CHAPTER 15: THE SHIFT

The shift is perhaps the most controversial topic in baseball today. Detractors, who inevitably tend to be old-school types, feel the shift is against the spirit of the game and is unfairly penal to left-handed power hitters. The modern fan sees the shift for what it is, a legitimate strategy no different than positioning the infielders slightly differently in response to the count or the hitter's spray chart. And the hardcore sabermetrics-lover sees the shift as evidence of the evolution of the game brought on by smarter management, a victory for the nerds.

When I first saw the shift, I was reminded of the sport of cricket, the closest analog to baseball in the sporting world. In cricket, teams almost always un-balance their defense to one side of the batter, then pitch (or bowl as it is in that sport) accordingly. It is part of the game and indeed is part of the appeal of the sport. Hitters have to have the ability to hit the ball to both sides of the field which is not as straightforward as it is in baseball, or they will face very extreme shifts designed to exploit their deficiencies. The effectiveness of the shift in cricket actually led to one of the great sporting controversies, known as the Bodyline scandal[1]. The strategy was to put all of the fielders on the left (pull) side of the batter, then bowl at the batter's body on purpose to induce a pull shot, which is a baseball-style swing designed to pull the ball. The strategy of throwing at the batter, when done on the bounce, is legal in cricket. The batter was then faced with either getting out of the way of every pitch, getting hit on purpose, or pulling the ball into a stacked field, a high-risk, low-percentage shot. Many injuries resulted, and it created a major diplomatic controversy between England and Australia. Eventually the rules of the sport were changed to ensure the strategy was no longer as viable as it was before the incident, although variations are still commonly employed.

Visually, in both sports, the shift appears very intimidating to the viewer at home. The three infielders on the right-hand side against the left-handed power hitter seem to form an impenetrable wall through which no ground ball and most liners can never pass. As the sharpest analytics crews have studied the strategy, it is a matter of course that the gains from this wall must far out-weigh whatever coverage of the opposite field is lost from moving the extra fielder over. The left-handed power hitters, who rely on hard ground balls through the infield for much of their production, must switch to bunting or slicing the ball the other way; otherwise they will surely be shut out of the game.

Or so everyone thought, until someone actually bothered to do a decent study of the shift. Russell Carleton studied the shift in a series of articles[2] and found that for the most part, it doesn't actually suppress hitter wOBA, after adjusting for the strength of hitters who face the shift. While hitters do hit fewer singles against the shift, they manage more extra-base hits and walks, which tends to make the

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[1] https://en.wikipedia.org/wiki/Bodyline

[2] https://www.baseballprospectus.com/news/article/29085/baseball-therapy-the-pretty-good-case-that-the-shift-doesnt-work/

strategy more or less a wash. A win for the old-school crowd, who knew of the shift but decided not to shift anyway, because they thought the side-effects were worse than the benefits of the treatment. A common theme in our medical-industrial-scientific complex-driven world.

In any event, while the Carleton articles on the topic are excellent, it is worth taking a look at the shift to understand it within the framework we have developed thus far in this book. Why doesn't the shift work? Is there anything pitchers are doing wrong, or it is simply a story of the fielders not being in as improved of a position as we thought? Is there any way the shift can be made better? And is there any subset of hitters where the shift is a better choice?

Who Gets Shifted

The subset of hitters who teams choose to shift against tend to be above-average power hitters, for two reasons. One, teams tend to shift more often against more established hitters, presumably because with more statistics in hand they can analyze the spray pattern of these hitters more effectively. More established hitters tend to be more established for a reason, because they hit the ball harder. And two, power hitters tend to pull the ball more often, which leads to more hard-hit ground balls, the strategy the shift was built to stop.

Throughout this chapter we are limiting our sample of hitters to only those who have at least 200 plate appearances lifetime, who are facing pitchers who have at least 150 plate appearances lifetime. The impact of making this cutoff is very slight – but the cutoff tends to favor hitters more than pitchers. If the overall average hitter wOBA is slightly better than you might expect, this is the reason why.

Using the Statcast hit location data, we can measure the pull tendency of hitters based on the average horizontal angle of batted balls of that hitter. With respect to a right-handed hitter, a ball hit directly over second base is given a zero-degree angle, a ball pulled down the third-base line is given a negative 45-degree angle, and a ball sliced down the first-base line is given a positive 45-degree angle. Through taking the average of the angle of all balls hit in play, we can produce a measure of pull tendency. All hitters produce a range of average outcomes, with the most extreme pull hitters averaging between -10 and -15 degrees, and the average hitter averaging just over -5 degrees to the left of the second base bag.

While we could have just used the percentage of balls pulled, the above statistic is most predictive of whether a hitter will pull the ball in the future, where the shift is presumably most effective. We will come back to this statistic later on when we study which hitters may be best to shift against. For now, it is useful to understand that it does appear teams study hitters, and only shift against those hitters with higher pull tendencies according to this statistic:

Opposing Hitter Stats by Shift and Runner Status				
Defense	Average Hitter wOBA, Other Games	wOBA in Current Plate Appearance	Average Horizontal Angle of Batted Balls	Percentage of Time Strategy Used
Shift, Bases Empty	0.346	0.343	-7.6 degrees	17.8%
Regular, Bases Empty	0.335	0.328	-4.1 degrees	75.4%
Strategic, Bases Empty	0.338	0.332	-5.6 degrees	6.8%
Shift, Runners On	0.346	0.346	-8.1 degrees	9.8%
Regular, Runners On	0.337	0.336	-4.5 degrees	80.8%
Strategic, Runners On	0.336	0.349	-5.3 degrees	9.5%

In the above table we have split plate appearances into two situations – the first with the bases empty, and the second with runners on base. Teams are hesitant to shift with runners on base, only shifting 9.8% of the time in this situation versus 17.8% when the bases are empty. Instead, with runners on, teams are more likely to use what is referred to by Statcast as "strategic" alignments, which are defenses where the infield is in to prevent the bunt, or occasionally defenses where teams guard the line.

In all situations, better and more pull-focused hitters are more likely to be shifted. The average hitter facing the shift averaged about a 10-point higher wOBA across other plate appearances and had an average pull tendency of about 3.5 degrees higher than non-shifted hitters. But at first glance, we can see that the shift did not appear to depress the wOBA of hitters in these situations. With the bases empty, 0.346 hitters averaged a 0.343 wOBA against the shift for a three-point improvement for the defense, but 0.335 hitters average a 0.328 wOBA against normal defenses for a seven-point improvement. With runners on base, hitters perform roughly in-line with their overall career wOBA regardless of whether they are facing the shift, although hitters do tend to perform a little better against the "Strategic" alignment as we might expect, since these types of defenses often involve the infield playing out of the most wOBA-suppressing fielding positions.

It is well known that having runners on base tends to improve hitter outcomes for two reasons – one, the first baseman plays in a sub-optimal position to hold the runner, and two, the average pitcher who has allowed a runner on base earlier in the inning is probably pitching slightly worse at the time than the average pitcher who has yet to allow a runner on base. Either way, the average under-performance with the bases empty is actually larger, by 4 wOBA points, when teams do not shift compared to when they shift.

We see that the shift, at least at the macro level, does not appear to be effective at suppressing hitter wOBA. But one issue with studying the shift is that many hitters are almost never shifted, while others are shifted a relatively high percentage of the time. Although unlikely, our table above could simply be capturing a subset of hitters that perform better against the shift for some reason other than the their wOBA in other plate appearances. Most hitters almost never face the shift, and a very small subset face the shift in almost every plate appearance. These types of hitters won't help us in an analysis of whether the shift works, because when we compare their stats in a shift situation to their past stats, their past stats will almost completely have come from either the same or opposite situation, making it difficult to see which, if any differences in the underlying stats are coming as a result of the defense.

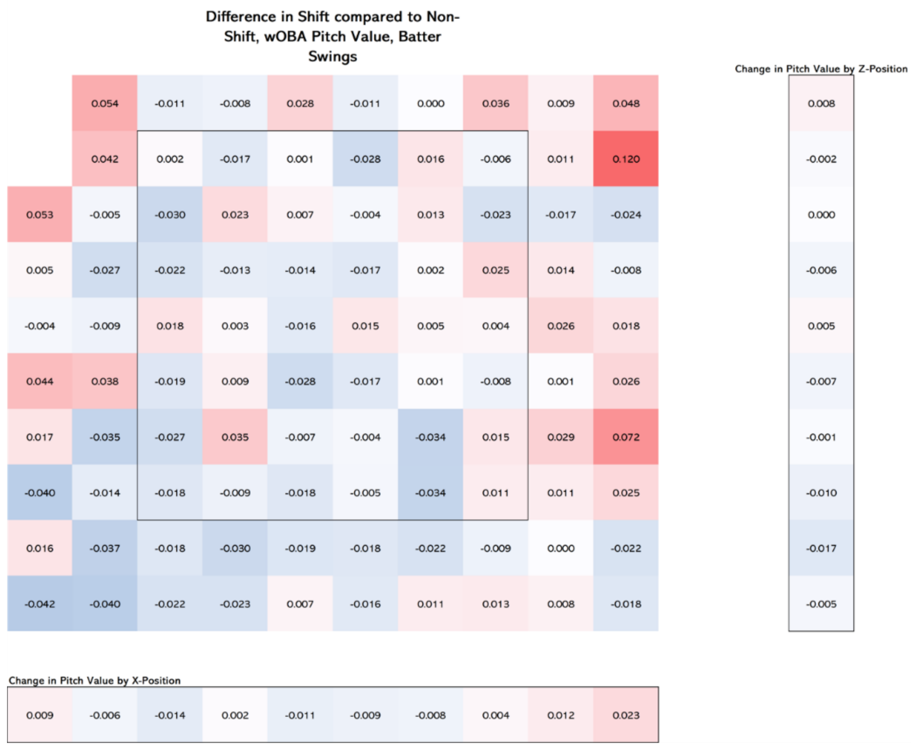
To account for this, we instead will focus on those hitters who have faced both defenses, using a cutoff of between 20 and 80% of all pitches faced coming against shifts. In addition, we will only study plate appearances where there are no runners on base, to avoid any complications that may result from base runners hurting the effectiveness of the defense. Finally, when comparing shift to non-shift situations, we will remove the "strategic" defensive alignments, because these probably contain a mix of defenses that are similar to a shift, as well as defenses that are like normal defenses, but worse in terms of suppressing hitter wOBA.

How the Shift Influences the Hitter and Pitcher

The fundamental strategic idea of the shift is that when hitters hit a ground ball or low line drive, many hitters will hit the ball to the pull side of the infield far more often than the opposite field. From a pitching perspective, we'd expect the types of pitches that usually induce these ground balls would be more effective with such a defense. Pitches down-and-in, and breaking balls anywhere tend to be the best pitches to induce the hitter to "roll over" on the pitch. We can visualize this phenomenon with the following heatmap, showing the average pull angle by pitch location (negative means the pitch was pulled more on average, with -45 representing a ball down the third-base line hit by a right-handed hitter, 0 a ball hit up the middle, and 45 a ball hit down the first-base line):

Balls down-and-in are pulled more often; a ball on the low-inside corner is pulled an average of 20 degrees, almost half the way between the second-base bag and the third-base line. On average, hitters pull the ball; only pitches well up and away are hit on average right of the second-base bag. In addition, the higher the pitch, the later the hitter tends to swing, meaning these balls tend to be hit more often to the opposite field. This suggests that to take advantage of the shift, pitchers should focus on targeting the low-inside part of the plate. Note that in this chapter we have included the two boxes outside of our main heatmap, that sum together all pitches in the corresponding row (of pitch height) or column (of pitch x-direction), to help better visualize the impact the shift has on pitch effectiveness by location.

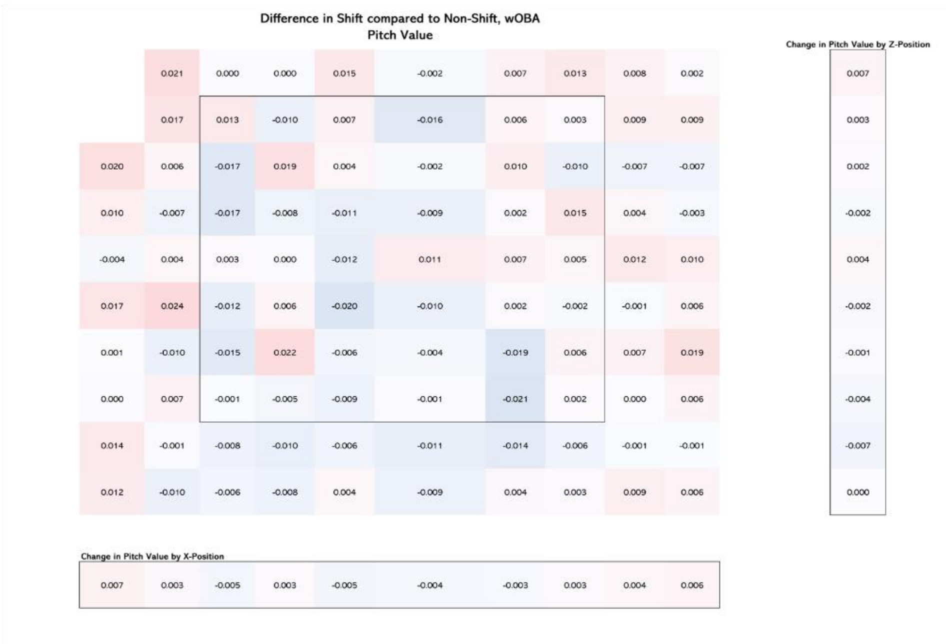
We can visualize which pitches perform relatively better in the shift by using comparative heatmaps. With our sample of hitters who have faced a significant number of shift and non-shift plate appearances, we create a heatmap of the difference in wOBA per pitch in each area of the heatmap, using the average wOBA in shift situations minus the wOBA of the same hitters and pitches faced in non-shift situations. To see if the shift works as intended, we start with a wOBA comparative heatmap when the hitter swings at the pitch:



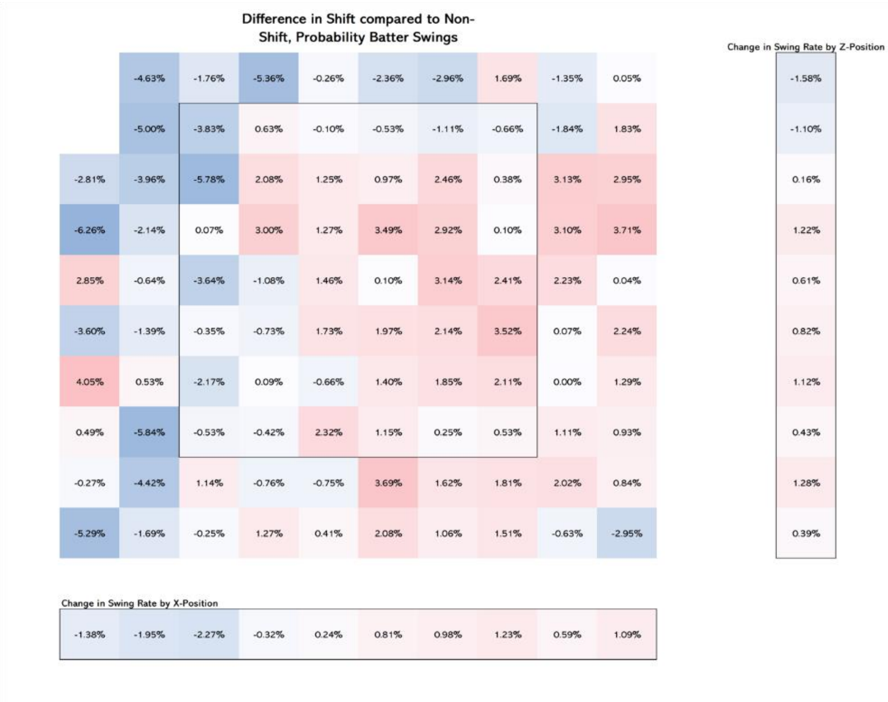
We can see that as one might expect, the down-and-in pitch and low pitches in general are more effective when the batter swings in a shift situation, as these pitches are most likely to lead to the pulled ground ball into the stacked infield. Although there is some volatility, hitters tend to average 20-30 wOBA points worse when swinging against pitches thrown in these areas when the shift is on. Hitters make contact more often with these pitches when they do swing, with all of the wOBA benefit to the defense coming from worse results on balls hit in play.

On the other hand, hitters perform much better against outside pitches when facing the shift, particularly outside pitches well out of the zone. Usually these are terrible pitches to swing at, but hitters have managed to poke many of these to the opposite field and get free hits that would not have been hits against a normal defense. Pitches slightly off the plate away generally do not generate a ton of swings and misses compared to pitches below or above the zone; instead the issue for the hitter is that hitters cannot square these pitches up and often hit a weak liner or grounder. But the giant hole on the opposite side makes these outcomes much more favorable to the hitter.

Still, overall, the shift seems to be working well; if the batter swings, most pitches in the zone tend to perform much better. And while the batter performs better against pitches off the plate outside, usually it is still a win for the pitcher when the batter swings at a pitch like this, even with the hole in the defense created by the shift. But perhaps the hitters know this, and take more pitches as a result, focusing on swinging at outside pitches and taking more inside pitches. Let’s see how pitches as a whole, in all situations, perform in shift versus non-shift situations:



Overall, pitches down-and-in still perform slightly better than before, as do low pitches in general. But pitches thrown off the plate, both inside and outside of the zone, are very slightly worse, and in general there are not huge benefits to the shift anywhere; instead of the 20 to 30 point wOBA benefit we saw when the batter swung at the pitch, the average outcome is more like a benefit of 5-10 wOBA points relative to the non-shift when thrown in the best locations, offset by worse performance in other locations. With the outside pitches, we know the reason is because hitters perform better against these pitches when they swing, but with the inside pitches it is somewhat less obvious. We know hitters don’t do well against these pitches when they swing, meaning the only possible reason for the improved performance is that they swing less often, and take more balls as a result. We can confirm this by comparing the probability hitters swing in shift versus non-shift situations:

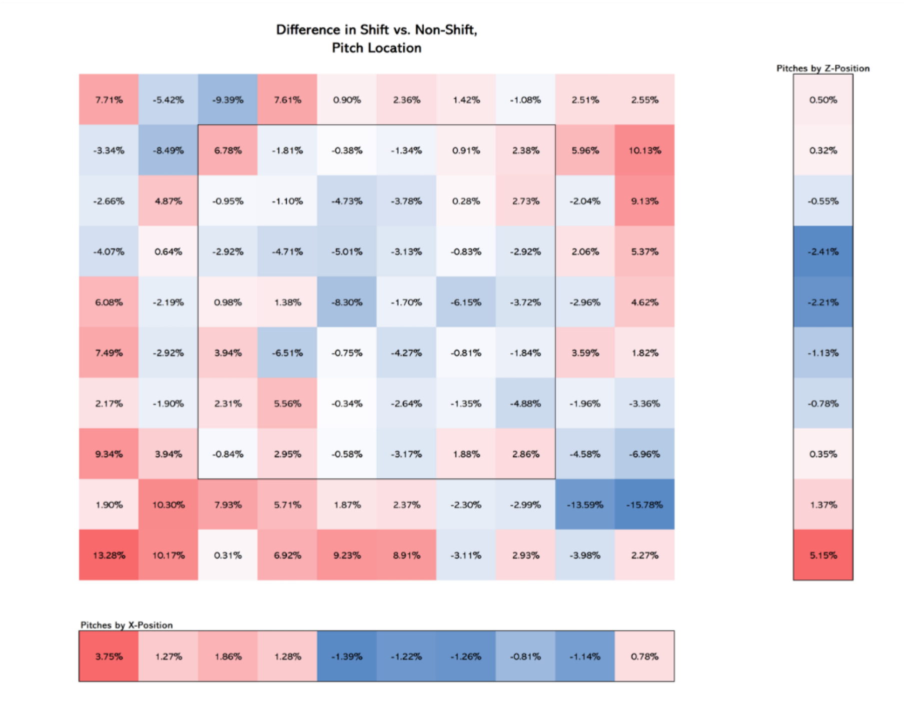


As expected, hitters adjust to the shift and lay off pitches on the inside half of the zone, while they swing more often at pitches down the middle and on the outer half of the plate. The difference is slight, only a few percentage points, but is enough to substantially swing the odds against the shift and offset many of the gains of the strategy on balls thrown inside. Hitters see the defense and know that the pitcher is likely to want to work inside, and also know that they don't want to swing at such pitches as there is little they can do against them. On the other hand, they know that even weak contact against outside pitches is likely to be more effective than usual and swing more often against these types of pitches. Across all pitches, hitters swing roughly the same amount regardless of the shift, but they adjust their swing patterns to optimize their outcomes. Finally, one more subtle factor tends to hurt the shift. Umpires are less likely to give the pitcher the call when the pitch is on the inside corner of the plate as compared to the outside corner of the plate.

One last important point to make is that hitters, for the most part, don't have the ability to suddenly hit balls pitched inside to the opposite field just because the shift is on, or if they do have this ability, aren't using it. We can understand this from the following heatmap, showing the difference in horizontal hit angle by location between hitters in shift and non-shift situations:

For a pitch thrown in the same location, hitters actually pull the ball very slightly more by around 1.5 degrees on average in shift compared to non-shift situations. This is not due to hitter intent, but because pitchers throw more off-speed pitches when the shift is on; in addition, the type of hitter who faces the shift probably has somewhat more of a pull tendency, even though we have only included hitters who face the shift on a regular basis in our study.

Finally, it is useful to look at how pitchers tend to pitch in the shift, compared to non-shift situations, through a map of pitch density comparing shift to non-shift locations:

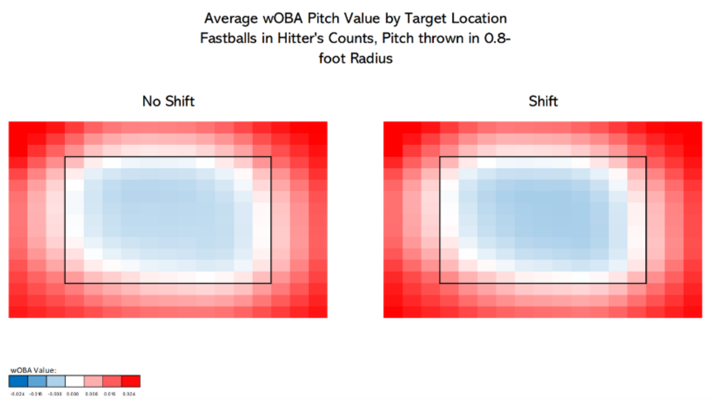


Pitchers throw slightly more pitches inside and slightly fewer pitches middle-away with the shift on. They also throw far more pitches lower in the zone, and down and off the plate inside. This strategy would appear to be correct, since pitches thrown in these areas tend to be the type of pitches that the shift helps the most when the batter swings. The problem is that hitters know these pitches are coming and don't swing as often, and in addition, pitchers almost never get a strike call on pitches marginally off the plate inside. This reduces many of the benefits of the shift.

While pitches in the zone middle-away tend to be less effective with the shift on, these pitches over the plate still tend to be effective for the pitcher compared to pitches thrown outside the zone. We know from our study earlier in the book that in most counts, any pitch over the plate is a positive outcome for the pitcher. As pitchers throw about 1% more pitches out of the zone in shift situations, this reduces their effectiveness overall. A final factor hurting the shift is that even though the shift helps teams defend it better, the down-and-in pitch is suboptimal as hitters tend to hit this pitch well. Hitters perform better against this pitch than any other, and while they don't perform quite as well against this pitch with the shift on, it is starting from a higher base level than pitches in other parts of the zone. In other words, the shift demands that the pitcher pitch to the hitter's strength.

In the end, the shift doesn't work well because baseball is a balanced game, and pitchers are just not that accurate. Pitchers clearly adjust their target down-and-in to take advantage of the shift, and when they throw strikes or induce a swing when doing so, their outcomes are much better. The problem is that hitters know these pitches are coming, seem to recognize them more easily, and counter the strategy by not swinging. If pitchers were accurate enough to always throw strikes down and in on the hands, the shift would be almost unbeatable, but they are not.

Instead, when pitchers try to target the low-inside corner, they miss a large percentage of the time and throw too many balls. When combined with the fact that hitters know this is coming and know not to swing, the benefits of slightly better performance on strikes when the shift is on are offset by hitters being more ahead in the count on average. One possibility would be for the pitcher to pitch normally, throwing their usual mix of pitches middle and middle-away. To explore this, we can plot the pitch value by target in the zone, in shift vs non-shift situations against the same set of hitters, focusing on fastball/hitter's counts (1-0, 2-0, 3-1, 3-2, and 2-1):



We can see that the optimal target is nearly in the exact same part of the zone for these above-average accuracy pitchers able to locate within an 0.8-foot radius. Although the down-and-in pitch does very slightly better in the shift, the pitcher shouldn't target it, because as we have shown elsewhere, the risk of throwing more balls is not worth the slight payoff of having a ball slightly more likely to be hit into the defense. If pitchers could locate with perfect accuracy, the shift would be dominant, but real pitchers, who are probably even less accurate than the 0.8-foot radius we show, are not able to fully take advantage.

Where the Shift Works

The shift is only about 3 wOBA points per plate appearance less effective with the bases empty and performs the same as the traditional defense with runners on base. This means it is likely that there is a subset of hitters and pitchers where the shift is an effective strategy. The most obvious candidates would be the most extreme pull hitters. We can find the most extreme pull hitters by using the average horizontal angle of batted balls discussed earlier, and compare the performance of hitters by their pull tendency in shift vs. non-shift situations:

Shift Effectiveness by Hitter Average Pull Angle			
Average Pull Angle (Degrees), Other PA	**Percentage of Time Faced Shift**	**Change in wOBA per Pitch, Shift – Not Shift**	**Percentage of Hitters**
Greater than 12	61.5%	-0.0056	2.0%
9 to 12	50.9%	0.0001	27.0%
6 to 9	40.7%	-0.0004	40.4%
3 to 6	31.6%	0.0029	24.4%
Less than 3	11.4%	0.0154	6.2%

Although there are few of them, the shift does seem to be effective against the absolute most extreme pull hitters who average a horizontal pull angle of over 12 degrees. 5.6 wOBA points per pitch is a significant gain – there are just under four pitches per shifted plate appearance, meaning the shift suppresses these hitters by 20 wOBA points per plate appearance. Fortunately, teams are already using the shift against these hitters a very high percentage of the time. On the other hand, the shift is very ineffective against hitters who pull the ball less than the average hitter. Against the subset of hitters who pull the ball the least, the shift has actually performed 15.4 wOBA points per pitch worse than not shifting.

It is also worth looking at whether the shift is less effective against righties. Intuitively, the shift should be a little better against lefties, because when a ground ball is fielded on the right side of the infield, it almost always results in an out, while ground balls fielded on the left side, while still usually resulting in outs, are somewhat less good for the defense due to the longer throw. On the other hand, having three fielders on the left-hand side may mean that when fielders reach a grounder in this situation, they have an easier play. We turn to the results for the answer:

Shift Effectiveness by Hitter Average Pull Angle Versus Righties			
Average Pull Angle (Degrees), Other PA	Percentage of Time Faced Shift	Change in wOBA per Pitch	Percentage of Hitters
Greater than 12	21.1%	-0.0028	0.4%
9 to 12	33.7%	-0.0011	16.0%
6 to 9	32.5%	0.0005	40.4%
3 to 6	29.8%	0.0033	32.4%
Less than 3	15.0%	0.0095	10.8%

The numbers show that as we would expect, teams don't shift nearly as often against right-handed hitters. But there is nothing wrong with shifting against more extreme pull right-handed hitters who pull the ball nine degrees or more on average as the shift has been slightly more effective against these hitters, with a wOBA value per pitch one point lower than when teams don't shift. Where the shift is very bad against righties is when it is used against those hitters who do not have an extreme pull tendency. Righties don't pull the ball quite as hard as lefties, on average, and this probably leads to the shift being somewhat overused against them. There may be a subset of die-hard shift teams who make too many shifts against righties, and these shifts are terrible – they are improving the performance of these hitters by almost 10 wOBA points per pitch, or 40 wOBA points per at bat. This is enough to turn an average hitter into one of the best hitters in the league!

While it is unlikely that "average pull angle left of second base" is likely to break through as a new advanced statistic, an easy rule of thumb is that for a hitter to be worth shifting against, they probably should be in the top 10-15% of pull hitters in the league. Shifting against the middle set of hitters around 15-50% is around neutral and shifting against the bottom half of hitters by pull tendency is just outright bad. This means that we should probably see the shift against, on average, one to two of the hitters in an average opposing lineup.

In addition to hitters, there are some pitchers who tend to induce hitters to pull the ball as well. The most obvious would be pitchers who like to work in on the hands with the cutter, as well as pitchers with a good change-up. These pitchers may be better candidates to back up with the shift. The spread in pull tendency across pitchers is not nearly as wide as it is with hitters, making it somewhat unlikely that any pitchers are great shift candidates. However, we can take a look at how these pitchers have performed in shift and non-shift situations anyway:

Shift Effectiveness by Pitcher Average Pull Angle			
Average Pull Angle (Degrees), Other PA	Percentage of Time Team Shifted	Change in wOBA per Pitch, Shift – Not Shift	Percentage of Pitchers
Greater than 6	46.1%	0.000	20.0%
3 to 6	39.8%	0.001	52.6%
Less than 3	37.2%	-0.002	27.4%

We see no real difference between the performance of those pitchers who induce the most pulled balls, compared to those pitchers who tend to induce contact more towards the opposite field, and the opposite-field tendency pitchers actually performed better under the shift. One thing to note is that pitchers who induce opposite-field contact tend to be better pitchers in general. Usually this is because they have better velocity, as that is the best way to ensure hitters swing late, and better velocity is always good. Either way, shifting should probably be only done in response to extreme pull hitters, and the pitcher's tendencies can likely be ignored in this situation.

Conventional Defense is a Shift

One of the less appreciated aspects of the conventional defense is that it is a strategic shift in its own right, accompanied by a pitching strategy that pitchers naturally use to maximize its benefits. Although we have just finished talking about how the shift does not work well other than against extreme pull hitters, the truth is that it probably is a better positioning of the field on average against where most reasonable shift-candidate hitters actually hit the ball. If pitchers just used a normal pitching strategy, aiming for the center of the plate, the results of the shift would likely be slightly better than that of the conventional defense, and it would become an effective default strategy.

However, the conventional defense, with fielders somewhat out-of-position on the opposite-field side of the infield, is designed to take advantage of the fact that hitters do not hit the ball as hard when they are forced to go the other way, the fact that the inside pitch is penalized by the umpire compared to the outside pitch, and the fact that a hit batter is the biggest single-pitch penalty in baseball unless the pitcher has thrown three balls already. This has created the tendency of pitchers across the league to target their pitches, especially their fastballs, slightly down-and-away of center. With this type of pitching strategy, the defense should be naturally aligned more towards the opposite field than normal. In a sense, pitchers have always pitched to their defense, even if they did not quite know the reasons why.

The problem with the conventional defense strategy of "fielders out-of-position, pitch down-and-away" is that it causes pitchers to throw too many balls off the plate outside compared to if they had aimed at the dead-center of the plate. But against the best power hitters, where walks are less bad and who can do more damage against inside pitches, this strategy may be viable. The problem is the best hitters tend to pull the ball more often and are better shift candidates as well. In the end baseball is a balanced game, and the optimal defense is probably somewhere between the shift and the conventional defense, allowing the optimal target to be in the center of the plate early in the count, maximizing the chance the pitcher throws a strike.

Conclusions

While the shift is much-maligned by baseball purists, the truth is that it is ineffective against the majority of hitters. Only the most extreme pull hitters are notably worse against it, and if anything, teams are probably shifting too much in today's game. The reason the shift does not work well is that the pitcher feels pressured to work inside, which leads to too many balls early in the count. This is compounded by the hitter having the knowledge that the pitcher is likely to work inside, meaning they hit in a more optimal manner, taking more balls in off the plate compared to when they face a neutral defense.

The shift does work well when the hitter puts the ball in play, and against the most extreme pull hitters can be an effective strategy. The shift is not any more or less effective against righties and strong pull-tendency righties are fine shift candidates. The best strategy when pitching with the shift is to pitch like you are pitching with a normal defense, perhaps throwing a few more off-speed pitches since hitters tend to pull these pitches more often.