Analyzing the Impact of the NCAA's Shot Clock Change in 2015 on Teams' Offensive Efficiency

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Abstract

In 2015, the NCAA Division 1 College Basketball committee decided to decrease the shot clock time from 35 seconds to 30 seconds. The intention was to improve the quality of games by increasing points scored and quickening the pace of play. Teams now face a tighter time constraint, thus increasing pressure during play, and likely resulting in more frantic plays and a decreased efficiency at turning possessions into points. Consequently, we hypothesize that teams with an existing slower pace at the time of the shot clock change will face greater difficulty in converting points under the new shot clock. Therefore, we conduct a difference in means test between the top 9% of teams by pace and bottom 9% of teams by pace before and after the 2015 rule change.

Introduction

Over the last decade, NCAA Men's Division 1 basketball has experienced a decline in quality due to low-scoring games and a slower pace. This has become most apparent in the end of games when waves of fouls and timeouts extend game time. In an effort to prevent low scoring, slow pace games from becoming the norm, the NCAA men's basketball committee reduced the shot clock from 35 seconds to 30 seconds in 2015. As a result of the rule change, a team's offense had less time to organize and execute plays in order to score points. Two factors that we will be utilizing throughout our research are team offensive efficiency and adjusted team tempo. Team offensive efficiency, percentage of points scored divided by number of possessions, measures the ability of a team to organize and execute plays in a game whereas adjusted team tempo, the number of possessions a team would have in a game against the average NCAA opponent, can serve as an indicator of a team's pace of play. Our research analyzes how the NCAA men's basketball shot clock rule change in 2015 affected offensive efficiency across faster- and slower-paced teams in the NCAA, are teams with a slower pace of play impacted more significantly than those that have a faster pace of play?

Offensive efficiency is an ideal metric that measures how team scoring is affected by the rule change. Because shorter shot clocks will increase the number of possessions each team has per game, each team will have more opportunities to score. This will potentially create higher scoring games. If we looked only at team scoring data, our analysis of team scoring would be confounded by the increased number of possessions. Offensive efficiency measures how well teams can convert possessions to points. Intuitively, less time on the shot clock will impact the ability to convert possessions into points because a less organizational time will have more rushed, frantic plays. Moreover, less time should yield higher turnover rates, a worse shot selection, and less organization among teams. Overall, offensive efficiency is a good indicator of how the new time constraint will impact team success on each possession -- this metric allows us to go beyond number of points scored in order to distinguish impact on teams categorized by a particular pace of play.

Although the NCAA's stated goal was to increase pace of play and the number of points scored nationwide, we suspected that the rule change would affect some teams more drastically than others. Possessions that extend into the last ten seconds of the shot clock, and particularly into the last five seconds of the shot clock, tend to be more disorganized, more frantic, and less efficient. Utilizing data from kenpom.com, we found the fastest teams in the 2014-2015 season (the year prior to the rule change) averaged about 15 seconds per possession, while the slowest teams utilized 20 seconds per possession.

Let's consider what the rule change would look like for both the fastest and slowest teams based on these averages. If a team is one of the slowest in the nation, thereby utilizing on average 20 seconds of the shot clock per possession, we will assume that approximately half of their possessions will take longer than 20 seconds. Subsequently, if we assume that these possessions are evenly distributed among every second from 20 seconds to 35 seconds, then 3.33% of this team's possessions will fall across every second from 20 to 35 second interval. Therefore, 16.65% of the team's possessions will occur in the dreaded last five seconds of the shot clock, while 33.33% of the team's overall possessions will occur in the last ten seconds. Theoretically, this means that one-sixth of a team's possessions would either have to increase their "speed" or be considered a turnover. However, after the shot clock is reduced from 35 to 30 seconds, if this same team averages 20 seconds per possession and we apply the same assumptions, then 25% of the team's possessions will occur in the final five seconds, while 50% will occur in the final ten seconds. Conversely, if we looked at one of the fastest teams in the 2014-2015 seasons under the same assumptions, then prior to the rule change only 12.5% of their possessions would occur in the last five seconds and 25% would occur in the last ten seconds. Theoretically, this means that one-eighth of a team's possessions would either have to increase their "speed" or be considered a turnover. While obviously this thought experiment takes into account the assumptions that shots will be normally distributed across the seconds remaining on the shot clock, the basis of the argument holds - if a team tends to be slower and utilize more of the shot clock, more of their possessions will be affected by the diminished shot clock time. Similarly, a faster team that utilizes less of the shot clock will be less affected by the shot clock change. Therefore, our hypothesis is that slower teams, who tend to use more of the shot

clock, will be more negatively impacted by the reduction in the shot -- as indicated by a reduced offensive efficiency -- than faster teams will.

Previous literature pertaining to the rule change's impact throughout the league is limited. Previous studies exist examining the rule change's impact on the pace of play, number of points scored, and offensive impact vs. defensive impact. Ken Pomeroy's study investigated the impact of this change on points scored and pace of play. His study found that pace was about 2 possessions higher per team and that scoring was 2.4 points higher per team as well (Winn 2016). Another study was conducted to determine whether the rule change would unintentionally empower defenses over offenses (Winn 2015). The study found that team's defenses did not receive unintentional benefits over the offenses. It also substantiated Pomeroy's claims that overall points and pace of play increased per team. With that being said, neither study investigated how the rule change impacted teams differently based off of their existing pace of play. This is the primary goal of our statistical investigation. We aim to find evidence, using two difference in means tests, one on fastest teams and one on slowest teams, as well as supplementary statistical techniques, that teams with a relatively lower pace of play will be more dramatically impacted by the rule change in comparison to existing fast teams.

Data and Research Design

The entirety of the data used in this analysis is sourced from kenpom.com, which has tracked Division 1 basketball stats since 2002. Our dataset spans three seasons prior to the rule change (2012-2013, 2013-2014, 2014-2015) and the three seasons following the rule change (2015-2016, 2016-2017, 2017-2018). Each observation is a given game for a given team in a given season. For example, if a given team plays 30 games each season, said team is expected to have 180 observations (30 games/season x 6 seasons) in the dataset. While we initially examined our data through an arbitrary threshold of 30 teams, we deemed beings with a percentage of total teams to be a better measure. We chose the top and bottom 9% of all 344 teams, which is approximately 31 teams each, as it is the closest percentage to our initial selection of 30 teams. The remainder of the paper will use the 9% threshold for our analysis. Rather than

using the single seasons immediately prior and post rule change, we aim to maximize the number of data points by using a three season dataset in each direction to give more precise results. To measure the pace-of-play, we utilized "Adjusted Tempo." "Adjusted Tempo," a statistic developed by Ken Pomeroy, owner of kenpom.com, which measures the number of possessions a team would have over the standard 40-minute game against a team who plays at the average NCAA tempo. We came to the determination that "Adjusted Tempo" was the correct metric, as investigations into average possession length per game failed to account for the speed of the opponent -- a faster opponent would naturally increase a team's number of possessions, while a slower opponent would naturally decrease a team's number of possessions. "Adjusted Tempo," however, accounts for an opponent's speed and produces a universal value that can be compared with every team across the NCAA.

Utilizing the "Adjusted Tempo" data, we filtered the ~350 NCAA basketball teams for the top 9% of teams with the fastest pace-of-play during the 2014-2015 season and the bottom 9% teams with the slowest pace-of-play during the 2014-2015 season. Our decision to focus on the 2014-2015 season as our filter of the fastest and slowest teams was to best isolate the effects of the rule change on offensive efficiency. By filtering based on the "Adjusted Tempo" immediately prior to the rule change, we maximized the temporal accuracy of our results. Additionally, during the six years of data, some teams either did not play Division 1 every season, or merged with another team (e.g. Abilene Christian, Arkansas Little Rock, IPFW, Texas Pan American, Grand Canyon, Incarnate Word, and UMass Lowell). These teams were removed from our data set.

Analysis

We conducted a statistical difference in means test to evaluate the null hypothesis that there is no significant difference in the average offensive efficiency for the 9% fastest teams and 9% slowest teams before and after the rule change. Our alternative hypothesis that there is a significant difference in the average offensive efficiency before and after the rule change for the fastest 9% and slowest 9%. Realizing

that our selection of the top and bottom 9% was arbitrary, we performed the same test across every level from 5% to 25% to demonstrate how the gap in offensive efficiency varies by a bin's grouping size.

In addition to performing a series of difference in means tests, we also performed a placebo test on the 2013-2014 season to determine if in fact, the year of the rule change was significant. In order to do this, we performed the same difference in means test at the 9% level, but instead of using the years 2012-2013, 2013-2014, and 2014-2015 seasons as the "prior" years and using the subsequent three years as the "post years," we utilized only the 2012-2013 and 2013-2014 seasons as the "prior" years, while using the subsequent four years as the "post" years. If this test produced an identical result to the original result, then we could identify the 2014-2015 season as not being significant at all, and that the changes to offensive efficiency occurred completely independent to the rule change. We selected the 2013-2014 season as the "placebo post year" to maximize the accuracy of our results, as utilizing any year after the actual change would have factored in the rule change itself and thus would have been useless in analyzing the placebo test. We used the 2013-2014 season rather than the 2012-2013 season so as to minimize any noise that would occur between the rule change and the placebo year.

Results

Of the fastest 9% of teams, we found evidence to reject the null hypothesis -- that there is no difference in offensive efficiency post rule change -- at the 95% confidence level ($N(30) = 8.255 \times 10^{-8}$). The mean offensive efficiency changed from 103.6 to 105.8 (Figure 1). Similarly, there was a sizable shift in the median. Conversely, of the slowest 9% of teams, we did not find evidence to reject the null hypothesis -- that there is no difference in offensive efficiency post rule change -- at the 95% confidence level. Of the slowest 9% of teams, the mean stayed constant at 104.8 as can be seen in Figure 1.

Figure 1

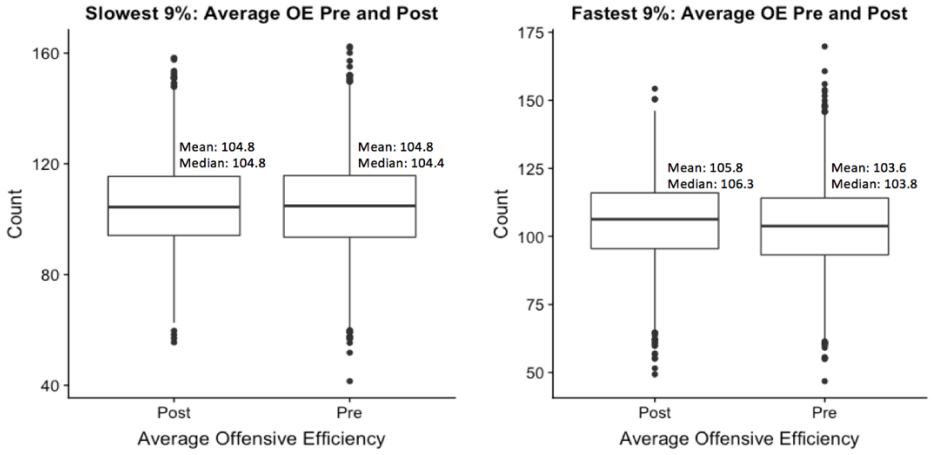
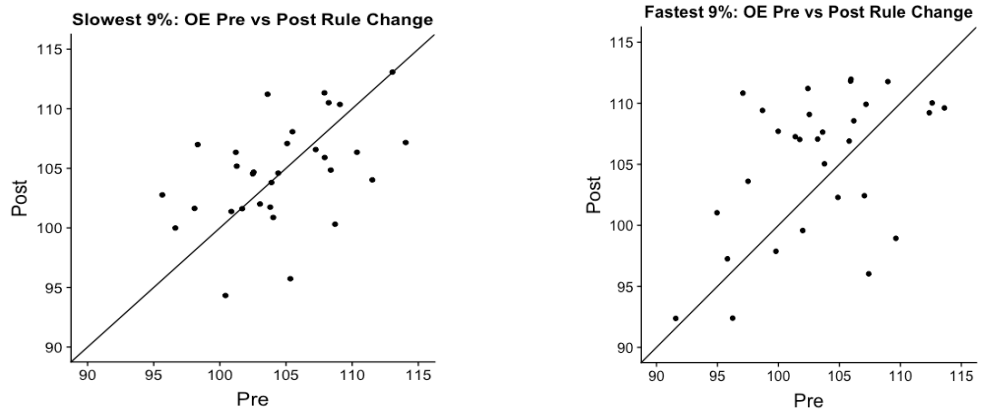
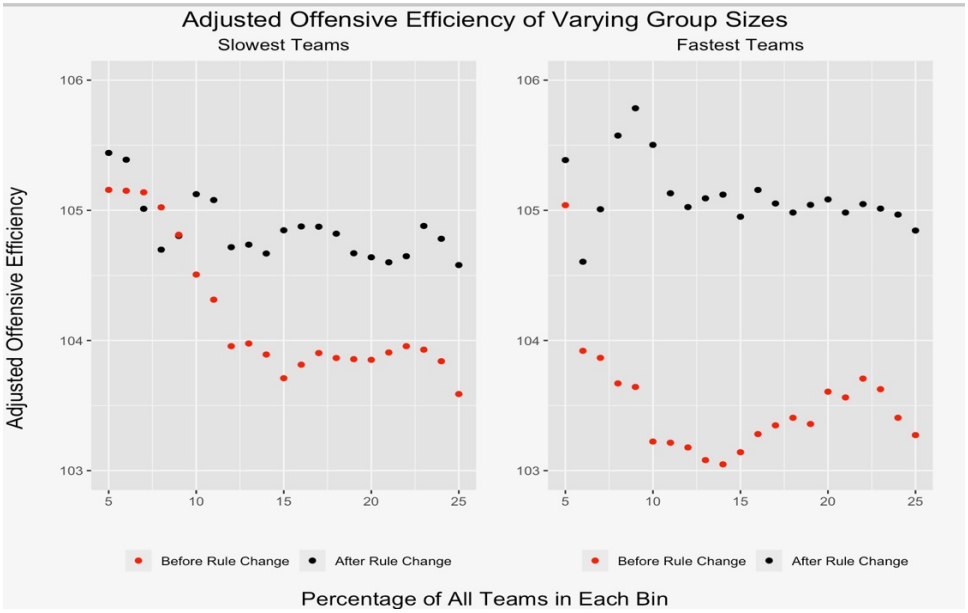


Figure 2



In Figure 2, we find that more teams lie above the 45 degree line of both the top 9% and the bottom 9% of teams. Each team above the 45 degree line had a higher offensive efficiency post rule change as compared to pre rule change. More notably, 20 out of the top 9% of teams fall above the line, whereas 15 out of the bottom 9% of teams fall above the line. This is a reasonable outcome considering that we did not find statistical significance that the bottom 30 of teams experienced a change in offensive efficiency as a result of the rule change, but did find statistical significance that the top 30 teams experienced a change in offensive efficiency.

Figure 3



Our decision to utilize the top and bottom 9% was arbitrary and was outlined prior to performing our statistical analysis. We believe that the 9% threshold of teams is large enough to appropriately conduct an analysis, but also small enough to prevent homogeneity of pooled data. However, in an effort to demonstrate the change in offensive efficiency in varying grouping sizes we performed the same statistical tests across the 5% to 25% levels. Figure 3 visualizes the results of conducting our analysis at these varying thresholds. We found that for the 6% and below threshold for the top teams, there is no significant difference before and after the rule change. Similarly, for the bottom 10% threshold for bottom teams, we found no statistical change before and after the rule change. Figure 4 provides a detailed breakdown for each percentage threshold, the mean offensive efficiency before and after the rule change, as well as the results of the difference in means tests that determined whether those changes were statistically significant. It should be noted in the table that there is a massive increase in offensive efficiency across the board, with the lone exception of the very slowest teams.

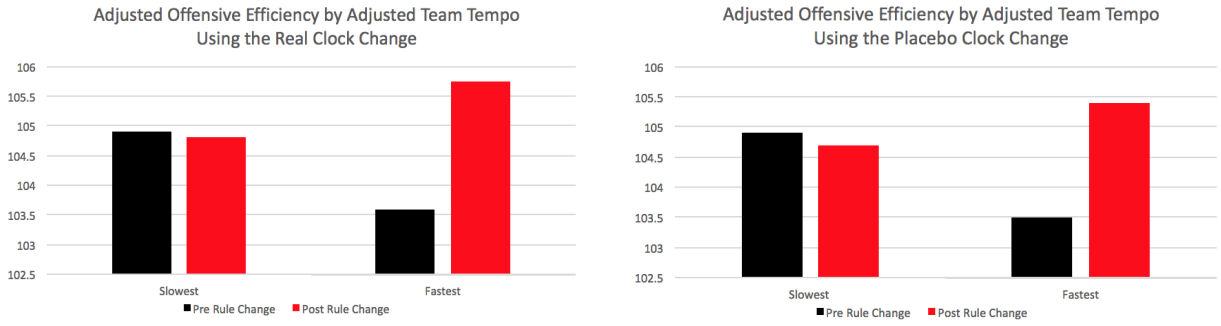
Figure 4: Table of Offensive Efficiency Difference in Mean Tests

Portion of teams tested	Average OE top- pre rule change	Average OE top- post rule change	P value on test for top	Average OE bottom- pre rule change	Average OE bottom- post rule change	P value on test for bottom
5%	105.039	105.385	.523	105.157	105.441	.610
6%	103.920	104.604	.163	105.150	105.388	.637
7%	103.866	105.008	.0125	105.011	105.011	.787
8%	103.670	105.574	<0.01	105.023	104.697	.453
9%	**103.642**	**105.784**	**<0.01**	**104.812**	**104.802**	**.981**
10%	103.223	105.502	<0.01	104.506	105.124	.118
11%	103.214	105.130	<0.01	104.313	105.079	.040
12%	103.178	105.025	<0.01	103.956	104.717	.033
13%	103.081	105.092	<0.01	103.977	104.736	.025
14%	103.049	105.121	<0.01	103.892	104.668	.018
15%	103.141	104.951	<0.01	103.710	104.847	<0.01
16%	104.281	105.156	<0.01	103.814	104.876	<0.01
17%	103.348	105.052	<0.01	103.903	104.874	<0.01
18%	103.406	104.983	<0.01	103.865	104.820	<0.01
19%	103.358	105.042	<0.01	103.856	104.670	<0.01
20%	103.607	105.084	<0.01	103.851	104.639	<0.01
21%	103.562	104.983	<0.01	103.908	104.601	<0.01

22%	103.707	105.048	<0.01	103.956	104.647	<0.01
23%	103.929	104.880	<0.01	103.626	105.013	<0.01
24%	103.406	104.967	<0.01	103.841	104.781	<0.01
25%	10.273	104.845	<0.01	103.586	104.579	<0.01

Green = Statistically significant at 95% confidence; Red = Not significant

Figure 5



In addition to performing difference in means tests at the various levels, we performed a placebo test to inform whether the 2015-2016 season, the year after the rule change, was in fact significant (Figure 5). Rather than in the previous analysis where we split the data set into the three years before to the rule change (2012-2013, 2013-2014, and 2014-2015) and after the rule change (2015-2016, 2016-2017, and 2017-2018), we reapportioned the years to be separated into the initial two seasons (2012-2013 and 2013-2014) as the "before" seasons, while the final four seasons (2014-2015, 2015-2016, 2016-2017, and 2017-2018) became the "after" seasons. The real statistical analysis found no increase in offensive efficiency for the slower-paced teams after the rule change, while the same metric increased from 103.6 to 105.7 for the faster-paced teams. In the placebo analysis, the slower-paced teams decreased slightly from 104.7 to 104.9, while the faster-paced teams increased from 103.5 to 105.4. Comparing the changes in offensive efficiency in the real analysis to the placebo we find that the increases are more muted than in the placebo than in real analysis. We found that the placebo demonstrates that the 2014-2015 season is not statistically significant as a cutoff year.

Discussion and Limitations

Our initial hypothesis was that slower-paced teams would be more affected by the shot clock rule change that the faster-paced teams. However, we found there was no statistically significant difference in offensive efficiency for the slowest teams before and after the shot clock change. In contrast to this lack of change for slower-paced teams, we found that the faster-paced teams increased their offensive efficiency dramatically over the six seasons. A possible explanation for this development is found in the results from our placebo test. The placebo test found that the 2014-2015 season was not statistically significant, and that the changes in offensive efficiencies over the six seasons were not entirely due to the rule change. Given that the general increase in offensive efficiency is unrelated to the rule change, there must have been a universal change to the efficiency in college basketball. A plausible explanation of this dramatic increase is the newfound emphasis on efficiency and advanced analytics across the NBA and NCAA in recent years. Advanced analytics provided by companies such as Second Spectrum, has allowed teams in the NBA to access and take advantage of previously untapped data regarding optimal game strategies like shot selection. Utilizing this information NBA teams have increased their efficiency across the board by widely adopting the strategy of shooting 3-pointers and easy 2-pointers close to the basket, as well as taking as many trips to the free-throw line as possible. The Golden State Warriors, winners of three of the last four NBA finals, are most successful example of this strategy. This strategy have been copied across the NBA and has trickled down to college basketball and college teams have grown dramatically more efficient with the implementation of this new strategy. This phenomenon is a potential explanation for the dramatic increase in offensive efficiency we see in our analysis.

Despite the external impact on offensive efficiency across the 2012-2017 seasons, there are instances in our data which may demonstrate that the shot clock did in fact have a greater effect on slower teams than faster teams. For example, in Figure 4, the general trend for slower teams from the 5% to 9% level is that teams experience little to no change in offensive efficiency before and after the shot clock change. These are teams who are most likely to take the shot clock down to its final seconds, and

subsequently be most affected by the new time constraint. This lack of change is interesting when compared with the slowest teams at the 15% to 25% level, where there is a massive increase in offensive efficiency. These levels include teams who are probably slower, but are probably not consistently taking the clock down to its final seconds, therefore they are probably far less impacted by the shot clock change. Additionally, across the board the faster teams were able to also find massive gains in offensive efficiency. A hypothesis for this massive differential between the very slowest teams and the others in our discussion is the increase in offensive efficiency due to the change in style discussed above, was in fact counter-balanced by a decrease in offensive efficiency due to the change for the very slowest teams.

In performing this analysis, it is important to acknowledge the limitations and assumptions in our design to appropriately discuss the findings. Most obvious is that there is an assumption that the adjusted offensive efficiency statistic is a fair metric for categorizing the fastest teams and the slowest teams in college basketball. Additionally, we utilized the adjusted tempo metric to determine the faster-paced and slower-paced teams across college basketball. A potential limitation of adjusted tempo is that the main factor is the number of possessions a team has in a given game. However, several factors can skew a team's number of possessions and would misrepresent the team's actual pace. For example, a slower-paced team with a high number of offensive rebounds would have an inflated relative to the time they typically hold the ball on an offensive possession. However, we assume that teams that are significantly affected by these trends are outliers and that over the course of the data set that the tempo data is a good indicator of a team's speed.

Another limitation to our analysis is our usage of the 2014-2015 season as the standard for identifying the faster-paced and slower-paced teams. Obviously, teams could change styles, coaches, or adjust to the new shot clock to dramatically alter their tempo, however, changing teams or tempo metrics in each season to account for these changes would cause too much noise in our data, making meaningful conclusion hard to draw. Finally, our analysis focused entirely on the effects of the shot clock on offensive efficiency, and we assumed defensive efficiency held constant. Although we utilized Adjusted Offensive Efficiency, which does account for the average performance of the opponent (and therefore the

opponent's defense), we did not perform any other procedures to account for the impact of the opponent's defense on offensive efficiency in each game scenario. Inherently, our inability to control for the exogenous factors mentioned above is certainly impacting our observations. With this limitation, it is difficult to separate our observations from existing noise, thus limiting our ability to draw definitive conclusions about the impact of the shot clock change on offensive efficiency.

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