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One’s Pain is Another’s Gain - Early Career Exposure and Later Labor Market Outcomes

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Abstract

This paper investigates whether early career exposure of unexperienced employees to employers affects their later career outcomes. The extent to which entry-level workers get to demonstrate their abilities is an important determinant of how precisely the employer can estimate their talent. I implement a novel instrumental variable strategy, exploiting co-worker injuries as a source of random variation in junior employee working time. Co-worker injuries create vacant slots in team rosters, which are filled by junior workers, increasing their exposure. The results show that additional exposure increases junior workers' rehiring probability as well as their post entry-level salary and contract length.

Keywords: rehiring decisions, employer learning, labor market entrants, worker ability revelation, National Hockey League
JEL: M51, J63, J24, Z22

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1 Introduction

The process of determining which employees to retain and which ones to let go has long been a challenge in personnel management. This predicament is particularly prevalent in high-skilled industries where there it is often difficult for managers to perfectly observe the skill or talent of their workers. Furthermore, the uncertainty regarding the ability of a worker to perform well is at its highest at the start of their career. The combination of this uncertainty and the disconnect between decision makers and workers creates a formidable barrier for management when it comes to accurately evaluating the abilities of junior employees, thereby complicating worker retention decisions. This paper examines whether early career exposure of inexperienced employees to employers in their industry leads to changes in managerial decision making regarding their future employment and earnings.

There are two challenges in estimating these relationships. First, the degree to which employers observe a worker's talent is often correlated with the talent of the worker itself, yielding biased results. Second, in many occupations it is difficult to establish the degree to which employers observe and learn about a junior worker's talent. Accurate measures of employer learning are either not available or only weakly related to the variable they intend to proxy. Existing literature has primarily focused on evaluating whether worker wages progressively align with initially unobserved productivity characteristics as tenure increases, effectively utilizing labor market outcomes as indicators of employer learning's presence (Altonji & Pierret, 2001; Farber & Gibbons, 1996; L. B. Kahn & Lange, 2014; Lange, 2007). Less is known about the direct effect of employer learning on these labor market outcomes themselves (Pallais, 2014; Stanton & Thomas, 2016).

The industry featured in this paper is unique in that it allows to solve both these issues simultaneously. First, firm specific co-worker injuries or illnesses during each of these working periods can be used as an instrument for how many working opportunities each junior worker gets, eliminating the bias caused by unobserved worker talent. Second, the degree to which entry-level workers get to demonstrate their talent to the employer is accurately measured by the number of working opportunities that they get. The industry in question is the National Hockey League (NHL), being the most commercially successful ice hockey league worldwide. Here, all entry-level workers, also known as rookies, initially sign a three-year entry-level contract (ELC) after which the hiring team or another employer can decide to rehire them or not.[1]

[1] This is similar to other industries where employees can either be promoted or fired after a certain time period, also known as up-or-out contracts (Waldman, 1990).

Taking advantage of these unique features, I implement a novel instrumental variable (IV) strategy exploiting co-worker injuries as a source of random variation in entry-level career playing time. An injury sustained by a (senior) co-worker creates a vacant slot in a team's NHL playing squad. In most cases, an entry-level player is then called up to fill this slot, giving them the chance to demonstrate their talent at the highest competitive level. Consequently, a positive relationship exists between the number of co-worker injuries and the number of playing opportunities that an entry-level worker gets during their entry-level career. Using co-worker injuries as an instrumental variable, the results indicate that entry-level career playing time in the NHL has a positive impact on the later career outcomes of entry-level players. In my preferred specification the IV coefficients show that an additional 10 hours of NHL exposure, equal to approximately half a standard deviation, increases the rehiring probability of an entry-level player by 8.3%, while their post entry-level salary and contract length, conditional on being rehired, increase by 35% and 32% respectively.

The primary purpose of the instrumental variable method is to eliminate the role of player talent in establishing the relationship between playing time and later labor market outcomes. The remaining positive relationship between the instrumented NHL playing time and the labor market outcomes can then be explained by the employer learning about player talent changing managerial decision making, or by rookies gaining hockey skills (human capital) at an accelerated rate in the NHL in comparison to the minor league.[2] I evaluate which of the two channels is most plausible using various mechanism analyses. The results provide compelling evidence in support of the employer learning hypothesis, indicating that managerial decision making is influenced by the employer's ability to accurately estimate player talent. Conversely, limited evidence is found to suggest that rookies significantly enhance their hockey skills at an accelerated rate when selected to play in the NHL compared to playing in the minor league.

This paper relates to various topics within the field of labor economics. First is the literature on firm provision of general skills training. Becker (1962) argues that general skills training is under-provided when workers can use these skills outside of their current company and cannot compensate the firm for their up-front investment. Public information on worker ability and general human capital are similar in that both generate future productivity benefits and require up-front investments (Pallais, 2014). Increasing knowledge on the ability of entry-level workers raises the likelihood that firms are able to pick the best employees to continue to work in the industry. However, when talent

[2]When not playing in the NHL most rookies play in the minor league, also known as the American Hockey League (AHL)

is only revealed on-the-job, its discovery is costly. It comes at the price of increased variance in output, given that there is less certainty about the productivity of entry-level workers compared to senior workers.

A closely related theory by Terviö (2009) shows that the public information externality that comes paired with on-the-job learning of worker ability combined with ex-ante uncertainty about entrant worker talent can lead to market failure. When employees cannot commit to long term contracts, it is often not in the best interest of firms to test out unexperienced workers as other firms can benefit from it too. The result is that there is an unfavourable selection of incumbent workers with mediocre talent, which optimally would be replaced by entry-level workers with more upside potential in their expected output.

In the NHL there are several factors that could cause variation in worker exposure to lead to sub-optimal rehiring practices. It is certainly possible that NHL teams undertest their entry-level players as other teams may capitalise on this incurred cost by offering the tested rookie contracts of their own. As shown by Terviö (2009) this can lead to sub-optimal rehiring decisions. In addition, the scarcity of major league (NHL) playing opportunities makes it such that not all entry-level workers can be tested at this level leading to the employers making uninformed rehiring decisions. Players, who by chance get many opportunities to demonstrate their talent, could be mistakingly rehired over plausibly more talented players who do not get such opportunities, which also can be viewed as sub-optimal since exposure in itself does not reflect a worker's productive abilities.[3]

There are few studies on inefficient hiring of workers, mostly using data from low-wage online labor markets (Pallais, 2014; Stanton & Thomas, 2016).[4] Both papers find evidence that the precision at which employers can estimate the talent of unexperienced workers increases their (re)hiring rate and wages. Peeters, Szymanski, and Terviö (2022) analyse the football manager industry. Their analysis shows that early career estimates of manager talent are noisy compared to later career estimates, allowing for on-the-job talent revelation. The results indicate that capital constrained firms are more susceptible to hiring inefficiencies due to the fact that an unlucky draw from the

[3]In this paper the focus is on junior workers with more exposure to their managers being rehired more frequently than those with less exposure, all else equal. In the context of the NHL, other (re)hiring inefficiencies, such as gender biases (see Fernandez-Mateo and Fernandez (2016)) or inefficiencies resulting from task disparities before and after promotions (see Benson, Li, and Shue (2019)), are unlikely to be significant factors. The NHL working population relatively homogeneous in their non-hockey related attributes, and worker tasks remain mostly unchanged before and after rehiring.

[4]The literature on the role of job referrals is more extensive. It argues that having social ties to the incumbent work force can improve entrant worker's probability of entry and wages through incumbent workers providing employers with information about the entrant (M. Brown, Setren, & Topa, 2016; Eliason, Hensvik, Kramarz, & Skans, 2023; Glitz & Vejlin, 2021; Kramarz & Skans, 2014). Whereas this literature primarily considers a junior worker's first job, I focus on their later labor market outcomes, following the initial contract.

novice worker pool could lead to bankruptcy. As a result, they choose to hire a proven mediocre senior worker instead to ensure a certain level of output. The crucial identifying assumption in this literature is that the signal of talent is randomly assigned to workers. Without an explicit source of randomisation this cannot be guaranteed. The identification strategy employed in this paper constitutes a substantial contribution in addressing this issue.

Closely related is the employer learning literature. Farber and Gibbons (1996) formulate a model which describes how sequential measures of worker output increase the employer's knowledge of their talent. They further show empirically that readily observable signals of worker talent have a high correlation with wages at the start of careers, whereas unobservable measures of worker talent are only factored in as careers progress, providing evidence of employer learning. Altonji and Pierret (2001) and Lange (2007) implement extended versions of the Farber and Gibbons (1996) to establish the existence of statistical discrimination at the start of careers and estimate the speed at which employers learn about worker talent. Finally, L. B. Kahn and Lange (2014) expand on this work by accounting for the possibility that workers themselves become more productive with experience and evaluating the resulting effect on wages. In line with this literature, I propose that signals of worker productivity in the form of NHL playing opportunities increase the precision at which employers estimate junior worker talent and evaluate how this impacts manager's decisions.[5]

I also contribute to the literature that shows how luck can shape worker's careers (L. B. Kahn, 2010; Oyer, 2006; Wachter & Bender, 2006). For example, Gong, Sun, and Wei (2018) show that young footballers whose teams get relegated, benefit from this relegation by having increased playing time and experience in the following season, leading to higher career earnings in the long run. In this paper, I show that absence of senior workers due to injury or illness can improve career trajectories of younger workers through increased exposure at the highest competitive level.

This study is performed in a particular industry, which raises the question whether the results are generalisable. The NHL shares similarities with skill-intensive industries characterized by high wages and hierarchical structures, such as law, consultancy, and private equity firms. Similar to the NHL, these industries often exhibit limited visibility of junior workers within the workplace. In hierarchical firms, limited visibility typically arises when junior workers are assigned to separate locations within the office, possibly resulting in minimal collaboration opportunities with senior

[5] Information (a)symmetry is a central theme in the employer learning literature as it can influence the behaviour of employers in the industry. For examples, see Gibbons and Katz (1991) and Schönberg (2007). In the NHL I expect employer learning of worker talent to be largely symmetric between teams or firms. The process of in-game talent revelation is televised and analysed by all teams that have an interest in any given player. As such, all teams have similar information when competing to (re)hire an entry-level player.

managers, who ultimately make the rehiring decisions.[6] Another similarity can be drawn to industries where slot constraints are relevant in determining career trajectories (Bianchi, Bovini, Li, Paradisi, & Powell, 2023). In my setting, slot constraints arise due to the team size being fixed, leading to limited working opportunities for young workers as well as limited slots for rehiring or promotion. Other industries that feature similar slot constraints for contract extension or promotion are bureaucracies (Bertrand, Burgess, Chawla, & Xu, 2020), the public sector (Bianchi et al., 2023) and academia (Borjas & Doran, 2012). The issue with many of these industries as a research environment for my question is that exposure of junior workers to management is often determined by worker skill, rather than being random.

Several scholars have shown that sports industries can be helpful in solving these empirical difficulties due to the abundance of data and unexpected shocks (L. M. Kahn, 2000; Palacios-Huerta, 2023). This paper is a prime example of this, using rich data encompassing an entire industry and exploiting co-worker injuries as a source of random variation in the estimation process. However, I am not the first to use sports data to answer economic and managerial questions. In fact, there are numerous papers exploiting the advantages that sports data can offer (J. Brown, 2011; Cohen-Zada, Dayag, & Gershoni, in press; Glennon, Morales, Carnahan, & Hernandez, 2021; Miklós-Thal & Ullrich, 2016), as well as those that specifically use the NHL data for this purpose (Amodio, Hoey, & Schneider, in press; Grohsjean, Kober, & Zucchini, 2016; Hoey, Peeters, & van Ours, in press; Kahane, Longley, & Simmons, 2013; Stuart, 2017; Stuart & Moore, 2017).

In summary, the contribution of this paper is fourfold. First, I estimate the relationship between the precision at which the employer can estimate worker talent and later labor market outcomes using an accurate measure of how often the employer observes the worker. Second, I implement a novel instrumental variable strategy to eliminate the role of confounding factors such as worker talent in estimating this relationship. Third, I deviate from the standard assumption in the employer learning literature which excludes the potential role of human capital accumulation in determining wages. I do this by explicitly testing whether the result is most consistent with employer learning resulting from on-the-job talent revelation or with workers acquiring human capital on-the-job. Lastly, whereas most of previous research has focussed on labor market effects of employer learning in low-wage industries where spot contracts dominate, this paper features a prime example of a high-wage industry with well defined long term contracts.

[6] Examples of other papers discussing various management practices for revealing (junior) worker talent in hierarchical firms are Meyer (1994) and Hofmann and Indjejikian (2022).

2 Institutional Setting

The NHL is one of the five major sports leagues in North America and consists of teams from both the United States and Canada. Its total revenues fluctuate around \$5 billion annually (Ozanian & Badenhausen, 2020).

Most NHL careers start at the yearly draft, where players are chosen in sequential order by the NHL teams, resulting in an ordering of players denoted by their draft number. The process repeats itself for seven rounds. First round draft picks are usually the ones expected to perform best in the NHL. Those drafted beyond the third round are often not even signed to an ELC. As such, draft information is a good indicator of rookie potential. The drafting team has the exclusive rights to sign the drafted player.

Following the draft, players are typically assigned to their team's minor league affiliate. All NHL teams have an affiliated team in the minor league (AHL), where most entry-level workers start their career by default. Major sports leagues use these minor leagues to reveal talent at a lower price (Terviö, 2009). Talent revelation is cheaper here because the costs of fielding a potentially bad team is much lower than in a major league. At the same time the ability signal is less precise because minor league performance does not translate into major league performance without noise.[7] Importantly, the management and location of an NHL team and its minor league affiliate team are largely separate. This organisational and geographic distance means that players are not observed directly by their NHL employers when playing in the minor league.[8] As a result, the precision at which NHL management can estimate a rookie's ability to play at the major league level is largely determined by the number of NHL playing opportunities that they get.

After the three year entry-level contract, the rookie's current team must decide whether to rehire them, the length of the post-rookie contract and the salary that they will pay the player. At the same time other teams can put in offer sheets. The current team retains the right to re-sign the rookie if they match the salary offered by the other team.[9] Notice here that the rehiring decision is essentially made at the league level as other teams can poach away rookies from other teams if they desire. The implications of this for the IV strategy are discussed in Section 7.

[7] NHL and AHL performance during an ELC, as measured by average points scored per game, are only weakly correlated with a correlation coefficient of 0.42. This excludes players who only play in one of two leagues during their ELC. This claim is further supported by similar findings in the professional basketball (NBA) (Coates & Oguntimein, 2010) and professional Australian football (AFL) (McIntosh, Jackson, & Robertson, 2021).

[8] While not the main result of these papers, Amodio and Martinez-Carrasco (2023) and Menzel (2021) show that organizational distance has a negative effect on knowledge spillovers and transmission of information within firms.

[9] For a schematic overview of NHL entry-level careers see Appendix Figure A.1.

Before the yearly trade-deadline, which occurs with around one fourth of the season still to go, player mobility between the minor league (AHL) and the major league (NHL) is restricted. There are only few exceptions that allow players who are part of the 23-man active NHL roster to be exchanged for rookies that play in the minor league.[10] These restrictions make it more difficult to test rookies in NHL games. Teammate injuries in the NHL form one of the exceptions to these player movement restrictions. In most cases team management can replace the injured player with a rookie from the AHL without penalty and at the same time is actually forced to do so, because they need to fill the vacant spot in the NHL squad. This then gives the replacement rookie a chance to demonstrate their talent at the highest competitive level.

A team's lineup, or the set of players that play during a game, consists of 12 offense players and 6 defense players, divided into 4 offense lines and 3 defense lines. At any given time there is one line on the ice for each position. The offense and defense lines rotate independently of each other. On average, any given line is on the ice for 45 seconds before being substituted by the next line.[11] NHL games last for 60 minutes, excluding sudden-death overtime and stoppages of play. The resulting league average playing time per game is 15 minutes for offense players (60 min / 4 lines) and 20 minutes for defense players (60 minutes / 3 lines). Each NHL team plays 82 games per season, leading to a maximum of 246 NHL playing opportunities during an ELC.

3 Data

I construct a rich data set containing detailed information concerning the entry-level career of an NHL rookie. Contract data, obtained from capfriendly.com, form the first ingredient of this data set. The data include the signing date, the contract type (entry-level or post entry-level), the contract length and the salary that is paid to the player.[12] Secondly, game-level statistics containing information on a player's playing time and performance are collected from nhl.com. Game-level injury data from mangameslost.com are used to be able to evaluate the effect that teammate injuries have on the game-level and rookie-career aggregate playing time of an entry-level player.

The resulting data set is structured such that all NHL player-games of rookies signed to an ELC are accounted for regardless of whether they play in the NHL or in the minor league. As such, I measure the playing time of all signed rookies for each game of their (parent) NHL team as well

[10] These exceptions are described in Appendix Section B.1.

[11] Contrary to other sports, being part of the lineup in hockey guarantees playing time.

[12] The contract data is augmented using data from prosportstransactions.com, eliteprospects.com and hockeydb.com.

as how many co-workers were injured during this game. When players do not play a given NHL game, their playing time is set to zero. The data covers nine seasons, ranging from the 2010-2011 season until the 2018-2019 season.

3.1 Game-Level Variables

At the game-level the objective is to relate teammate injuries to rookie playing time in order to obtain a game-level prediction of playing time that is independent of player talent. Table 1 presents the summary stats for the variables used to make this prediction.

Playing time is a combination of the probability to play and playing time given that a player is selected. Panel A of Table 1 shows that rookies only play in the NHL sporadically, with the offense players having a 29% chance of making the lineup and defense only 24%. When selected, the average minutes played per position are 14.4 for offense and 19 for defense, which is slightly lower than the respective league averages. The standard deviations show substantial variation in the playing time assigned to rookies, which is likely due to the coach assigning more ice time to the more talented players.[13] Performance is measured by the points scored variable, which is the sum of the number of goals scored and assists given during a game. The statistics show that offense rookies score on average more points than defenders during a game.

Teammate injuries are a key determinant of a rookie's likelihood of playing and their corresponding playing time. Injuries are defined by missed games due to an injury that has occurred before. All teammates injured during a game are summed for offense and defense players separately. The resulting injury stock counts reflect how many vacant spots in the roster need to be filled. Injuries can be subdivided into rookie and veteran injuries. Veterans, defined as any player who is on a post-rookie contract, play more games and minutes on average. As a result, veteran injuries are expected to have a larger positive effect on rookie playing time as compared to rookie injuries.

Panel B of Table 1 shows the descriptive statistics of game-level injury counts for both offense and defense players. In both positions the rookie injury counts are mostly zero as shown by the mean injury counts which are close to zero. This is intuitive given that rookies generally play fewer games and are less prone to injury due to their age. The veteran injury counts are more dispersed, leading to variation in the number playing opportunities that rookies get.

At the same time, another subdivision can be made with regard to the severity of the injury.

[13] Appendix Figure A.2 shows the full distribution of rookie-game playing time for both offense and defense players.

Table 1: Game Level Summary Statistics

Variable	Mean	Std. Dev.	Min	Max	Observations
	Panel A: Rookie Statistics				
Offense					
Selected to play	0.29	0.45	0.00	1.00	111,463
Playing time (min)	14.40	3.89	0.05	28.45	31,866
Points (goals + assists)	0.45	0.71	0.00	5.00	31,866
Defense					
Selected to play	0.24	0.43	0.00	1.00	58,646
Playing time (min)	19.01	4.31	0.38	35.53	13,897
Points (goals + assists)	0.29	0.55	0.00	5.00	13,897
	Panel B: Injury Stocks				
Offense					
Rookie injuries	0.23	0.48	0.00	4.00	21,284
Veteran injuries	1.38	1.23	0.00	8.00	21,284
All injuries	1.61	1.33	0.00	9.00	21,284
Defense					
Rookie injuries	0.11	0.33	0.00	3.00	21,284
Veteran injuries	0.84	0.89	0.00	6.00	21,284
All injuries	0.95	0.96	0.00	7.00	21,284
	Panel C: Player Contracts				
Offense					
Rookie contracts	8.84	2.72	3.00	16.00	272
Veteran contracts	14.72	2.38	8.00	21.00	272
Total contracts	23.56	2.34	16.00	30.00	272
Defense					
Rookie contracts	4.91	1.58	1.00	9.00	272
Veteran contracts	7.88	1.26	5.00	11.00	272
Total contracts	12.79	1.57	8.00	17.00	272

Notes. Statistics presented in panels A are at the rookie-game level, those in panel B are at the team-game level and those in panel C are at the team-season level. In panel A, the selected to play statistics are calculated for based on all rookie playing opportunities, whereas the points and minutes played statistics are calculated for games actually played by rookies.

Most injured players are assigned to the injured reserve, opening up a spot on the 23-man active roster. This frees up the opportunity for the coach to call up a player from the minor league to take their spot. Players on the injured reserve cannot be called up from the injured reserve for a minimum of seven days. Resultantly, if the injury is not expected have a long duration, the coach may decide to keep them in the active roster. In this case the injured player must be replaced by another player on the active roster, meaning that the injury can only affect playing time of rookies that are already on the active roster. After the yearly trade-deadline there are no limits on the size of the active roster. Consequently, any player under contract is eligible to replace the injured player regardless of whether the injured player is sent to the injured reserve or not. A full split out of injuries by player-type and severity is presented in Appendix Table A.1. The table shows that the majority of injured players are put on the injured reserve, rather than being retained on the active roster.

When a team has more contracts on the books for a given position it makes it less likely that any given rookie is chosen to play. Likewise, a team with more players under contract has more replacement players to choose from when an injury occurs. Consequently, the number of players under contract is a key control variable when establishing the relationship between teammate injuries and rookie playing time. To avoid situations where the performance of the players influences the number of contracts I use the number of contracts on the books at the start of the season before any player trades have occured.

Panel C of Table 1 gives an overview of how contracts are distributed across team-seasons. On average teams have about 9 rookie and 15 veteran offense contracts for a given team-season. For defense these averages are 5 and 8 respectively. When summed, teams have an average of 24 offense and 13 defense players under contract. This corresponds with the average team having 12 offense players in addition to the 12 required to play. For defense this would imply 7 excess players in addition to the 6 required to play. The standard deviations of total contracts are approximately 2.4 and 1.6 for offense and defense respectively, indicating that there is considerable dispersion in the number of contracts across team-seasons.

3.2 Later Labor Market Outcomes

The primary outcome variable used in this paper is an indicator for whether the rookie is rehired after their three-year entry-level contract. This variable is generated by simply observing if another contract was signed in the season after the entry-level contract has expired. Secondary outcome variables include the salary and contract length of the second contract, conditional on being rehired. Within the sample there are players who played in the NHL during their ELC and those that did not. Table 2 shows the descriptive statistics for the rehiring probability, post entry-level wage and contract length of both groups separately.[14]

There are large disparities in labor market outcomes between rookies with and without NHL experience. Players with positive playing-time ($PT > 0$) are rehired at a rate of 92% with an average salary of \$1.7m USD for an average contract duration of 2.26 seasons. Of the players who did not play in the NHL during their ELC ($PT = 0$) only 46% were signed to a new contract

[14] A full summary statistics table with covariates used in the second stage can be found in Appendix Table A.4.

with an average salary of \$648k USD and average contract duration of 1.15 seasons.[15] The 75th percentile and maximum salary statistics indicate that there is also a higher probability to earn superstar wages when the player obtains NHL experience during their ELC. Furthermore, only those with NHL experience are able to secure long term contracts right after their ELC.

Table 2: Post Entry-Level Career Labor Market Outcomes

	NHL Playing Time > 0			*NHL Playing Time = 0*		
Statistic	Rehiring Decision	Post Salary (\$m)	Contract Length	Rehiring Decision	Post Salary (\$m)	Contract Length
N	557	514	514	177	81	81
Mean	0.92	1.73	2.26	0.46	0.65	1.15
St. Dev.	0.27	2.08	1.80	0.50	0.08	0.39
Min	0	0.55	1	0	0.55	1
Pctl(25)	1	0.65	1	0	0.58	1
Pctl(75)	1	2.00	2	1	0.70	1
Max	1	16.00	8	1	0.87	3

Notes: The statistics are subdivided for players who did not play in the NHL during their entry-level career (Total PT = 0) and those who did play in the NHL (Total PT > 0). The sample contains 734 completed entry-level careers, of which 595 players are rehired.

4 Methodology

4.1 First Stage: Game-Level Playing Time and Injuries

The purpose of the game-level regression is to obtain a game-level prediction of a rookie's playing time that is independent of other factors that could influence the rehiring probability and the post-rookie salary. The predicted playing time is then used as an instrument for actual playing time, eliminating the role of such confounding factors. To this end, I implement the following regression model:

$$PT_{itgs} = \beta_0 + \beta_r * RI_{itgs} + \beta_v * VI_{itgs} + \gamma_r * RC_{ts} + \gamma_v * VC_{ts} + \mathbf{X}'_{itgs}\ \psi + \mathbf{Z}'_{itgs}\ \omega + \delta_s + \varepsilon_{itgs} \quad (1)$$

In this equation the playing time (PT_{itgs}) of rookie i playing for team t during game g in season s depends on the stock of rookie (RI) and veteran injuries (VI) within the position of rookie i of NHL team t during game g. The stock of injuries is defined by the number of players that could not play in game g as a result of an injury that occurred before. The stock of rookie injuries

[15] In my sample 52% of players that were not rehired went to the minor leagues, 21% went to European leagues, 14% went to the Russian KHL and 13% retired from hockey. The salaries in all these leagues are much lower than in the NHL with a few exceptions in the Russian league. As a result, most rookies that do not continue in the NHL after their ELC, do so because they were not offered a new NHL contract.

excludes any potential injury of rookie i. Both rookie and veteran injury stocks are subdivided into injuries that caused the player to be placed on the injured reserve and injuries where the player was retained on the active roster. To control for the number of possible replacements available for the injured player(s) I include the number of rookies (RC) and veterans (VC) under contract at the beginning of a team-season. X'_{itgs} is a vector of controls containing a dummy for whether the player is an offense or defense player, the contract year that the rookie is in and whether game g is after the trade deadline of season s. The control variables in X'_{itgs} are interacted with the injury stock and contract variables. These interactions are represented by Z'_{itgs}. The injury stock and contract variables are not interacted with each other. The interactions between the trade-deadline indicator and the contract variables are also omitted to avoid multicollinearity issues. Finally, I include season fixed effects δ_s. It's important to notice that the pecking-order in which rookies are picked to fill in the spot of an injured player does't play a role here, because all rookies in the same contract year are assigned the same predicted playing time for a given team-game.

In terms of accurately predicting game-level playing time, the model needs to account for the censored nature of playing time. A Tobit-II selection model is used to incorporate this aspect into the analysis. The censored expectation of playing time ($E(PT|X)$) is calculated as being a product of the probability of observing positive playing time given the values of the regressors (X), multiplied by the expected playing time, given that playing time is positive and values of X.

$$E(PT|X) = P(PT > 0|X) * E(PT|PT > 0, X) \tag{2}$$

4.2 Second Stage: ELC Playing Time and Labor Market Outcomes

The second step in the estimation process is to aggregate actual and predicted playing time as estimated by Equation 1. The aggregate entry-level career predicted playing time is then used as an instrument for aggregate actual playing time.[16] I estimate the relationships between playing time and post entry-level labor market outcomes by estimating the following regression model:

$$Y_{ipts} = \beta_0 + \beta_1 * PT_i + \beta_2 * EC_{ts} + \beta_3 * AGE_{ts} + \beta_4 * DR_i + \beta_5 * DR_i * DN_i + \phi_p + \delta_s + \varepsilon_{ipts} \tag{3}$$

In this model Y_{ipts} is a dummy for being rehired, the logarithm the post-rookie salary and contract length if rehired. PT_i represents the total playing time during the three-season entry-level

[16] For more information on using fitted values from non-linear regressions as an instrument see Angrist and Pischke (2009), pp. 190-192.

contract of player i. I control for the count of expiring rookie and veteran contracts (EC_{ts}) as well as the average age (AGE_{ts}) of all players under contract in the same position and team as the rookie, in the final year of the rookie's ELC.[17] In addition, I add an indicator for whether the rookie was drafted (DR_i), which is then interacted with their draft number (DN_i).[18] Including the expiring contract controls for the gap in the roster of team t in the next season, potentially increasing the need to rehire the rookie whose contract is ending.[19] Controlling for the average age of players in the same position as the rookie isolates the potential confounding effect of injury-prone older players needing replacing. Adding the draft information controls for the innate ability of the rookie. Finally, I include position (ϕ_p) and last season fixed effects (δ_s).[20]

5 Main Results

5.1 First Stage: Game-Level Playing Time and Injuries

The first step is to generate a game-level prediction of playing time for each all games during a rookie's ELC. The results following from Equation 1, are presented in Appendix Table A.2. In summary, the results show that rookies have a higher probability of playing in the NHL when both rookies or veterans playing in their NHL affiliate team, in the same position, are injured. Unsurprisingly, the number of contracts that a team has a negative effect on the probability of playing, as there are more alternatives for team management to choose from when replacing an injured player. Injuries do not have large effects on playing time conditional on playing. The coefficients for the key control variables show that defenders are less likely to play, but injuries have a larger positive effect on their probability of playing. Rookies in later years of their ELC are more likely to play and injuries have less of an effect on the probability of playing. Finally, after the yearly trade deadlines there are more opportunities for rookies to play along with a more positive effect of injuries on the probability of playing.

The next step is to aggregate predicted PT and actual PT to the ELC level. Appendix Table A.3 shows the relationship between predicted and actual PT at the ELC level. Control variables

[17] A player's age is only recorded when they play in a given season.

[18] Undrafted players do not have a draft number, which is why the interaction with the draft indicator is required here.

[19] Note here that also other teams could put in offers on the rookie of the team in question, reducing the importance of this control variable.

[20] The control for the last season of the ELC indirectly also controls for the first and second season of the ELC as these are the two preceding seasons. This control is especially important given the lockout in the 2012-2013 season, which caused the season to have 48 games, instead of 82, limiting playing time.

are progressively added as in the second stage results. For all specifications the constant is negative and the coefficient of predicted PT is above 1.[21] More importantly, the partial r-squared of the instrument in column (3) is 0.029, indicating that, conditional on all control variables used in the second stage, approximately 2.9% of the variation in ELC level NHL playing time can be explained by the variables presented in Equation 1.

5.2 Second Stage: ELC Playing Time and Labor Market Outcomes

The primary objective of this paper is to estimate the effect of an entry-level workers getting the chance to demonstrate their ability to current and future employers on their probability of being rehired as well as their post ELC salary and contract length. Table 3 displays the OLS and IV results for Equation 2.

Panel A shows the results for the rehiring decision. Without control variables, the OLS coefficients in column (1) indicate that a 10 hour increase in ELC playing time significantly increases the probability of being rehired by 6.5%. This is a substantial increase when taking into account that the average total ELC playing-time is 16.4 hours with a standard deviation of 21.5 hours. The constant indicates that the baseline probability of being rehired for offense rookies after the 2012-2013 season is 69%. The corresponding IV estimate (column (4)) is slightly higher than the OLS estimate, showing an 8.2% increase in rehiring probability for an additional 10 hours played. The result is not statistically different from the OLS result. In columns (2) and (5) I add controls for the number of expiring contracts and the average age of rookies' peers, both measured within the rookie's team and position in the last year of their ELC. Both the OLS and IV coefficients for playing time do not change substantially, confirming that expiring contracts and peer age do not play a large role in determining the rehiring of entry-level players.[22] Finally, in columns (3) and (6), I add an indicator for whether the player is drafted, which is interacted with their draft number. This allows to interpret the effects of rookie exposure to team management (measured by playing time) conditional on innate ability. The IV coefficient is now only significant at the 10% level. Nevertheless, the magnitude of the coefficient is not very different from the other IV estimates, nor the OLS estimates. I conclude that after accounting for endogenous factors such as rookie ability, the aggregate NHL playing time or the exposure of entry-level players to their employer is still

[21]This results from the game-level regression always predicting a positive value for predicted PT along with the fact that some players never play during their ELC.

[22]See Appendix Table A.5 for the output of columns (3) and (6) for each dependent variable with coefficients reported for all control variables.

relevant for their rehiring probability. This suggests that employer learning of rookie talent rather than their talent itself is responsible for the positive relationship between playing time and the rehiring rate.

Table 3: NHL Playing Time and Later Labor Market Outcomes

	Panel A: Rehiring Decision *(N = 734)*					
	Ordinary Least Squares			*Instrumental Variable*		
	(1)	(2)	(3)	(4)	(5)	(6)
NHL Playing Time	0.065^{***}	0.067^{***}	0.055^{***}	0.082^{***}	0.090^{***}	0.083^{*}
(tens of hours)	(0.006)	(0.006)	(0.007)	(0.028)	(0.033)	(0.044)
Constant	0.688^{***}	−0.189	−0.180	0.658^{***}	−0.372	−0.372
	(0.041)	(0.350)	(0.351)	(0.063)	(0.432)	(0.458)
R^2	0.136	0.145	0.159	0.128	0.130	0.141
First Stage F-stat	.	.	.	39.35	30.00	21.31
	Panel B: Log Post ELC Salary *(N = 595)*					
NHL Playing Time	0.294^{***}	0.295^{***}	0.294^{***}	0.295^{***}	0.298^{***}	0.302^{***}
(tens of hours)	(0.007)	(0.007)	(0.008)	(0.030)	(0.036)	(0.048)
Constant	13.232^{***}	12.936^{***}	13.014^{***}	13.230^{***}	12.909^{***}	12.957^{***}
	(0.044)	(0.373)	(0.378)	(0.076)	(0.511)	(0.537)
R^2	0.782	0.783	0.783	0.782	0.782	0.783
First Stage F-stat	.	.	.	28.14	21.50	14.47
	Panel C: Log Post ELC Contract Length *(N = 595)*					
NHL Playing Time	0.205^{***}	0.206^{***}	0.208^{***}	0.237^{***}	0.260^{***}	0.281^{***}
(tens of hours)	(0.008)	(0.008)	(0.009)	(0.037)	(0.044)	(0.061)
Constant	0.176^{***}	−0.041	−0.080	0.110	−0.577	−0.661
	(0.053)	(0.449)	(0.456)	(0.093)	(0.638)	(0.682)
R^2	0.541	0.542	0.542	0.528	0.507	0.492
First Stage F-stat	.	.	.	28.14	21.50	14.47
Last Season FE	✓	✓	✓	✓	✓	✓
Position FE	✓	✓	✓	✓	✓	✓
Expiring Contracts		✓	✓		✓	✓
Average Peer Age		✓	✓		✓	✓
Draft Information			✓			✓

Notes: For the instrumental variable regressions I use the sum of predicted playing time estimated in accordance with the Tobit-II estimation procedure outlined in 4.2. In all columns I include last season and position fixed effects. In columns 2 and 5 I add expiring contract and average peer age controls. In columns 3 and 6 I also add a dummy for whether the player is drafted, which is interacted with their draft number. The control variables are omitted from the output. For results including control variable coefficients, see Table A.5. Standard errors are reported in parentheses. Significance is indicated as follows, $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$.

Panel B presents the effect of ELC playing time on the salary in the season following the ELC, conditional on being rehired. The OLS and IV estimates are very close in magnitude. Looking at the

IV estimates, I conclude that an additional 10 hours of playing time during the ELC increases the salary in the subsequent season by approximately 35% ($100(e^{0.3}-1)$). This percentage is substantial, not only because of the ELC playing time distribution, but also because of the magnitude of the salaries that we are examining. The average post ELC salary in the sample is approximately $1.6m USD. A 35% increase of this average would be approximately $550k USD. The results suggest that team management is either more comfortable in offering higher salaries or have to offer these higher salaries as a result of more intense competition in the league for rookies who got more exposure in the NHL during their ELC.

Panel C shifts the focus to the post entry-level contract length (in years), conditional on being rehired. Again the coefficients of the OLS and IV estimates are relatively close in magnitude. In the OLS regressions the control variables make almost no difference in the playing time coefficients. In the IV the coefficients go up slightly as more controls are added. The IV estimate with the most stringent controls in column (6) indicates that an additional 10 hours of NHL playing time increases the length of the post entry-level contract by 32% ($100(e^{0.28}-1)$), which is very close to the estimate for the increase in salary. Again, this result can be explained by the rehiring team being more confident in singing longer contracts with rookies who had more exposure in the NHL or increased competition among teams to make them the best offer.

6 Mechanisms and Explanatory Analysis

The results in the previous section establish the relationship between rookie playing time during their ELC and their later labor market outcomes. The instrumental variable strategy serves to eliminate confounding factors such as player talent from the analysis. The effect that remains can be attributable to employer learning about rookie talent and updating their beliefs as a result of observing them play, but also to the rookies gaining hockey skill at an accelerated rate in the NHL as compared to in the minor league (AHL). In this section I explore which of these mechanisms is the most likely explanation for the positive relationship between rookie playing time and their rehiring probability, post entry-level salary, and contract length.

6.1 Identifying Employer Learning using lineup Preferences

The identification strategy in this paper exploits the fact that teammate injuries often force the coach to select entry-level players in their playing lineup, inducing them to learn about the replacement rookie's talent. Here, I statistically test whether employers learn about rookie talent by evaluating whether their lineup preferences change following a veteran player's return from injury. To this end, I establish whether rookies are retained in the lineup by comparing the number of rookies in the lineup per position before, during and after a veteran injury. During the span of a veteran injury, the number of rookies in the lineup is likely to be higher than before the injury, which is purely a result of the void in the lineup needing to be filled. However, if the number of rookies in the lineup after the injury spell is still significantly higher than before the injury, I conclude that management has changed its preferences as to who to put in the lineup in favour of one of the rookies that replaced the injured veteran.[23]

I set up the data such that I observe the number of rookies in the lineup before, during and after each injury, meaning that a team-game relative to when an injury occurs is the unit observation. For each injury I include five games before and after the injury to be able to compare number of rookies in the different periods.[24] I then estimate the following regression model:

$$R_{mtg} = \beta_0 + \beta_1 * D_{mtg} + \beta_2 * P_{mtg} + \beta_3 * P_{mtg} * ID_m + \mathbf{X}'_{mtg}\,\psi + \delta_m + \varepsilon_{mtg} \tag{4}$$

In this equation R_{mtg} represents the number of rookies in the lineup for a given position in game g of team t relative to when injury m occurs. Variables D_{mtg} and P_{mtg} indicate whether game g was *during* or *post* injury.[25] The base category consists of games prior to the injury. The post-injury indicator variable is interacted with the duration of the injury (ID_m), which is coded as an indicator for whether the injured player missed 5 or more games. The more games that the injured player misses, the more opportunity team management has to learn about the ability of replacement player. Importantly, X'_{mtg} includes controls such as the stock of other veteran injuries for a given game as well as the stock of rookie injuries and an indicator for whether the game is after the trade-deadline or not. Lastly, I include injury fixed effects δ_m, meaning that all coefficients are estimated relative to the pre-injury period of injury m.

[23]In total there are 4,060 veteran injuries in the sample, of which 2,584 are offense injuries and 1,476 are defense injuries. Appendix Figure A.3 presents a schematic overview of how these injuries affect rookie playing time, not only during an injury, but also after the injury. Separate figures for offense and defense injuries are presented in Appendix Figure A.4 and Appendix Figure A.5.

[24] I exclude injuries that occur in the first and last five games of a given season such that the pre and post injury windows are always five games in length.

[25]During the injury, the injured veteran cannot play, but after the injury they are available to be put in the lineup.

Table 4: Veteran Injuries and the Number of Rookies in the Lineup

	Dependent variable:			
	Number of Rookies in lineup			
	Offense		Defense	
	(1)	(2)	(3)	(4)
During Injury	0.374^{***}	0.381^{***}	0.316^{***}	0.319^{***}
	(0.007)	(0.007)	(0.006)	(0.006)
Post Injury	0.078^{***}	0.061^{***}	0.045^{***}	0.037^{***}
	(0.007)	(0.008)	(0.006)	(0.008)
Post Injury*1(Inj. Duration >= 5)		0.045^{***}		0.019^{*}
		(0.012)		(0.011)
Observations	36,773	36,773	22,324	22,324
R^2	0.878	0.878	0.845	0.845
Average Number of Rookies	2.16	2.16	1.03	1.03
Average Duration (Games)	8.88	8.88	8.99	8.99
Control Variables	✓	✓	✓	✓
Injury FE	✓	✓	✓	✓

Notes: The regressions above show the effect of a veteran player injury on the number of rookies in the lineup. The unit of observation is a team-game relative to when the veteran injury occurred. The during injury indicator variable is equal to 1 while the injured veteran is not able to play. The post-injury variable is equal to 1 for the 5 games after the injured veteran has recovered from injury. The base category are the 5 games before the injury occurs. Duration is coded as an indicator for whether the injury lasted for 5+ games. The control variables include the number of other veterans that are injured and not able to play during a given game, the number of rookies that are not able to play due to injury and whether the game in question is after the trade deadline. The control variables are omitted from the output. Standard errors are reported in parentheses. Significance is indicated as follows, $^{*}\,p < 0.1, ^{**}\,p < 0.05, ^{***}\,p < 0.01$.

Table 4 shows the effect of a veteran injury on the lineup choices of team management. Column (1) shows the effect of any veteran injury on the number of rookies in the offense lineup. The coefficient for the during injury indicator variable is 0.374, indicating that on average approximately 37% of games missed by injured veteran players are accounted for by replacement rookies. Interestingly, the coefficient for the 5 games after the veteran has recovered is still significant with a value of 0.08, suggesting that substantial share of rookies are retained in the lineup when the veteran returns. In column (2) the injury duration variable enters as an indicator for whether the injury lasted longer than four games. The coefficient for the interaction of the injury duration indicator with the post injury indicator shows that rookie retention is a lot higher for longer injury durations. This suggests that most of the employer learning about rookie ability occurs in the first few games that they play. More specifically, the probability of rookie retention is $0.061/0.381 \approx 16\%$ when the injury last less than five games. This retention probability jumps to approximately 28% ((0.061+0.045)/0.381) when the injury lasts for 5 games or more.

Similar conclusions can be drawn for the defensive lineup, as shown in columns (3) and (4). Rookie retention is lower for defense injuries. Additionally, the effect of injury duration is less pronounced than for offense. These two results combined suggest that turnover is lower in the defensive lineup, which is quite plausible given that there are only half as many defenders as compared to offense players in a standard ice-hockey team lineup.

On the whole, the results suggest that the preferences of team management change when they are forced to put a rookie in the lineup as a result of the injury. A large share of the rookies that replace injured veterans are retained in the lineup after the veteran recovers from injury. Additionally, the duration of the injury, or the duration of the period during which the replacement rookie can be observed, has a positive impact on rookie retention. It's important to note that, in most cases, when a rookie is retained in the line-up after the veteran player has recovered from injury, another player dropped from the lineup rather than the previously injured veteran (see Figures A.3, A.4 and A.5). This suggests that rookies are not retained due to lingering injury effects.

In Appendix Table A.6 I evaluate whether rookie performance during the injury period affects their retention probability in the post-injury period. The results show that a large part of rookie retention is driven by the rookie's performance during the injury period and that the duration of the injury amplifies this effect.

6.2 Substitutability Between Major and Minor League Experience

Having shown that injuries do in fact cause team management to update their beliefs on rookie talent, I now turn to the second channel via which NHL playing time could influence later labor market outcomes. To this end, I evaluate whether skill accumulation in the NHL is accelerated in comparison to the AHL, or put differently, whether a player misses out on skill accumulation when they do not play in the NHL.

The first step in answering this question is to estimate at which rate missed NHL games are replaced with AHL games. To establish to which degree missing an NHL game is equivalent to missing out on in-game experience all-together, I regress the number of games played in the NHL during player i's entry-level career on the number of games played in the AHL, controlling for the last season of the rookie's career. The resulting coefficient of -0.96 is not statistically different from -1, indicating that the replacement rate between NHL and AHL games is nearly one-to-one.[26]

[26] This result is for the subsample of players with a positive number of NHL games. The results for the full sample are slightly higher (-0.883), but still indicative of a near one-to-one replacement rate between AHL and NHL experience. These results can be found in Appendix Table A.7.

The next step is to evaluate the effect of both NHL and AHL experience on player performance. To facilitate this analysis, I gather both NHL and AHL player-game performance statistics for all the entry-level careers in my NHL sample. Then for each player-game played in the NHL I calculate the cumulative sum of games played before in the both the AHL and the NHL separately. Using these experience variables, I perform regressions with the number of points (goals + assists) scored by a rookie during an NHL game as the dependent variable. Finally, I include rookie fixed effects in both regressions to control for selection bias originating from better rookies playing larger share of their games in the NHL. As such, the results can be interpreted as showing how rookie NHL performance evolves as their entry-level career progresses by which league they gain experience in. I then perform F-tests to establish whether NHL and AHL experience are equally valuable in increasing the performance of the rookie.

Table 5: Experience and Performance across Leagues

	Dependent variable:		
	NHL Point Count (goals + assists)		
Players:	All	Offense	Defense
NHL Games Played (/82)	0.058***	0.064***	0.042***
	(0.007)	(0.008)	(0.011)
AHL Games Played (/82)	0.063***	0.083***	0.013
	(0.017)	(0.021)	(0.028)
P-Value Equal Coefficients	0.79	0.45	0.39
Observations	34,601	24,086	10,515
R^2	0.082	0.079	0.058
Rookie FE	✓	✓	✓

Notes: These regressions show how experience in the minor league (AHL) and the NHL affect performance when playing in the NHL. Both AHL and NHL experience is measured in 82 game increments, which is equal to the maximum games played for one season. The p-value for equal coefficients is derived from an F-test, testing the restriction that the coefficients of both AHL and NHL experience are equal. I only include rookies who played in both the AHL and NHL during their ELCs. Significance is indicated as follows, $^{*}p<0.1,^{**}p<0.05,^{***}p<0.01$.

Table 5 shows the results for all players combined as well as for offense and defense rookies separately. For all players together, the coefficients for NHL and AHL experience are very similar and not statistically different from each other. An additional 82 games played in either league is associated with around 0.06 more points scored per game in the NHL. Columns (2) and (3) show that experience is more valuable for offense rookies, which is unsurprising given that offense players' primary task is to score goals and give assists.[27] Nevertheless, the coefficients for both AHL and NHL experience are not statistically different from each other for both offense and defense rookies.

6.3 Sub-Optimal Post Entry-Level Contracts

I have established that players who get more playing opportunities resulting from teammate injuries are more likely to be rehired, sign contracts with higher post entry-level salaries and longer contract lengths. In combination with the result in Section 6.1, showing that team management has a tendency to retain rookies in the lineup after observing them following a teammate injury, there is compelling evidence that players have more favorable outcomes when more exposed to team management. The question remains whether this is efficient[28] from the management's point of view. Testing this for the rehiring decision is difficult, because I do not observe how productive the non rehired players would have been, if they were rehired. For the post entry-level salary I can test for efficiency by evaluating whether those with more NHL playing time and subsequent higher post entry-level salaries also perform better in the first year following their ELC. I perform OLS and IV regressions as outlined in Equation 3, replacing the outcome variables with the number of goals and points scored per 15 minutes in the season following the ELC.[29] Again, I include a full set on controls, including expiring contracts, average age of players under contract, in their position, in the last entry-level season of the rookie, and their draft information.[30] The results are shown in Table 6.

In column (1) I simply regress the number of goals scored by a player divided by the number of minutes that they play in the first season following their ELC on the number of minutes played in the NHL during their entry-level career. Provided that more talented players play more minutes in their ELC, it is unsurprising to find that there is a positive correlation between these variables. In column (2) I apply the IV method to eliminate the bias originating from player talent. Notably the coefficient drops substantially and becomes insignificant. This reduction in effect size is even more pronounced for points scored (goals + assists) per 15 minutes, as shown in columns (3) and

[27] Defensive performance is more difficult to quantify. As a result, less value should be attributed to the defender results. The found conclusions still hold when performing the analysis using the "plusminus" statistic, which is arguably a more defender oriented task.

[28] Here efficiency is defined as not taking into account player exposure when deciding on the rehiring decision, their post entry-level salary and post entry-level contract length. Player exposure is not a productive asset of the player and as such should ideally not be rewarded in terms of an increased rehiring rate, post entry-level salary or contract length.

[29] To observe a player's post entry-level performance they must be rehired before the 2018-2019 season and play in the NHL in the first season following their rehiring, resulting in a sample of 416 players.

[30] Excluding these controls does not change the results in a meaningful way.

(4). Taken together, these results indicate that those who get more exposure due to teammate injuries do not actually perform better than those who get less exposure in the year after their ELC. However, the results in columns (5) and (6) for post entry-level salary and contract length using the same sample shows that these players who get more exposure do obtain higher salaries and longer contracts after their ELC. Taken at face value it seems that team management is inefficiently allocating higher salaries and longer contracts to players with more NHL playing time during their ELC, without getting a return on this in terms of performance. Assuming this result extrapolates to the rehiring decision, this would also mean that there is a bias towards rehiring rookies based on their NHL exposure. A likely explanation for these preferences is that NHL managers are risk adverse. Consequently, they cannot afford to rehire a potentially sub-par player and as a result are more inclined to rehire and pay a premium for entry-level players who got to prove themselves during their ELC.

Table 6: Post Entry-Level Performance & Salary *(N = 416)*

	Post Entry-Level Contract				*Log Post ELC*	
	Goals per 15 Mins		*Points per 15 Mins*		*Salary*	*Length*
	(1)	(2)	(3)	(4)	(5)	(6)
NHL Playing Time	0.016^{***}	0.003	0.042^{***}	-0.020	0.286^{***}	0.263^{***}
(tens of hours)	(0.003)	(0.017)	(0.005)	(0.034)	(0.056)	(0.072)
Constant	0.006	0.125	0.222	0.805^{*}	13.011^{***}	-0.586
	(0.143)	(0.217)	(0.237)	(0.420)	(0.703)	(0.900)
R^2	0.241	0.203	0.308	0.004	0.771	0.484
OLS/IV	OLS	IV	OLS	IV	IV	IV

Notes: For the instrumental variable regressions I use the sum of predicted playing time estimated in accordance with the Tobit-II estimation procedure outlined in 4.2. In all columns I include last season fixed effects, position fixed effects, average peer age in last rookie season, contract expiry variables and draft information. The control variables are omitted from the output. The first stage F-statistic is 11.61 in all IV columns. Standard errors are reported in parentheses. Significance is indicated as follows, $^{*}\, p < 0.1, ^{**}\, p < 0.05, ^{***}\, p < 0.01$.

7 Robustness & IV Mechanics

The instrumental variable analysis in this paper exploits teammate injuries as an instrument for rookie playing time. To do so successfully teammate injuries must be randomly assigned to rookies and they must only affect their rehiring probability through their effect on rookie playing time. The random allocation assumption is very plausible as rookies themselves have little influence on whether a teammate stays healthy or which team they're assigned to in general.

Next, teammate injuries are assumed to impact rookie labor market outcomes solely through increased playing time opportunities. One potential objection is that more injured teams might require rehiring of rookies due to personnel shortages in the season following the ELC. Conceptually, this argument isn't very strong for the following reasons. Firstly, the NHL season break between April and October allows injured players to recover fully, minimizing the impact on rookie rehiring decisions which occur between seasons.[31] Secondly, injuries are frequent but short-lived, with an average duration of 7 games or about 2.5 weeks. Teams must be prepared for this and maintain flexibility with an abundance of players to fill in when needed. As such, the high incidence of injuries in one season is unlikely to drive rookie rehiring decisions based solely on increased personnel needs. Thirdly, rookies need not be rehired by their own team, nor do teams need to rehire their own rookies. This is evidenced by that fact that, in my sample, 53% of players who are not rehired by their own team are rehired by another team in the league. The remaining 47% are not rehired by an NHL team. Put differently, rehired rookies must be preferred over other rookies ending their contracts (at any team) as well as veteran free agent players. As such, teams with many injuries who'd arguably be in need of additional players, have many options for filling their vacancies beyond just their own rookies. All these reasons combined make it unlikely that rookie rehiring decisions and contract offers are related to teams having a season with exceptionally few or many injuries.

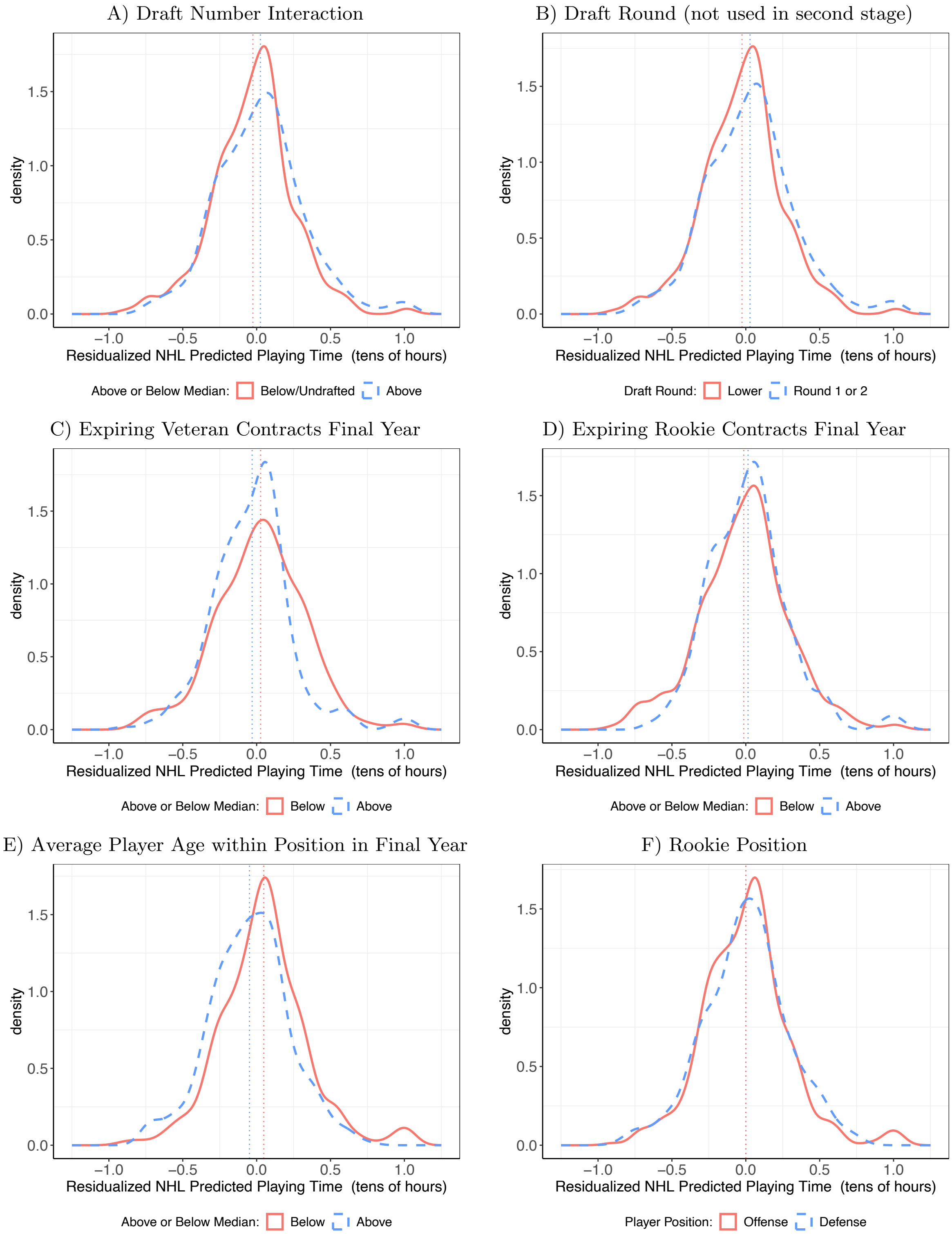
7.1 Instrument Validity and Mechanics

I empirically test the above claims by comparing the distributions of the instrument (predicted NHL playing time) against various subsets of covariates included in the full specification. To do this, I obtain the residuals after regressing the instrument the fixed effects used in all regressions, being the position of the rookie and the season in which their ELC ends. Subsequently I plot these residuals against above and below median values of all covariates used in the second stage or by other relevant subgroups. These distributions can be found in Figure 1.

If the distribution of the instrument is not very different across various subsets of the used covariates, then it seems unlikely that there are other omitted factors that would be confounding my results, or that the instrument is not randomly assigned. Across all covariates the distributions for above and below median values seem very similar, yielding similar average values of the residualized instrument across subsets. Only for the average age variable the instrument has slightly lower values for cases where the rookie has older peers in their final ELC season, which is contradicts the suggestion that older players being more injury prone would be driving the results in Table 3.

[31] There are only a handful of injuries in the data which last beyond the summer breaks.

Figure 1: Distribution of Instrument by Various Covariates *(N = 734)*



Notes: These Figures depict the residual distributions obtained by regressing the instrument (NHL predicted playing time) on the fixed effects used in all specifications in the second stage (position and last season FE). Subsequently I plot these residuals against above and below median values of all covariates used in the second stage or by other relevant subgroups. For the Draft Number graph I add the undrafted players as being picked last before splitting the sample. For the Draft Round graph I simply split first and second round draft picks from the rest. The dotted lines resemble the corresponding subgroup averages. By construction the average values are equal when splitting by player position.

7.2 Exogeneity and Teammate Injuries

Buidling on the previous section, I further test the exclusion restriction by redoing the IV analyses using only shorter injuries, injuries that do not cross season boundaries as well as excluding injuries sustained by older players. When using only shorter injuries, I exclude injuries in the top quartile of injury duration ($>$ 9 games) before calculating the injury stock counters for each team-game. For these injuries we can be more certain that they only affect rookie exposure in the current season, but should not have an effect on team health in the next season. To more explicitly tackle this issue, I perform the same procedure, but then exclude all injuries that cross season boundaries, meaning that a player is injured before the end of a season and at the start of the next. These injuries are particularly suspect because an injury has to be exceptionally severe to last beyond the 4-6 month break in between seasons. Given this severity, it is likely that team management can anticipate the long duration of injury recovery and could use this information when making their rehiring decision and contract offer. Lastly, I perform a third analysis where I remove injuries sustained by players who are in the top quartile of the age distribution in the season in which the injury is sustained.[32] This explicitly targets the concern that older, more injury prone, players lead to both increased exposure of rookies and an increased need to hire more players for the next season.

The results are presented in Appendix Table A.8. The baseline estimates for comparison can be found in Table 3 in columns (4) and (6). Restricting the analysis to only consider shorter injuries (columns (1) and (2)) has a large negative effect on the relevance of the instrument, as shown by the large drop in first stage F-statistics. This is not unsurprising given that longer injuries make up the bulk of injury stock across all playing opportunities. Nevertheless, the point estimates are not very different from the baseline results. Only for the rehiring decision, the coefficients become insignificant, which I attribute to the reduction in instrument relevance and subsequent increase in standard errors. Excluding injuries that cross season boundaries from the analysis (columns (3) and (4)) seems to have even less effect on the point estimates. Also, first stage relevance is largely unaffected due to a more targeted removal of suspect injuries. Given that the cross season injuries are the ones that are most likely to induce team management to change their rehiring decision and contract offer, these results provide convincing evidence that this is not likely to play a large role in my analysis. Lastly, when removing injuries sustained by older players (columns (5) and (6)), the point estimates are also mostly unaffected, assuaging above mentioned concerns.

[32] These procedures remove 66%, 6% and 36 % of games missed by injured players respectively.

8 Conclusion

There is much debate over whether employers make optimal rehiring decisions. A key determinant in this regard is the accuracy of information management possesses about the talent of entry-level workers. However, firms face limited capacity to effectively test these workers and uncover their true potential, raising concerns about the extent to which optimal rehiring decisions can be made. This study aims to examine whether the extent to which management observes worker talent during their entry-level careers influences decision-making concerning their post-entry labor market outcomes.

To investigate this, I use a comprehensive dataset from the National Hockey League (NHL). Leveraging co-worker injuries as a source of random variation in exposure of junior workers to management, I implement a novel instrumental variable approach to as good as randomise exposure of junior workers to their employers. The findings reveal that junior workers who by chance have more opportunities to showcase their talent are not only more likely to be rehired but also secure higher post entry-level salaries and longer contracts.

I further evaluate whether the found rehiring practices are sub-optimal by evaluating whether the more exposed junior workers also perform better after their entry-level contract. Again, using an instrument to randomly assign exposure across workers, the results indicate that rehired workers who get more opportunities to show their talent, do not actually perform significantly better than those who got fewer opportunities. At the same time, the former are paid significantly more and obtain longer post entry-level contracts than the latter, indicating that firms are willing to pay a premium for workers of which they can estimate talent more precisely without getting any returns in terms of improved performance.

Following the reasoning above, there may also be a bias towards hiring players who got more exposure during their ELC, meaning teams may be missing out on hidden talent among workers who are not observed and subsequently less likely to be rehired. Often (NHL) employers cannot accurately estimate the talent of all workers due scarcity of testing opportunities and the potential cost in terms of lost productive efficiency or increased uncertainty in production. While it may be that NHL managers are making optimal decisions given the information is available to them, evidence suggests that they at the very least do not make fully informed rehiring decisions, overlooking potentially talented untested players.

Assuming that the found results would generalise to other high-wage labor markets several recommendations follow. Firstly, barriers to testing junior workers should be alleviated as much as possible as they hinder the transmission of valuable information about worker talent. In the NHL, for example, efficiency could be improved by increasing player mobility between the major and minor league, making it easier and less expensive to test a junior worker.[33] Such organisational distance also exists in other high-skilled industries, such as consulting, finance and litigation, where junior and senior workers may work in different locations within the office or have limited collaboration opportunities, or both. Since senior staff are often in charge of promotion and rehiring decisions, increasing the observability of junior workers in the work place could help them make more informed and possibly better decisions. Secondly, if the results are interpreted as indicative of sub-optimal rehiring decisions, managers should be careful when hiring workers who they have observed more and as a result are more convinced of their talent. Whenever possible, managers should make an effort to learn about the capabilities of other workers as much as possible before deciding who to promote and who to lay off. In addition, being conscious of the bias towards hiring more exposed junior workers, may prevent managers from mistakingly overlooking workers who may have had less exposure but possess valuable skills and potential.

[33] See Appendix Section B.1 for more information on these mobility restrictions between leagues.

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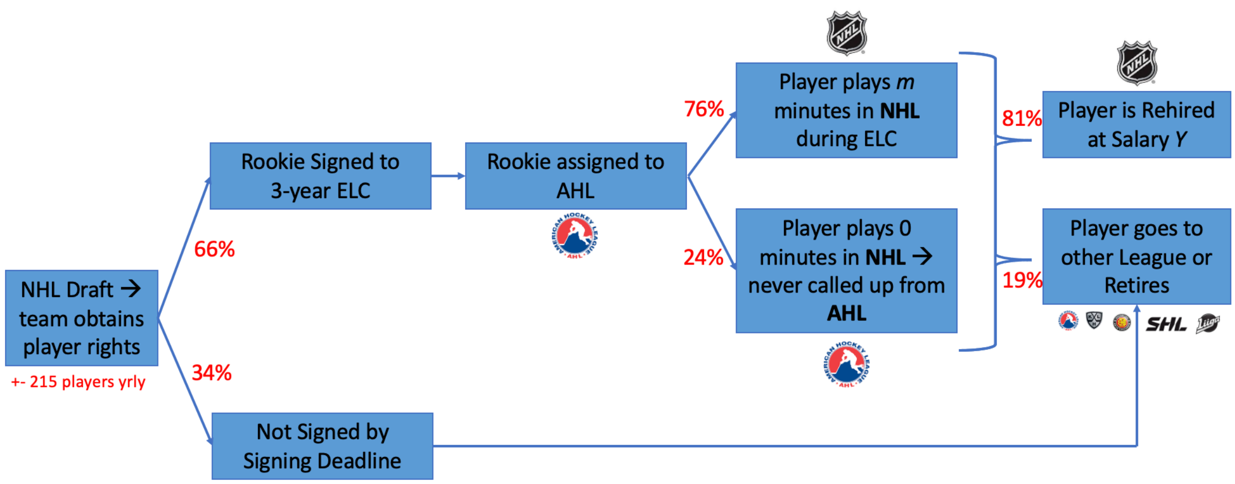
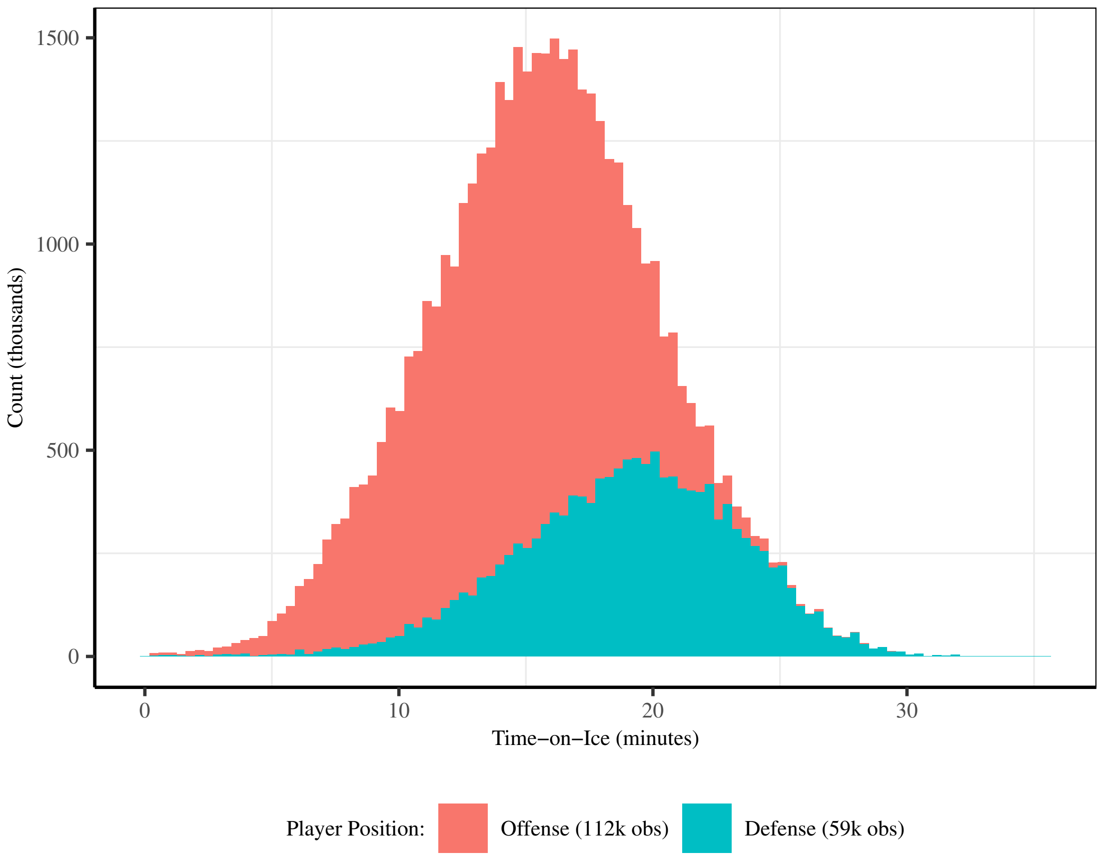
A Additional Figures & Tables

Figure A.1: Schematic Overview NHL Entry-Level Career



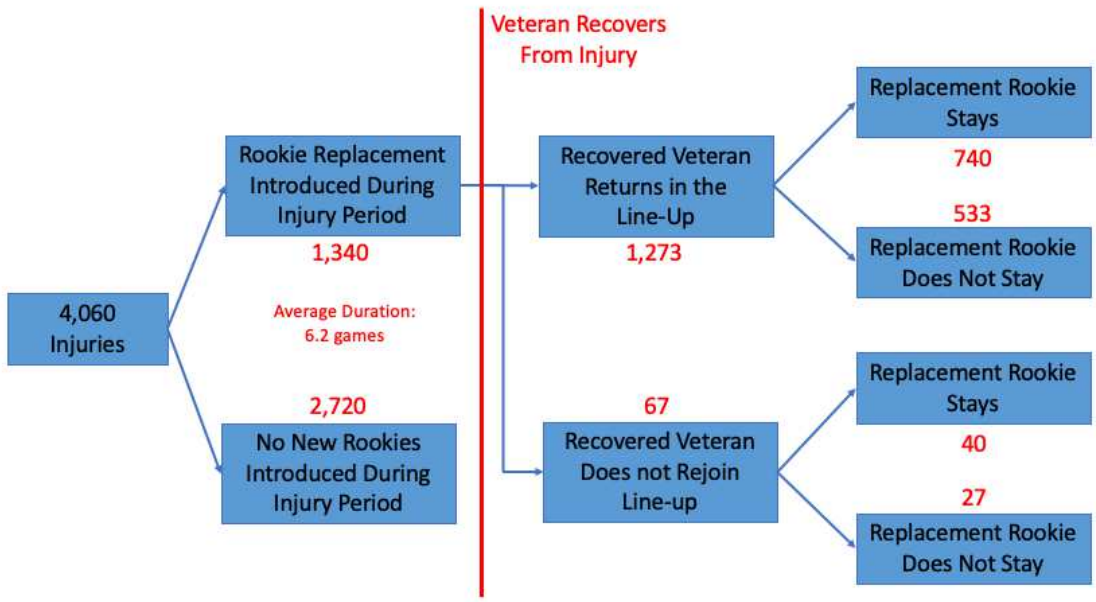
Notes: The percentages refer to the probability of each alternative occurring following the previous step in the diagram. After the draft the team can decide whether to sign the rookie to a contract or not. This must be decided before a given deadline. If the rookie is signed to a 3-year entry-level contract, then the team retains the rights to this player. Most players are assigned to the AHL after signing an ELC. Then, during the career of the entrant, the coach must decide how much ice time to allocate to the player. Some players get a positive number of minutes in the NHL, whereas others are never called up to play in the NHL. After the ELC has expired the general manager of the team that initially hired them must decide whether to rehire the player or not and at which salary to rehire them.

Figure A.2: Game-Level Distribution of Rookie Playing Time



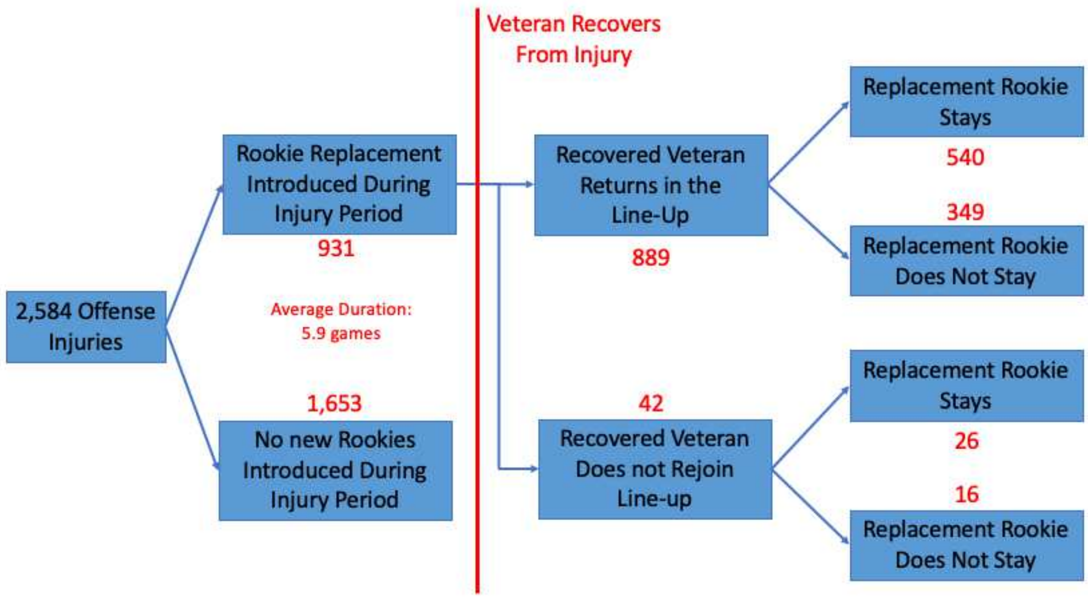
Notes: Observations = 170,355 (124,592 zeros & 45,763 positive values). Zero values are omitted.

Figure A.3: Veteran Injuries and Rookie Replacements



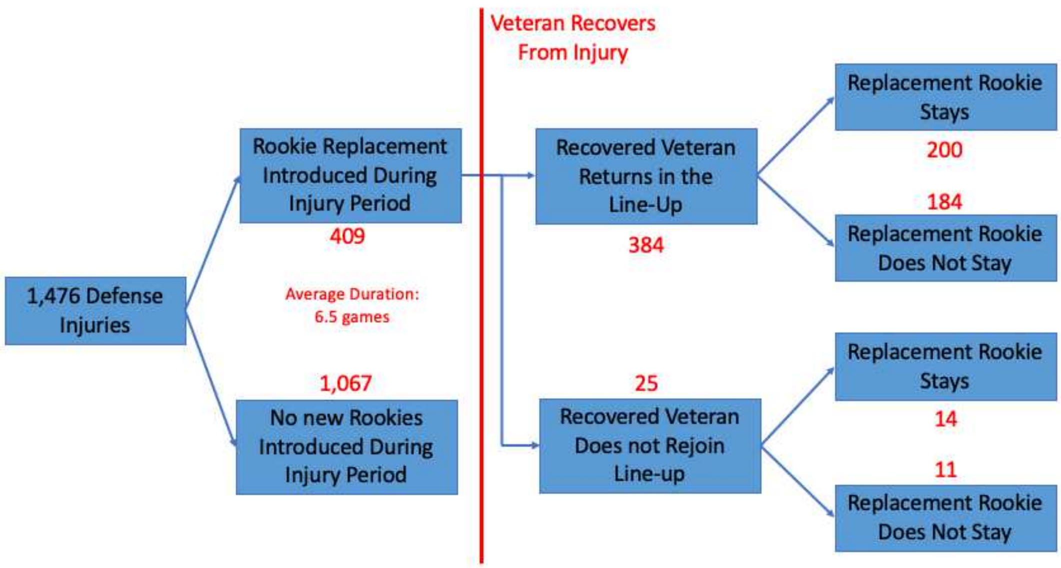
This figure shows how any veteran injury can change coach preferences. The number are aggregated to represent both offense and defense injuries. The red numbers refer to the number of offense injuries for which the statement in the blue box above or below is true. Everything to the left of the red vertical line is relevant for the period during which the veteran is injured. Everything to the right of this line refers to what happens when the veteran recovers from injury. Rookie replacements are rookies that did not play in the five games preceding the injury. All statements are considered to be true if they hold for at least one game during the relevant period. For example, if an injury lasts for 10 games and a replacement rookie is introduced for only one of those games, then the count for rookie replacements introduced still goes up by one. It can also be the case that more than one new rookie is introduced during the injury period, in which case the count for injuries in which rookies were introduced still increases by one. Figures for offense and defense separately can be found in Appendix (Figures A.4 and A.5).

Figure A.4: Veteran Injuries and Rookie Replacements Offense



This figure shows how offense veteran injuries can change coach preferences. The red numbers refer to the number of offense injuries for which the statement in the blue box above or below is true. Everything to the left of the red vertical line is relevant for the period during which the veteran is injured. Everything to the right of this line refers to what happens when the veteran recovers from injury. Rookie replacements are rookies that did not play in the five games preceding the injury. All statements are considered to be true if they hold for at least one game during the relevant period. For example, if an injury lasts for 10 games and a replacement rookie is introduced for only one of those games, then the count for rookie replacements introduced still goes up by one. It can also be the case that more than one new rookie is introduced during the injury period, in which case the count for injuries in which rookies were introduced still increases by one.

Figure A.5: Veteran Injuries and Rookie Replacements Defense



This figure shows how defense veteran injuries can change coach preferences. The red numbers refer to the number of offense injuries for which the statement in the blue box above or below is true. Everything to the left of the red vertical line is relevant for the period during which the veteran is injured. Everything to the right of this line refers to what happens when the veteran recovers from injury. Rookie replacements are rookies that did not play in the five games preceding the injury. All statements are considered to be true if they hold for at least one game during the relevant period. For example, if an injury lasts for 10 games and a replacement rookie is introduced for only one of those games, then the count for rookie replacements introduced still goes up by one. It can also be the case that more than one new rookie is introduced during the injury period, in which case the count for injuries in which rookies were introduced still increases by one.

Table A.1: Game-Level Injury Count Frequencies

(a) Offense Injuries

	Rookie Injuries			*Veteran Injuries*		
Injury Count	Combined	Non IR	IR	Combined	Non IR	IR
0	17009	19537	18511	5626	13492	9225
1	3753	1639	2585	7222	6056	6961
2	488	93	187	4843	1339	3396
3	24	6	1	2378	313	1273
4	10	9	0	827	61	344
5	0	0	0	273	19	54
6	0	0	0	77	3	25
7	0	0	0	34	1	6
8	0	0	0	4	0	0

(b) Defense Injuries

	Rookie Injuries			*Veteran Injuries*		
Injury Count	Combined	Non IR	IR	Combined	Non IR	IR
0	19121	20403	19968	8852	15649	12667
1	2040	855	1250	8293	4719	6566
2	113	26	59	3190	778	1665
3	10	0	7	702	116	325
4	0	0	0	200	22	61
5	0	0	0	35	0	0
6	0	0	0	12	0	0

Notes: Reported numbers refer to the injury stock of a team for a given game. The injured players are not able to start this game as a result of an injury that has occurred before. Injuries are subdivided by contract type and severity. Rookies are players signed to an entry-level contract. Veterans are players who are signed to a new contract after their entry-level contract. More severely injured players can be sent to the injured reserve (IR), which opens up a spot on the 23-man active roster. Players on the injured reserve cannot be called up to play for a minimum of seven days. Non injured reserve (Non IR) injuries do not open up a spot on the 23-man active roster. The combined column shows team-game totals of the IR and Non-IR columns. Total team-game observations = 21.284.

Table A.2: Tobit-II Model Game-Level Playing Time

	Dependent variable: Playing Time (minutes)	
	$P(PT > 0 \mid X)$	$E(PT \mid PT > 0, X)$
Veteran Injuries (Non IR)	0.132^{***} (0.011)	0.396^{***} (0.068)
Rookie Injuries (Non IR)	0.012 (0.027)	−0.125 (0.161)
Veteran Injured Reserve	0.134^{***} (0.007)	0.057 (0.053)
Rookie Injured Reserve	0.049^{**} (0.021)	0.047 (0.129)
Veteran Contracts	-0.122^{***} (0.003)	-0.229^{***} (0.028)
Rookie Contracts	-0.065^{***} (0.003)	0.077^{***} (0.022)
Defender	-0.819^{***} (0.072)	4.478^{***} (0.425)
2nd Year	0.170^{***} (0.034)	1.639^{***} (0.213)
3rd Year	0.615^{***} (0.034)	1.638^{***} (0.232)
Past Trade Deadline	0.065^{***} (0.012)	0.448^{***} (0.068)
Defender*Veteran Injuries (Non IR)	0.070^{***} (0.011)	−0.076 (0.063)
Defender*Rookie Injuries (Non IR)	0.100^{***} (0.032)	-0.427^{**} (0.173)
Defender*Veteran Injured Reserve	0.084^{***} (0.009)	0.245^{***} (0.053)
Defender*Rookie Injured Reserve	−0.028 (0.026)	-0.973^{***} (0.155)
Defender*Veteran Contracts	-0.057^{***} (0.006)	-0.113^{***} (0.034)
Defender*Rookie Contracts	0.005 (0.005)	-0.099^{***} (0.027)
2nd Year*Veteran Injuries (Non IR)	-0.067^{***} (0.012)	-0.257^{***} (0.068)
3rd Year*Veteran Injuries (Non IR)	-0.087^{***} (0.012)	-0.288^{***} (0.067)
2nd Year*Rookie Injuries (Non IR)	−0.038 (0.031)	-0.590^{***} (0.176)
3rd Year*Rookie Injuries (Non IR)	-0.055^{*} (0.030)	0.103 (0.171)
2nd Year*Veteran Injured Reserve	-0.022^{**} (0.009)	0.034 (0.056)
3rd Year*Veteran Injured Reserve	-0.025^{***} (0.009)	-0.225^{***} (0.053)
2nd Year*Rookie Injured Reserve	-0.057^{**} (0.026)	−0.064 (0.155)
3rd Year*Rookie Injured Reserve	-0.081^{***} (0.026)	−0.028 (0.149)
2nd Year*Veteran Contracts	0.004^{*} (0.003)	-0.045^{***} (0.015)
3rd Year*Veteran Contracts	−0.004 (0.003)	0.061^{***} (0.015)
2nd Year*Rookie Contracts	0.017^{***} (0.003)	-0.036^{*} (0.019)
3rd Year*Rookie Contracts	0.002 (0.003)	-0.142^{***} (0.018)
Past Trade Deadline*Veteran Injuries (Non IR)	0.036^{***} (0.010)	-0.097^{*} (0.056)
Past Trade Deadline*Rookie Injuries (Non IR)	0.071^{***} (0.025)	0.176 (0.135)
Past Trade Deadline*Veteran Injured Reserve	-0.023^{**} (0.009)	-0.131^{***} (0.050)
Past Trade Deadline*Rookie Injured Reserve	0.047^{*} (0.027)	-0.362^{**} (0.149)
Observations	170,103	170,103
Average $P(PT > 0)$ & $E(PT \mid PT > 0)$	0.27	15.80
Log Likelihood	−221,663.000	−221,663.000
ρ	0.155^{**} (0.061)	0.155^{**} (0.061)
Season FE	✓	✓

Notes: This Tobit-II model is used to predict game-level playing time (PT) for rookies by multiplying $P(PT > 0|X)$ with $E(PT|PT > 0, X)$. Standard errors are reported in parentheses. Significance is indicated as follows, $^{*}\ p < 0.1, ^{**}\ p < 0.05, ^{***}\ p < 0.01$.

Table A.3: Relationship Predicted and Actual Playing Time

	Dependent variable:		
	NHL Playing Time ELC (minutes)		
	(1)	(2)	(3)
Predicted NHL Playing Time ELC	1.683^{***}	1.542^{***}	1.157^{***}
(instrument in minutes)	(0.268)	(0.282)	(0.251)
	-0.012	0.061^{*}	0.063^{**}
	(0.007)	(0.035)	(0.031)
Observations	734	734	734
R^2	0.075	0.084	0.286
Partial R^2 Instrument	0.053	0.040	0.029
Last Season FE	✓	✓	✓
Position FE	✓	✓	✓
Expiring Contracts		✓	✓
Average Peer Age		✓	✓
Draft Information			✓

Notes: These regressions show the relationship between the predicted PT from Equation 1 and the actual PT aggregated to the entry-level career level. Control variables are added in the same way as in the second stage (Table 3) to see how the partial r-squared of the instrument is affected. Standard errors are reported in parentheses. Significance is indicated as follows, $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$.

Table A.4: Descriptive Statistics Entry Level Careers

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Rehired	734	0.81	0.39	0	1	1	1
Post ELC Salary ($m USD)	595	1.58	1.96	0.55	0.65	1.50	16.00
Post ELC Contract Length (years)	595	2.11	1.72	1	1	2	8
NHL Playing Time (tens of hours)	734	1.64	2.15	0.00	0.01	2.69	9.74
Predicted NHL Playing Time (tens of hours)	734	1.56	0.37	0.65	1.32	1.76	2.97
Defender	734	0.34	0.48	0	0	1	1
Expiring Rookie Contracts	734	3.56	1.68	0	2	4	10
Expiring Veteran Contracts	734	5.38	2.56	0	3	7	14
Average Age within Position in Last Season	734	26.32	1.13	23.39	25.53	27.05	30.60
Drafted	734	0.88	0.33	0	1	1	1
Drafted*Draft Number	734	61.72	56.78	0	14	97.8	228
Draft Round 1	734	0.27	0.44	0	0	1	1
Draft Round 2	734	0.20	0.40	0	0	0	1
Draft Round 3	734	0.13	0.34	0	0	0	1
Draft Round 4	734	0.09	0.29	0	0	0	1
Draft Round 5	734	0.08	0.27	0	0	0	1
Draft Round 6	734	0.07	0.25	0	0	0	1
Draft Round 7	734	0.04	0.19	0	0	0	1
Last Season 2012-2013	734	0.13	0.34	0	0	0	1
Last Season 2013-2014	734	0.14	0.35	0	0	0	1
Last Season 2014-2015	734	0.15	0.36	0	0	0	1
Last Season 2015-2016	734	0.17	0.38	0	0	0	1
Last Season 2016-2017	734	0.13	0.33	0	0	0	1
Last Season 2017-2018	734	0.13	0.34	0	0	0	1
Last Season 2018-2019	734	0.15	0.35	0	0	0	1

Notes: This Table presents descriptive statistics for all variables used in the second stage of the estimation of the IV estimation as well as statistics for the draft rounds in which rookies are picked. The sample contains 734 completed entry-level careers.

Table A.5: NHL Playing Time and Labor Market Outcomes with Controls

	Dependent variable:					
	Rehiring Decision		Log Post ELC Salary		Log Post ELC Length	
	OLS	*IV*	*OLS*	*IV*	*OLS*	*IV*
	(1)	(2)	(3)	(4)	(5)	(6)
NHL Playing Time	0.055^{***}	0.083^{*}	0.294^{***}	0.302^{***}	0.208^{***}	0.281^{***}
(tens of hours)	(0.007)	(0.043)	(0.008)	(0.048)	(0.009)	(0.061)
Defender	−0.002	−0.008	-0.087^{*}	-0.089^{*}	0.030	0.011
	(0.042)	(0.043)	(0.045)	(0.047)	(0.054)	(0.060)
Drafted	0.145^{***}	0.074	−0.042	−0.059	−0.005	−0.180
	(0.048)	(0.116)	(0.054)	(0.127)	(0.065)	(0.161)
Drafted*Draft Number	-0.001^{***}	−0.0003	−0.0002	−0.00004	0.0003	0.002
	(0.0003)	(0.001)	(0.0003)	(0.001)	(0.0004)	(0.001)
Expiring Rookie Contracts	0.008	0.006	0.004	0.004	−0.007	−0.012
	(0.009)	(0.010)	(0.010)	(0.011)	(0.012)	(0.013)
Expiring Veteran Contracts	−0.010	−0.009	−0.001	−0.001	0.006	0.007
	(0.007)	(0.007)	(0.008)	(0.008)	(0.010)	(0.010)
Average Peer Age Last Season	0.031^{**}	0.038^{**}	0.010	0.012	0.009	0.028
(within player position)	(0.013)	(0.017)	(0.014)	(0.019)	(0.017)	(0.024)
Constant	−0.180	−0.372	13.014^{***}	12.957^{***}	−0.080	−0.661
	(0.351)	(0.458)	(0.378)	(0.537)	(0.456)	(0.682)
Observations	734	734	595	595	595	595
R^2	0.159	0.141	0.783	0.783	0.542	0.492
F-Stat	.	21.31	.	14.47	.	14.47
Last Season FE	✓	✓	✓	✓	✓	✓

*Notes: This table contains columns 3 and 6 for all dependent variables in Table 3 and reports the coefficients for rookie position, draft information and expiring contracts. Standard errors are reported in parentheses. Significance is indicated as follows, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.*

Table A.6: Veteran Injuries and which Rookies are Retained

	Dependent variable:					
	Rookie i in lineup in Game g					
	All Offense Rookies			Pre-Injury Games = 0		
	(1)	(2)	(3)	(4)	(5)	(6)
During	0.110^{***}	0.146^{***}	0.146^{***}	0.470^{***}	0.452^{***}	0.452^{***}
	(0.004)	(0.004)	(0.003)	(0.009)	(0.008)	(0.008)
Post	0.041^{***}	-0.004	-0.012^{***}	0.275^{***}	0.210^{***}	0.212^{***}
	(0.006)	(0.005)	(0.004)	(0.015)	(0.014)	(0.013)
Perf. During	0.082^{***}	0.105^{***}		0.020	0.123^{***}	
	(0.006)	(0.006)		(0.019)	(0.038)	
Inj. Duration	-0.018^{***}			-0.008^{***}		
	(0.0003)			(0.0004)		
Post*Perf. During	0.015^{*}	0.038^{***}	0.057^{***}	0.282^{***}	0.310^{***}	0.292^{***}
	(0.009)	(0.008)	(0.007)	(0.035)	(0.032)	(0.031)
Post*Inj. Duration	-0.008^{***}	-0.002^{***}	-0.001^{**}	-0.002^{*}	0.001	0.001
	(0.001)	(0.001)	(0.0005)	(0.001)	(0.001)	(0.001)
Perf. During*Inj. Duration	0.025^{***}	0.026^{***}		0.010^{***}	0.011^{***}	
	(0.001)	(0.001)		(0.001)	(0.002)	
Post*Perf. During*Inj. Duration	0.016^{***}	0.013^{***}	0.010^{***}	0.008^{**}	0.003	0.005^{*}
	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)
Constant	0.722^{***}			-0.014		
	(0.004)			(0.009)		
Observations	64,102	64,102	64,102	15,599	15,599	15,599
R^2	0.168	0.393	0.604	0.232	0.407	0.468
Adjusted R^2	0.168	0.374	0.578	0.232	0.382	0.440
Control Variables	✓	✓	✓	✓	✓	✓
Injury FE		✓			✓	
Injury-Rookie FE			✓			✓

Notes: The regressions above show which offense rookies are retained after after an veteran offense injury. The control variables include the number of other offense veterans that are injured and not able to play during a given game, the number of offense rookies that are not able to play due to injury and whether the game in question is after the trade deadeline. The control variables are omitted from the output. The unit of observation is a team-game of player i relative to when the veteran injury occurred. The sample is restricted to rookies that completed their three year ELC within the sample period. The during injury indicator variable is equal to 1 while the injured veteran is not able to play. The post-injury variable is equal to 1 for the 5 games after the injured veteran has recovered from injury. The base category are the 5 games before the injury occurs. The sample only includes rookies that played at least one game in the "during" period and that were not injured themselves during the entire observation period. In columns 4-6 the sample is further restricted to only include players who did not play in the 5 games before the injury. Performance during indicates the average number of points (goals + assists) obtained by rookie i in the games that the veteran was injured. Duration refers to the number of games missed by the injured veteran player. Standard errors are reported in parentheses. Significance is indicated as follows, $^{*}\ p < 0.1, ^{**}\ p < 0.05, ^{***}\ p < 0.01$.

Table A.7: NHL & AHL Games Played during ELC

$$NHLGP_i = \beta_0 + \beta_1 * AHLGP_i + \delta_s + \varepsilon_i$$

	Dependent variable:	
	NHL Games Played	
	NHL GP > 0	Full Sample
AHL Games Played	-0.960^{***}	-0.883^{***}
	(0.022)	(0.025)
Constant	188.033^{***}	176.188^{***}
	(4.421)	(5.519)
Observations	557	734
R^2	0.795	0.636
Adjusted R^2	0.793	0.632
F-test p-value	0.066	0.000
Last Season FE	✓	✓

*Notes: This left column only includes a subset of entry-level players which had a positive number of NHL games. I control for the last season of the ELC (LS_i) such that the regressions incorporate the fact that the 2013/2013 NHL season was shortened to 48 games from 82 games. The F-test p-value is the resulting p-value from testing whether the AHL games player coefficient is equal to -1. Standard errors are reported in parentheses. Significance is indicated as follows, * $p < 0.1$,** $p < 0.05$,*** $p < 0.01$.*

Table A.8: NHL Playing Time and Labor Market Outcomes - IV Robustness

	Short Injuries		*Within Season Injuries*		*No Old Player Injuries*	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Rehiring Decision *(N = 734)*						
NHL Playing Time	0.068	0.079	0.079***	0.086*	0.074**	0.077*
(tens of hours)	(0.048)	(0.077)	(0.028)	(0.044)	(0.029)	(0.045)
Constant	0.682***	−0.366	0.664***	−0.409	0.673***	−0.326
	(0.092)	(0.595)	(0.062)	(0.440)	(0.064)	(0.466)
R^2	0.136	0.147	0.131	0.139	0.134	0.149
First Stage F-stat	12.90	6.54	40.22	20.83	36.72	19.15
Panel B: Log Post ELC Salary *(N = 595)*						
NHL Playing Time	0.280***	0.269***	0.294***	0.297***	0.308***	0.326***
(tens of hours)	(0.048)	(0.092)	(0.030)	(0.048)	(0.031)	(0.052)
Constant	13.261***	13.389***	13.232***	13.179***	13.203***	12.765***
	(0.108)	(0.780)	(0.075)	(0.513)	(0.077)	(0.559)
R^2	0.780	0.779	0.782	0.783	0.781	0.777
First Stage F-stat	11.30	4.00	30.08	14.39	27.92	13.87
Panel C: Log Post ELC Contract Length *(N = 595)*						
NHL Playing Time	0.206***	0.230**	0.232***	0.266***	0.240***	0.292***
(tens of hours)	(0.058)	(0.110)	(0.036)	(0.061)	(0.038)	(0.066)
Constant	0.174	0.100	0.120	−0.168	0.103	−0.746
	(0.130)	(0.937)	(0.091)	(0.640)	(0.094)	(0.711)
R^2	0.541	0.537	0.532	0.509	0.525	0.476
First Stage F-stat	11.30	4.00	30.08	14.39	27.92	13.87
Last Season FE	✓	✓	✓	✓	✓	✓
Position FE	✓	✓	✓	✓	✓	✓
Expiring Contracts		✓		✓		✓
Average Peer Age		✓		✓		✓
Draft Information		✓		✓		✓

Notes: For the instrumental variable regressions I use the sum of predicted playing time estimated in accordance with the Tobit-II estimation procedure outlined in 4.2. In all columns I include last season and position fixed effects. In columns 2, 4 and 6 I add the full control set including draft information and expiring contracts. Columns 1 and 2 exhibit the outcomes solely utilizing injuries that lasted less than 9 games for the instrument, while columns 3 and 4 demonstrate the results obtained by excluding injuries that cross season boundaries for the instrument. Finally, columns 5 and 6 . The control variables are omitted from the output. Standard errors are reported in parentheses. Significance is indicated as follows, $* p < 0.1, ^{**} p < 0.05, ^{***} p < 0.01$.

B Appendix: Additional Information about National Hockey League

B.1 Determinants of Entry-Level Player Playing Time

The NHL is a suitable environment to research the effect of employer-employee exposure. During an entry-level career the coach of the team decides how much playing time, or time-on-ice, to assign to them for each game that the team plays. The number of times the rookie is chosen to play and how much they subsequently play is a key indicator of how precisely the coach and the general manager can estimate their ability to perform well. Only in the real-game setting can they truly evaluate how effective the player is at the NHL level, which is eventually the setting in which the rookie must be able to perform if they are to be rehired after their ELC.

Calling up players from the AHL to the NHL is easy. However, sending down veteran players is not as easy, which complicates the process of calling up rookies. Most veteran players must go through waivers before being reassigned to the AHL. A players who goes through waivers is offered up to all other teams before they can be placed in the AHL. If claimed by a team, that team must assume the player's existing contract and it's taken off the player's former team's books. This rule limits veteran player mobility between the NHL and the AHL and, given that there is a 23-man active roster limit, also complicates the decision to call up an entry-level player from the AHL. This is where injuries come into play. Teams can replace injured veterans with rookie players without having to clear them through waivers first.

Consequently, teammate injuries play a significant role in how much ice-time is allocated to a rookie. When an injury occurs, the coach is forced to find a replacement for the newly formed hole in the 23-man active roster of their team. Therefore, as a result of a random event, the teammate injury, more ice-time could be allocated to the rookie. There are a number of factors that influence this process such as the trade-deadline and the number of contracts that a team has on the books. Before the trade-deadline, which usually occurs with around one-fourth of the regular season still to be played, teams are limited to a maximum of 23 players on their active roster of which 20 are needed to play a game. Two of these 23 players must be goalies, which are excluded from the analysis. To free up a spot on the 23-man roster the injured player must be assigned to the injured reserve. When a player is assigned to the injured reserve, the team is not allowed to call them up again for a minimum of seven days. When assigned to the injured reserve the veteran players does not have to clear waivers as is the case when they would be sent down from the NHL to the AHL. For minor injuries or illnesses such as a cold the team may decide to not send the injured player to the injured reserve, not freeing up a spot on the 23-man roster. When the rookie is already on the 23-man active roster before the injury occurs, also non injured reserve injuries can positively influence their playing time. After the trade deadline there is no 23-man roster limit, making it easier to call up rookies from the minor leagues.

The number of contracts on the books of an NHL team also plays a significant role in this process. When a team has more players under contract for a given position, it has more alternatives to choose from when a player gets injured, reducing the chance that any one rookie is picked to play. Therefore, I control for the number of players under contract when evaluating the effect of teammate injuries on rookie playing time.

B.2 How Ice Hockey Works

An NHL ice hockey game consists of three 20 minute periods. The clock is stopped when the referee blows the whistle after which the game resumes after a face-off. During a face-off the referee drops the puck on the ice and the players battle for puck possession. The standard rink sizer in the NHL is 200 feet long and 85 feet wide. The goal of hockey is to shoot the puck in the net of the opposing team.

The game roster size, a subset of the active roster, of a hockey team is capped at twenty players. Each team consists of three defense lines and four forward lines, containing two and three players respectively. Players can freely rotate on and off the ice. A player is on the ice for 45 seconds of playing time on average. When a player commits a foul they have to sit in the penalty box for two, four or five minutes depending on the severity of the foul. During this time the team plays with one less player. The probability that the opposing team scores during a penalty goes up by a significant amount. A team can have a maximum of two penalties at any given time. A third penalty is added to the end of the first two penalties.

The team that has scored the most goals during regulation time wins the game. If the score is equal, the game goes into a five minute sudden-death overtime period in which each team has three players on the ice. Having less players increases the probability that a goal is scored. If both teams do not score, the game is decided via a penalty shootout. The team that wins obtains two points towards their league standing. The losing team obtains one point if they lose in overtime or the penalty shootout and zero points if they lose in regulation time.