to find the best value at each position. While baseball and basketball teams are busy hiring economics PhDs, the National Hockey League is still reliant on old talent assessment methods. Very few teams have math or economics majors in their front offices, instead relying on scouts to make the ultimate assessment on players. These scouts may often rely on more basic statistics such

as goals and assists and more qualitative metrics such as player size. This market inefficiency presents an enormous advantage to teams that are willing to undergo a statistical revolution. The Oakland Athletics of baseball used these tools to level the playing field against teams that had much more money to spend. Unlike most other sports, the NHL has a hard salary cap, with no exceptions allowed. Set at $64.3 million for the 2013-14 season, this hard cap means that teams who can capitalize on market inefficiencies will not be using it to catch up to big spending opponents, but instead pulling ahead of the rest of the league.

This study is one of the first to examine the role of contract and teammate effects on player performance in the NHL. By looking at the effect of a player being in their contract year as well as having teammates in a similar position, player performance can be more accurately predicted in the future. If *ex ante* and *ex post* effects occur as predicted, teams will know not to overvalue players that have a rise in performance in the final year of their contract due to increased effort and/or selfish play. Additionally, teams may be able to get players with many years left on their contract in a trade who are undervalued due to their selfless play which helps other teammates score. This study also has implications for the principal agent model for all employers. Employees shirking work and exhibiting opportunistic behavior are a major problem in the labor force. When workers have an incentive to perform, such as hoping to receive a new contract, they generally work hard. However, when their salary is guaranteed and they are not being evaluated, many may shirk their responsibilities. It is necessary for companies to provide a further incentive for workers to exert maximum effort at all time.

A necessary addition to the model this paper will use was the effect of team quality on performance, as well as the interaction of team quality and contract effects. Players on teams that make the playoffs and continue to succeed once there receive additional pay, with teams losing in the first round receiving $250,000 to disperse among their players and the Stanley Cup champion receiving $3.75 million to split among their 25 players. Additionally many players have bonuses in their own contracts that provide further pay for winning a championship. Not only is there an explicit monetary incentive to win, but winning teams receive a great deal of media attention, which can lead to commercial opportunities and increased exposure to other teams general managers. Therefore, it is important to see if players who have an incentive to play selfishly in the final year of their contract become team players if there is the possibility of a championship.

This paper used data from the 2008-09 to 2011-12 seasons, for a total of four years. All years before 2008 did not have comprehensive individual salary data, while the 2012-13 season was shortened by a strike, so it is not representative of a traditional year and was not included. Performance data was provided by "hockey-reference.com," data on wages was provided by *USA Today* and total salary value and length was found on "capgeek.com." Goalies were not included in the dataset as they have an entirely different measure of performance than skaters. Additionally, their performance is much more dependent on teammates as their number of saves and save percentage is entirely reliant on which shots the defense allows on goal. The dataset was further limited to players who played in half of the season (41 games) or more, so that players who only participated in a handful of games did not bias the results. Finally, only players who had

played in both the observation season and the season before were used, so that a fixed effects model could incorporate the innate ability of a player. Even after these restrictions were made, there were still 1,934 player observations in the model. Data was gathered on the performance and make-up of a player's team, contract status (salary and length) and a wide variety of performance metrics. Plus minus, an important statistic measures the point differential between a player's team and their opponents while the player was on the ice. Finally, a variable PERCENTCY, was calculated to determine the percentage of players on a team in the final year of their contract.

Table 1: Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
pts	31.3485	20.7597	0	113
plusminus	0.2916	11.1732	-35	50
s	124.1355	66.2672	6	528
shotpercent	8.3357	4.3656	0	26.7
Wins	40.6866	6.775	24	54
age	27.879	4.5307	19	42
Salary	2,445,006	2,008,358	475,000	12,000,000
ContractYear	0.4488	0.4975	0	1
ContractLength	1.1815	1.7008	0	14
PERCENTCY	0.4488	0.1477	0.083	0.761
Observations	1934			

Notes: Summary statistics for skaters who played in at least 41 games in a given season from 2008-09 to 2011-12. S is shots taken, and is the total for a given season, as are pts, plusminus and shotpercent. ContractYear is a dummy variable equal to 1 if a player is in the final year of their contract and ContractLength is equal to the number of years remaining on a contract after the season, giving the mean length of a player contract of 1.1815 + 1 of 2.1815 years at the start of a season. PERCENTCY is equal to the percentage of players on a team in the final year of their contract with 0.44 equal to 44 percent.

IV. Model and Results

To start the analysis of the dataset, it was important to examine the relationship between performance and contract status. The main purpose of this paper is to investigate

the relationship between contract effects and performance. However, if better players do not have higher wages and longer contracts, then the monetary incentive for opportunistic behavior would not exist. If players with better statistics are not paid more, then there would be no reason to study the contract effects on performance, as players would have no incentive to exert extra effort in order to improve their stats. It is predicted that employers (teams) attempt to allocate their resources to players with the highest ability. Therefore, the more points a hockey player is scoring, the more likely it is they have a large multi-year contract. The following model was run to examine the relationship between performance and contract status:

$$Z_{i,t} = \beta_0 + \beta_1 pts + \beta_2 ptsprev + \beta_3 Age + \alpha_P + \alpha_J + \alpha_t + \varepsilon_{i,t}$$

where Z is a contract feature, and dummy variables for position, team and year are included. Various performance metrics were tested, and points (goals + assists) were determined to have the strongest association with contract features. Employers often look at goals and assists when considering the overall value of a player. The equation is estimated for either salary or the length of a contract with independent variables of performance, current performance and age.

Table 2: Effect of Performance on Contract Status

Dependent Variable	pts	ptsprev	age
Salary	25605.02***	45869.35***	110680.5***
	(2382.2240)	(2230.5200)	(6927.0430)
ContractLength	0.0055**	0.0302***	-0.0236***
	(0.0027)	(0.0025)	(0.0079)

Notes: Results are from a regression with position, team and year dummy variables. Standard errors are in parenthesis and ***,**,* indicate statistical significance at the 1%, 5% and 10% level respectively. ContractLength is equal to the number of years remaining on a contract after the season of observation, so that a player in the final year of their contract has a ContractLength of 0.

Points, points in the previous season and age all had a significant and positive effect on wages. Points and points in the previous season had a significant and positive

effect on the length of a contract while age had a significant and negative effect on contract length. These results are all intuitive. Performance in the previous season had a much larger effect on both contract features examined. Because a players' contract is only based upon past play, it should be mainly associated with historical performance. However, employees with higher salaries are likely to perform better in the future than their co-workers, causing the relationship between current point totals and the contract. Finally, a selection bias means that older players are likely to have been in the league for a long time due to high levels of talent. Additionally, their union often requires increased compensation as their playing career goes on. However, because those older players have fewer expected years remaining, they are more likely to receive shorter contracts than younger stars. With the expected relationship between performance and contract status ensured, a study of contract, teammate and team quality effects on performance could begin.

The next series of regressions examine the relationship between teammate contract status and player and team performance. Similar to Stiroh (2007) the following model was run:

$$Win_t = \beta_0 + \beta_1 PercentCY + \beta_2 AllStars + \alpha_J + \varepsilon_{i,t}$$

where PercentCY is the percentage of players on a team in the final year of their contract, AllStars is the number of All Stars on the team and α_J is a team dummy variable. If players in their contract year try hard and exert maximum effort, it will improve their teams win total. However if they behave selfishly to try to score more goals at the expense of their teammates, win totals will go down. Following Werber (2012) a fixed effects model that estimates teammate effects was used. When using a performance metric as the dependent variable it is important to use fixed effects to control for the

innate ability of the player. Players have different ability levels and each player remains the same individual throughout the dataset, allowing for a fixed effects estimation. Using fixed effects ensures that just the desired effects are captured, rather than being biased by differences in ability between players. The teammate effects fixed effect model was as follows:

$$P_{i,t} = \beta_0 + \beta_1 CY + \beta_2 PercentTCY + \beta_3 AllStars + \alpha_i + \varepsilon_{i,t}$$

where P is the plusminus for a season, CY is a dummy variable equal to one if a player is in the final year of their contract and PercentCY is the percentage of their team that is in their contract year. PercentCY is a modified version of the PERCENTCY variable, as it is in terms of numerical percent (0-100) rather than 0.00-1.00. A positive coefficient on CY indicates increased performance in the final year of a contract, while a negative coefficient on PercentCY shows that teammates may be playing selflessly to help co-workers looking for a payday. If players with many years left on their deals are being selfless, this could be part of the reason for diminished performance after a new contract, rather than shirking.

Table 3: Teammate Effects

Dependent Variable	ContractYear	PercentCY	All Stars
Wins		0.0398***	1.559***
		(0.0847)	(0.119)
plusminus	1.203**	-0.0433**	1.459***
	(0.594)	(0.0204)	(0.327)

Notes: Standard errors are in parenthesis and ***,**,* indicate statistical significance at the 1%, 5% and 10% level respectively. PercentCY is the percentage of a team in the final year of their contract. When wins is the dependent variable team dummy variables are included in the model, while plusminus was modeled with player fixed effects.

A large and significant coefficient on PercentCY with wins as the dependent variable shows that having many contract year players is good for team success. Players

in their contract year may work hard to make the team better to receive attention and monetary bonuses that are associated with success. An alternative explanation for the large coefficient on PercentCY is that if a team decides to invest in star players, the rest of their team will receive mainly short-term contracts. Therefore it might be the high paid stars that drive success, rather than the athletes in the final year of their contract. However, the inclusion of the number of All-Stars on a team shows a positive and significant effect of having both contract year players and stars. Being in the final year of a contract was found to increase an NHL player's plus minus, while having more teammates in their contract year had a negative effect and having more star teammates had a positive impact. Similar to Werber's study on basketball, this lends credence to the idea that players with a longer contract play selflessly, giving opportunities to their teammates.

The most important model in this paper looks at contract effects and the effect of team quality on player performance in the NHL. By using a wide variety of performance variables as the dependent variable in this model, it is possible to see what specifically is changing in a player's effort and performance as they respond to contract and team quality effects. The general model used was run with player fixed effects to capture innate ability and is as follows:

$$P_{i,t} = \beta_0 + \beta_1 CY + \beta_2 ContractLength + \beta_3 Age + \beta_4 Wins + \gamma WinsCY + \alpha_P + \alpha_J + \alpha_t + \alpha_i + \varepsilon_{i,t}$$

where P is one of seven performance variables: plusminus, points, shots, games played, shot percentage, assists and minutes played. CY is a dummy variable equal to one if a player is in the final year of their contract, WinsCY is an interaction term between the CY dummy and a team's win total. Alphas are dummy variables for position, team, year and individual (player fixed effects) respectively. If a player wants to increase their

statistics, in addition to exerting extra effort on and off the ice, they can play through injuries to maximize their games played and the number of minutes they play in each game. Additionally they can take more shots to try and increase the number of goals they score, a popular metric with fans and management alike for assessing player quality. However, if they would have been better off passing the puck instead of taking those extra shots, the percentage of their shots that score goals would likely go down. This comprehensive model allows for a wide variety of insights into contract effects in the National Hockey League.

Table 4: Player Performance Regressions

Dependent Variable	ContractYear	ContractLength	Age	Wins	WinsCY
plusminus	7.2513**	-0.6855***	-0.6062**	0.8088***	-0.1855**
	(3.4145)	(0.2505)	(0.2419)	(0.0702)	(0.0822)
pts	7.3620**	-0.3821	-1.7040***	0.4642***	-0.1917**
	(3.5709)	(0.2619)	(0.2530)	(0.0734)	(0.0859)
s	20.8555*	0.0116	-3.9430***	0.5591**	-0.4937*
	(10.9462)	(0.8029)	(0.7757)	(0.2252)	(0.2635)
gp	1.6920	-0.2923	-0.5022*	0.1692**	-0.0602
	(3.7086)	(0.2720)	(0.2628)	(0.0763)	(0.0893)
spercent	-1.5347	-0.1370*	-0.2538***	0.0259	0.0258
	(1.0051)	(0.0737)	(0.0712)	(0.0206)	(0.0242)
Assists	5.7295**	-0.1348	-1.0757***	0.3487***	-0.1386**
	(2.5482)	(0.1869)	(0.1806)	(0.0524)	(0.0613)
Time on Ice	49.4227	-0.7382	-12.391**	1.5497	-1.2916
	(82.378)	(6.0431)	(5.8384)	(1.6949)	(1.9836)

Notes: Results are from a fixed effects regression with position, team and year dummy variables. Standard errors are in parenthesis and ***,**,* indicate statistical significance at the 1%, 5% and 10% level respectively. ContractLength is equal to the number of years remaining on a contract after the season of observation. WinsCY is equal to the ContractYear dummy variable multiplied by the number of wins of the team that player is on. S stands for the number of shots in a season and spercent is the percentage of shots that score goals.

This series of regressions allows for a better understanding of contract effects in the NHL. A player being in the final year of their contract is associated with a statistically significant increase in their plus minus, their point total, assists and the number of shots

they take. Being in a contract year is also associated with more games played and a worse shot percentage, although these were not statistically significant observations at the 10% level. The more years remaining on a player's contract, the worse their plus minus, point totals and shot percentage, the fewer the number of games they play and the worse their shot percentage. However only plus minus and shot percentage had a significant relationship with contract length, with the effect of contract length on plus minus significant at the 1% level. Age had a significant negative effect on all seven performance metrics. The only variable that had an effect on minutes played was Age, demonstrating that it is truly performance changing due to contract status, not just time on the ice. The number of wins a player's team had led to a significant and positive effect on every performance variable except shot percentage and minutes played, which were positive but not statistically significant. Finally, the interaction term of team quality and the final year of a contract had a significant and negative effect on plus minus, points, assists and shots, a negative effect on games and minutes played and a positive effect on shot percentage.

When examining the effects presented by the model, the easiest to determine are age and team win totals. Regardless of what variable is used, growing older causes poorer performance. By including player fixed effects, the model looks at what happens to individual players as they grow older, and intuitively their performance declines. The better an NHL player's team, the better their performance. Plus minus reflects the score differential when a player is on the ice, so the better their team is the higher their plus minus. Having great teammates also increases the number of opportunities one has to score and those chances are often easier. Teammates are more likely to convert passes into assists, increasing assist totals. When your team is contending for the playoffs and a

championship, you are less likely to take games off for injuries, leading to an increase in games played. The lack of a statistical significance to contract length on most variables suggests that once a player receives a new contract they may not be shirking but the composition of their team may have changed. Perhaps all of the money spent to sign them decreased the quality of the rest of the team, leading to plus minus decreasing but not other metrics. Or, as the model of teammate effects showed, teammates in their contract years may be taking away opportunities.

The most important implications of this model come from the coefficients on contract year and the wins and contract year interaction term. As predicted, being in the final year of one's contract is associated with a significant increase in points, plus minus, assists and shots taken. The large increase in all four measures of performance demonstrates the incentives at work for employees seeking a new contract. By working hard in the offseason they can improve their game and their plus minus score. This extra effort goes hand in hand with a player taking more shots to try to score goals and boost their statistics to increase their overall point totals. The relationship between contract year and games played was positive, but not significant. In the case of playing time, there are forces working in opposite directions, as players want to play as many games as possible to increase their stats, but will be less likely to play if injured as a significant injury will decrease their future wages. It was predicted that if a contract year player is selfish they will take more shots but at a lower success rate, as they will be taking shots they would ordinarily pass to a teammate. While there was a negative relationship between contract year and shot percentage, it was not significant. While players may be more selfish, their increased effort could correspond to more shots going into the goal.

This model helps reconcile the discrepancy that having more athletes in the final year of their contract improves overall team performance, but decreases the performance of their individual teammates (Table 3). Intuitively this is difficult to comprehend. How could a player exerting maximum effort to gain a new contract help the team win more, but decrease the goal differential of a specific teammate's time on the ice. Ultimately, the explanation for these results is likely due to the close-knit nature of hockey teammates. Players perform much better in their final contract year but their shot percentage does not significantly decrease. However, the number of shots they take goes up greatly, indicating that it is not their selfish behavior, but their teammates selfless behavior that is helping to increase their statistics. Selflessness would seem to be better for a sports team while selfishness detrimental, so this could explain why the team does better if they have many employees fighting for a new contract. Many goals in the NHL are scored on power plays, when a team gets a one or more man advantage on their opponent. By allowing a teammate to play during the man advantage rather than oneself, or foregoing scoring opportunities, one would be increasing their teammate's statistical performance and decreasing his own stats, while not hurting the team. This selflessness goes hand in hand with the extra effort provided by contract year players to help the team but hurt the statistics of the individual.

The coefficient on the WinsCY variable shows the effect of team quality on contract effects in the NHL. For players in the final year of their contract, the better their team is, the fewer points, plus minus and shots they have. These three relationships were statistically significant while the negative association of WinsCY and games played and the positive association of WinsCY and shot percentage were not significant. One

explanation for these results is that when an athlete is on a good team that is competing for a championship they are more likely to be selfless and play for the team. Being on a championship team leads to performance bonuses, commercial opportunities and increased exposure. When an employee is seeking a new contract, their primary incentive is to be noticed as a worthy asset. When they are on a bad team, the best way to receive attention is to score as many goals as possible, often at the expense of your teammate's opportunities.

Competing for a championship provides both monetary incentives and the opportunity to fulfill the ultimate dream of most athletes. Therefore, the better your team is, the more likely you will be to pass the puck to open teammates and take better quality shots, while resting up for the playoffs if need be. However, the negative coefficient on assists demonstrates that teammates may also be resting for the playoffs. At an average win total of 41 wins, the coefficients on CY and Wins*CY are equal and opposite. Therefore contract year players on bad teams see their performance increase, while those on good teams have worse statistics. It is important to remember that the coefficient on the interactive term is relative. Relative to players on bad teams, people on good teams have less of an incentive to play as hard as possible for better statistics, instead resting for the playoffs to ensure peak performance at the most important time. It is possible that players in the final year of their contract on a good team shirk responsibility, riding their teammates coattails to success. Both explanations, shirking and resting could help explain the negative effect on plus minus. However, it is most likely that players who normally have an incentive to increase their statistics at the expense of the team instead forego individual statistics to help achieve the goal of winning a championship. Rather than

dedicate themselves to maximizing their performance throughout the season, they instead conserve effort in order to play their best when their team needs them the most.

V. Conclusions

This research confirmed the results of previous studies on other sports that athletes perform opportunistically and increase their effort in the final year of their contract. Performance of NHL players declined after a new contract was signed, but only marginally. The results indicate that players who are in the final year of their contract are given opportunities from their teammates due to their selflessness. The higher the share of players in the final year of their contract, the better a team performs, as players extra effort may benefit both themselves and the team. One of the most important contributions of this paper is the evidence that the performance of players in the final year of their contract declines the better their team is. Rather than playing selfishly to maximize personal gain, individuals with the chance at a championship and the monetary benefits that come with it sacrifice personal statistics for the gain of the team.

The results in this paper confirm that the opportunistic behavior exhibited in baseball and basketball are applicable to the National Hockey League. Much like in the NBA, shirking may not be as big of a problem as anticipated, as selfish players competing for contracts may simply be taking away shots from their teammates. These results have important implications for how hockey teams allocate their resources, as the optimization of wages is crucial for success. When evaluating potential free agents, general managers should not put too much weight on just the previous season and instead look at long term performance. If player's have only been in the league for a small period of time, it would be useful to see if improved performance has occurred due to selfish

play, which is reflected in rising shot totals with diminishing scoring percentages. There is also an opportunity to pursue players on great teams who may be undervalued due to statistics that are diminished due to selfless play exhibited by that individual. Finally, if given the choice between a shorter term contract with a higher per annum value and a multi-year alternative, signing a player to a shorter deal may be preferable due to the incentives in effect for contract year players.

This study reveals important results for all employers. Employees clearly have an incentive to behave strategically to maximize personal gain regardless of the effect on the firm. However, when presented with additional performance incentives, NHL players play for the good of the team. Therefore, firms can increase work effort by offering additional incentives such as performance bonuses and the possibility of a promotion. The promise of group incentive pay could be key in improving employee performance.

One limitation of this study is that some players have their contracts re-negotiated during their contract cycle, which could affect the incentives they face. Reciprocal behavior may also be occurring amongst teammates, who help improve each other's statistical performance during their contract years. Incorporating those factors into the model would provide a better picture of how NHL players respond to contract incentives. It would be ideal to include individual performance bonuses in the model to further capture the effect of team and individual performance on contract effects in the NHL. While the NHL does not make these bonuses readily available, their inclusion would provide further light on the interplay of team quality and contract effects. This author plans to pursue these additional areas of study to provide an even more comprehensive picture of contract effects in the National Hockey League.

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