14TH ANNUAL
MIT SLOAN
SPORTS ANALYTICS CONFERENCE
MARCH 6 - 7, 2020 | BOSTON, MA
presented by ESPN

Judgement Under Uncertainty: An Empirical Evaluation of NHL Draft Picks

Other Sports

Paper ID: 4M4GR07JR

1. Introduction

Are National Hockey League (NHL) executives effectively assessing the value of their draft picks? This paper constructs a rigorous framework for market values of NHL draft picks and measures their deviation from pick value based on player performance. Past research has been insufficient in several regards, including small sample of draft picks, lack of detailed statistical analysis, or ineffective comparison methodology for different positions. To address these deficiencies, this paper uses a 40-year sample of draft trades, a statistical analysis method which models the NFL Trade Value Chart, and a Point Shares statistic designed to evaluate the offensive and defensive contributions of each player.

By comparing the market value of each draft pick versus the performance of players at that draft slot, this paper demonstrates NHL executives are not effectively assessing the value of their draft picks. In the absence of a cohesive draft pricing strategy, teams exhibit overconfidence in their ability to choose, trading up for picks that have lower value than they estimate, and present bias in trading away future picks which have higher value. Organizations can apply this research to evaluate their draft assets and optimize player return from the NHL Entry Draft by trading down and trading for future picks, while drafting more defensemen later in the draft.

1.1. Background

To complete a comprehensive analysis of the draft, it is important to understand the NHL labor market. Every year, new players are assigned to teams through a draft [2]. There are seven rounds of the draft. In the first round, the first two (or three in previous years) draft selections are determined via lottery among all teams who did not make the playoffs [2]. The team with the worst record has the highest probability to win the lottery, and the odds of winning the lottery decrease until the team with the best record that did not make the playoffs [2]. The remaining teams who do not win the lottery draft in reverse order from their regular season record [2]. Playoff teams then draft in the reverse order of their post-season success [2]. The Stanley Cup Champion selects last, the runner-up selects second-last, conference finalists select in the two preceding slots, etc… [2]. Within each draft grouping, tiebreakers are decided by regular season record, where teams with worse records choose earlier [2]. For rounds 2-7, teams draft in reverse order from their regular season record.

Each player is then selected to sign a contract in the order discussed, and players can only sign with the team that drafted them [2]. These are three-year two-way entry-level contracts, which currently pay a minimum of $750,000 and a maximum of $925,000 at the NHL level [3]. Two-way contracts stipulate that a player's salary is dependent on the league which they are assigned to play [3]. Drafted players who do not start on an NHL roster are assigned to the American Hockey League (AHL), Canadian Hockey League (CHL), National Collegiate Athletic Association (NCAA), or an alternative developmental league depending on their background.

An important note about the NHL is that teams are subjected to a binding salary cap. For the 2021-2022 season, the salary cap is $81.5 million [3]. Players on a two-way contract who do not play throughout the NHL regular season do not count against the salary cap, and have a discounted cap hit if they play between 1-49 NHL games [3]. 18- and 19-year-old players who do not compete in a minimum of 10 NHL games have their contracts extended ("Entry Level Slide") by one year [3].

1.2. Uniqueness of the NHL

The NHL Entry Draft is best suited for an analysis of the impacts of biases on decision making out of the big four professional sports in the United States for the following reasons:

There is no significant difference between the salary of the first pick and the final pick in the NHL draft. In the NFL, MLB, and NBA, salary decreases as the draft progresses [4]. As discussed in Thaler and Massey's paper, this may lead to a "loser's curse" (as seen in the NFL), where a higher amount of surplus value (performance value – compensation costs) is achieved as the draft progresses [1]. This will result in teams with worse regular season performance obtaining lower surplus value than successful ones, and further damage the parity of the sport [1]. In the NHL, the difference between the maximum and minimum entry level contract is $175,000, less than 0.2% of the salary cap [3]. This salary is only relevant once the player is ready to compete in the NHL, since two-way contracts can be extended using the Entry Level Slide discussed in 1.1 [3]. Furthermore, the maximum entry-level salary is approximately 1.1% of the cap, nearly 3x less than the average NHL salary [5]. Therefore, draft trades will more accurately reflect organizations' evaluation of draft picks, as opposed to moves which affect their salary cap space.

Secondly, in contrast to the NFL, NHL has developmental leagues such as the AHL, CHL and NCAA. In 2020, 98.2% of players drafted did not play an NHL game in their first season [6]. Therefore, drafted players do not have to become impactful immediately, thus minimizing possible excuses for present bias, such as drafting players to "win now". Furthermore, players who can make an impact immediately are likely signing their entry-level contract with teams who have the worst records in the NHL, because of the draft order [2].

Unlike the MLB, NHL teams can trade their draft picks, thereby equating the value of the picks traded away to the picks received [7]. Using an appropriate model, the market value of each pick can therefore be determined and compared with the performance of players at that draft position.

Finally, NHL players can be classified into three groups (Forward, Defenseman, and Goalie) as opposed to the much larger number of roles in the NFL and MLB [8]. With only six players on the ice at a time, it is easier to compare players and their contributions to a team's ability to win.

1.3. Literature Review

Past NHL draft research can be divided into two categories: Evaluating NHL draft picks using player performance and determining draft pick value using draft trades.

1.3.1. Evaluation of NHL Draft Picks using Player Performance

In 2011, Michael Schuckers investigated the value of a draft pick using players selected from 1988-1997 [9]. Schuckers paper discussed performance using the metric of Games Played [9]. His Draft Pick Value Chart corresponds to the prediction of number of games played based on draft position [9]. However, this metric does not consider goals, assists, and other individual statistics, especially

considering games played does not directly consider Time on Ice, where a player is able to contribute to team success. Schuckers does not evaluate how teams value draft picks, simply how they should if they are constrained to evaluating draft assets using games played [9]. Finally, statistics on goodness of fit are not provided, so evaluating the effectiveness of this model is difficult [9].

An article by Stephen Burtch in 2015 on the relative value of a draft pick was written using Games Played and Expected Points/Game Played at each draft slot from 1995-2007 [11]. This article uses thresholds of 60, 100, and 200 Games Played as benchmarks for performance, and does not explain the modelling technique applied [11]. When assessing Expected Points/GP, defensemen and goalies were excluded from the analysis (~40% of all players) [11]. Only forwards were used to construct the Relative NHL Draft Pick Value Chart [11]. The modelling technique in this article is not shown rigorously, and the results of this analysis are not generalizable to defensemen and goalies [11].

1.3.2. Evaluation of NHL Draft Picks using Draft Trades

In 2013, Eric Tulsky used 46 draft trades to determine the value of an NHL draft pick, setting the value of the picks traded away equal to the picks received [10]. However, in this article, the author continuously modified the model from an exponential to a power law without a rigorous modelling technique [10]. Furthermore, the actual model was not written in terms of exponential and power law parameters, simply a list of values [10].

1.3.3. Advancement of Previous Research

This paper will expand on Tulsky's work using a 40-year sample of draft trades, and a rigorous statistical analysis methodology which models the NFL Trade Value Chart (See 2.2). Furthermore, this research will elaborate on the work of Burtch and Schuckers by assessing the performance of drafted players. However, this analysis will use a 30-year dataset of Point Shares, an advanced statistic designed to evaluate forwards, defensemen, and goalies with a positional adjustment (See 2.3.1 and Appendix A) [12]. By comparing the Draft Trades and Point Shares Models, this paper will determine the ability of NHL executives to assess the value of their draft picks.

2. Methodology

2.1. Data

Draft trades were webscraped from ProSportsTransactions [13]. 356 trades from 1980-2020 involving only draft picks were separated into two groups: 191 involving picks from the current year, and 165 involving both current and future picks (See Table 1) [13].

Table 1: Summary of Draft Trades Dataset [13]

	Current Pick Trades	Future Pick Trades
# of Trades	191	165
# of 2-for-1 Trades	151	51
# of 3-for-1 Trades	24	2
# of 2-for-2 Trades	10	1
# of 4-for-2 Trades	3	0
# of 3-for-2 Trades	1	0
# of 1-for-1 Trades	2	111

Mean # of Picks Trading Down	1.07	1.01
Standard Deviation # of Picks Trading Down	0.26	0.08
Mean # of Picks Trading Up	2.14	1.34
Standard Deviation # of Picks Trading Up	0.39	0.50

The Point Shares of players from the 1980-2010 draft classes were then webscraped from hockey-reference.com [6]. This dataset included 7751 players: 4451 forwards, 2532 defensemen, and 768 goalies (See Table 2).

Table 2: Summary of Point Shares Dataset [6]

	Forwards	Defensemen	Goalies
# of Players	4451	2532	768
Mean Point Shares	7.28	8.80	13.29
Standard Deviation Point Shares	21.08	22.32	32.01
Max Point Shares	217.1	211.77	217.84

2.2. Draft Trades Analysis

Applying Thaler and Massey's methodology, a two-parameter Weibull distribution was used to model the current pick trades:

$$\sum_{i=1}^{m} v({t_i}^H) = \sum_{j=1}^{n} v({t_j}^L) \quad (1)$$

$$v({t_i}^r) = e^{-\lambda({t_i}^r - 1)^\beta} \quad (2)$$

where $v({t_i}^r)$ is the value of t_i, the ith draft pick for the team trading up (if $r = L$) or trading down (if $r = H$), m picks are traded from the team trading down for n picks from the team trading up, and β and λ are the parameters to be estimated [1]. Combining these equations:

$${t_1}^H = \left(-\frac{1}{\lambda}\log\left(\sum_{j=1}^{n} e^{-\lambda({t_i}^L - 1)^\beta} - \sum_{i=2}^{m} e^{-\lambda({t_i}^H - 1)^\beta}\right)\right)^{1/\beta} + 1 \quad (3)$$

Given the picks exchanged in each trade, we substitute all ${t_i}^L$ and all ${t_i}^H$ except the highest draft pick involved in the trade $({t_1}^H)$ into (3). To solve for the parameters β and λ, a Mean Percent Error (MPE) minimization function of ${t_1}^H$ was applied. Minimizing MPE ensures the error in the lowest-numbered draft picks (highest associated value) is minimized. The Weibull Distribution was used to model the draft picks as it provides more flexibility in estimation than a traditional exponential [1]. When applied to the NFL Trade Value Chart, the Weibull Distribution proposed by Thaler and Massey achieved an R^2 score of 0.999 over a 25-year interval from 1983-2008 [1].

With the estimated parameters from current pick trades, the discount rate for future picks can be calculated as the percentage difference between the difference in draft value in the absence of future picks and the estimated value of the future picks.

2.3. Point Shares Analysis

2.3.1 Calculation of Point Shares

To adjust for the differences between the roles of each position, this paper will use the Point Shares statistic, developed to estimate the number of points contributed by each player [12].

$$TPS = OPS + DPS + GPS \tag{4}$$

where TPS is the Total Point Shares, equated as the sum of Offensive, Defensive and Goalie Point Shares:

$$OPS = \frac{MG_{SF}}{MG_{PP}} \tag{5}$$

$$DPS = \frac{MG_{SA}}{MG_{PP}} \tag{6}$$

$$GPS = \frac{2}{7}\frac{MG_{GA}}{MG_{PP}} \tag{7}$$

where MG_{SF} is each skater's Marginal Goals For, MG_{SA} is each skater's Marginal Goals Against, MG_{GA} is each goalie's Marginal Goals Against, and MG_{PP} is the Marginal Goals Per Point [12]. The formula for each variable is shown in Appendix A.

2.3.2. Modelling Point Shares

The Point Shares of each player were normalized against their draft class. This was done for two reasons. Firstly, to prevent number of years in the NHL from becoming a factor. Without normalization, the Total Point Shares of an active player drafted in 2010 could be compared against a retired player drafted in 1980. Secondly, because the opportunity cost of choosing one player is not being able to draft certain players later in the same draft, it would not make sense to compare players across different draft years. This will prevent strength of draft class from affecting the Point Shares analysis.

The mean value of each draft pick was then modeled using a two-parameter Weibull distribution and re-normalized between 0 and 1. The parameters were estimated using a Sum of Squared Errors (SSE) minimization function, since the range of draft pick values is between 0 and 1. MPE minimization would skew error as the value of the draft pick approached 0.

Another area of interest is the value of forwards, defensemen, and goalies relative to one another.

Thus, the above analysis was repeated with the positional datasets. This will allow for position optimization based on draft slot.

3. Results

3.1. Draft Trades Analysis

Applying (3), the distribution was modeled with $\lambda = 0.304$ and $\beta = 0.581$ (MPE = 9.91%), acheiving an R^2 score of 0.934. Figure 1 plots the proposed model and the value of the picks exchanged for the top pick acquired. Table 3 presents a shortened version of the NHL Draft Trade Value chart (see full chart in Appendix B).

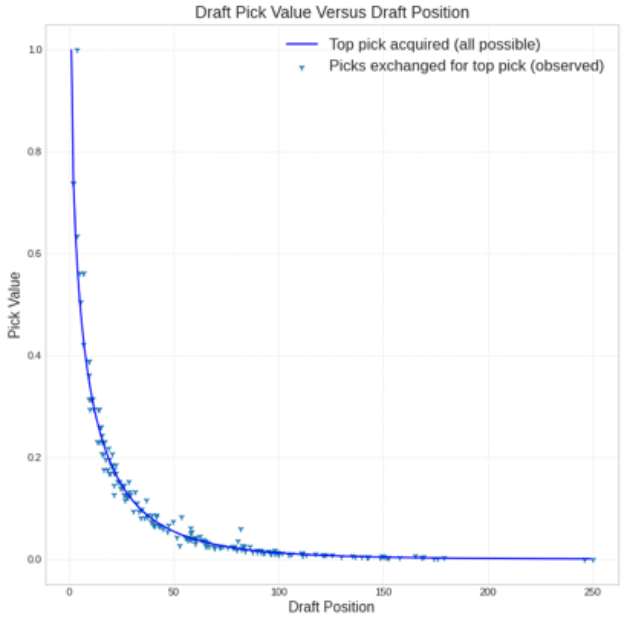

Figure 1: Estimated value of each pick and the observed value of the picks exchanged.

Table 3: Using the draft trade parameters, each draft pick value was calculated.

Pick #	Value	Pick #	Value	Pick #	Value	Pick #	Value	Pick #	Value
1	1000.00	16	230.81	31	111.56	46	62.30	105	10.93
2	737.86	17	218.23	32	106.95	47	60.12	110	9.65
3	634.61	18	206.64	33	102.59	48	50.83	115	8.53
4	562.40	19	195.93	34	98.46	49	56.03	120	7.57
5	506.49	20	186.00	35	94.55	50	54.12	125	6.72
6	460.97	21	176.77	36	90.84	55	45.68	130	5.99
7	422.76	22	168.18	37	87.31	60	38.82	135	5.34
8	390.00	23	160.16	38	83.96	65	33.17	140	4.77
9	361.47	24	152.67	39	80.77	70	28.49	150	3.83
10	336.33	25	145.65	40	77.74	75	24.58	160	3.09
11	313.98	26	139.07	41	74.85	80	21.29	170	2.51

12	298.93	27	132.89	42	72.10	85	18.52	180	2.05
13	275.85	28	127.07	43	69.48	90	16.16	190	1.68
14	259.45	29	121.60	44	66.97	95	14.14	200	1.38
15	244.50	30	116.43	45	64.58	100	12.42	210	1.14

Applying this regression to 165 trades involving future draft picks, teams lost, on average, 42.4% of their future pick value with a standard deviation of 57.34%. The median discount rate was 39.50%, the maximum discount rate was 280% and the minimum discount rate was -56.86%.

3.2. Point Shares Analysis

Applying (2), the parameters to model the Point Shares data for all positions, forwards, defensemen, and goalies are shown in Table 4. Figure 2 plots the proposed models and the normalized Point Shares data, and Figure 3 plots each model against one another. Table 5 presents a shortened version of the NHL Point Shares Value Chart (see full chart in Appendix C).

Table 4: The estimated parameters with corresponding SSE and R^2 for each model.

Model	All Positions	Forwards	Defensemen	Goalies
λ	0.420	0.434	0.318	0.296
β	0.391	0.404	0.443	0.427
SSE	0.0158	0.0128	0.0285	0.0660
R^2	0.880	0.830	0.667	-1.73

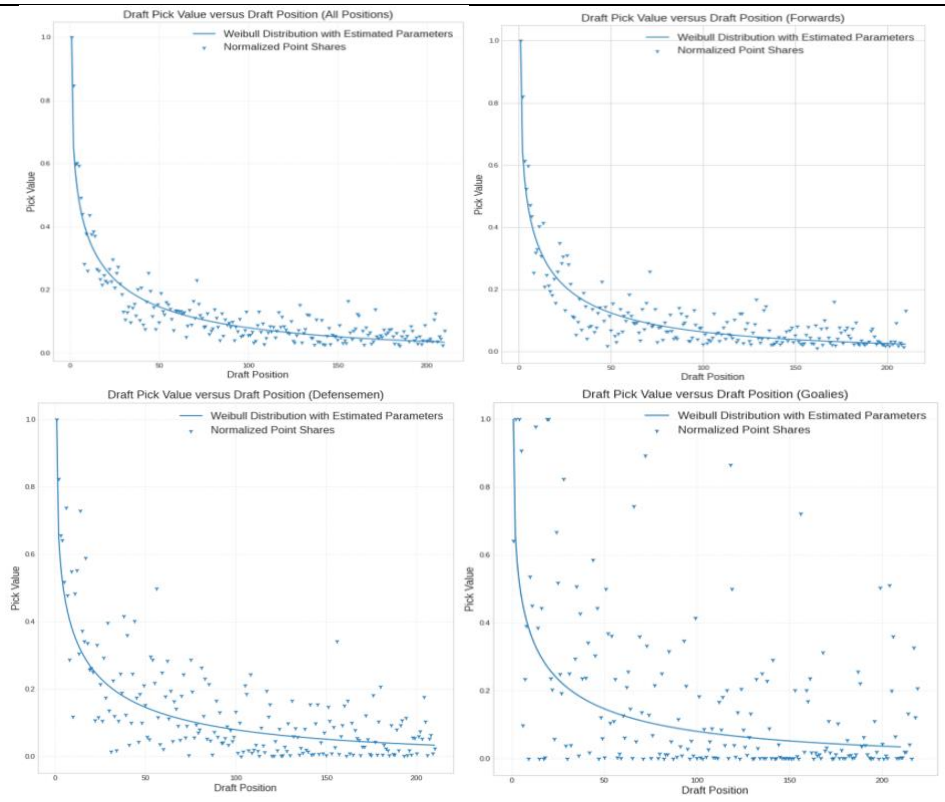

Figure 2: The Point Shares models for All Positions (top left), Forwards (top right), Defensemen (bottom left), and Goalies (bottom right).

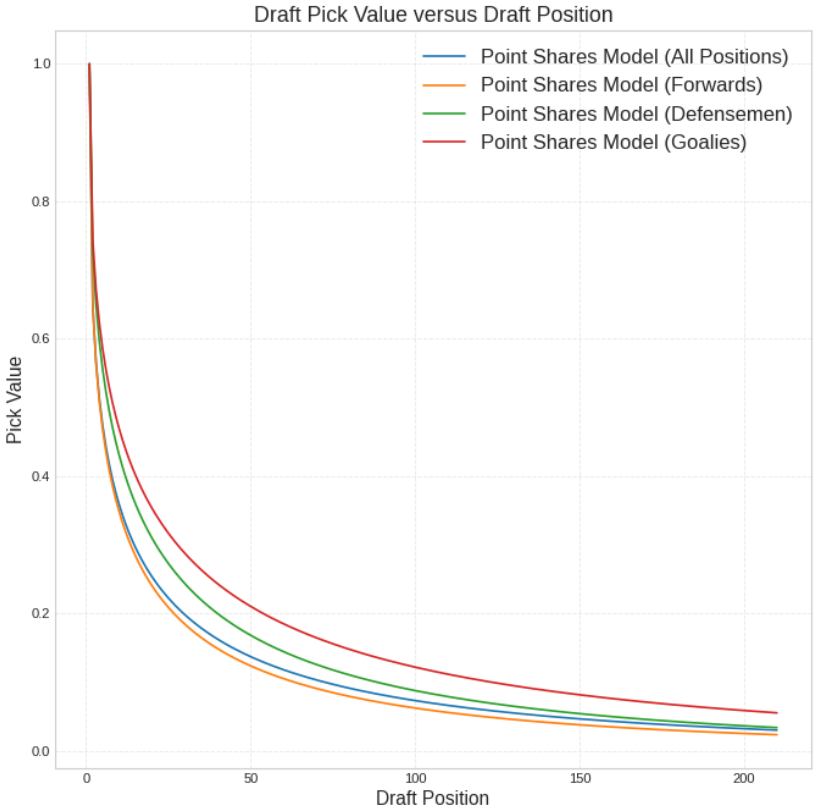

Figure 3: Comparison of Forwards, Defensemen, Goalies and All Positions Point Shares Models.

Table 5: Using the Point Shares parameters for all positions, each draft pick value was calculated.

Pick #	Value	Pick #	Value	Pick #	Value	Pick #	Value	Pick #	Value
1	1000.00	16	286.15	31	193.83	46	146.22	105	69.41
2	647.91	17	277.14	32	189.77	47	143.82	110	66.06
3	566.03	18	268.74	33	185.87	48	141.48	115	62.96
4	513.31	19	260.88	34	182.13	49	139.21	120	60.08
5	474.13	20	253.49	35	178.52	50	137.01	125	57.40
6	442.94	21	246.55	36	175.05	55	126.86	130	54.90
7	417.08	22	239.99	37	171.70	60	117.96	135	52.57
8	395.03	23	233.78	38	168.47	65	110.08	140	50.38
9	375.84	24	227.90	39	165.36	70	103.07	150	46.40
10	358.90	25	222.31	40	162.35	75	96.77	160	42.88
11	343.76	26	217.00	41	159.44	80	91.09	170	39.74
12	330.11	27	211.94	42	156.62	85	85.95	180	36.93
13	317.68	28	207.10	43	153.90	90	81.26	190	34.40
14	306.31	29	202.49	44	151.26	95	76.97	200	32.12
15	295.84	30	198.07	45	148.70	100	73.03	210	30.05

3.3. Comparison of Point Shares and Draft Trades Model

Figure 4 shows the All Positions Point Shares Model and the Draft Trades Model on the same plot.

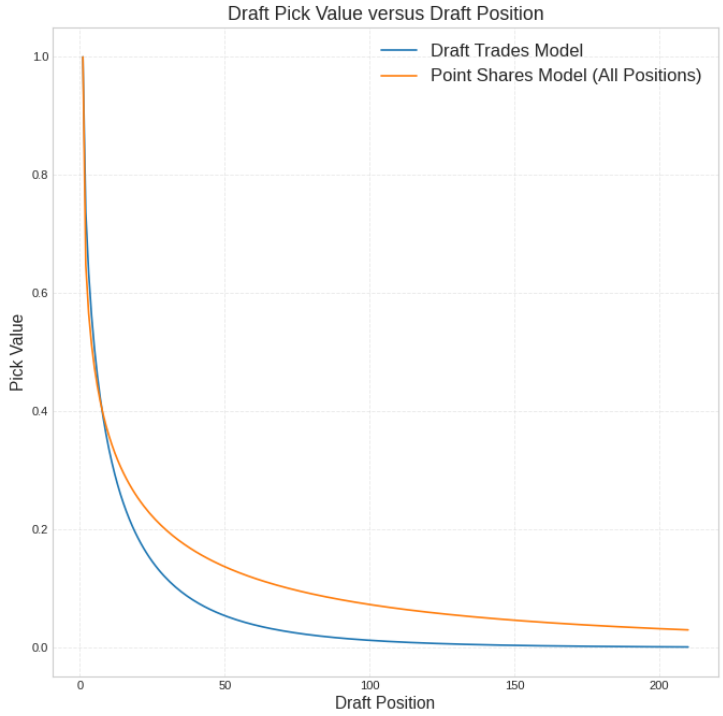

Figure 4: Comparison of Draft Trades Model versus All Positions Point Shares Model.

4. Discussion

4.1. NHL Draft Trade Value Chart

While the purpose of this paper is to determine the effectiveness of NHL executives in assessing the value of their draft picks, the Draft Trade Value Chart itself is a novel creation in the NHL and provides market values for each draft pick through which transactions can be evaluated. One of the key differences between the NHL Draft Trade Value Chart and NFL Trade Value Chart is the steepness of the curve. In the NHL, the market value of the 5th pick is approximately 50% of that of the first, decreasing initially at a rate almost double that of the NFL [1]. This result is mostly intuitive, given the fact that NFL salaries decrease by almost 50% over the first 10 picks, while the difference is insignificant in the NHL [1]. As a result, NFL players drafted later would have higher relative value, as they take up less of the salary cap [1]. Assuming the Efficient Market Hypothesis holds, the steepness of the curve would suggest a strong ability to discern talent in the NHL, and a vast drop off as the draft continues.

Another important feature of the Draft Trade Value Chart is the goodness of fit of the estimated Weibull Distribution ($R^2 = 0.934$). This R^2 value is lower than the one constructed by Thaler and Massey (0.999). However, when the paper was written, the NFL Draft Value Chart had already been constructed by Mike McCoy in 1991, and thus, prices had been predetermined [1]. This makes an

analysis of the NHL more valuable, as it allows us to determine how NHL executives value picks in the absence of a cohesive pricing strategy.

Another significant result from the Draft Trade Value Chart was the discount rate teams apply when trading away future picks. Because most players don't play in the NHL the year they are drafted, the expected discount rate should be near 0. However, the proposed NHL Draft Trade Value Chart finds teams undervaluing future draft picks by 42.4% on average. The 57.34% standard deviation in draft value indicates the high levels of risk associated with trading future draft picks due to the uncertainty in draft position. For example, by trading away a current pick for a future pick one round earlier, a team is guaranteed to improve the value of their pick, with as much as a 60-pick jump in draft value. Furthermore, if the highest pick involved in the trade is in the second round or later, it is almost guaranteed to have no impact on the team's active roster, since the player drafted in that slot will play in a developmental league.

4.2. Point Shares Analysis

The Point Shares analysis provides interesting insight into the actual value of an NHL draft pick. From the two-parameter Weibull Distribution for all players, the model fits the data well, achieving an R^2 score of 0.880. In the analysis of forwards and defensemen alone, the model is still effective, with R^2 values of 0.830 and 0.667 respectively. However, for goalies, a Weibull Distribution is not suitable, as the R^2 value is -1.73, worse than a horizontal line. There are two reasons why this may be the case. Firstly, goalies are least commonly drafted out of all hockey players, comprising 9.9% of all drafted players [6]. With a limited amount of data for each pick, outliers have a larger impact on the model. Secondly, a goalie's ability to accumulate Point Shares is binary i.e., there is only one goalie on the ice during a game. Therefore, players drafted later who are given a sustained opportunity to play in the NHL will have a vastly different Point Shares than a backup goalie or someone who never plays in the NHL. This contrasts to forwards and defensemen since there are 12 forwards and 6 defensemen who are shifted on and off the ice.

A takeaway from the comparison of the positional models is that the value of defensemen is higher relative to the value of forwards as the draft progresses (See Figure 4). This difference can be seen in Table 6:

Table 6: The relative value of forwards versus defensemen as the draft progresses.

Pick #	Value (F)	Value (D)	Pick #	Value (F)	Value (D)	Pick #	Value (F)	Value (D)	Pick #	Value (F)	Value (D)
10	348.40	430.98	60	105.00	144.27	110	55.68	78.79	160	34.60	49.61
20	240.28	309.76	70	90.63	125.54	120	50.17	71.24	170	31.81	45.69
30	184.22	243.31	80	79.19	110.44	130	45.43	64.71	180	29.34	42.19
40	148.57	199.56	90	69.88	98.00	140	41.33	59.01	190	27.13	39.06
50	123.58	168.11	100	62.17	87.60	150	37.75	54.02	200	25.14	36.24

The results of this analysis would suggest that an NHL executive focused on optimizing Point Shares would draft a higher number of defensemen later in the draft, as the expected return from this draft capital will be higher.

An important note on each of the Point Shares models is the steepness of the curve. A possible explanation for this steepness lies in the opportunities given to players drafted earlier. Players drafted early are exposed to NHL coaches and player mentors from the start of their careers, while players drafted later are sent to developmental leagues with less successful players and coaches at lower levels of competition. This gap in mentorship, along with the pre-existing gap in talent which led to one player being drafted over another, leads to a much larger difference in performance.

4.3. Discussion of Draft Trades and Point Shares Model

The key difference between the Point Shares versus Draft Trades Model is salient in Figure 3. Beyond the first seven picks, every draft pick has a higher Point Shares value than Draft Trades. As mentioned in 4.2., the gap between players drafted in different rounds is large, but not nearly as large as NHL executives estimate it to be. As seen in Table 7, the percentage difference between the Draft Trades and Point Shares value rises.

Table 7: The percentage difference in value between Draft Trades and Point Shares Models.

Pick #	% Difference	Pick #	% Difference	Pick #	% Difference	Pick #	% Difference
10	6.71%	60	203.89%	110	584.73%	160	1287.34%
20	36.29%	70	261.81%	120	693.92%	170	1483.85%
30	70.11%	80	327.83%	130	817.14%	180	1703.83%
40	108.83%	90	402.92%	140	955.95%	190	1949.73%
50	153.17%	100	488.17%	150	1112.06%	200	2224.25%

Table 7 demonstrates exorbitant gaps in how NHL executives value draft picks versus their actual value. Furthermore, this table does not consider future discounting. Despite acting in a highly uncertain environment of predicting the future performance of young players from a variety of different backgrounds, teams demonstrate overconfidence in their ability to choose, undervaluing later picks by more than 2000%. Because this difference grows as the draft progresses, any trade involving a higher pick for a set of lower picks which falls upon the NHL Draft Trade Value Chart will lead to a higher expected benefit for the team trading down.

NHL executives are also highly vulnerable to present bias, trading future draft picks at an average discount of 42.4%, despite it having minimal impact on the active roster. Therefore, the results of this paper match that of Thaler and Massey, which concludes that “teams should trade down, not up” and that trading away current picks for future ones “provides a significant opportunity for teams with a longer-term perspective” [1].

Beyond trading down and trading for future picks, there are other methods teams can use to optimize their return from the NHL Entry Draft. As seen in Figure 4 and Table 4, defensemen have a higher expected Point Shares relative to forwards at the same draft slot. While data is limited when it comes to goalies, an inspection of Figure 2 would show a higher degree of variation in the performance of later goalie selections in the draft than forwards and defensemen, and therefore higher possible upside. Considering the difference between the Point Shares and Draft Trades model at the same pick, it is possible to exploit this valuation by trading for lower picks in the draft and drafting defensemen at those picks. Because of the steeper decline in Point Shares for forwards, early draft picks may be better spent on forwards rather than defensemen.

4.4. Next Steps

Various steps can be taken to develop a more comprehensive framework for the value of an NHL draft pick. Firstly, when exchanging players for draft picks, how are the contributions of the player weighted against the uncertainty in drafting? Developing a unified measurement system to compare the value of an NHL draft pick versus a player's ability to improve a team upon acquisition would allow teams to better understand the value of their assets.

Another extension to this work will be developing an open-source software which will allow an input of the draft order, a team to trade with, and output possible draft trade opportunities according to the Draft Trades and Point Shares Value Chart.

While this paper serves to specifically examine overconfidence and present bias, the endowment effect is another psychological phenomenon whose impact on NHL executives has not yet been measured. The Endowment Effect occurs "when we overvalue something that we own, regardless of its objective market value" [1]. Because draft picks are more abstract and uncertain compared to active NHL players whose value is better understood, do teams overvalue their players relative to the draft picks they could be traded for?

5. Conclusion

The results of this paper disagree with the Efficient Market Hypothesis, which assumes that markets make unbiased predictions of the future. NHL executives exhibit overconfidence and present bias in their decision making without grasping how difficult it is to predict future performance of young athletes. Furthermore, the results of this paper complement Thaler and Massey's in exemplifying the biases existing across major sports despite strong economic incentives.

The proposed Draft Trade Value Chart provides the first cohesive draft pricing strategy based on the decision-making of NHL executives. With this chart, teams can determine whether or not proposed trades are appropriately evaluating their draft picks based on their established draft prices. Furthermore, in trades involving future picks, teams can approximate the discount rate applied to other teams' picks or their own.

With the Point Shares Draft Value model for all positions, organizations can estimate the expected return of their draft capital. Given the positional models, teams can also determine the appropriate sequence of draft picks which will maximize their Point Shares return based on position while still maintaining a balanced roster.

By comparing the NHL Draft Trade Value Chart with the Point Shares Draft Value Chart, analytic-driven teams can exploit the gross undervaluation of certain draft assets and accumulate a prospect pool which will eventually contribute to organizational success. Given the salary cap and draft ordering system designed to maximize parity across the NHL, an upper hand in draft strategy will provide an opportunity for teams with a long-term focus.

References

[1] C. Massey and R. H. Thaler, "The loser's Curse: Overconfidence vs. market efficiency in the National Football League Draft," *SSRN Electronic Journal*, 2010.

[2] Jones, Wayne. "How the NHL Entry Draft Works: A Complete Guide." *Hockey Answered*, 12 May 2021, https://hockeyanswered.com/how-the-nhl-entry-draft-works-a-complete-guide/.

[3] "NHL CBA FAQ - Capfriendly - NHL Salary Caps." *CapFriendly*, 28 June 2021, https://www.capfriendly.com/faq.

[4] Staudohar, Paul D. "Salary Caps in Professional Team Sports." *Bureau of Labor*, 1998, https://www.bls.gov/opub/mlr/cwc/salary-caps-in-professional-team-sports.pdf.

[5] "What Is the Average NHL Salary?" *Gaimday*, 6 Apr. 2021, https://www.gaimday.com/blog/average-nhl salary/#:~:text=The%20average%20NHL%20player%20salary%20is%20%242%2C554%2C463%20USD%20for%20the,league%20minimum%20of%20%24700%2C000%20USD.

[6] "NHL entry and Amateur draft history," *Hockey*. [Online]. Available: https://www.hockey-reference.com/draft/. [Accessed: 15-Aug-2021].

[7] Warja, Bob. "Why Can't MLB Teams Trade Draft Picks?" *Bleacher Report*, Bleacher Report, 2 Oct. 2017, https://bleacherreport.com/articles/380347-why-cant-mlb-teams-trade-draft-picks.

[8] "Positions." *Positions - BR Bullpen*, Baseball-Reference, 13 Aug. 2021, https://www.baseball-reference.com/bullpen/Positions#:~:text=Playing%20all%20nine%20positions%20in,the%20spotlight%20for%20a%20day.

[9] Schuckers, Michael. *What"s an NHL Draft Pick Worth? A Value Pick Chart for the National Hockey League*. https://myslu.stlawu.edu/~msch/sports/Schuckers_NHL_Draft.pdf.

[10] T., Eric. "NHL Draft: What Does It Cost to Trade up?" *Broad Street Hockey*, Broad Street Hockey, 25 Apr. 2013, https://www.broadstreethockey.com/2013/4/25/4262594/nhl-draft-pick-value-trading-up.

[11] Burtch February 24, Stephen. "Analyzing the Value of NHL Draft Picks." *Sportsnet.ca*, Sportsnet, 24 Feb. 2015, https://www.sportsnet.ca/hockey/nhl/analyzing-value-nhl-draft-picks/.

[12] Kubatko, Justin. "Calculating Point Shares." *Hockey*, Hockey-Reference, https://www.hockey-reference.com/about/point_shares.html.

[13] F. Marousek, "Hockey Draft Pick Transactions," *Hockey draft pick transactions*. [Online]. Available: https://www.prosportstransactions.com/hockey/DraftTrades/Years/. [Accessed: 15-Aug-2021].

Appendix A: Point Shares Formulas

$$TPS = OPS + DPS + GPS \tag{1}$$

$$G_{SC} = \frac{(G_S + A_S * 0.5) * G_T}{(G_T + A_T * 0.5)} \tag{2}$$

$$MG_{SF} = \frac{G_{SC} - \frac{7}{12} T_S G_{AC}}{T_A} \tag{3}$$

$$MG_{PP} = \frac{G_L}{P_L} \tag{4}$$

$$OPS = \frac{MG_{SF}}{MG_{PP}} \tag{5}$$

$$SA_G = \frac{SA_{GT}}{SA_{LT}} \tag{6}$$

$$MG_{GA} = \frac{19}{12} SA_G T_G GA_{LT} - GA_{GT} \tag{7}$$

$$GPS = \frac{2}{7} \frac{MG_{GA}}{MG_{PP}} \tag{8}$$

$$T_{SP} = \frac{T_S}{T_{TS}} \tag{9}$$

$$MG_{SP} = \frac{7 - 2\frac{SA_{TT}}{SA_{LT}}}{7} \tag{10}$$

$$PO_A = \begin{cases} \frac{5}{7}, & A = Forward \\ \frac{10}{7}, & A = Defenceman \end{cases} \tag{11}$$

$$MG_{TA} = \frac{19}{12} G_{LT} GT - GA_T \tag{12}$$

$$PM_{SA} = \frac{1}{7} PO_A (PM_S - T_S \frac{PM_T}{T_{TS}}) \tag{13}$$

$$MG_{SA} = T_{SP} PO_A MG_{SP} MG_{TA} + PM_{SA} \tag{14}$$

$$DPS = \frac{MG_{SA}}{MG_{PP}} \tag{15}$$

$TPS = Total\ Point\ Shares$
$OPS = Offensive\ Point\ Shares$
$DPS = Defensive\ Point\ Shares$
$GPS = Goalie\ Point\ Shares$
$G_{SC} = Goals\ Created\ by\ Skater$
$G_S = Goals\ Scored\ by\ Skater$
$A_S = Assists\ by\ Skater$
$G_T = Goals\ Scored\ by\ Team$
$MG_{SF} = Marginal\ Goals\ by\ Skater$
$T_S = Time\ on\ Ice\ by\ Skater$
$G_{CA} = Goals\ Created\ by\ All\ Forwards\ or\ Defensemen$
$T_A = Time\ on\ Ice\ by\ All\ Skaters$
$MG_{PP} = Marginal\ Goals\ Per\ Point$
$SA_G = Shots\ Against\ Adjustment\ for\ Goalie$
$SA_{GT} = Shots\ Against\ Per\ Minute\ for\ Goalie$
$SA_{LT} = League\ Shots\ Against\ Per\ Minute$
$MG_{GA} = Marginal\ Goals\ Against\ for\ Goalie$
$T_G = Minutes\ Played\ by\ Goalie$
$GA_{LT} = League\ Shots\ Against\ Per\ Minute$
$GA_G = Goals\ Against\ for\ Goalie$
$T_{SP} = Proportion\ of\ Team\ Time\ on\ Ice\ for\ Skaters$
$T_{TS} = Team\ Time\ on\ Ice\ for\ Skaters$
$MG_{SP} = Proportion\ of\ Team\ Marginal\ Goals\ Against\ Assigned\ to\ Skaters$
$SA_{TT} = Team\ Shots\ Against\ Per\ Minute$
$SA_{LT} = League\ Shots\ Against\ Per\ Minute$
$PO_A = Positional\ Adjustment\ for\ Skaters$
$MG_{TA} = Team\ Marginal\ Goals\ Against$
$G_{LT} = League\ Goals\ Per\ Game$
$GT = Team\ Games$
$GA_T = Team\ Goals\ Against$
$PM_{SA} = Plus\backslash Minus\ Adjustment\ for\ each\ skater$
$PM_S = Plus\backslash Minus\ for\ each\ skater$
$PM_T = Team\ Plus\backslash Minus$
$MG_{SA} = Marginal\ Goals\ Against\ for\ each\ skater$

Appendix B: NHL Draft Trade Value Chart

Pick #	Value	Pick #	Value	Pick #	Value	Pick #	Value	Pick #	Value
1	1000.00	43	69.48	85	18.52	127	6.42	169	2.56
2	737.86	44	66.97	86	18.01	128	6.27	170	2.51
3	634.61	45	64.58	87	17.53	129	6.13	171	2.46
4	562.40	46	62.30	88	17.06	130	5.99	172	2.41
5	506.49	47	60.12	89	16.60	131	5.85	173	2.36
6	460.97	48	50.83	90	16.16	132	5.72	174	2.31
7	422.76	49	56.03	91	15.73	133	5.59	175	2.26
8	390.00	50	54.12	92	15.31	134	5.46	176	2.22
9	361.47	51	52.29	93	14.91	135	5.34	177	2.17
10	336.33	52	50.53	94	14.52	136	5.22	178	2.13
11	313.98	53	48.85	95	14.14	137	5.10	179	2.09
12	298.93	54	47.23	96	13.78	138	4.99	180	2.05
13	275.85	55	45.68	97	13.42	139	4.88	181	2.01
14	259.45	56	44.20	98	13.08	140	4.77	182	1.97
15	244.50	57	42.77	99	12.74	141	4.67	183	1.93
16	230.81	58	41.4	100	12.42	142	4.56	184	1.89
17	218.23	59	40.08	101	12.10	143	4.46	185	1.85
18	206.64	60	38.82	102	11.80	144	4.37	186	1.82
19	195.93	61	37.60	103	11.50	145	4.27	187	1.78
20	186.00	62	36.43	104	11.21	146	4.18	188	1.75
21	176.77	63	35.30	105	10.93	147	4.09	189	1.71
22	168.18	64	34.21	106	10.66	148	4.00	190	1.68
23	160.16	65	33.17	107	10.40	149	3.91	191	1.65
24	152.67	66	32.16	108	10.14	150	3.83	192	1.61
25	145.65	67	31.19	109	9.89	151	3.75	193	1.58
26	139.07	68	30.26	110	9.65	152	3.67	194	1.55
27	132.89	69	29.36	111	9.41	153	3.59	195	1.52
28	127.07	70	28.49	112	9.18	154	3.51	196	1.49
29	121.60	71	27.65	113	8.96	155	3.44	197	1.46
30	116.43	72	26.84	114	8.74	156	3.36	198	1.44
31	111.56	73	26.06	115	8.53	157	3.29	199	1.41
32	106.95	74	25.31	116	8.33	158	3.22	200	1.38
33	102.59	75	24.58	117	8.13	159	3.16	201	1.36
34	98.46	76	23.87	118	7.94	160	3.09	202	1.33
35	94.55	77	23.20	119	7.75	161	3.03	203	1.30
36	90.84	78	22.54	120	7.57	162	2.96	204	1.28
37	87.31	79	21.91	121	7.39	163	2.90	205	1.26
38	83.96	80	21.29	122	7.22	164	2.84	206	1.23
39	80.77	81	20.70	123	7.05	165	2.78	207	1.21
40	77.74	82	20.13	124	6.88	166	2.73	208	1.19
41	74.85	83	19.57	125	6.72	167	2.67	209	1.16
42	72.10	84	19.03	126	6.57	168	2.61	210	1.14

Appendix C: NHL Point Shares Value Chart

Pick #	Value	Pick #	Value	Pick #	Value	Pick #	Value	Pick #	Value
1	1000.00	43	153.90	85	85.95	127	56.38	169	40.04
2	647.91	44	151.26	86	84.97	128	55.88	170	39.74
3	566.03	45	148.70	87	84.01	129	55.39	171	39.44
4	513.31	46	146.22	88	83.08	130	54.90	172	39.15
5	474.13	47	143.82	89	82.16	131	54.42	173	38.86
6	442.94	48	141.48	90	81.26	132	53.95	174	38.58
7	417.08	49	139.21	91	80.37	133	53.48	175	38.29
8	395.03	50	137.01	92	79.49	134	53.02	176	38.01
9	375.84	51	134.86	93	78.64	135	52.57	177	37.74
10	358.90	52	132.78	94	77.79	136	52.12	178	37.47
11	343.76	53	130.75	95	76.97	137	51.67	179	37.20
12	330.11	54	128.78	96	76.15	138	51.24	180	36.93
13	317.68	55	126.86	97	75.35	139	50.80	181	36.66
14	306.31	56	124.99	98	74.57	140	50.38	182	36.40
15	295.84	57	123.17	99	73.79	141	49.96	183	36.14
16	286.15	58	121.38	100	73.03	142	49.54	184	35.89
17	277.14	59	119.64	101	72.28	143	49.13	185	35.63
18	268.74	60	117.96	102	71.54	144	48.73	186	35.38
19	260.88	61	116.31	103	70.82	145	48.33	187	35.13
20	253.49	62	114.70	104	70.10	146	47.93	188	34.89
21	246.55	63	113.12	105	69.41	147	47.54	189	34.64
22	239.99	64	111.59	106	68.72	148	47.16	190	34.40
23	233.78	65	110.08	107	68.04	149	46.78	191	34.16
24	227.90	66	108.62	108	67.37	150	46.40	192	33.93
25	222.31	67	107.18	109	66.71	151	46.03	193	33.69
26	217.00	68	105.78	110	66.06	152	45.66	194	33.46
27	211.94	69	104.41	111	65.42	153	45.30	195	33.23
28	207.10	70	103.07	112	64.79	154	44.94	196	33.01
29	202.49	71	101.75	113	64.17	155	44.59	197	32.78
30	198.07	72	100.47	114	63.56	156	44.23	198	32.56
31	193.83	73	99.21	115	62.96	157	43.89	199	32.34
32	189.77	74	97.98	116	62.37	158	43.55	200	32.12
33	185.87	75	96.77	117	61.78	159	43.21	201	31.90
34	182.13	76	95.59	118	61.21	160	42.88	202	31.69
35	178.52	77	94.43	119	60.64	161	42.55	203	31.48
36	175.05	78	93.30	120	60.08	162	42.22	204	31.27
37	171.70	79	92.18	121	59.53	163	41.90	205	31.06
38	168.47	80	91.09	122	58.99	164	41.58	206	30.86
39	165.36	81	90.02	123	58.45	165	41.26	207	30.65
40	162.35	82	88.98	124	57.92	166	40.95	208	30.45
41	159.44	83	87.95	125	57.40	167	40.64	209	30.25
42	156.62	84	86.94	126	56.89	168	40.33	210	30.05