A New Era of Major League Baseball: How the 2023 MLB Rule Changes are Impacting Player Performance and Team Strategy

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1. Introduction

Major League Baseball (MLB) has largely been played the exact same way since the American League joined the National League in 1901. The pitcher stands 60 feet and 6 inches away from home plate and delivers the baseball for the batter to try to hit. Little about the game has been regulated except for the adjustment of the pitcher's mound height in 1968 and the recent addition of manager challenges. However, before the start of the 2023 MLB Season, MLB commissioner Robert Manfred announced a new set of rules that perhaps change the game of baseball we once knew.

In efforts to increase the pace of play, a pitch clock was introduced which displays a countdown. The pitcher must deliver the pitch before the timer expires, or the batter is awarded a "ball". Additionally, if the batter is not ready before the timer expires, the pitcher is awarded a strike. When there are no runners on base the pitcher has 15 seconds to deliver the pitch and when there are runners on base the pitcher has 20 seconds to deliver the pitch. In previous seasons, when baserunners lead from a base the pitcher could attempt to pick them off by throwing to the base and tagging the runner out before they can make it back to the base. However, the new rules only allow for two pickoff attempts and if a third attempt in unsuccessful the baserunner is awarded the next base. One fallout of this particular rule is that pickoff attempts are more valuable, so pitchers use them sparingly. This gives the baserunner an advantage when stealing bases.

Another rule change is about restricting defensive shifts. In the past, teams could align their defensive players however they wanted in order to prevent hits. For example, if a lefty batter has a strong tendency to pull the baseball (hit it to the right), infielders might shift to the right side of the field (seen in Figure 1). This type of shift is now illegal as two infielders are

required to be on either side of 2nd base (seen in Figure 2). This rule is meant to "increase the batting average of balls in play, to allow infielders to better showcase their athleticism and to restore more traditional outcomes of batted balls". [1]

Figure 1: Illegal Defensive Positioning

[1] (Castrovince 2023)

Figure 2: Legal Defensive Positioning

The final rule added for the 2023 season is an increase in base sizes. All bases expect for home plate increased from 15 square inches to 18 square inches (seen in Figure 3). The change in base size decreases the distance between 1st base to 2nd base, and 2nd base to 3rd base by 4.5 inches. The main reason for this rule change was to decrease player collisions on bases but it has the effect of more stolen base attempts and a higher success rate.

Figure 3: New MLB bases vs. old

The data used to analyze the new rule changes comes from *Baseball Reference*, a highly reliable data source for Major League Baseball player statistics and team statistics. The dataset contains all 897 players who registered an at bat and all 1,064 pitchers who appeared in a game this season. Batter statistics such as runs batted in (RBIs), home runs, base on balls (walks), strike outs, batting average, on base percentage, slugging percentage, total bases, at bats, stolen bases and plate appearances are recorded by *Baseball Reference*. The data also contain pitcher statistics such as wins, losses, appearances, strike outs, walks, earned run average (ERA), innings pitched, walks and hits per innings pitched (WHIP), earned runs, stolen bases allowed and home runs allowed. Additionally, these same statistics both on a team level as well as individual player level are included. These performance statistics are collected every year in the MLB. This paper will use statistics from years 2018 through 2023 to assess whether there was any significant difference in performance due to the rule changes. A subset of players will be chosen from these years. This group of players will be some of the top players in the MLB as the goal of this paper is to see how the new rules impact the best players.

The 2023 MLB rule changes are the largest set of rules implemented in the MLB in one season and can have an impact of team strategy moving forward. The motivation for this paper is to discover how team strategy can perhaps adapt to the new rules. Additionally, this paper targets professionals in baseball operations as the finding can inform decision makers on assembling rosters and in-game strategies. Players with play styles that adversely benefit from the new rules can be drafted, signed through free agency, and traded for to create a stronger roster. Additionally, players are negatively impacted from the rule changes can be removed from rosters and traded before their true value is realized.

This paper will describe the rules themselves and comment on some holistic data from the 2023 season before analyzing specific batter and pitcher statistics, select player case studies, and roster implications. This paper will proceed as follows: Section 2 reviews relevant literature and provides a brief history of Major League Baseball. Section 3 is a detailed description of the methodology and data used in the analysis. The paper turns to Sections 4 ad 5 which present results using both graphical trends and statistical significance testing. Section 6 provides case studies of a select players. The paper concluded in Section 7 with a summary of its findings and suggestions for further research.

2. Literature Review

Major rule changes in sports have not only happened in Major League Baseball. In any sport that has a large change in rules, the question fans and teams ask is how it will impact the players. The National Basketball Association (NBA) has undergone several impactful rule changes in its history. Mahmound Nourayi analyzes the NBA rule changes and their impact on player performance. He specifically looks into the addition of the 24 second shot clock, introduced in 1954, and the addition of the 3-point line, introduced in 1979. Nourayi examined the effect of rule changes on playoff games by comparing in-game statistics for games before and after the rule changes. The method of analysis was using t-tests to determine if differences in mean statistics were significant. In the first finding, he noticed that that after the rule change of the shot clock teams shot 2.4 – 4.5 fewer free throws; this finding was significant at the 0.001 level. [2] While the NBA is not comparable to the MLB, the type of analysis that Nourayi did in his study can be used to examine rules changes in the MLB. A pre and post rule change t-test can show

[2] (Nourayi 2019)

any statistically significant results caused by rule changes. One limitation of this type of analysis is that with several rule changes occurring at once, it is hard to say which exact rule change is having the greatest impact. However, contextualizing the game of baseball and logical reasoning can provide a suggestion as to which rule is most impactful.

While the analysis of player statistics in sports is common practice among general managers and scouts, analyzing player statistics in an economic setting is a relatively new concept. A 2007 paper written by Justin Kubatko, Dean Oliver, Kevin Pelton and Dan Rosenbaum introduces the idea of using economic analysis to evaluate player performance in the NBA. One statistic they propose is plus/minus.[3] This statistic is familiar to current NBA fans but was a new concept when the paper was published. It is a simple statistic that measures the point differential a player has while being on the court. For example, if a player is on the court and their team scores 25 while the opponent scores 20, the player will have a plus/minus of +5. Similarly, if a player is on the court while their team gets outscored 15 to 30, their individual plus/minus will be -15. Kubatko and his peers had used OLS regressions to predict statistics such as shooting percentage and possession efficiency, among others. Their analysis leads them to a much simpler statistic, plus/minus, that has strong predictability on player success. This paper was featured in the *Journal of Quantitative Analysis of Sports* and was seen as a major steppingstone for future researchers interested in the analysis of player performance in sports.

Major League Baseball is one of the most difficult sports leagues in the world with pitchers having the ability to throw a fastball above 100 MPH and a curveball with 12 inches of vertical drop. Due to the memorizing ability of players, fans and analysts are notorious for creating new statistics to analyze their favorite players. One famous statistic, wins above

[3] (Kubatko et al. 2007)

replacement (WAR), is a popular statistic for player performance. It is meant to measure exactly what it says: how many wins a player gives their team above the replacement level player. For example, Ronald Acuña of the Atlanta Braves had a WAR in the 2023 regular season of 8.3, according to *FanGraphs*. This means that Acuña earned the Braves 8.3 wins more than they would have if they swapped Acuña for an average/replacement level player. The formula for WAR is as follows:

$$WAR = (Batting\ Runs + Baserunning\ Runs + Fielding\ Runs + Positional\ Adjustment + \text{League Adjustment} + \text{Replacement Runs}) / (\text{Runs Per Win})$$

The formula is widely used across general managers to determine the value of players, however; there are a few issues with the formula that Benjamin Baumer, Shane Jensen and Gregory Matthews outline in their 2015 paper in the *Journal of Quantitative Analysis of Sports*. Bluntly, the WAR statistic is subjective in nature. The formula contains terms such as positional adjustment and league adjustment. According to *FanGraphs*, positional adjustment is an addition or subtraction of runs based on the position the player plays, seen in figure 4 below.

Figure 4:FanGraphs Positional Adjustment

Position	Adjustment
Catcher	(+12.5)
First Base	(-12.5)
Second Base	(+2.5)
Third Base	(+7.5)
Shortstop	(-7.5)
Left Field	(+2.5)
Center Field	(-7.5)
Designated Hitter	(-17.5)

The reasoning for each run value is not described by *FanGraphs*, the major provider of WAR data. Additionally, in the modern MLB, players play a wide range of positions which is not accounted for by this positional adjustment. Similarly, league adjustment is not an objective term of the WAR formula. The term was meant to consider differences between the National League and the American League, but barriers between the two leagues are nonexistent in today's MLB. Every team is mandated to play every other MLB team and rules such as the designated hitter rule were changed in 2020 to be consistent across both leagues. Currently, there are no systemic differences between Nation and American Leagues.

Baumer, Jensen and Matthews found that the calculation of WAR depends on "proprietary data, ad hoc methodology, and opaque calculations." [4] Together, they propose a new statistic: openWAR. OpenWAR is based on public data, transparent methodology and gives a principal standard for the term replacement player. They propose this new statistic as they find that WAR has very little reproducibility. In other words, from season to season the same player is unlikely to have a similar WAR. The players' baseline statistics such as batting average and RBIs could be very similar, but WAR could change drastically. WAR is too dependent on other players in the MLB and does not focus enough on the individual. The basis on Bamer, Jensen and Matthews' openWAR model is that all runs scored or runs saved in a baseball game must be attributable to either batting, fielding, baserunning or pitching. They run a simulation-based model to determine the value an individual player brings to the outcome of a baseball game. By assigning a numerical value to their expected runs above or below average, they are able to quantify how much a player impacts the probability of a win. Their work on openWAR shows that predicting a player's value to a baseball game with an economic based approach is useful for

[4] (Baumer et al. 2015)

redefining how MLB executives think about player evaluation. Additionally, it provides the framework for other analysis to be done on the individual player without comparing the player to others.

The complexity of baseball has evolved immensely since the first Major League Baseball games were played in 1901. While the 2023 rule changes are the largest in baseball history, it is important to note how the strategy of winning baseball games has changed from 1901 to 2023. John McMurray examines how stolen base strategy has evolved from the early days of the MLB to the 1970s, what is considered the start of the modern era of baseball. In his 2015 article, which was published in the *Baseball Research Journal*, McMurray summarizes trends in each decade leading up to the 1970s. He reports that in the early twentieth century, teams averaged more than 10 stolen bases per home run. [5] Scoring was low as players were less skilled than they are now. The 1920s were a blip of incredible strategy change. In the previous decade teams stole over 10 bases per home run and the 1920s teams on aggregate had 15 more total home runs than stolen bases. The game took on an offense focused strategy. The 1930s and 1940s saw more of the same as different player archetypes emerged. Players were thought of in different categories: power hitters, speed players and contact hitters. Instead of all around solid athletes playing baseball, players of different body types and builds took over the league. It was no longer a strategic advantage for all players to have speed if a power hitter can tally a run on a home run while a speed player needs to steal their way into scoring position on the basepath. McMurray summarizes this dilemma with a perfect quote from former Boston Red Sox manager Joe Cronin. Cronin said, "why risk an out, [by attempting a stolen base] when most any batter on your club, if he connects properly, can smack it over the fence [via a home run]?" Base stealing becomes

[5] (McMurray 2015)

too risky when runs are scored in different ways. In the early MLB, overall scoring was low and stealing a base was extremely valuable as it increases the odds of scoring. In the 1930s to 1940s, this ideology changes as scoring was higher, and runs were less valuable.

The 1950s saw generational power hitters such as Ted Williams, Willie Mays, Hank Aaron and Mickey Mantle emerge. Their power hitting abilities decreased the value of stolen bases even more as this decade of MLB baseball had the lowest number of stolen bases to date. These stars continued to hit home runs at an impressive rate and speed player fell under the radar.

The 1960s however, saw a slight change in baseball strategy. While the power hitters still hit home runs, speed players like Luis Aparcicio and Maury Wills reclaimed the value of a stolen base. Wills stole 104 bases in 1962, which was a record at the time, and Aparicio led the American League in stolen bases from 1956 to 1964. Their ability to steal bases was undeniable and it provided great success to the teams they played for. These types of speedy players forced managers to keep them in the lineup, even though they struggled to hit home runs, because it added a dimension to their team's run scoring ability. Managers would either place them at the very top or very bottom of the lineup to have them on base while the best hitters were at bat. The strategy this time was to have players on base to create runs, but also have more runs scored in the event of a home run by the power hitters. Additionally, power hitters had a greater tendency to hit for extra bases. Extra bases is a term used for a hit that results in more than a single. Speedier players on base can score easily from first base in the event that a power hitter hits a double. Overall, speed added a new wrinkle to the game of baseball.

The 1970s, or the start of the modern era of baseball, saw a surge in stolen bases. Wills and Aparicio set the framework for MLB players of the future. Teams now knew that having

players that could steal bases and players that could hit for power increased win probability. But the 1970s introduced a new archetype of player: somebody that could hit for power and had speed. Joe Morgan and Reggie Jackson were at the forefront of the new power and speed combination. Morgan's abilities helped the Cincinnati Reds win consecutive World Series titles in 1975 and 1976 and Jackson helped the New York Yankees win consecutive world series titles in 1977 and 1978. Several other players fit into the power and speed mold; never before in league history displayed so many players with both abilities. The new archetype of player still exists in the MLB today and the 2023 rule changes encourage more base stealing. This increases the value of the Joe Morgan and Reggie Jackson style players who are in the MLB today.

While batter archetypes have adapted over time, pitchers have been one of two categories throughout the entirety of the history of the MLB. A pitcher either starts the game, and is considered a "starter," or enters the game later and is considered a "reliever." Starting pitchers are intended to pitch several innings, anywhere from 3 to 9 innings. A reliever typically pitches 1-2 innings in critical portions of the game. For example, a reliever will enter the game in the 8th or 9th innings in close games to shut down an offense. The pitches and speed at which pitchers throw has adapted such that modern pitchers throw harder and have higher spin rates, but their archetypes of starters and relief pitchers has not changed.

3. Methodology

The methodology builds off of baseball strategy trends described in the review of relevant literature. Current baseball players all have different strengths and playstyles. For this paper, players are divided into three playstyles: just power, just speed, or power & speed. Power players are ones that are well known for hitting home runs and gathering a lot of runs batted in. Speed

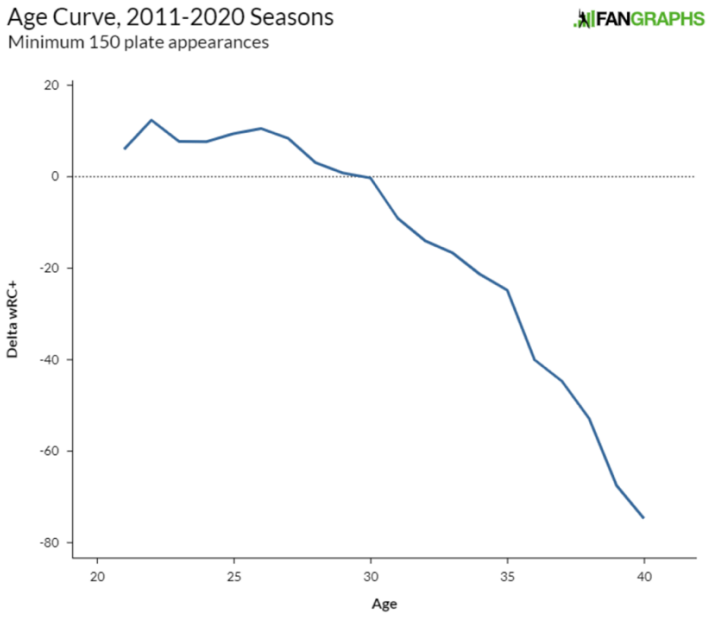
players are ones that can steal bases but do not nearly hit as many homeruns. Power and speed players are skilled at both hitting and running the bases. All players used in this dataset are top players in the MLB. Average and below average level players are not considered in this paper. Yearly statistics have been gathered for players used in years from 2018-2023. New players who entered the MLB during this time are still considered for this paper but will not have data for the years they did not play. The players playstyle categories were determined by viewing trends in their career stats, not how they performed in the 2023 season. Figure 5 shows the list of players used as well as their designated playstyle categories. Power hitting is much more prominent in the MLB and players that have speed also tend to have power, thus there are far less pure speed threats in the MLB today. This is represented in the dataset.

Figure 5: List of Batters in Dataset & Playstyle Categories

Just Power	***Just Speed***	***Power and Speed***
Aaron Judge	Harrison Bader	Byron Buxton
Adam Duvall	Jarren Duran	Cody Bellingher
Adolis Garcia	Trent Grisham	Corbin Carroll
Alex Bregman	Bobby Witt Jr.	Jazz Chisholm Jr.
Bo Bichette		Jose Altuve
Byrce Harper		Mookie Betts
Carlos Correa		Randy Arozarena
Freddie Freeman		Ronaldo Acuna Jr.
Kris Byrant		Shohei Ohtani
Manny Machado		Mike Trout
Matt Chapman		Jose Ramirez
Matt Olson		Trae Turner
Max Muncy		Christian Yelich
Nelson Cruz		Julio Rodriguez
Nick Castellanos		Cedric Mullins
Nolan Arenado		Fernando Tatis Jr.
Ozzie Albies		Luis Robert Jr.
Paul Goldschmidt		Kyle Tucker
Pete Alonso		Francisco Lindor
Rafael Devers		Byan Reynolds
Vladamir Guerrero Jr.		George Springer
Willson Contreras		Marcus Semien
Willy Adamas		
Xander Bogaerts		
Yordan Alvarez		
Corey Seager		
Kyle Schwarber		
Anthony Rizzo		
Austin Riley		

The only criteria for placing players into categories is based off their historical trends. Given injuries and playing time, using a holistic approach such as requiring greater than 20 stolen bases per year to be considered a speed player does not make sense. 2018-2023 as the range of years for the data was selected based on the average age of players in their prime. *FanGraphs* examines the age in which all players in the MLB tend to decline in production. They chart wRC+ (weighted runs created) on age. The statistic used, wRC+ is a way to examine how much a player contributes to a team's ability to score and prevent runs. They find that after the age of 30, players begin to have a negative wRC+ meaning they are not contributing to the team's success as much as they used to.[6] Figure 6 shows the chart created by Chet Gutwein, a former *FanGraphs* writer.

Figure 6: Player Age on wRC+



[6] (Gutwein 2021)

If players begin to decline in production around the age of 30 and tend to enter the MLB around the age of 22, a player "prime" would last 8 years. By selecting the years 2018-2023, 6 whole years, it captures players in their prime. While some players are older and some younger than 30 in the dataset, player "primes" are not at all the same years but by gathering 6 years it is more likely to have players in their best years of production and not while they are declining.

The statistics analyzed will be stolen bases, batting average, home runs, runs batted in, strike outs, and total bases. These are all headline player statistics and are used in player evaluation by fans and general managers alike. In order to have comparable data across players, the data needs to be adjusted. Batting average is in a ratio already so it will not be adjusted. Stolen bases, home runs, runs batted in, strike outs, and total bases are absolute numbers and will need to be put normalized to control for issues such as playing time or injuries. Thus, these variables will be converted into per at bat or per game statistics so that a player who played 50 games in a season can be compared to a player who played 150 games in a season. Stolen bases and total bases will be converted into per game statistics by taking the key variable and dividing them by games played. These two variables will be per game statistics because they do not occur in a single at bat, rather tallied throughout a game. Stolen bases are not accomplished while hitting and total bases are an accumulation of all outcomes of a player at bats, not a single at bat. According, these variables will be expressed as:

$$\frac{Stolen\ Bases}{Total\ Games\ Played}\ AND\ \frac{Total\ Bases}{Total\ Games\ Played}$$

Home runs, runs batted in, and strikeouts will be converted to per at bat statics as they are all outcomes of a single at bat. A player can hit a homerun in a single at bat, tally 0-4 runs batted in, or strike out. These new ratios would represent how likely one of these outcomes will occur in in given at bat. Accordingly, these variables will be expressed as:

$$\frac{Home\ Runs}{Total\ At\ Bats}\ AND\ \frac{RBIs}{Total\ At\ Bats}\ AND\ \frac{Strikeouts}{Total\ At\ Bats}$$

While divided into their playstyle categories, the average will be taken of each statistic in individual seasons from 2018-2023. The average will be then tested against the 2023 results to see if there is significant change. For example, I hypothesize the 2023 MLB rule changes to adversely impact players who incorporate speed into their game and because of this, just speed & power and speed players will be analyzed as individuals as well.

Once the new normalized variables are calculated they are demeaned by each individual. For example, an average will be taken on each variable for each player from years 2018-2023. Each statistic is subsequently subtracted from the 6-year mean. This aims to control for general trends in the data outside of the 2023 rule changes. Some trends in the overall data are an increase in homeruns following the MLB's alleged scandal of experimenting with different baseballs throughout 2019-2021. Additionally, a number of players in the dataset have not been playing the MLB from 2018-2023. These younger players tend to hit less runs and have fewer RBIs as they are adjusting to MLB level playing. The addition of them to the dataset lowers the overall level of statistics. Demeaning each individual attempts to control for these trends. For rule changes in sports, supported by the literature, a t-test is preferred to a regression so demeaning is the best way to control for other factors as one would do in a regression.

Figure 7: List of Pitchers in Dataset & Playstyle Categories

Starter	***Reliever***
Zack Wheeler	Tanner Scott
Spencer Strider	Felix Bautista
Kevin Gausman	David Bednar
Sonny Gray	Devin Williams
Gerrit Cole	Camilo Doval
Zac Gallen	Emmanuel Clase
Justin Steele	Josh Hader
Logan Webb	Alexis Diaz
Zach Eflin	AJ Minter
Jordan Montgomery	Clay Holmes
Blake Snell	Gregory Stoto
Aaron Nola	Andres Munoz
Corbin Burnes	Jordan Rromano
Luis Castillo	Evan Phillips
Dylan Cease	Will Smith
Justin Verlander	Craig Kimbrel
Sandy Alcantara	Jhoan Duran
Jose Berrios	Kenley Jansen
Freddy Peralta	
Framber Valdez	
Christian Javier	
Lucas Giolito	
Kyle Gibson	
Taijuan Walker	

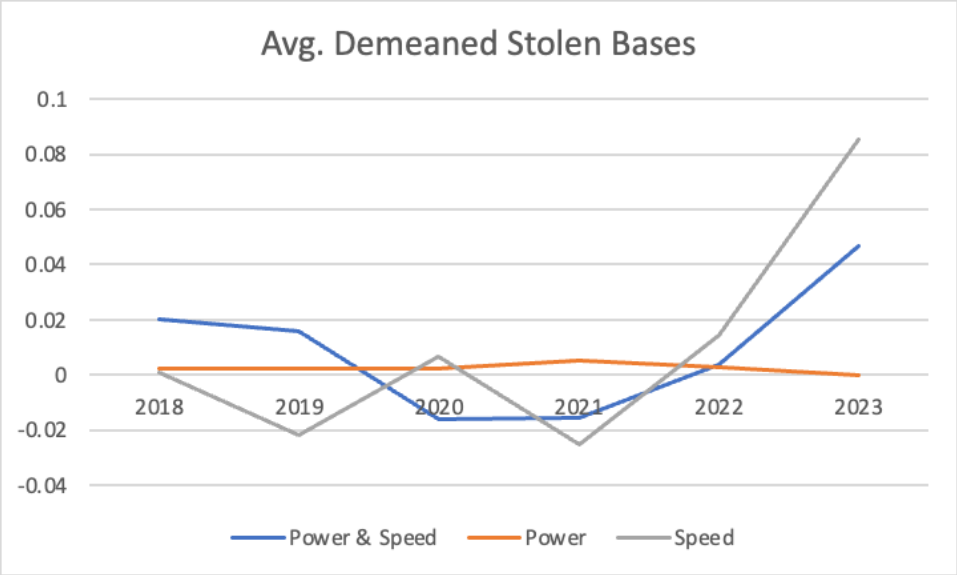
This list of starting and relief pitchers was selected from a list of top pitchers in each category based on performance in the 2022 MLB season. The criteria for placing a pitcher in either category is based on when they enter a game.

The statistics used to analyze pitcher performance are earned runs average (ERA), innings pitched (IP), fielding independent pitching (FIP), walks and hits per innings pitched (WHIP), hits, home runs, walks and strike outs. However, hits, home runs, walks and strike outs are all put into per 9 innings ratios. This is a typical analysis for MLB pitcher performance. The same analysis of demeaning the data and comparing the 2023 season to an average of the 2018-2023 average was done for pitchers.

4. Results: Graphical Data Trends

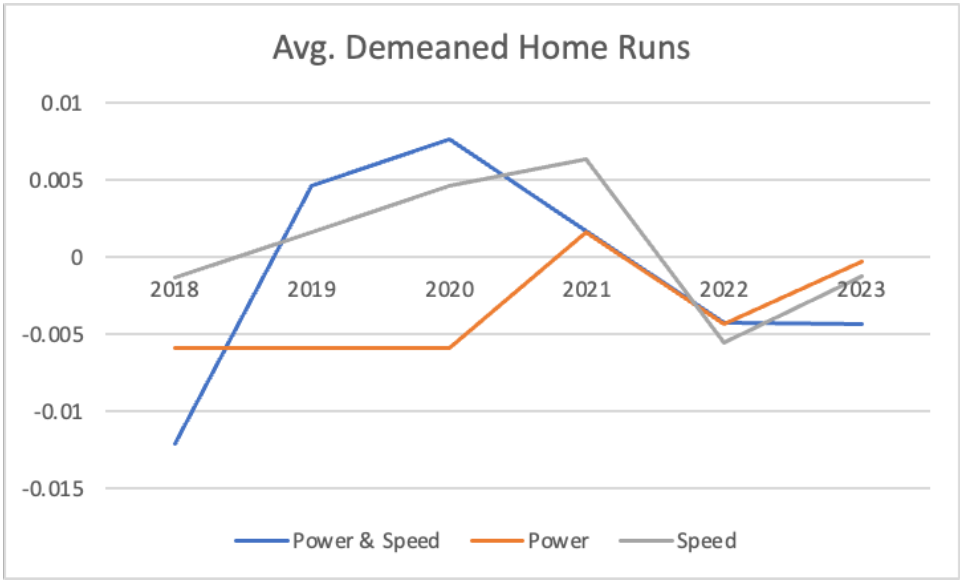
After putting players into groups based on archetypes, collecting the data from 2018-2023, transforming the data into normalized numbers, and demeaning the data, summary statistics were found for each viable by archetype. For these summary statistics, an average was taken for each statistic by player archetypes and the findings are as follows:

Figure 8: Stolen Base Trends



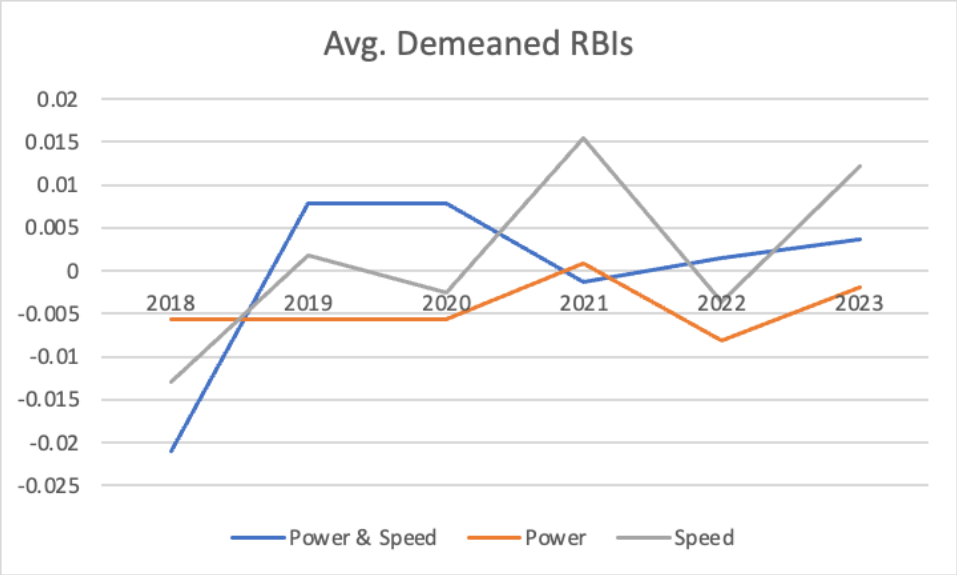
Per figure 7 above, we see that for power & speed and speed player stolen bases have jumped meaningfully from 2022 to 2023. Additionally, for power players the stolen base trendline is flat meaning there is little impact from the rules on a power players ability to steal bases. One such reason for the overall trends seen in stolen base data is that the pickoff rule, pitch clock, and base size make it easier to steal bases. The pickoff rule allows players to know if they will be picked off, the pitch clock allows runners to time steal attempts with precision, and the increase in base size decreases the overall distance between bases. Incentives matter and several of the new ruled incentive players to get larger leads and attempt for stolen bases.

Figure 9: Home Run Trends



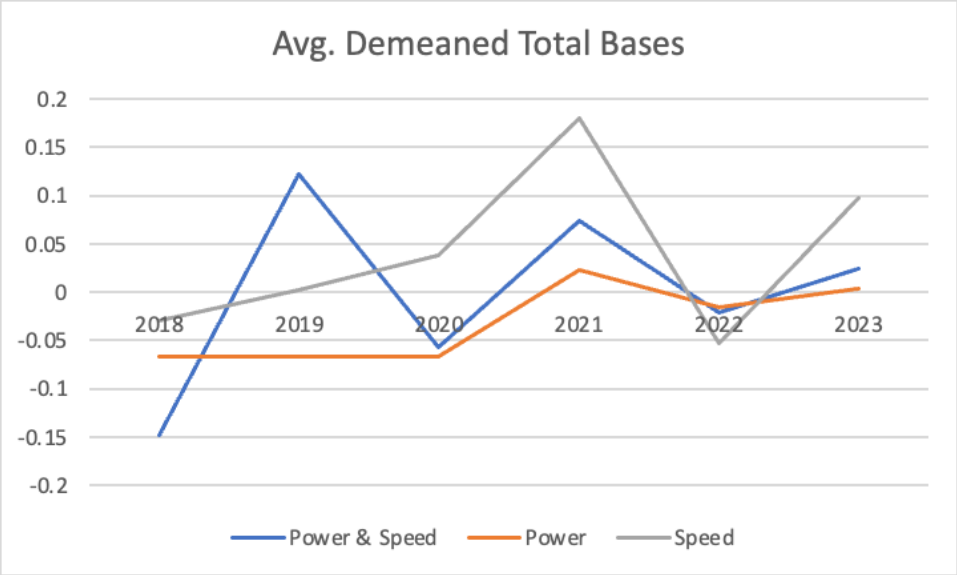
For power and power & speed players there is a clear jump from 2022 to 2023, however the jump is only to approach zero. This suggests that players of either archetype are returning to their 6-year average in home runs. While the value in 2023 may not be significantly high objectively, it reverses a significant trend of less home runs in the years leading up to 2022. The peak in 2019-2021 is likely from the MLB ball tampering scandal and will likely have similar results for pitcher statistics.

Figure 10: RBIs Trends



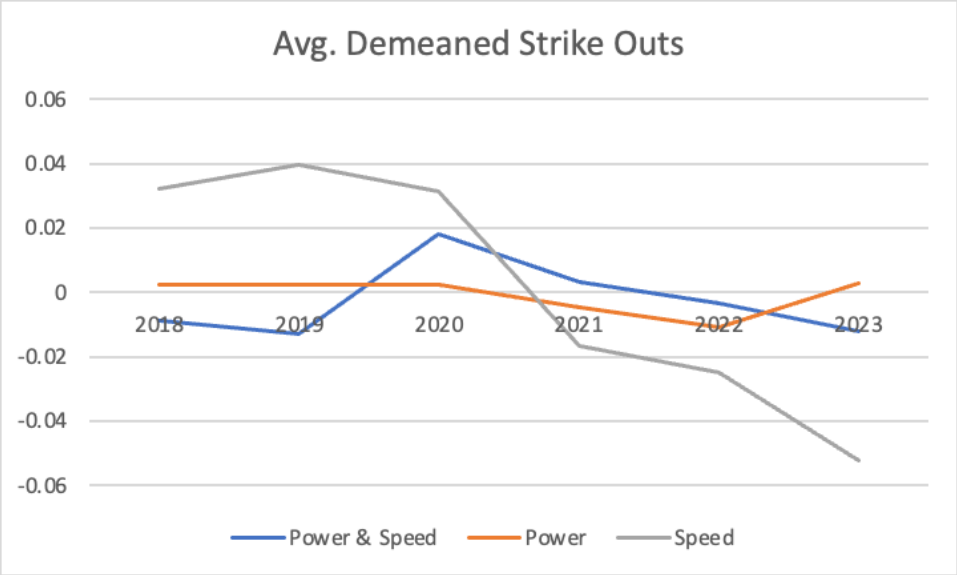
Across all three player archetypes, RBIs increase from 2022 to 2023, with the most obvious jump coming from speed players. One implication of this is that managers recognize the important of having speed players throughout the lineup rather than just at the top of the lineup, which was common strategy in previous years. Having speed players in different parts of the lineup allows them to come to bat with more opportunities for RBIs.

Figure 11: Total Bases Trends



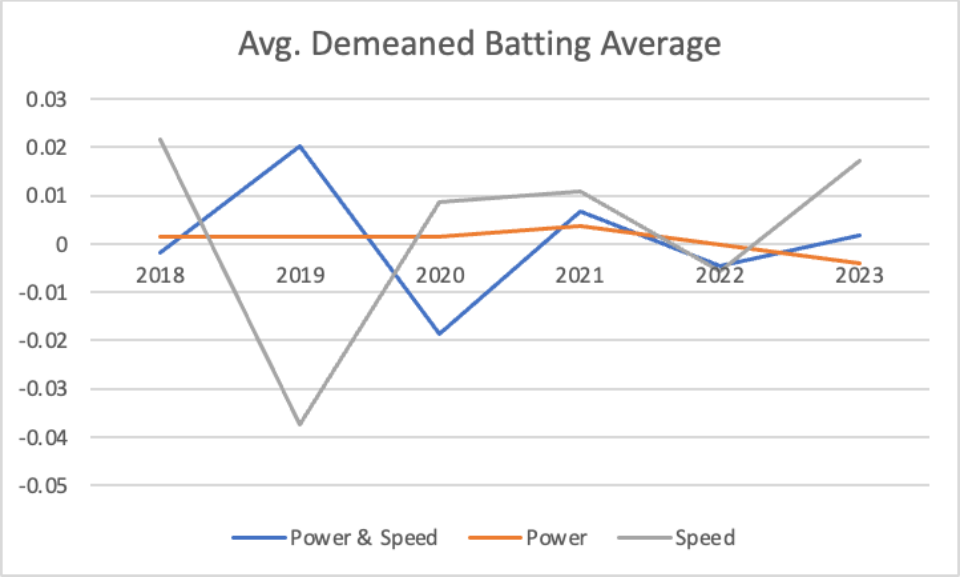
Once again, across all three player archetypes total bases is up from 2022 with speed players making the most obvious jump. With defensive positioning being mandated in 2023, it is possible that players are securing more hits as defenses cannot adjust to specific player tendencies. This increases their total base count. Additionally, the increase in homeruns also contributes to the increase in total bases as a homerun accounts for four total bases.

Figure 12: Strike Out Trends



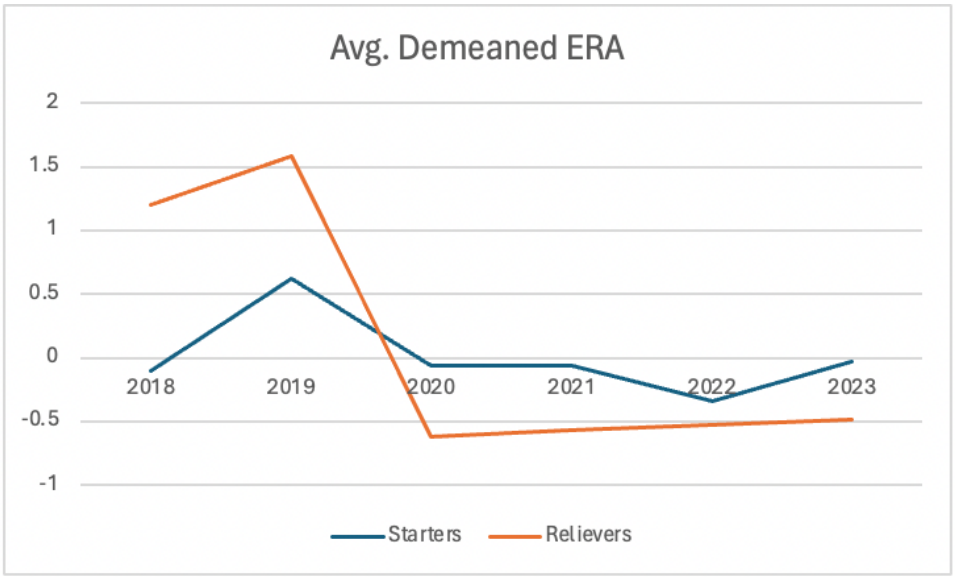
For power and power & speed players, strike outs have remained somewhat flat with the addition of the 2023 rule changes. Speed players however see a steep drop in strike outs. With stolen bases increasing drastically, the importance of getting speed players on base increases as well. If a speed player reaches base and can steal a base, it puts a runner in scoring position. Managers perhaps are working with speed players such that they make more contact when at bat rather than swinging and missing. This hypothesis makes intuitive sense with RBIs increasing for all three player types: more players reaching base and getting into scoring position to be driven in later in the inning.

Figure 13: Batting Average Trends



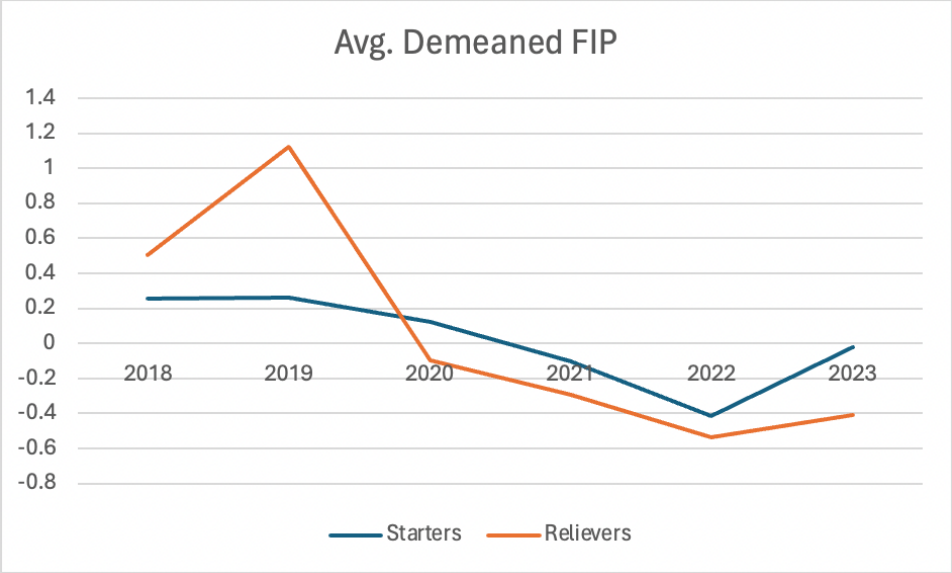
For power and power & speed players, batting average has remained mostly flat. Speed players, however, see a sharp increase. The hypothesis of why speed players are seeing less strike outs can also apply for batting average. If speed players are making more contact, it is also plausible that they are having more hits.

Figure 14: ERA Trends



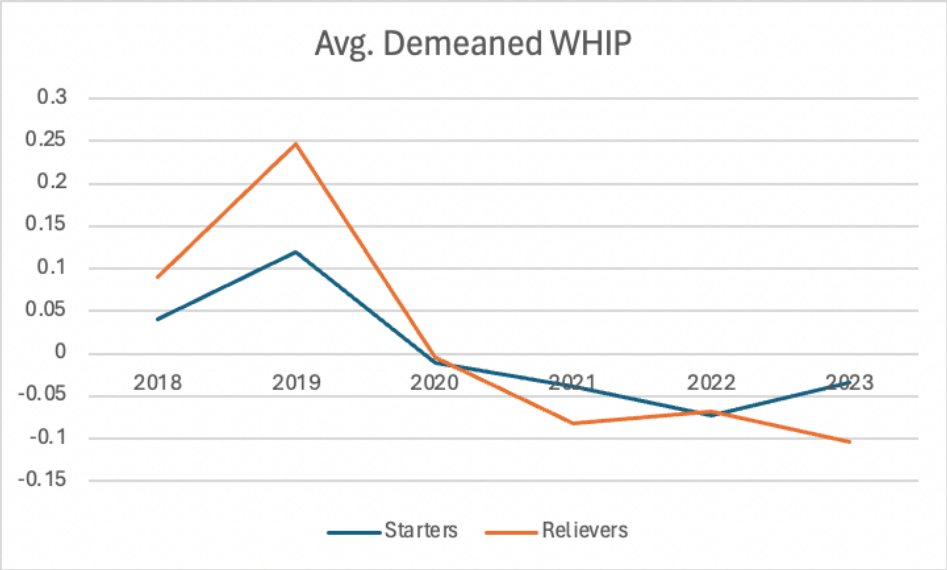
Across both starting and relief pitchers there is little change in earned run average in 2023. Both groups have elevated trend lines in 2018 and 2019, but both groups return to near 0 meaning the 2023 season was average for them. Overall, the 2023 MLB saw 22,425 runs scored which is not significantly higher from previous seasons. In fact, out of the years sampled, the 2019 season was the highest run total in a single season so we would expect a higher ERA in that year compared to others. 2018 and 2019 will be interesting years to consider for pitcher statistics as they will be elevated for these two seasons across all statistics. Several factors could explain why these two seasons are higher than the rest. A simple reason could be that this set of pitchers are getting better with age; they are reaching their prime now as opposed to in 2019. This could be true, but the dataset contains 42 players across different ages so it unlikely they all reach their prime in the same years. Additionally, the data is demeaned and attempts to correct for any age issue. Another reason could be the alleged ball tampering scandal in which different types of baseballs were used in different games. While the scandal was never proven, in part because the MLB owns its own manufacturing facilities, the league did experience an increase in runs. Balls hit in play had higher exit velocities and pitchers had harder times spinning the ball. It is possible, of course, that all pitchers had worse statistics during these seasons, among other factors.

Figure 15: FIP Trends



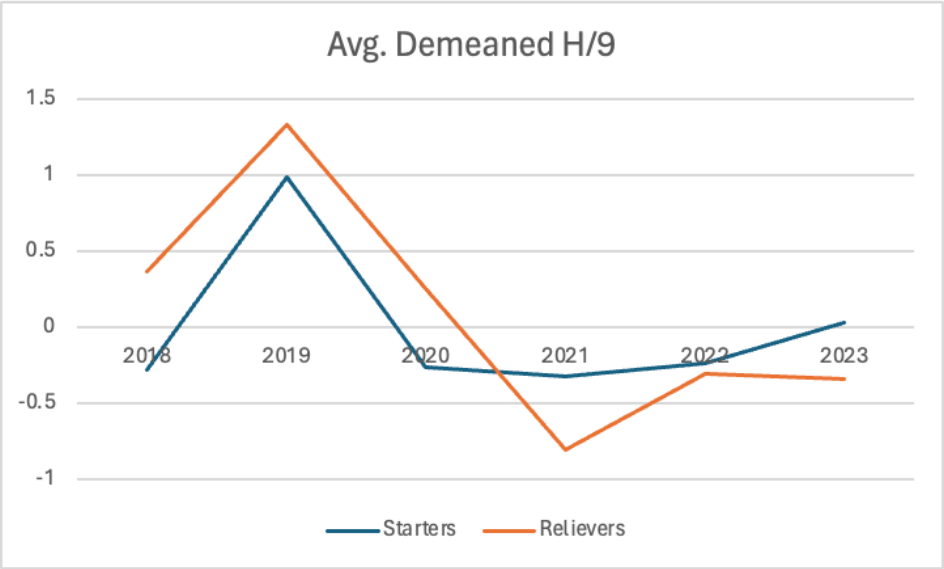
For both starting pitchers and relief pitchers, FIP increase in the 2023 season and the increase is more drastic for starting pitchers. FIP, or fieldling independent pitching is meant to measure pitcher effectiveness by removing fielding from the equation. The calculation only takes into account statistics the only a pitcher can control. These statistics are strikeouts, walks and home runs allowed. An increase in FIP is a negative for pitchers as a low FIP, similar to ERA, is good. A higher FIP means that some combination of strikeouts are down, walks are up, or homeruns are up.

Figure 16: Walks and Hits per Innings Pitched Trends



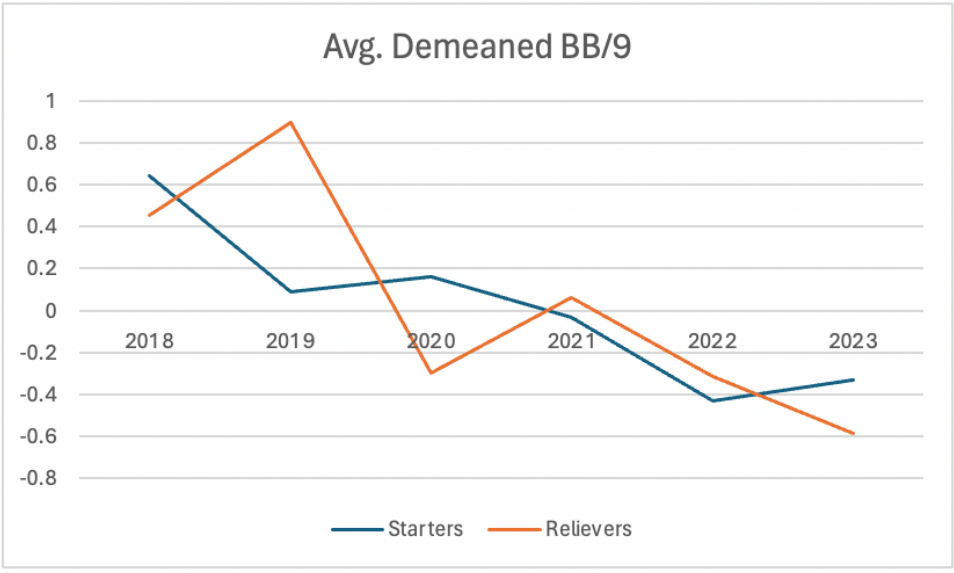
WHIP also does not seem to vary a significant amount in 2023 across both starers and relievers. However, in 2023 starters and relievers move in opposite directions. Starters WHIP increases while relivers WHIP decreases. Starters log many more innings and face more batters, so it is possible that hitters reaching base via walks is coming through in staters WHIP. As stated previously in the paper, batters who have base stealing ability are possibly being coached to reach base more frequently and this would partially be from walks. Relief pitchers do not experience this increase in WHIP. Relief pitchers tend to pitch in higher leverage spots, meaning when the stakes are highest. They might be adjusting to speed hitter strategy to throw them more strikes to avoid allowing walks.

Figure 17: H/9 Trends



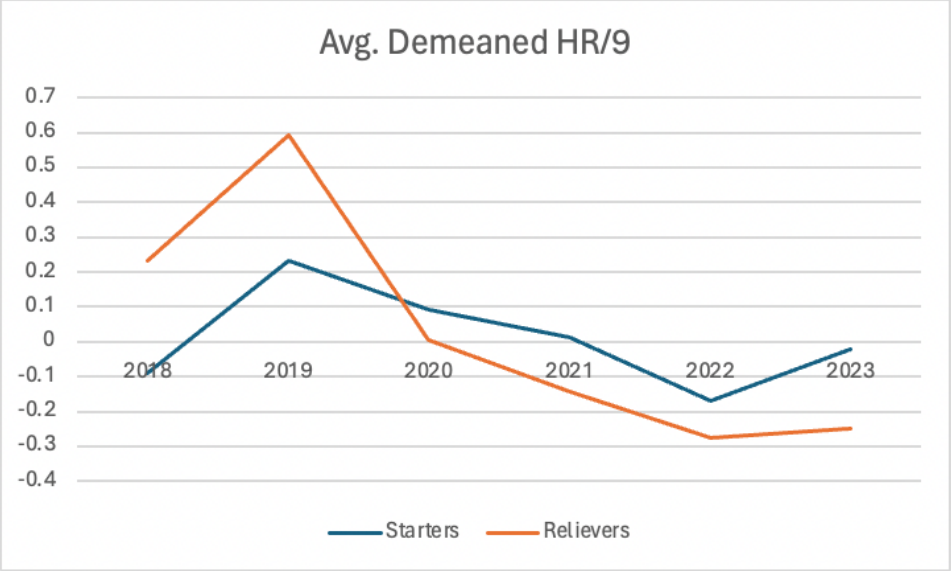
Similar to WHIP, starting pitchers see a slight increase in H/9 in 2023 while relivers see a slight decrease. This is intuitive as if WHIP considers walks and hits, we expect the same for trend for hits. While the variance in 2023 is not large, the direction of the change is important to note.

Figure 18: BB/9 Trends



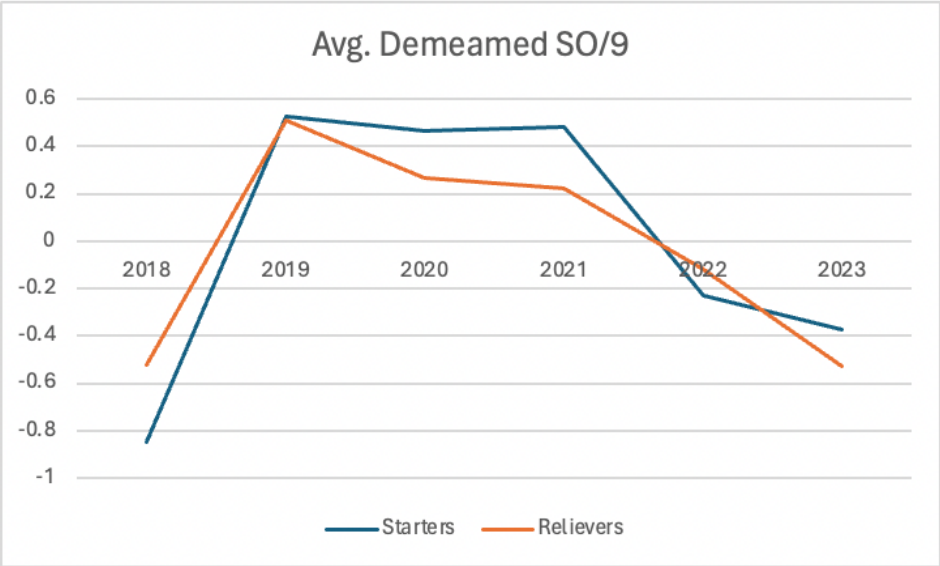
Unsurprisingly, BB/9 follows a similar trend to WHIP and H/9. Starting pitchers increase in 2023 while relief pitchers decrease. Outside of the 2023 season, BB/9 follows a general decreasing trend from 2018 to 2023. This downward trend is more defined than WHIP and H/9. Pitchers in general are allowing fewer walks and I attribute this to batters being more aggressive. With stolen bases being more valuable, it will be interesting to see how batter strategy will change with several seasons of the new rules.

Figure 19: HR/9 Trends



In 2023, starting pitchers allowed more HR/9 and relief pitchers appear to remain flat. Remember hitter trends, speed and power & speed players increased their homerun totals in 2023. What is interesting with the pitcher trends is that it appears that the home runs are coming off starting pitchers rather than relief pitchers.

Figure 20: SO/9 Trends



Strike outs per 9 decreased for both starters and relievers in 2023. This follows a downward trend since 2021. Connecting to the hitter trends, speed players saw the greatest decrease in strike outs per at bat. I believe this supports the theory that speed players are changing their approach to be more selective at the plate in order to reach base. Additionally, speed players are playing more games, meaning pitchers holistically are getting less strike outs.

5. Results: Significance Testing

To test for significance in the data a t-test was performed on each demeaned statistic by player type. This was done between the 2023 season and an average of each of the previous 6 MLB seasons. The test was done with the 2023 season on the historic average; thus, a positive t-statistic occurs when the 2023 season is larger than the historic mean and vice-versa. Results will be displayed and discussed below by player archetype.

Figure 21: Power Hitter T-test Summary

Power Hitters					
	T-statistic	Pr(T < t)	Pr(T != t)	Pr(T > t)	Degrees of freedom
Home runs per at bat	-0.106	0.458	0.916	0.542	168
RBIs per at bat	-0.295	0.384	0.769	0.616	168
Total bases per game	0.086	0.534	0.932	0.466	168
Strike outs per at bat	0.441	0.670	0.660	0.330	168
Stolen bases per game	0.014	0.506	0.989	0.495	168
Batting average	-0.842	0.201	0.401	0.800	168

Across all statistics considered, power hitters did not have any significant changes in the 2023 season when compared to their 6-year historical average. While not significant at the 5% level, the sign of the t-statistics provide insight into how the 2023 season rule changes impact the game. The large negative t-statistic on batting average suggests that power hitters struggled adjusting to the new rules. The pitch clock likely impacted their approach in the batter's box. Hitters had less time to think about what pitch a pitcher might throw to them. Baseball is a very mental sport, and less thinking time can impact strategy.

Figure 22: Power & Speed Hitter T-test Summary

Power & Speed Hitters					
	T-statistic	Pr(T < t)	Pr(T != t)	Pr(T > t)	Degrees of freedom
Home runs per at bat	-1.021	0.155	0.310	0.845	105
RBIs per at bat	0.491	0.688	0.625	0.312	105
Total bases per game	0.302	0.382	0.763	0.382	105
Strike outs per at bat	-1.220	0.113	0.225	0.887	105
Stolen bases per game	3.600	1.000	0.001	0.000	105
Batting average	0.214	0.585	0.831	0.415	105

Power and speed players had a t-statistic of 3.600 for stolen bases per game, which was statistically significant at the 1% level. Additionally, home runs per at bat and strike outs per at bat decreased substantially. Stolen bases per game is an obvious statistic to increase significantly

as the rule changes encourage more stolen base attempts. Larger bases make the distance runner need to cover shorter. With the old bases, being 15 square inches, the distance between first base and second base was 88 feet and 1.5 inches. Now with the new bases, being 18 square inches, the distance between first base and second base is 87 feet and 9 inches. While this 4.5-inch decrease in distance is not nominally large, it allows for runners to reach the base quicker than before. In the 2023 season there were 1.8 stolen base attempts per game, 1.4 successful attempts, which was good for an all-time best 80.2% success rate. In the prior 2022 season there were 1.4 attempts per game, 1.0 successful attempts, and a 75.4 success rate.

Similar to power hitter, power & speed hitters struggled with strike outs. This is likely for the same reason, less time to think in the batter's box. Home runs were also down for power and speed players. While not statistically significant, this decrease could be related to player strategy. With the increase in stolen bases, teams can focus on getting a runner in scoring position with a steal of second base. This would mean simply reaching base with either a single or a walk can eventually result in a runner on second. An 80.2% success rate is strong and if a player has speed, this is a low-risk strategy.

Figure 23: Speed Hitter T-test Summary

Speed Hitters					
	T-statistic	Pr(T < t)	Pr(T != t)	Pr(T > t)	Degrees of freedom
Home runs per at bat	-0.235	0.409	0.819	0.591	12
RBIs per at bat	1.588	0.931	0.138	0.069	12
Total bases per game	0.633	0.269	0.539	0.269	12
Strike outs per at bat	-1.721	0.056	0.111	0.945	12
Stolen bases per game	2.710	0.991	0.019	0.010	12
Batting average	0.975	0.826	0.349	0.174	12

Speed players experienced a statistically significant increase in stolen bases per game at the 5% level. This increase was likely due to the same reasons detailed for power & speed players. RBIs per game did not statistically significantly increase, but it was marginally close. A potential reason for this increase could be that speed players are getting placed in different parts of the batting order. Historically, MLB teams would have a token speed player who either hit leadoff, first in the lineup, or last in the lineup. With the emergence of stolen bases in the 2023 season it is possible that speed players are too valuable to leave out of the lineup and thus find themselves hitting in different parts of the batting order. If batters are placed in the middle of the lineup, it is more likely that runner will be on base when they reach the plate, increasing their opportunity to tally RBIs. Strike outs per game decrease substantially, but not significantly. This could be caused by a change in strategy by speed players in the batter's box. Reaching base in any way is more valuable as a stolen base places a player in scoring position. Speed players could potentially be more selective at pitches they swing at to avoid striking out.

Batters were selected for this analysis based on their traits of speed and/or power, as well as their recent success. All batters in this sample have experienced recent success. In a future study, it could be beneficial to consider a larger sample of hitters or even consider all major league hitters. While it is encouraging to see statistically significant results with a small sample size, the new MLB rules have only been in use for one whole season. It will be important to continue analyzing player stats for a number of years into the future as a larger sample size is proffered for this type of analysis.

Figure 24: Starting Pitcher T-test Summary

Starting Pitchers					
	T-statistic	Pr(T < t)	Pr(T != t)	Pr(T > t)	Degrees of freedom
ERA	0.039	0.516	0.969	0.484	129
FIP	-0.095	0.462	0.924	0.538	129
WHIP	-0.822	0.206	0.413	0.794	129
H/9	0.276	0.609	0.783	0.392	129
HR/9	-0.448	0.328	0.655	0.673	129
BB/9	-1.812	0.036	0.072	0.964	129
SO/9	-1.607	0.053	0.111	0.945	129

The significance testing for starting pitchers reveals that BB/9 decreased significantly at the 5% level and SO/9 was marginally close to being significantly lower at the 5% level. The significance of the BB/9 decreasing contradicts the previous theory that players with base stealing ability are changing tier approach at the plate to reach base more frequently. However, the test of significance is done by comparing the six-year average to the 2023 season. When looking at figure 18, there is a clear downward trend from 2018 to 2023. This causes the six-year average to be relatively high. Amongst starters, BB/9 has an increase from 2022 to 2023 which contradicts the t-test.

The -1.607 t-stat for SO/9 shows a strong negative magnitude and suggests starting pitchers are getting fewer strikeouts when compared to years prior. This supports the theory on speed players reaching base more frequently. While not significant at the 5% level, the sign of the t-test is still important to analyze.

All other statistics for starting pitchers did not have substantial movement in the 2023 season when compared to the six-year average. ERA, FIP, H/9 and HR/9 had little movement suggesting the rules did not impact starting pitchers for these stats. WHIP however saw a decrease with a t-stat of -0.822 which was not significant, but important to note. BB/9 decreases significantly, and WHIP considers walks, so it makes sense that this statistics also decreases.

Figure 25: Relief Pitcher T-test Summary

Relief Pitchers					
	T-statistic	Pr(T < t)	Pr(T != t)	Pr(T > t)	Degrees of freedom
ERA	-0.971	0.167	0.334	0.833	80
FIP	-1.233	0.111	0.221	0.889	80
WHIP	-1.098	0.138	0.276	0.862	80
H/9	-0.556	0.290	0.580	0.710	80
HR/9	-1.643	0.052	0.104	0.948	80
BB/9	-1.366	0.088	0.176	0.912	80
SO/9	-1.009	0.158	0.316	0.842	80

Relief pitchers largely follow the same t-test trends as starters. BB/9 also significantly decreases at the 5% level and SO/9 decreases strongly, but not significantly. One difference between starters and relievers is that relivers are allowing less HR/9, nearly significant at the 5% level. Between power, speed, and power & speed hitters, none of the hitter categories saw significant changes in home runs. Relievers having a near significant decline in HR/9 is a surprise as this change does not overlap anywhere else in the data. All reliever statistics examines decrease to some degree, and aside from SO/9, all decreases suggest relievers are becoming stronger pitchers. In other words, all statistics except SO/9 are improving. This finding indicates the importance of a strong bullpen for team success. If relievers are improving as a group, it is important for teams to have more top-of-the-line relievers in their bullpen.

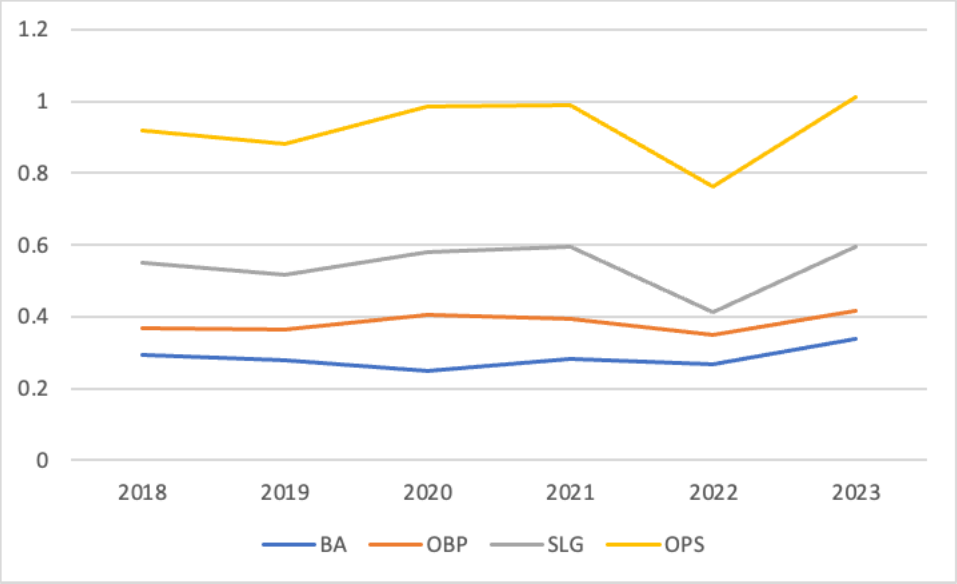
Overall, for pitchers, there is a downward trend from 2018-2023 for most statistics. This causes the six-year average to higher than the 2023 season causing most t-stats to be negative. The method for testing pitcher changes was done in the same way for batters. Perhaps a different method should be used to analyze pitcher performance, such as decreasing the panel size to only 3 years. Additionally, the pitcher set was selected due to their recent success, not their historic success. Batters tend to be strong players for a longer time than pitchers. It is possible that the pitcher statistics are more susceptible to age and when players enter their prime.

6. Case Studies

Ronald Acuña

Ronald Acuña Jr. of the Atlanta Braves was awarded the MVP award of the National League in the 2023 season. The star right fielder hit 41 home runs, 106 RBIs, 35 doubles, scored 149 runs, had a 0.337 batting average, a 0.596 slugging percentage, a OBP of 0.416, a 1.012 OPS, and stole 73 bases. All of these statistics were career highs for Acuña and the first time a player stole at least 73 stolen bases in a year since Tommy Harper is 1969. Acuña was first unanimous NL MVP since Bryce Harper in 2015, and only the third since 2002.

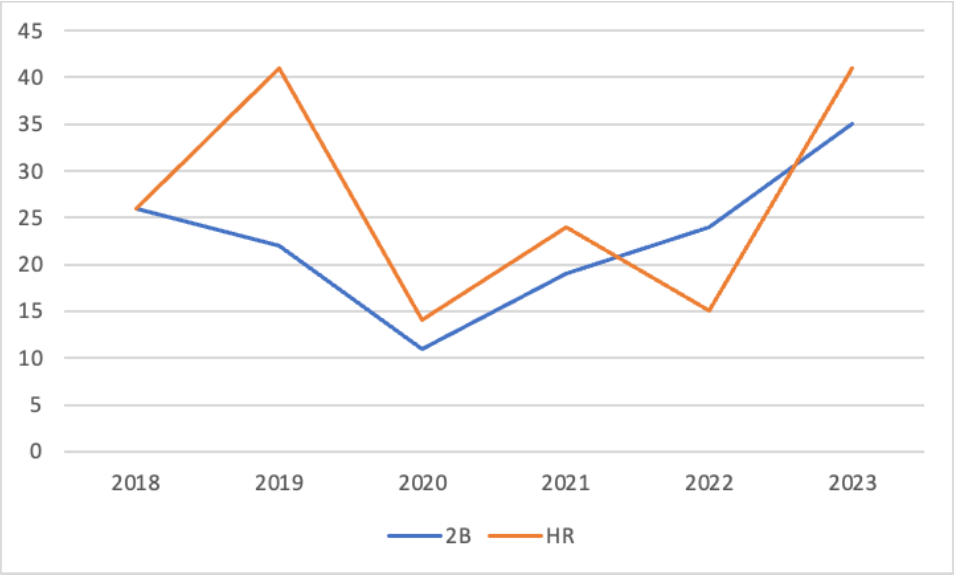
Figure 26: Ronald Acuña Jr/ Batting Ratios



While Acuña was a fantastic player before the new rule changes, there is no doubt that the changes positively impacted his play style. All four major batting ratios clearly jump in the 2023 season. As a power & speed player, Acuña obviously has speed, evident by his absurd 73 stolen bases. But the new rules coupled with his speed have the potential to change his strategy. His OBP, or on base percentage, jumps in 2023 as he potentially is being more conservative at

the plate. Acuña drew 80 walks in 2023 which is a career high. Drawing more walks means he reaches base more often and being on base more often will lead to more stolen bases under the new rules.

Figure 27: Ronal Acuña Doubles and Home Runs



Acuña hit 41 home runs, which he has done before, but he also hit 35 doubles, 9 more than his previous career high. His career high slugging percentage means he was hitting a higher rate of extra base hits than ever before, and the career high doubles contributes to that. The new rules increased the base size and therefore decreased the distance between bases. A shorter distance allows a fast player like Acuña to 'push it' on a long single and try to turn it into a double. Acuña's historic season will need an encore in 2024 as the Braves look to win another World Series in the past 4 years.

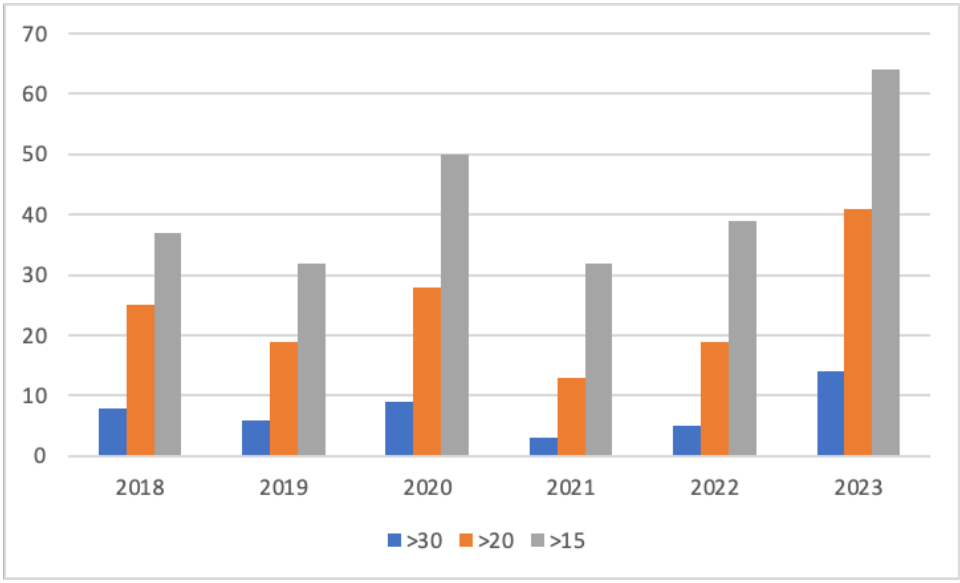
Jarren Duran

Jarren Duran is an outfielder in the Boston Red Sox organization and until the 2023 season, spent time in and out of the minor leagues. He struggled to find consistent time in the majors as in 2021 he appeared in 33 games and in 2022 he appeared in 58 games. However, Duran put together a 102 game season in 2023 that was cut short by injuries. The season saw him put up 0.346 OBP and 0.482 slugging percentage, good for 0.828 OPS. He stole 24 stolen bases and hit 34 doubles, both illustrative of his speed. Duran is not an outstanding hitter, but typically led off for the Red Sox. He was able to spend so much time with the major league club this year due to what he could do on the base path. 24 stolen bases in just 102 games are an impressive result. 34 doubles and a 0.482 slugging percentage is an unexpected result from Duran, or any pure speed player for that matter. Duran was notorious for pushing for a double on many softly hit singles to the outfield. The smaller distance from home to 2nd base allowed him to do this many times. His speed and aggressiveness on the basepath earned him more time in the lineup and will likely have a larger role in 2024.

Stolen Bases & Expected Runs

In the 2023 MLB regular season there were 3,500 stolen bases, up from 2,487 in 2022 and 2,214 in 2021. While the nominal league number of stolen bases is insightful, the player dispersion is more insightful. Below shows the number of players who stole more than the 30, 20, and 15 bases from 2018-2023.

Figure 28: Number of Players above Threshold of Stolen Bases



Stealing 30 bases has historically been seen as an outstanding season as fewer than 10 players accomplish this feat from 2018-2022, but in 2023 15 players passed this threshold. Additionally, more players, than in recent history, have stolen more than 20 and 15 bases. It is clearly easier to steal bases as more players are doing it and it will impact how teams construct their rosters in the near future.

Using an expected runs in an inning calculator, created by former baseball analyst Greg Stoll, we can figure out how many expected runs are added in an inning by a successful stolen base. The calculator uses actual game data from 1957-2015 and the expected runs output is essentially the average runs scored in a similar scenario.

Figure 29: Expected Runs from 1st to 2nd (one runner on base)

	Runner on 1st	Runner on 2nd	Runs added
0 out	0.87357	1.12135	0.24778
1 out	0.52051	0.69004	0.16953
2 out	0.2211	0.33127	0.11017

Figure 30: Expected Runs from 1st to 2nd (2 runners on base)

	Runners on 1st and 3rd	Runners on 2nd and 3rd	Runs aded
0 out	1.75926	1.98871	0.22945
1 out	1.18071	1.40232	0.22161
2 out	0.51128	0.60239	0.09111

Figure 29 shows the expected runs added by a runner stealing 2nd base with different numbers of outs. In this scenario, there are no other runners on base. Figure 30 shows the expected runs added of stealing 2nd base when another runner is on 3rd. Clearly, stealing a base with 0 out increases expected runs the most, but in each case a stolen base increase expected runs. MLB teams are well aware of the expected runs calculator as it is a critical aspect of in game decisions. Greg Stoll also created a similar calculator that informs win probability in different in-game scenarios, down to the balls and strikes count.

Stealing bases certainly increases expected runs and win probability, but without other players to bat the runner across home, the stolen base means nothing. In fact, speed alone does very little for winning. In 2021 and 2022 MLB seasons, before the new rules, there was only a 0.05 correlation between stolen bases and regular season wins. This correlation dropped to 0.03 in the 2023 season as more teams began stealing. There are many more factors that go into winning such as starting pitching, bullpen strength, and numerous batting statistics. However, stole bases can be beneficial to a time with other strengths as well. Getting on base is the first and most important step to scoring runs. While homeruns are important, having runners on base increases the runs scored. Base runners provide additional benefits such as distracting pitchers and causing defenders to be more precise in their fielding. The point is a team needs effective batters to help runners score.

7. Summary

The 2023 Major League Baseball rule changes were a huge risk. It was the largest set of rules ever implemented at once in any major sport, and it seemed to have paid off. MLB game run times have declined to the lowest since before 2000 and the MLB brought in almost $11B in revenue, an all-time high.

The player themselves were impacted in different ways. Speed and power & speed players are stealing significantly more bases and speed players are striking out significantly less. It is possible that players with base stealing ability are changing their approach at the plate to be more conservative and reach base at higher rates. The base size and limited pickoff attempts are likely the contributing factors. Power hitters experienced no significant changes after the rule changes. Starting pitchers saw significantly less BB/9 while relievers saw no significant changes. The new era of Major League Baseball is more friendly to speedy players and rosters should adjust accordingly.

Building a roster with adequate batting strength, coupled with all around athleticism is where MLB teams are shifting their focus. The new rules allow for more scoring opportunities and teams can take advantage of this. I expect to see more athletic teams with speed throughout the lineup. Teams should still have their star power hitters, but surrounding those players with guys that can get on base and into scoring position will lead to more runs. In terms of pitching, due to the increase in scoring chances, teams should turn their focus to bolstering bullpens of experienced pitchers. Pitching in ‘clutch’ moments will be more frequent with more runners on base and getting into scoring position so GMs and managers should focus on matchups and experience. Pitchers that can consistently throw strikes avoid walks will be in higher demand.

Future work should consider more seasons of data in the post rule change era. More seasons will happen with time and more data will allow for confident and precise results. Additionally, it could be beneficial to consider all MLB batters in the dataset, not just top players. By considering a larger set of players, it could provide insights to how lower-level players are impacted by the rules. A case study of stolen base statistics such as lead distance, jump time and player measurables like speed and arm length could provide greater precision into how certain players are able to steal more bases. Lastly, catchers are an important factor in stolen bases and should be studied. Arm strength and pop time are measurables that can be analyzed to suggest better way for catchers to successful throw out more base stealers.

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