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MLB Rule IV Draft: Valuing Draft Pick Slots

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Abstract

This study explored the Net Present Value (NPV) in dollar terms of draft pick slots in the Major League Rule IV Draft. In order to accomplish this, the cumulative performance of players selected in each slot within the draft was evaluated and brought to the Present Value of the time they were selected using a discount rate. The performance of the players was determined using the baseball-reference Wins Above Replacement (WAR) metric. It is intuitive that earlier draft picks are the most valuable; however, it is unclear how quickly the value of draft picks decline. This research demonstrates that the decline in NPV is rapid for the first 40 draft selections before the pace slows. Around the 116th selection, draft pick slots level off and experience little decline, as teams are less able to determine the value of the players' talents. There is substantial difference between the top 5 picks in the draft and the draft picks following the 116th selection, as the top 5 picks are worth in excess of $28 million each, while the later selections level off around $2 million each.

Introduction

Every season, Major League Baseball (MLB) organizations invest millions of dollars to identify and acquire the top amateur talent in the United States and Canada through the league's Rule IV draft. MLB teams devote money and resources to scout amateur talent in order to find the players that will be able to make an impact at the Major League level. These investments are certainly worthwhile, but the value of each slot in the draft is unknown.

The Amateur Draft is vital to Major League organizations as it is a source of cost-controlled players, who can help limit a team's payroll while still remaining competitive in the standings.[1] The first-year player draft, as it is sometimes called, is the MLB's method of allocating amateur talent to MLB teams. Players from high schools, junior colleges, 4-year colleges or other amateur clubs in Canada, the United States and its territories are eligible to be selected in the MLB Rule IV draft, which consists of 40 rounds. While the draft occurs in June, which is near midway through the MLB season, each team's draft order is decided based on the team's win-loss record from the previous season. Teams with the worse winning percentage from the previous year earn the first choice to select a player.[2]

Upon being selected in the draft, players can sign Minor League contracts and are able to negotiate signing bonuses of varying amounts.[3] Drafted players,

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[1] Cost-controlled players are players in their first six seasons in the Major Leagues, when they earn salaries below their market value. This will be explained in greater detail later in the paper.
[2] "First-Year Player Draft Rules." *Major League Baseball,* mlb.mlb.com/mlb/draftday/rules.jsp.
[3] Prior to 2012, drafted players could sign Major League contracts out of the draft, however, the new Collective Bargaining Agreement (CBA) in 2012 stipulates that teams can no longer sign players to MLB contracts out of the draft. For the purposes of this research, it was assumed that all players signed Minor League contracts, as this is the new rule for teams. MLB contracts for recently drafted players were always relatively rare, so this should not have affected the results.

however, are not obligated to sign with the team that drafts them and can, instead, choose to return to school or an amateur club and re-enter the draft the following year.[4]

The option for the players to refuse to sign and re-enter the draft in another year provides the player with greater leverage to help increase their signing bonuses. While this has always been a feature of the first-year player draft, it has taken on greater importance as signing bonuses have exploded in recent years. According to Joe Halverson of *Bleacher Report*, teams invested more than $200 million in bonuses during each of the 2009 and 2010 MLB Rule IV Drafts.[5] Signing bonuses have continued to rise since 2010, but so have the price of free agents, which makes it even more essential that clubs are able to select amateur players that can provide cost-controlled talent at the MLB level.

In addition to the rise in signing bonuses, MLB has instituted new draft rules that impose strict penalties on teams that exceed the allotted money in their bonus pool. In 2012, MLB created bonus pools for each team that limited the amount of money teams can give out to their draftees. These bonus pools are based on the amount of draft picks each team has and where those draft picks are located in the draft. Each slot in the first 10 rounds of the draft has a recommended signing bonus, but teams are able to move that money around to other draft picks as long as they do not exceed the total recommended amount for all of their draft picks. However, if a club fails to sign a draftee, they also lose his slot's recommended signing bonus

[4] "First-Year Player Draft Rules."
[5] Halverson, Joe. "Why the MLB Draft Is the Best Bargain in the Game." *Bleacher Report,* Bleacher Report, 2 Feb. 2011.

from their pool, which makes it very important that clubs sign each of their draftees within the first 10 rounds in order to have all of their bonus pool at their disposal. If the team exceeds their draft pool, they are harshly penalized.[6]

The implementation of the bonus pools increased the imperative that teams know the bonus expectations of the players they plan to draft, so they are able to properly allocate their entire bonus pool. Beyond considering the bonus expectations of the players, teams must also take into account many other factors when selecting amateur talent. Each organization will have differing preferences on the player's pedigree, position, performance, talent and proximity to the Major Leagues. Each of these characteristics is measured relatively subjectively, which leads to even larger variations in the valuations of these amateur players.

It is clear that an earlier draft pick is always more valuable than a later pick, as it provides the team with the opportunity to select their preferred player before anyone else. Although teams may not rank the players in the same order, they still value the draft picks in the same order. This seems relatively intuitive, but the aim of this research was to determine just how substantial the differences in the financial valuations are between each draft pick slot.

Among all the major sports drafts in the United States, the MLB Rule IV Draft is the most difficult for teams to identify players who will ultimately contribute at the highest level. Whereas, many athletes in other professional sports can immediately star at the pinnacle of their sport after being drafted, baseball expects players to develop their skills at the Minor League level before earning an

[6] Callis, Jim. "2018 MLB Draft Bonus Pools, Pick Values." *MLB.com,* 29 Mar. 2018, https://www.mlb.com/news/2018-mlb-draft-bonus-pools-pick-values/c-269930084

opportunity in the Major Leagues. On average, it takes draftees 3 years to earn a promotion to the Major Leagues, which demonstrates that there is much more randomness contributing to the success or failure of baseball players selected in the draft.[7] During their time in the Minor Leagues, players' skills can regress or stagnate for unpredictable reasons ranging from injury to outside pressures or simply from being overmatched at a higher level of competition. Likewise, players' skills can improve dramatically for unforeseen reasons related to commitment level, coaching or simply developing late, for example. For these reasons, it is very challenging to predict which players will succeed at the Major League level based on their performance as an amateur.

While there are few certainties when drafting a player, the potential to select a player who can succeed at the MLB level for a fraction of the cost of a similarly productive free agent makes the draft a very important opportunity for each team. The framework of MLB's pay structure increases the importance of the first-year player draft. Under the Collective Bargaining Agreement (CBA) between the 30 MLB organizations and the players' union, MLB teams control the rights of their players for the player's first six seasons in the Major Leagues.[8] While players are under team control, they are not able to become free agents, unless the club releases them. This feature of the CBA helps suppress the salaries of young Major League players. During the player's first three years in the Major Leagues, the team has the right to

[7] Murphy, Matthew. "The Net Value of Draft Picks." *The Hardball Times*, 22 May 2014.
[8] "2017-2021 Basic Agreement." *MLB Collective Bargaining Agreement. http://www.mlbplayers.com/pdf9/5450407.pdf*

only pay him the MLB minimum salary of $535,000, according to the CBA.[9] After accruing 3 years of service time, the player is under club control through the arbitration process, which offers the player an opportunity to increase their salary, but will still suppress his earnings below free agent value.[10] Throughout the arbitration process, a player earns about 44% of his market value in the first year of eligibility, 61% in his second year and 64% in his final year before free agency.[11] These discounts on the production of the young, controllable players are what make the Amateur Draft so important for MLB organizations.

In order to measure the performance of the Major League players, this research used the baseball-reference Wins Above Replacement (WAR) metric.[12] This statistic measures a player's value by comparing his performance to that of a replacement player, who is someone who could easily be promoted from the Minor Leagues. While some players promoted from the Minor Leagues can be quite successful, the baseline used for a replacement level player is generally considered to be a player that can be acquired for little cost and provides little-to-no value. WAR calculates how many wins a player is worth compared to a replacement level player based on how many runs he generates more than a replacement player. WAR is a very attractive statistic because it measures a player's complete performance,

[9] "2017-2021 Basic Agreement." *MLB Collective Bargaining Agreement.*
[10] Players that rank in the Top 22% of players in service time with between 2 and 3 years of MLB experience become eligible for arbitration a year early as a "Super 2" player, which gives them 4 years through the arbitration process. Super 2 players still cannot become free agents until they have accrued 6 years of service time at the Major League level. Players usually earn 31% of their market value in their first year of arbitration as a Super 2.
[11] Silver, Nate. "Lies, Damned Lies: Valuing Draft Picks." *Baseball Prospectus,* 25 Aug. 2005.
[12] "Baseball-Reference.com WAR Explained." *Baseball-Reference.com,* www.baseball-reference.com/about/war_explained.shtml.

which allows for an easy comparison of players regardless of position.[13] WAR is still the most holistic metric to measure the value of MLB players and has been used extensively in similar research.[14]

The aims of this research were to determine the value, in dollars, of each slot in the MLB Rule IV Draft and to determine what player characteristics contribute to their Net Present Value (NPV). The following research questions were addressed:

1. What is the NPV of each slot in the MLB Rule IV Draft?
    a. How much NPV did the best draft pick generate in these 10 drafts?
2. What player characteristics contributed to their NPV?
    a. Specifically, do position player or pitcher draftees generate the highest NPV?
    b. Do high school or college draftees generate the highest NPV?

By analyzing the varying levels of success from players selected at each pick in the draft and comparing their costs to the costs of similar production on the free agent market, the surplus value of each pick was established. Through this process, the present value of each draft pick in the MLB Rule IV Draft was determined.

[13] "Baseball-Reference.com WAR Explained."
[14] Ball, Andrew. "MLB Draft 2013: How Valuable Are Draft Picks?" *Beyond the Box Score,* Beyond the Box Score, 25 June 2013, www.beyondtheboxscore.com/2013/6/25/4457048/2013-mlb-draft-how-valuable-are-draft-picks

Literature Review

Both within the public and academic communities there are numerous studies that address the question of how to value draft picks. Bobby Hubley investigated the link between a draftee's signing bonus and his subsequent productivity in the Major Leagues.[15] Stephen Spurr analyzed the ability of teams to find talent in the MLB Draft.[16] John Burger and Stephen Walters explored the value of MLB draft picks based on the internal rate of return (IRR) generated by each draft pick slot.[17] IRR is a measure used to determine the profitability of possible investments. It finds the discount rate that would be necessary to generate a Net Present Value equal to zero. In general, a higher IRR is associated with a more attractive investment.[18]

Hubley looked at the link between a player's signing bonus from the first-year player draft and their subsequent productivity in the MLB.[19] In Hubley's study, he considered draft picks from the first 10 rounds of the MLB Rule IV Drafts between 1999 and 2009. In his analysis, he controlled for the round and draft pick number to isolate the effect of the draftee's signing bonus on his success at the Major League level.

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[15] Hubley, Bobby. "Signing Bonuses & Subsequent Productivity: Predicting Success in the MLB Draft." *Haverford College,* 2012.
[16] Spurr, Stephen J. "The Baseball Draft." *Journal of Sports Economics,* vol. 1, no. 1, 2000, pp. 66-85., doi:10.1177/152700250000100106.
[17] Burger, John D., and Stephen J. K. Walters. "Uncertain Prospects." *Journal of Sports Economics,* vol. 10, no. 5, 2009, pp. 485-501., doi: 10.1177/1527002509332350.
[18] "Internal Rate of Return – IRR." *Investopedia,* Investopedia, 26 Mar. 2018, www.investopedia.com/terms/i/irr.asp.
[19] Hubley, Bobby. "Signing Bonuses & Subsequent Productivity: Predicting Success in the MLB Draft."

In order to measure the productivity of the players selected in the draft, Hubley measured three variables: WAR, whether they made an MLB appearance and whether they made an All-star appearance. The values of WAR were measured in terms of cumulative WAR, which is the player's total WAR in their first six years of MLB service; discounted WAR, which is a weighted version of cumulative WAR using an 8% discount rate; and average WAR, which is the average WAR per season for the player's first six years of MLB service time.

In his analysis, Hubley removed players that changed teams before accruing six years of service time, which ensured all the players in the dataset were still with the team that drafted them. Throughout the research, Hubley performed linear regressions to determine the effect differing variables had on the productivity of draftees at the Major League level. The research showed a small, but statistically significant, positive relationship between a player's signing bonus and his productivity in the Major Leagues. This finding suggests teams are rational and successful in identifying to whom they should give larger signing bonuses. Among the other findings of the study, 33% of players in the dataset appeared in a MLB game, while only 4% made an all-star appearance in their first six seasons in the Major Leagues.[20]

In his analysis of the success rate of MLB draft picks, Spurr limited his analysis to the 1966-1968 and 1983 MLB Drafts.[21] Spurr chose to analyze the data from the years immediately following the inaugural year of the MLB Draft in 1965. He did not want to use the initial draft's results because it would likely have

[20] Hubley, Bobby. "Signing Bonuses & Subsequent Productivity: Predicting Success in the MLB Draft."
[21] Spurr, Stephen J. "The Baseball Draft."

irregular results as teams worked to determine the proper approach to the draft. Spurr explored the ability of teams to identify talent in the MLB Draft that would reach the Major Leagues. He also investigated the differences among high school and college players in their likelihood of earning a promotion to the MLB.

In some of Spurr's basic analysis, he looked at the percentage of players that eventually reached the Major Leagues based on the player's overall draft position and schooling. Spurr also employed probit regression analysis to determine which variables had a statistically significant relationship to a player's ability to reach the Major Leagues. He did not consider any other metrics of performance beyond whether the player eventually appeared in a Major League game, so the player's performance once on an MLB roster did not impact the analysis in any way.

Through his analysis, Spurr found that a player's overall draft position was the most significant predictor of whether the player eventually reached the Major Leagues. Spurr found that teams have improved their ability to find talent in the MLB Draft as demonstrated by the lowering of the median overall draft position of those players that eventually reached the Major Leagues. The probit regressions Spurr conducted found that no team was better or worse than any other team at identifying Major League talent through the draft. Another significant finding from Spurr's research was that college athletes were originally undervalued in the draft; however, the market eventually adjusted for this by the 1983 endpoint of the study and schooling appeared to be properly considered in drafting decisions.[22]

[22] Spurr, Stephen J. "The Baseball Draft."

The research conducted by Burger and Walters explored MLB Drafts from 1990-1997 in order to provide proper time for each player to develop in their careers.[23] To evaluate the value of each draft slot, Burger and Walters investigated the IRR on each player's signing bonus by using the production of players selected with that pick during the years of their study. In their analysis, Burger and Walters only considered a player to create value for his team if he became a "regular," "good" or "star" player. As cited in Burger and Walters' research, Jim Callis of *Baseball America* formed these buckets and placed each of the players drafted in the sample within one of these buckets or other buckets that were not considered significant enough to generate positive returns for their team.[24]

In order to evaluate a player's contributions, Burger and Walters (2009) used Bill James' Win Shares metric, which quantifies all the ways in which a player can contribute to his team into one statistic.[25] The Win Shares metric is similar to the WAR statistic used throughout this thesis. Burger and Walters used the historical performances of previous picks to determine the IRR of the signing bonus based on: the probability of the player reaching the Major Leagues, the length of time it usually takes to reach the majors and the annual value in excess of their salary that successful players deliver to their teams.

Through their research, Burger and Walters determined that the representative first round pick delivered an IRR of nearly 44%. This demonstrated that the successful first round picks far outweigh the failures of other first rounders.

[23] Burger, John D., and Stephen J. K. Walters. "Uncertain Prospects."
[24] Burger, John D., and Stephen J. K. Walters. "Uncertain Prospects."
[25] Burger, John D., and Stephen J. K. Walters. "Uncertain Prospects."

Among the other findings of the study, they discovered that the annual yield for high school draftees is far lower than collegiate draftees. Pitchers also delivered a lower annual yield than position players. As exhibited in other studies, they also found that returns declined in later rounds of the draft as the talent lessened.[26]

Although none of these research papers directly investigated the same question as the one this study addressed, they all provided valuable insights into the draft and player development system in the professional baseball industry. Hubley's study, especially, provided a helpful guide for analyzing the production of first-year player draft selections. Similar to Hubley's research, this analysis used a discount rate to weight earlier production more than later production. This paper, however, did not remove players who changed teams before they completed 6 years of service time in the Major Leagues. This research differed from Hubley's as it did not investigate the correlation between signing bonuses and performance; instead, it determined the value of each draft pick slot based on the production of previous draft picks at each slot. Spurr's study supported the need for this research by providing further evidence that later picks are worth far less than earlier picks, which is intuitive. His study also showed that college draftees have become properly assimilated into the market after initially being undervalued. Burger and Walters explored a similar question of the value of MLB Draft picks; however, they set out to determine the draft pick's IRR on his signing bonus, as opposed to his surplus value by calculating the player's NPV. This study did not bucket the players by their performance level as Burger and Walters did, instead it used the WAR metric to

[26] Burger, John D., and Stephen J. K. Walters. "Uncertain Prospects."

determine the player's value. In addition, the current study investigated more recent drafts than each of the previously discussed studies.

Data

The data analyzed in this research was collected from Baseball-Reference, which is an online website that houses historical baseball statistics for every MLB player and is widely used by major media outlets.[27] Baseball-Reference also has information on every MLB Draft, which made it a perfect resource for this analysis. This study investigated the MLB Rule IV Drafts between 2000 and 2009, which provided 10 years of drafts to analyze. These draft years were selected because they are both not too old and not too recent. Drafts that are too old can provide misleading conclusions because both the rules and strategies employed in the draft change, which can impact the results of the drafts. On the other hand, more recent drafts would not provide enough time for the draftees to reach the Major Leagues and accrue six years of service time.

The research assigned valuations to picks made during the first 10 rounds of the draft. This cutoff was used because these picks are often the most talented players and also the most likely to sign.[28]

During this analysis, only draftees that signed with the team that drafted them were considered. If the player was drafted multiple times, their draft position and other variables were only studied from the time they signed. After removing all instances where the draftee did not sign, there were 2,944 draft selections remaining. Of these 2,944 players, 1,972 attended college, either a 2-year college or

[27] "Baseball-Reference.com." *Wikipedia, Wikimedia Foundation,* 10 Apr. 2018, en.wikipedia.org/wiki/Baseball-Reference.com.
[28] If a team fails to sign a draft pick from the first 10 rounds, the team loses the signing bonus allotment for that pick, which will shrink their available bonus pool size. For this reason, most teams draft players they are confident will sign.

a 4-year college. The remaining 954 draftees were selected out of high school. Among the players considered for this analysis, 1,503 were pitchers at the time of their selection, while 1,441 were position players. This preference for selecting pitchers was not surprising given the higher rate of attrition among pitchers.

Baseball-Reference provided the list of draft picks in the order they were selected as well as some other very meaningful variables. Among the other variables considered throughout this analysis were the player's position at the time of the draft, the team that selected the player, what education level he had prior to being selected, how long it took the player to appear in an MLB game, whether the player eventually completed his initial years of earning the league minimum salary and whether the player eventually earned enough service time to reach free agency. Additionally, Baseball-Reference also provided the player's WAR for each of his first six MLB seasons.

One of the most significant statistics throughout this analysis was WAR, which was involved in multiple variables in this research. The first variable that it factored into was the draftee's WAR during his first six seasons of team control (ControlWAR). The WAR of each season of every draftee's time in the Major Leagues was also considered by analyzing each player's WAR for each year removed from the MLB Draft (Y0, Y1, Y2, etc.). "Y0" denotes the season the player was drafted and in rare instances was the season the player made his MLB debut.

As referenced in the introduction, WAR compares a player's performance to that of a replacement level player, who is someone that can easily be called up from the Minor Leagues and provide no value to the team, either positively or negatively.

Baseball-Reference and Fangraphs.com, who both agree on the same replacement level benchmark, have calculated this baseline for replacement level. After calculating the number of runs a Major Leaguer creates above average, the number of runs a replacement level player generates are added to determine how many runs the player generates above the replacement player. This figure is then divided by the number of runs to earn a win, which is typically 10 runs per win.[29, 30] WAR was a very appealing statistic for this analysis because it includes adjustments for the league a player plays in, position played and accounts for all aspects of a player's game, including, offense, defense, base running and pitching.[31] All of these aspects of the statistic make it the best metric for evaluating a player's worth across positions and over different time periods because it accounts for the numerous ways that players can add value to their team. WAR is not a perfect statistic, by any means, and can misrepresent the contributions of certain players. As a context neutral statistic it can fail to properly evaluate relief pitchers, who often pitch in high-leverage situations. However, it was the best all-encompassing statistic to use for this analysis and served as a very good evaluation tool throughout this research.

Figure 1 below displays the relationship between WAR in a player's first six seasons in the Major Leagues and his overall draft position. As the plot shows, there is a lot of noise in the data, as many later picks performed better than earlier picks. While it is clear that later picks can, in some instances, outperform earlier picks, it is

[29] In this context, runs include contributions to create runs for a team as a hitter, but also to prevent runs as a defensive player or pitcher. For this reason, 10 runs approximating a win is not unexpected and has remained relatively consistent over the years.
[30] "Baseball-Reference.com WAR Explained."
[31] "Baseball-Reference.com WAR Explained."

also apparent that earlier picks are generally the more productive and valuable asset.

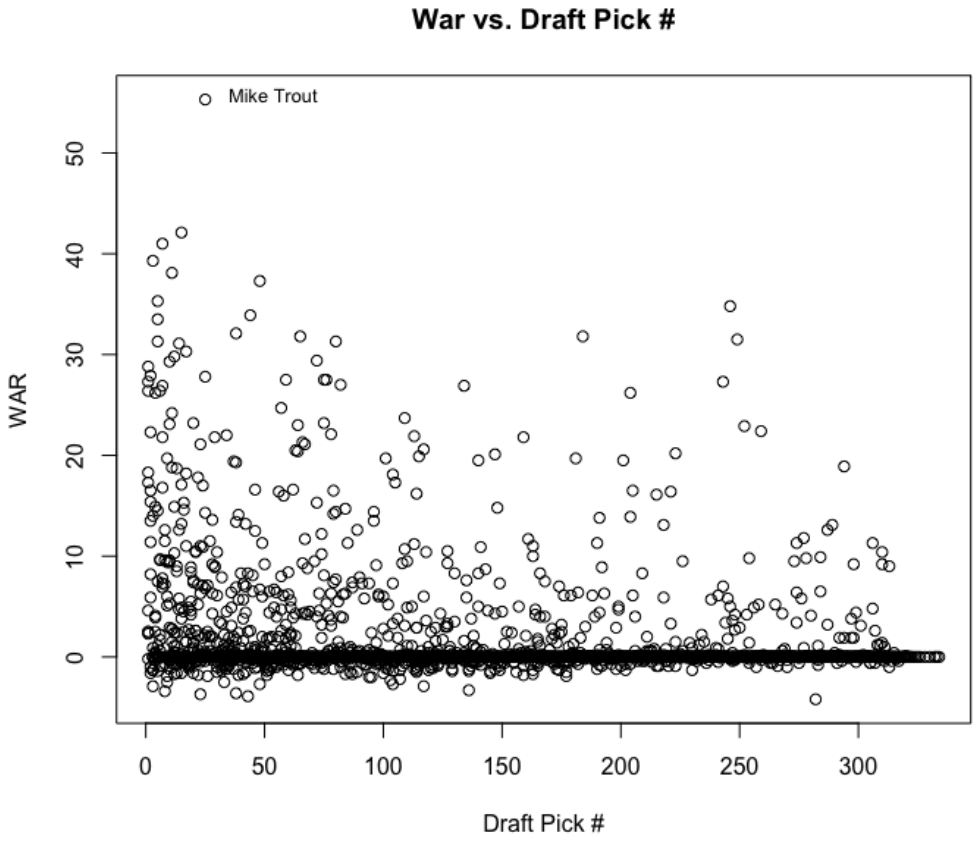

Figure 1

In an effort to smooth the plot of this scatterplot and better understand the shape of this data, a local regression (LOESS) was conducted to smooth the scatterplot by locally weighting the data. The LOESS method does not make any assumptions about the form of the relationship; instead, it allows the shape to be discovered using the data. Figure 2 below shows the results of the LOESS and displays that earlier picks are expected to produce more WAR than later picks; however, the decline is less steep after the 100th selection and levels off around the 150th selection.

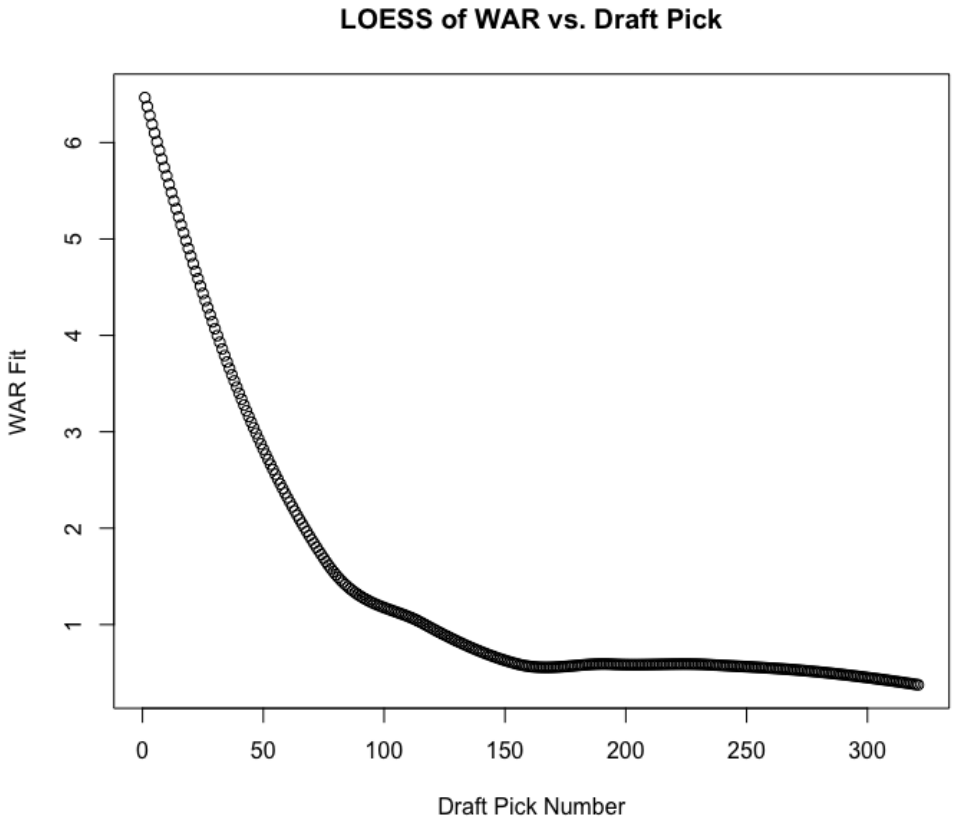

Figure 2

Beyond WAR, another numeric variable used during this analysis was the amount of time it took the draftee to reach the MLB after being drafted (Debut Year). The variable measured how many years passed before the player first appeared in an MLB game. In this analysis, the first year after the draft was Y1, so a player that debuted the same season they were drafted had a "Debut Year" equal to 0. For the calculations of the mean number of years that it took a player to reach the Major Leagues, a value of 1 must be subtracted from the mean in order to account for the fact that the variable counts the debut year as a year that has passed since the draft, although this was the same year as the draft, so the time in the Minor Leagues was equal to their debut year minus 1.

Along with these numeric variables, there were also various binary variables used throughout this research. For all of these variables, a value of 0 denoted a "no" response and a value of 1 denoted a "yes" response. The first binary variable was whether the draftee attended some level of college before entering the draft. This variable equates junior college experience with 4-year college experience as a way of separating high school draftees from the rest of the population. The next binary variable was whether the draftee eclipsed three years of service time in the Major Leagues or earned "Super Two" status to reach the arbitration process (Cleared Minimum). This variable was used to determine how many of the players in the sample not only reached the Major Leagues, but also remained in the Major Leagues for an extended period. The final binary variable was whether the draftee surpassed his six seasons of team control to earn free agency (Cleared Arbitration). Similar to the Cleared Minimum variable, this statistic aimed to see how many of these draftees were able to contribute enough at the Major League level to continue to hold a roster spot for a significant amount of time and allow their team to receive the maximum amount of value from their selection.

Other control variables that were considered throughout the analysis were the team that drafted the player (TM), the year the player was selected (YR), the round the player was selected (RD), his pick number within that round (RdPck), his overall draft pick number (OvPck), the level of school he attended before being drafted (School) and the position he played when drafted (POS). Table 1 below displays some of the descriptive statistics for variables used during this study.

Table 1

Descriptive Statistics of Variables Included in Analysis (n = 2944)

Variable	Description	Mean (sd)	% Dummy equal to 1	% Dummy equal to 0
ControlWAR	Total WAR under team control, if reached Majors	3.9 (7.5)		
College	1 means attended College		67.4	32.6
Debut Year	Years between draft and debut	3.02 (1.8)		
MLB	1 means they appeared in MLB		36.2	63.8
Cleared Minimum	1 means they reached Arbitration		16.1	83.9
Cleared Arbitration	1 means they reached Free Agency		9.4	90.6
Pitcher	1 means they were drafted as a pitcher		51.1	48.9

Methodology

In order to calculate the NPV of each draft pick slot, this research conducted typical NPV calculations, using the initial cost, a discount rate, the cash flows generated, a variable of time, and the variable costs of paying the salaries of the player.

The NPV Formula:

$$\left(\sum_{t=0}^{N} \frac{CF}{(1+d)^t}\right) - VC - SiBo$$

The initial cost for these calculations was the signing bonus each draftee received upon signing with the team that selected him. For this research, the assumed signing bonus was the 2018 bonus recommended by Major League Baseball for that selection.[32] In the formula above, the initial investment of the signing bonus is denoted by "SiBo" as a negative value because it was a cost to the team.

In order to account for the fact that teams would not realize the cost benefits of the controllable players immediately, it was necessary to bring the value of the draft picks to the present time. By implementing a discount rate, this research was able to analyze the present value of each draft pick slot. The discount rate was typically the cost of acquiring capital to invest. In this instance, the clubs would be measuring the cost to acquire capital in order to invest in young draftees. This analysis conducted the calculations with two discount rates because it is not clear what the cost of capital is for privately-held baseball teams. The use of two different

[32] Callis, Jim. "2018 MLB Draft Bonus Pools, Pick Values."

discount rates helped demonstrate the impact differing discount rates have on the valuations of draft pick slots and set a range of NPV of draft pick slots. It is marked in the formula as "d" in the denominator as it was used to lower the market value to present value.

While the WAR metric put a value on a player's performance in terms of the amount of wins they were worth, it was necessary to assign a dollar value per WAR. This dollar value from their WAR each season constituted the cash flow in the NPV calculations. According to research by Matt Swartz, one unit of WAR costs $9 million on the free agent market.[33] While the cost of one unit of WAR is often increasing with inflation, especially as more money flows into the game, Swartz's calculations are the most updated figures and fit the pattern of previous similar research.[34] Swartz's research also claimed the cost of a win is linear, which means teams pay the same amount per win for a 2-WAR player as they do for a 4-WAR player. This allows for $9 million figure to be used to calculate the value of all players in these drafts compared to players on the free agent market.

In order to calculate the production from each draft slot, this research measured the amount of wins generated from each slot for each season until they eclipsed 6 seasons in the Majors and computed the value of that production on the free agent market using the $9 million per WAR figure. These annual values served as the cash flow generated by each player in the NPV formula. In the NPV formula above, "CF" signified the value that each player generated on an annual basis. This is

[33] Swartz, Matt. "The Linearity of Cost per Win." *Fangraphs Baseball*, 14 July 2017.
[34] Creagh, Kevin, and Steve DiMiceli. "MLB Prospect Surplus Values – 2016 Updated Edition." *The Point of Pittsburgh,* 27 Mar. 2018.

not a constant number, as it changed depending on the production of each player and how they performed each year following the draft.

The variable of time used in the NPV formula was simply the number of years after the draft in which the player was selected. Denoted as "t" in the NPV formula, time was a significant variable in bringing the player's value back to present day because each year removed from the draft lowered the value of the draftee's production.

For this analysis, the variable cost for the production of each player was 31% of the player's market value. A player's market value was constituted by the amount of value he generated while under team control before accounting for any of the costs. The 31% figure for the variable costs was estimated by Andrew Ball at *Beyond the Box Score* and accounts for the draftee's salaries while under team control.[35] In his first three seasons of service time, the player can earn as little as the league minimum salary of $535,000. For his remaining seasons of service time, the draftee's salary is determined through arbitration, which still suppresses the player's value below his free agent market value. Throughout his first 6 seasons in the Majors, the player can expect to earn 31% of his market value. These variable costs were represented by "VC" in the NPV formula above.

After calculating the market value of the player, the variable costs and initial investment of the signing bonus were subtracted from the market value in order to find the NPV of the player. This NPV was considered the draft pick's surplus value because it was the value he generated in excess of his costs.

[35] Ball, Andrew. "MLB Draft 2013: How Valuable Are Draft Picks?"

In an effort to lessen the impact of outliers, the draft picks were grouped into buckets in order to add more players into each bucket, so each performance was weighted less heavily. This created a greater sample of similar talent to calculate a more accurate NPV of each range of draft picks. The initial investment of the signing bonus was the average of the 2018 recommended signing bonus for the picks in the bucket. The buckets initially consisted of 5 draft picks in order to generate a sample of approximately 50 observations, depending on how many draftees signed with their team. After the 30th selection, which is typically the conclusion of the 1st round in the Rule IV Draft, the bucket sizes increased to 10 draft picks each year in order to account for the increased likelihood that draftees will fail to reach the Major Leagues. An increase to 15 draft picks per bucket occurred after the 100th selection in the draft and an increase to 20 draft picks per bucket happened after the 220th selection in the Rule IV Draft. By increasing the size of the buckets it helped prevent outlier performances from having too significant an effect on the calculations.

Empirical Analysis

As discussed above, this study calculated the Net Present Value (NPV) of draft pick slots in the MLB Rule IV Draft by conducting discounted cash flow analysis on the performances of previous draftees. While it is intuitive that earlier draft picks carry a higher value because they offer a larger talent pool, it is not always the case that they generate the greatest production. Within the MLB Rule IV Draft it is very difficult to predict the best performers because players are often several years away from the Major Leagues and still require significant development. Throughout these development periods, many factors can impact a player's career trajectory including injury, regression of skills or a significant progression of talent. For this reason, success rates among Rule IV draft picks is very low, as many selections do not reach the pinnacle of their sport, and even more do not experience success at the highest level. It is imperative that the performances of successful draft picks provide sufficient value to make up for the low success rate. This analysis explored exactly how valuable these draft picks were and why the MLB Rule IV Draft is such an important feature for MLB teams to acquire inexpensive talent, even as signing bonuses increase.

Before diving into the main analysis, it was important to conduct a linear regression to identify the most statistically significant variables in predicting a draftee's WAR through his first 6 seasons of team control and to learn just how difficult it is to identify the top talent. The formula below represents the Ordinary Least Squares (OLS) Regression model used to see the impact player characteristics and drafting team have on a draftee's WAR during his first six MLB seasons.

$$WAR_1 = a_1 + B_1 OvpPk + \ B_2 Educ + B_3 TM + B_4 Pos$$

In this equation, *WAR* refers to the draftee's total WAR during his years of team control. *OvPck* denotes the number draft pick with which the player was selected in the draft, *Educ* is a variable that controlled for the draftee's education level prior to being selected, *TM* controlled for the team that selected the draftee and *Pos* controlled for the position the draftee played at the time of being selected. This equation isolated the effects of each of these variables on *WAR* in order to determine which variables had a statistically significant effect. Players that fail to reach the Major Leagues do not accumulate any WAR. For this reason, this equation removed players that never appeared in the Major Leagues from the analysis to only consider players that have appeared in an MLB game. While it further limits the sample, it still provided sufficient data points to gain an accurate understanding of the factors that influence a draftee's WAR while under team control.

This model had very little predictive power, as few variables were statistically significant; however, the draft pick slot was statistically significant ($p<.01$) as was the intercept. A one-unit increase in the OvPck number decreased the draftee's predicted WAR by .0149, which may seem insignificant; however, this decline becomes significant as the draft progresses to later picks. The positions of both left-handed pitchers and right-handed pitchers were also statistically significant ($p<.01$). Both pitcher groups led to two of the three highest declines of wins for any position based on the model, and were the only position variables that were statistically significant ($p<.01$). Education level and the drafting team did not carry statistical significance. With little predictive power in the variables it was not

surprising the model offered a meager R^2 of .07112. This R^2 means that just over 7% of the variance in a player's WAR during his first six seasons can be explained by the variables in this model. This low R^2 demonstrates just how difficult it is to predict successful Major League players as amateurs. Despite these difficulties, there is still significant value to be found throughout the draft.

As discussed previously, there is little empirical basis for choosing a discount rate for privately-held Major League teams. Therefore, two discount rates were used to provide a reasonable range for the value of draft picks. Table 2 below shows just how valuable these draft picks were when using a 10% discount rate. As explained earlier, the 10% discount rate was fitting because it provided a high estimation of the discount rate that teams may employ. This high estimation of the discount rate used to lower the value of draftees shows the low end of the potential range of values that draftees can create depending on the discount rate.

Table 2
NPV by Draft Pick Bucket using a 10% Discount Rate

	Bucket	Years To Debut	WAR	Market Value ($m)	Variable Cost ($m)	Signing Bonus ($m)	NPV ($m)
1	1-5	1.7	9.4	50.8	15.8	6.9	28.1
2	6-10	1.6	6.9	38.4	11.9	5	21.5
3	11-15	2	6.4	32.8	10.2	4	18.6
4	16-20	2.6	3.6	17.8	5.5	3.4	8.9
5	21-25	2.5	4.7	24.9	7.7	2.8	14.4
6	26-30	2.5	2.5	12.5	3.9	2.4	6.2
7	31-40	3.2	1.8	8.8	2.7	1.9	4
8	41-50	2.6	2	9.4	2.9	1.6	4.9
9	51-60	3.2	1.6	7.8	2.4	1.2	4.2
10	61-70	3.2	2.4	12.4	3.8	0.9	7.7
11	71-80	2.8	3.4	16.8	5.2	0.8	10.8
12	81-90	2.9	1.2	5.7	1.8	0.7	3.2
13	91-100	3.2	0.8	3.6	1.1	0.6	1.9
14	101-115	3.3	1.5	7	2.2	0.5	4.3
15	116-130	3.5	0.6	2.9	0.9	0.4	1.5
16	131-145	4	0.7	2.9	0.9	0.4	1.6
17	146-160	3.3	0.6	2.6	0.8	0.3	1.5
18	161-175	2.9	0.6	2.9	0.9	0.3	1.8
19	176-190	3.3	0.7	3.1	0.9	0.3	1.9
20	191-205	3.2	0.9	3.9	1.2	0.2	2.5
21	206-220	3.6	0.4	1.6	0.5	0.2	0.9
22	221-240	3.7	0.4	2.3	0.7	0.2	1.4
23	241-260	3.4	1.5	7.3	2.3	0.2	4.9
24	261-280	2.9	0.5	2.3	0.7	0.1	1.4
25	281-300	3.8	0.6	2.7	0.8	0.1	1.7
26	301-321	3.2	0.4	1.9	0.6	0.1	1.2

Table 2 shows that the first five draft pick slots each generated a NPV of $28.1 million dollars. An NPV of nearly $30 million is equivalent to a season's salary

of an elite free agent player. Acquiring enough surplus value through the draft can provide teams with the financial flexibility to pursue key free agents to complete their rosters. Table 2 above also makes clear that earlier selections often reach the Major Leagues sooner than later picks, which helps to increase their NPV. As Table 2 illustrates, draftees do not have to provide immense production at the MLB level to create surplus value for the team that selected them. With a low cost of acquisition, the level of production necessary to surpass their initial costs is very low.

While each pick generated surplus value, it was also clear that earlier picks are far more valuable than later picks, despite a higher cost of acquisition. Figure 3 below plots the NPV of each bucket to show how quickly the draft picks lose value, as the initial picks generated far greater returns than later picks. The red line in Figure 3 shows the general line of best fit, which gives a clear indication of the negative relationship between a draftee's NPV and his draft pick slot. However, because the relationship was not linear, the red line was not an accurate representation of the general decline for each draft pick. Instead, the blue line better fits the relationship of the data. The blue line is similar to the LOESS model referenced earlier and shows a similar pattern of decline in production based on their draft pick number. This blue line demonstrates how steep the decline was after each early selection and also shows the fact that there was little difference in the value of draft picks after the 116th selection in the draft. This was likely due to the difficulty in predicting players that were farther away from the Major Leagues. A select few individuals are clearly ahead of the rest of the draft class in terms of talent and projection, but it became much more difficult to differentiate the talent

and potential of the draftees after the 116th selection. After this draft slot, the majority of draft pick slots generated a NPV of around $2 million with some selections offering greater returns based on impressive performances of a few draftees at these picks. Initially, there was a precipitous decline in NPV between buckets until about the 40th selection, where the difference in NPVs dropped.

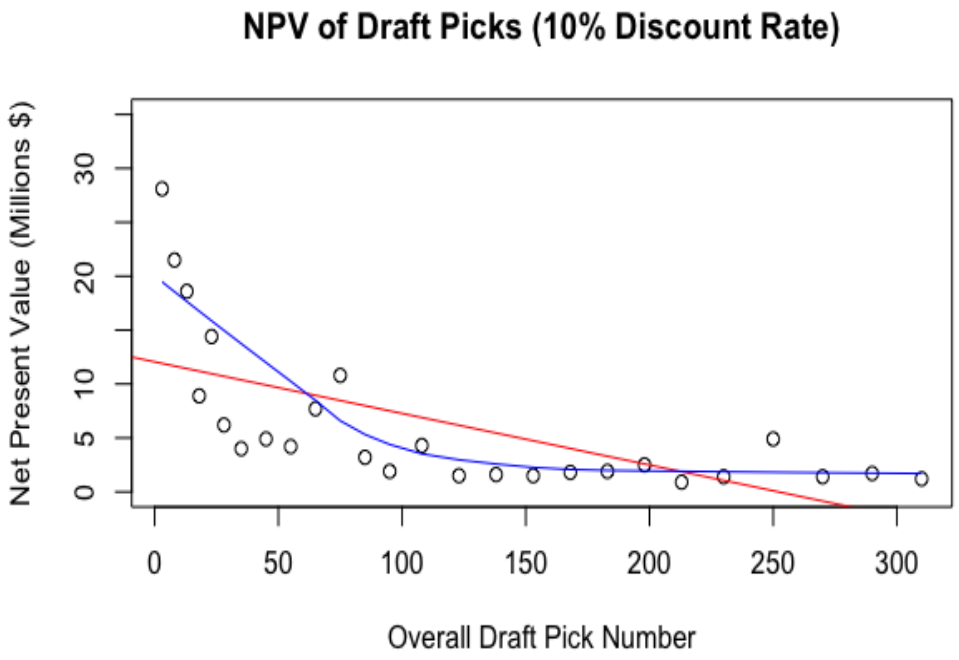

Figure 3

While 10% provided a very applicable evaluation of the MLB discount rate, it was important to consider how the value of draft pick slots changed based on the team's discount rate. The 5% estimation of the discount rate helped display the higher end of the range of values draftees can generate while under team control.

Table 3 below displays the NPV of each draft pick bucket using a 5% discount rate and provides a reasonable range that the two discount rates create on the NPV.

Table 3
NPV by Draft Pick Bucket using a 5% Discount Rate

	Bucket	Years To Debut	WAR	Market Value ($m)	Variable Cost ($m)	Signing Bonus ($m)	NPV ($m)
1	1-5	1.7	9.4	64.8	20.1	6.9	37.8
2	6-10	1.6	6.9	48.6	15.1	5	28.5
3	11-15	2	6.4	43.1	13.4	4	25.7
4	16-20	2.6	3.6	23.7	7.4	3.4	13
5	21-25	2.5	4.7	32.1	9.9	2.8	19.3
6	26-30	2.5	2.5	16.6	5.1	2.4	9
7	31-40	3.2	1.8	11.8	3.7	1.9	6.2
8	41-50	2.6	2	12.9	3.9	1.6	7.3
9	51-60	3.2	1.6	10.5	3.2	1.2	5.9
10	61-70	3.2	2.4	16.2	5	0.9	10.2
11	71-80	2.8	3.4	22.3	6.9	0.8	14.6
12	81-90	2.9	1.2	7.6	2.4	0.7	4.6
13	91-100	3.2	0.8	4.9	1.5	0.6	2.8
14	101-115	3.3	1.5	9.5	2.9	0.5	6
15	116-130	3.5	0.6	3.9	1.2	0.4	2.2
16	131-145	4	0.7	4.2	1.3	0.4	2.5
17	146-160	3.3	0.6	3.6	1.1	0.3	2.1
18	161-175	2.9	0.6	4	1.2	0.3	2.5
19	176-190	3.3	0.7	4.3	1.3	0.3	2.7
20	191-205	3.2	0.9	5.6	1.7	0.2	3.6
21	206-220	3.6	0.4	2.3	0.7	0.2	1.4
22	221-240	3.7	0.4	3	0.9	0.2	1.9
23	241-260	3.4	1.5	9.8	3.3	0.2	6.6
24	261-280	2.9	0.5	3.2	0.9	0.1	2.1
25	281-300	3.8	0.6	3.8	1.2	0.1	2.5
26	301-321	3.2	0.4	2.5	0.8	0.1	1.6

The NPV calculations increased significantly for the earlier picks, as their market value spikes from the lowered discount rate, which increased their variable

cost, but not by enough to negate the increase in their market value. The NPV of the first bucket increased to a value of $37.8 million, a rise of nearly $10 million. The nearly $10 million surge was good for a growth of over 34%. As part of MLB free agency, many of the league's best free agent talents have draft pick compensation attached to them that requires the signing team to forfeit a draft pick.[36] While the penalty for signing a free agent with draft pick compensation attached is not as steep as it used to be, the cost can still exceed $10 million in present value, which is no small price tag.

The draft pick buckets helped to increase the sample size under review. However, it was also important to evaluate the production of the 1st overall selection in the draft. The overall NPV of the 1st overall selection was $36.5 million when using a 10% discount rate, but increased to $51.1 million when using a 5% discount rate. Despite this impressive sum, the 1st overall selection did not generate the highest NPV in the years of this research. Instead, the 5th overall selection was worth $41.3 million of NPV using a 10% discount rate and was worth $53.2 million when using a 5% discount rate. Despite the higher NPV coming from the 5th overall draft pick, the 1st overall pick still had the greater value, as each 1st overall selection could have chosen the players selected with the 5th pick. In a small sample of 10 draftees for each selection, it was not possible to conclude that players selected 5th overall are more productive than players selected 1st overall. The higher value of the 5th overall selection in the draft was likely due to chance within this sample and a

[36] Previously, teams that signed a free agent with draft pick compensation were required to sacrifice their earliest selection, unless they were one of the Top 10 picks in the draft. Currently, however, clubs have differing penalties depending on their payroll status, but the harshest penalty is the loss of a team's second-highest and fifth-highest selections.

consequence of the limited sample size of 10 drafts. It is also important to note that under the new draft rules that impose harsh penalties for exceeding draft spending, it is very valuable to have higher picks that are accompanied by higher spending bonuses, which can be allocated to other picks as well. The similarity in the values of the 1st and 5th overall draft picks demonstrated that there was not a significant decline in value between the picks and lends credence to the use of the first bucket including each of the first 5 draft pick slots.

The most valuable player selected during this period of MLB drafts was Mike Trout, who was selected 25th overall in the 2009 draft. In his first 6 seasons in the Major Leagues, Trout was worth 55.3 WAR and generated a NPV of over $208 million using a 10% discount rate and the methods employed throughout this research. This amount of value was enormous and provided his team the flexibility to pursue many expensive free agents to help complete their roster. While this level of production is never the expectation when selecting a player in the MLB Draft, it serves to show the immense payoff that teams can receive.

While the initial objective of this thesis was to determine the NPV of draft pick slots, it was also valuable to analyze the values created by different subgroups of players. The first groups compared were position players and pitchers, as it was interesting to see if one group of players was more valuable in terms of NPV. The dataset considered for this research included 1,441 position players and 1,503 pitchers. Both position players and pitchers averaged right around three years to reach the Major leagues, with position players taking slightly longer at 3.1 years compared to the pitcher's duration of 2.9. While their developmental times were

similar, their NPV were not. Position players outpaced pitchers in value with an NPV of $5.8 million, while pitchers generated $3.9 million of value.[37] This discrepancy was not surprising, as pitchers are far more likely to be injured, which can hinder their development and lower their NPV. While WAR does not consider the context of a situation and can therefore misrepresent the contributions of relief pitchers, who garner much of their value from pitching in high leverage situations, this likely did not have a significant impact on these calculations. It was also unsurprising that position players outpaced pitchers in terms of NPV because the linear regression conducted for this research also found that pitchers experienced a statistically significant decline in WAR from the intercept that was steeper than the decline for position players.

The next groups analyzed were college draftees and high school draftees. Within the sample analyzed for this research, there were 1,972 players selected from a college program and 954 selected out of high school. Despite the preference for college draftees, it was actually the high school players that provided the higher NPV. While high school players took about a year and a half longer than college draftees to debut in the Major Leagues, they still generated greater present value, at $5.4 million compared to $4.6 million from college draftees.[38] The better production from high school draftees was likely due, at least in part, to the fact that the most talented baseball players are typically selected out of high school, while players that need more development and lack some of the natural tools go on to play in college to further develop and showcase their skills. While high school draftees were

[37] These NPV calculations do not consider the price of the signing bonuses for each position type.
[38] These NPV calculations do not consider the price of the signing bonuses for each position type.

generally considered riskier than college draftees, their 50th percentile of WAR under team control surpassed that of college draftees.

It is not only draftees like Trout that make the MLB Draft so valuable for teams, but it is also the many players that eventually reach the Major Leagues and help their teams as they earn suppressed salaries. Despite the failures of so many draftees to ever reach the pinnacle of their sport, the performances of those that do make the Majors generate enough value to make up for the lack of production from others.

Conclusion

The MLB Rule IV Draft is a valuable process to provide each team with impactful talent that can be acquired at a significant discount to his actual worth. This potential for discounted production comes with the significant risk that the draftee will never reach the Major Leagues and reward his club; however, it is clearly a risk that each team is more than happy to make. The true value of the draft pick slots is important to quantify, especially with the impact draft pick compensation has had on the contracts of free agents. As MLB has altered their rules on free agent draft pick compensation, it was necessary to expand upon previous research and include all draft pick slots within the draft's first 10 rounds.

The production of previous draft picks in the first 5 selections generated a NPV equivalent to that of an elite free agent's annual salary. While this level of value does not last long beyond the first 5 picks, the first 25 selections all provide NPV comparable to an average or better MLB player's annual salary in free agency. While the value of draft picks quickly declines until about the 40th selection, when its fall slows, until about the 116th selection when it levels off, there is still significant value to be acquired through these picks. Draft picks after the 116th selection often generated NPV in excess of $1.5 million, with a high of $4.9 million using a 10% discount rate. These levels of surplus value can be used by the organization to further entice free agents or to add quality role players to fill out their rosters. Significant production is not necessary from draftees in order to generate meaningful surplus value for their organizations.

The findings of this research demonstrate the significant value generated by successful draft picks, with the most valuable player selected generating an NPV of over $208 million. While few draftees will ever be this valuable, there is still plenty of opportunity to find surplus value in the draft. As free agent prices continue to rise, the MLB Rule IV Draft will continue to be even more valuable for MLB organizations looking to remain in contention for many years.

Future research on the value of draft pick slots can expand on this research by determining the salvage value of draft picks. Salvage value is the value of an asset at the end of its useful life.[39] In the context of draft picks, it refers to their value when they do not perform well at the Minor League level, but can still be traded away for other assets. For instance, what is the trade value of the first overall pick if the draftee struggles in the Minor Leagues? Many prospects struggle to acclimate to professional baseball, but they often still have value because other clubs believe in their talent, especially if they were selected early in the draft.

[39] "Salvage Value." *Investopedia,* Investopedia, 9 Jan. 2015, https://www.investopedia.com/terms/s/salvagevalue.asp

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Appendix

Linear Regression Output:

lm(formula = Arb_WAR ~ OvPck + School + TM + Pos)

Residuals:

Min	1Q	Median	3Q	Max
-12.103	-4.319	-2.239	1.646	43.157

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	10.116510	1.751223	5.777	1.01e-08	***
OvPck	-0.014859	0.002671	-5.563	3.40e-08	***
School	-0.197147	0.266613	-0.739	0.45981	
TMAstros	-1.123056	1.945312	-0.577	0.56386	
TMAthletics	-2.440156	1.687584	-1.446	0.14850	
TMBlue Jays	-2.386729	1.735035	-1.376	0.16925	
TMBraves	-1.272018	1.722807	-0.738	0.46048	
TMBrewers	0.387404	1.850739	0.209	0.83424	
TMCardinals	-1.746820	1.728425	-1.011	0.31243	
TMCubs	-0.697335	1.758752	-0.396	0.69182	
TMDevil Rays	0.005256	1.836812	0.003	0.99772	
TMDiamondbacks	-1.080569	1.627331	-0.664	0.50683	
TMDodgers	-1.347240	1.846848	-0.729	0.46588	

TMExpos -1.193840 2.149043 -0.556 0.57866

TMGiants -1.316354 1.676014 -0.785 0.43240

TMIndians -2.656755 1.820700 -1.459 0.14482

TMMariners -1.908734 1.872065 -1.020 0.30817

TMMarlins -2.257873 1.769175 -1.276 0.20217

TMMets -2.264523 1.828534 -1.238 0.21584

TMNationals -0.394187 2.040828 -0.193 0.84688

TMOrioles -2.584948 1.782171 -1.450 0.14724

TMPadres -2.526729 1.744347 -1.449 0.14778

TMPhillies -0.562305 1.804842 -0.312 0.75544

TMPirates -1.182046 1.787887 -0.661 0.50867

TMRangers -1.865968 1.822134 -1.024 0.30605

TMRays -3.899329 5.395060 -0.723 0.46999

TMRed Sox -0.294691 1.703847 -0.173 0.86272

TMReds -0.350759 1.811468 -0.194 0.84650

TMRockies -1.565193 1.792213 -0.873 0.38269

TMRoyals -0.586581 1.792871 -0.327 0.74360

TMTigers -2.305370 1.749241 -1.318 0.18783

TMTwins -0.156525 1.840852 -0.085 0.93226

TMWhite Sox -4.288926 1.790323 -2.396 0.01677 *

TMYankees -1.610446 1.731963 -0.930 0.35268

Pos2B -1.404572 1.612738 -0.871 0.38400

Pos3B -0.974083 1.413082 -0.689 0.49077

```
PosC         -2.792453   1.361036  -2.052  0.04045 *
 PosCF        2.594766   2.431532   1.067  0.28617
PosIF        6.546110   7.584601   0.863  0.38830
PosLF       -6.297861   4.468419  -1.409  0.15902
PoslHP       8.064077   5.427304   1.486  0.13763
PosLHP      -3.503926   1.238351  -2.830  0.00475 **
 PosOF       -2.293230   1.254825  -1.828  0.06791 .
PosRF       -2.200062   5.426982  -0.405  0.68527
PosRHP      -3.237520   1.171406  -2.764  0.00582 **
 PosSS       -3.022921   1.313721  -2.301  0.02159 *
 ---
 Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 7.395 on 1014 degrees of freedom
(1884 observations deleted due to missingness)
Multiple R-squared:  0.07562,         Adjusted R-squared:  0.03459
F-statistic: 1.843 on 45 and 1014 DF,  p-value: 0.0007221
```