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The 2021 NBA Rule Change: Analyzing Strategic Adjustments and Changes in Worker Productivity

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THE 2021 NBA RULE CHANGE: ANALYZING STRATEGIC ADJUSTMENTS AND CHANGES IN WORKER PRODUCTIVITY

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ABSTRACT

The NBA introduced a rule change for the 2021/22 season to stop shooters from drawing fouls from "non-basketball moves." This paper seeks to determine how the 2021 Rule Change has impacted productivity in the NBA and investigate whether it has caused teams to make strategic adjustments. My analysis reveals evidence that the rule change has limited offensive players' abilities to draw fouls on 3-point shots. While the rule change has rendered non-basketball moves ineffective, there is no evidence of strategic adjustments beyond this arena. I find only limited evidence that the rule change has impacted worker productivity. The findings imply that the rule change's impact on the game of basketball is localized to the foul rate on 3-point shots, and it has only a minute impact on other facets of the game.

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INTRODUCTION

In this paper, I analyze the effects of the 2021 NBA Rule Change. The change was implemented to limit unproductive player behavior that negatively affected the game and viewer experience. The 2021/22 season marked the first time since 2014 that the NBA's scoring average dropped from the prior season (Basketball Reference). The drop off in scoring prompted me to investigate whether the rule change was responsible for the decrease in offensive productivity. My hypothesis was that the rule change would allow defenders to play more aggressively, thus limiting offensive productivity. My analysis, however, reveals little evidence that productivity was affected by the rule change.

To analyze productivity in the NBA, I developed an economic framework to review the rule change and its subsequent effects on offensive and defensive productivity. I expand on Gannaway's definition of worker productivity in basketball from his 2014 paper, *Technological Change, Relative Worker Productivity, and Firm-Level Substitution* (Gannaway et. al.). In analyzing these effects, I contribute a statistical analysis of the NBA's latest changes in scoring technology to the literature on basketball.

My analysis centers around objective statistical measures of productivity, based on Oliver's Four Factors of Basketball Success (Oliver). I provide some supplemental evidence from NBA players and coaches to contextualize the rule change's effects, however. I uncover significant trends related to scoring and identify historically unusual shifts in offensive productivity within the 2021/22 season. Scoring increased significantly more within the '21/22 season than any other season in my data. Several other statistics like free throw attempts increased within the season as well. Despite this, scoring was still down as a whole from the previous season.

I find evidence that the rule change negatively impacted players' abilities to draw fouls on 3-point shots but find no such evidence for 2-point shots. Additionally, I find no evidence that shot selection was affected by the new rules. While I expected the new rules to impact other areas of the game, it seems like teams have not made any notable strategic adjustments. Players are, however, less incentivized to try to draw fouls through non-basketball moves.

Overall, I find the demonstrable impact of the rule change is restricted to 3-point fouls. Players attempted nearly 25% fewer free throws from 3-point attempts in 2021/22 than the previous season. Aside from 3-point fouls, I found the new rules were not responsible for significant shifts in productivity in 2021/22, and I cannot identify any strategic responses from its implementation. The lacking response from the new rules is notable, as it suggests that the rule change's impact was isolated to just one aspect of the game.

BACKGROUND ON THE RULE CHANGE

On September 30th, 2021, the NBA announced its new rule change via Twitter, "For the 2021-22 NBA season, there will be an interpretive change in the officiating of overt, abrupt or abnormal non-basketball moves by offensive players with the ball in an effort to draw fouls" (NBA Official). The NBA went on to emphasize points of focus: shooters launching into defenders at abnormal angles and other non-basketball moves where offensive players initiate contact with defenders. This strategy was widely known as "foul-hunting." Starting in 2021, shooters would no longer be awarded free throws when they initiated contact with defenders via non-basketball moves.

The 2021 Rule Change sought to correct the growing problem of offensive players forcing abnormal contact to gain free throws. Before the rule change, offensive players were able to erratically extend their body into defenders to draw a foul. This forced defenders to give more space to offensive players to avoid being called for fouls, which in turn made it easier for offensive players to find open

shots. Thus, the expected result of the rule change is two-fold: offensive players will draw fewer fouls and defensive players will be able to guard offensive players more tightly. This is not the only possible effect; the rule change could embolden defenders and cause an increase in foul calls as they play more aggressive defense.

The foul-hunting problem was especially pronounced on 3-point shots. Defenders did not want to give up an open 3-pointer, as that has proven to be one of the most efficient shots in basketball. At the same time, they dreaded getting called for a foul when defending a 3-point attempt closely enough for a shooter to initiate contact. It was a catch-22 situation for defenders, who were often limited in the ways they could defend shooters. The issue became more apparent as NBA teams increased their rates of 3-pointers in recent years, as offensive players gained more chances to draw shooting fouls.

The 2021 Rule Change was overwhelmingly met with positivity by players and fans alike. Spectators had often decried the “non-basketball” moves employed by shooters, saying that it made for poor basketball. A poll of fans found 87% to be in support of the rule change (Rivas). 2022 NBA Finals MVP Steph Curry was quoted on the topic before the season as saying, "the goal is to put the ball in the basket and not be out there just living and dying by trying to get to the free-throw line any way you can. I love the effort" (Slater). I seek to find if that effort was validated.

ECONOMIC FRAMEWORK

1. The Four Factors of Basketball Production

One goal of the research is to identify how NBA worker productivity changed in response to the 2021 Rule Change. Since the rule change is concerned with how fouls are called, I focus on behavior relating to gaining free throw attempts. I am also interested in substitutes for free throw attempts, as they allow us to observe behavioral changes stemming from the rule change.

From an economic perspective, the rule change can be viewed in a similar manner to that of the introduction of the 3-Point line in 1979. Gannaway calls that introduction an "exogenously imposed change in technology for scoring points in the NBA" in his 2014 paper (Gannaway et. al.). I view the 2021 Rule Change in a similar light, as it was an exogenously imposed change made by the league that took away a vehicle for scoring. While the rule change is probably not as impactful to the game of basketball as the introduction of the 3-point line, it could potentially affect players' productivity in a similar manner.

Gannaway's paper measures worker productivity for NBA players in terms of "points per attempt" on shots. Per NBAstuffer, Points Per Shot is calculated by taking the total number of points from 2-point and 3-point attempts and dividing that by the total number of field goal attempts (NBAstuffer). While this is a useful metric, it is crude in the sense that it does not take free throws or defense into account and is therefore limited in its application for the 2021 Rule Change. Rather than following Gannaway's methodology here, I take a multi-faceted approach to measuring worker productivity by using Oliver's "Four Factors of Basketball Success."

Dean Oliver is a former player, coach, and pioneer in the field of basketball statistics (NBAstuffer). His four factors are the elements he found to be most crucial to winning in basketball; they apply to offense and defense. From the offensive perspective, the four factors are *shooting* the ball efficiently, limiting *turnovers*, *rebounding* effectively, and taking as many *free throws* as possible—in that order (Oliver). On defense, teams seek to limit the offense's ability to execute the four factors. These factors were not picked arbitrarily—they are rooted in basketball efficiency metrics. In fact, a 2017 review of the four factors used regression analysis to find that they explain 91.7% of the variation in a teams' win totals (Jacobs).

The four factors serve as simple, useful metrics to analyze worker productivity in the NBA. To further specify these metrics: shooting is measured by effective field goal percentage, a weighted metric that takes the impact of 3-point shots into account; rebounds are measured in terms of offensive rebounds; and turnovers and free throw attempts are measured by their counting stats. The interpretation varies accordingly from the defensive perspective.

Out of the four factors, I am most focused on how the rule change affects shooting and the number of free throws a team takes. Changes in shooting would be captured in how teams adjust their shot selection in the absence of viable non-basketball moves. The potential effect on free throws is more straightforward, as I would expect teams to attempt fewer free throws after the rule change. Turnovers should increase as defensive productivity improves from the rule change. It is possible that rebounding could be indirectly affected by the rule change, but there is too much noise surrounding this stat to draw reliable conclusions. I attempt to measure the impact of the rule change on shooting, turnovers, and free throws through statistical and regression analysis.

Oliver's Four Factors of Basketball Success lend a way to measure worker productivity in the NBA. If the exogenous change in the rules affects offensive productivity, it should do so via shooting efficiency and free throw attempts, as it takes away an avenue for scoring. I would expect a similar response in turnovers to indicate changes in defensive productivity. The direct effect of the rule change should limit the number of fouls players can draw, and the ripple effects should impact other aspects of the game.

2. Foul Hunting as a Strategy

NBA players, teams, and coaches employ numerous strategies to score points and limit their opponent's production. Some strategies occur on a broad scale throughout the season, while others manifest only in niche situations. The rule change should express itself in situations where players try to

strategically foul hunt. Basketball is essentially a 2-player game, where offenses and defenses react to each other's strategies and adjust accordingly. There is a third party present, however; that being the referees. Here, we define foul hunting as a strategy relative to all three parties and contextualize its role in the game of basketball.

Changes in basketball are typically met with adjustments from both sides. An example of this is the "Hot Hand" phenomenon. The paper *Momentum Isn't Magic—Vindicating the Hot Hand with the Mathematics of Streaks* finds that players do shoot slightly better after making consecutive shots (Miller). The resulting adjustment is that defenders key into the shooter with the hot hand; the shooter's teammates benefit from this as they are left open. The improvement in team performance resulting from the Hot Hand phenomenon is noted in Dixit's *Thinking Strategically* and it highlights the connected nature of basketball (Dixit).

In the case of the 2021 Rule Change, all three parties in the game of basketball are affected by the rule change and should be expected to make strategic adjustments. Defenders no longer have to worry about being called for fouls when the offensive player initiates contact, so they should be able to play a more focused style of defense. Offensive players are more reliant on lapses in officiating if they wish to foul-hunt and cannot rely on their old strategies as heavily. Referees need to focus on calling the new rules, which could take some acclimation and potentially limit their attention to detail in other areas of the game.

Before the rule change, offensive players would repeatedly attack defenders to initiate contact and draw fouls. This necessitated a cautious approach for defenders. With the new rules, offensive players should not be able to repeatedly foul hunt in a game with success, as refs will zone into that player's behavior and their attempts will be rewarded with few free throws, if any. It is still possible that

a player can successfully draw a foul or two by catching the refs off guard, but these attempts must be well-timed. In general, we expect players to substitute away from foul hunting.

In the absence of foul hunting, I expect players and refs to make strategic adjustments. Offensive players must rely more on other strategies; this could manifest in differences in shot selection. Defenders and refs must also shift their attention accordingly. In particular, defenders should be able to play more aggressively. We investigate broader strategic adjustments later in the paper.

DESCRIPTION OF THE DATA

I drew my data from a variety of sources to observe the impact of the rule change from as many angles as possible. I scraped box score data from the NBA's website and downloaded detailed foul-related data from PBP Statistics. ESPN provided attendance data and Basketball Reference gave season-long averages for certain stats. The main cross-sectional dataset is comprised of dozens of team performance statistics from game-level observations. This gives granular data that allows for precise results in my analysis. My dataset contains basic box score data, information on the sources of fouls, advanced penalty metrics, season-long averages, the game's date, location, and attendance numbers. Summary statistics are shown in table 1:

Summary Statistics

Variable	Count	Mean	St. Deviation	Min	25%	50%	75%	Max
Home Dummy	18862	0.50	0.500	0.00	0.00	0.50	1.00	1.00
Season	18862	17.42	2.304	14.00	15.00	17.00	19.00	21.00
Rule Dummy	18862	0.13	0.337	0.00	0.00	0.00	0.00	1.00
Minutes	18862	241.62	7.165	240.00	240.00	240.00	240.00	340.00
Points Scored	18862	107.31	12.948	64.00	98.00	107.00	116.00	168.00
Field Goals Made	18862	39.72	5.242	19.00	36.00	40.00	43.00	63.00
Effective Field Goal %	18862	52.01	6.621	28.65	47.40	51.81	56.41	79.52
Field Goal Attempts	18862	86.69	7.312	60.00	82.00	86.00	91.00	129.00
3-pointers Made	18862	10.57	4.009	1.00	8.00	10.00	13.00	29.00
3-point Attempts	18862	29.59	8.211	4.00	24.00	29.00	35.00	70.00
3-point %	18862	35.58	9.190	0.00	29.40	35.30	41.70	84.20
3pt Ratio	18862	34.10	8.925	4.49	27.91	34.03	40.21	68.48
Free Throw Attempts	18862	22.58	7.300	1.00	17.00	22.00	27.00	64.00
Free Throw %	18862	76.71	10.395	14.30	70.00	77.30	84.00	100.00
Offensive Rebounds	18862	10.24	3.778	1.00	8.00	10.00	13.00	47.00
Defensive Rebounds	18862	33.85	5.399	16.00	30.00	34.00	37.00	57.00
Opponent's Defensive Rebounds	18862	33.85	5.399	16.00	30.00	34.00	37.00	57.00
Assists	18862	23.53	5.180	5.00	20.00	23.00	27.00	50.00
Turnovers	18862	13.83	4.938	-49.00	11.00	14.00	17.00	35.00
Pace	18862	98.18	2.799	91.10	96.45	98.39	100.16	105.51
Win %	18862	49.94	14.798	12.20	39.00	51.20	61.00	89.00
Opponent's Defensive Rating	18862	108.56	3.541	98.20	106.30	108.80	111.10	116.80
Difference from Avg Attendance	18862	-20.38	5452.425	-15922.69	-190.69	1489.31	3079.31	5897.31
3pt Foul Rate	18862	1.45	2.332	0.00	0.00	0.00	2.94	30.00
2pt Foul Rate	18862	14.44	4.567	0.00	11.27	14.29	17.31	38.46
Drawn 2pt Fouls	18862	9.18	2.925	0.00	7.00	9.00	11.00	23.00
Drawn 3pt Fouls	18862	0.44	0.700	0.00	0.00	0.00	1.00	6.00
Drawn Non-Shooting Fouls	18862	2.35	1.951	0.00	1.00	2.00	3.00	21.00

Table 1, Summary Statistics from the Dataset

I include data from every regular season NBA game, starting in the 2014/15 season and going through 2021/22. 2014/15 was chosen as it marks the first season where all teams had season-long access to "SportsVU" technology. SportsVU is motion-tracking technology that allows NBA teams to analyze aspects of the game that were not possible before (NBAstuffer). The statistical insights it offers have driven many changes in the way teams approach the game of basketball. Examples include an increased emphasis on three-point shooting and gaining free throw attempts. I refer to my statistically driven subset of seasons as the "SportsVU Era."

The data used in this research excludes games played in "the bubble," the NBA's quarantined site for the 2019/20 season after the onset of the Covid-19 pandemic. Cecchin's paper, *Oliver's Four-Factor Model: Validation through Causality*, considers these games to be outliers due to the large

number of statistical anomalies from the bubble (Cecchin). I follow this reasoning and exclude the bubble games from my dataset.

One aspect of NBA games relating to the pandemic is attendance. Many stadiums had restrictions resulting in few to no fans attending games during the pandemic. This is important to control for, but game-by-game data on attendance is not readily available. Instead, I approximate attendance using each team's season-long attendance averages (ESPN). While this is an imperfect measure of attendance, it largely controls for the reduction of fans in the 2020/21 season, when several arenas did not allow a single fan to attend all season. Additionally, I use each stadium's difference from the mean attendance in my regressions to give better insight into the effects of below average attendance.

In total, my dataset contains 18,862 observations of team performance in the regular season, which equates to a sample of 9,431 games with data for both teams. The sample size is large enough to yield significant insights. It also allows us to easily analyze trends across and within seasons.

REVIEW OF TRENDS

1. Long-Term Trends

Understanding the context of recent statistical trends in the NBA is crucial to understanding how the new rule change fits into the game of basketball. Much of the conventional wisdom of the sport has been abandoned since the introduction of SportsVU, as teams race to score more efficiently. Offenses have gravitated towards 3-point shooting and "positionless basketball," with 7-footers commonly shooting better than guards did in past eras. This has culminated in players performing better at Oliver's Four Factors and increasing productivity. In this section, I analyze the trends that have impacted worker productivity the most in recent years.

Oliver's first factor is shooting, measured by efficient field goal % (EFG). EFG appropriately weighs the value of 3-point shots by counting made attempts as 1.5 field goals, as opposed to traditional field goal % which counts them the same as 2-pointers. Thus, EFG is a better measure of shooting efficiency than traditional FG%. As shown in figure 1 below, it improved every year until dipping slightly in 2021/22:

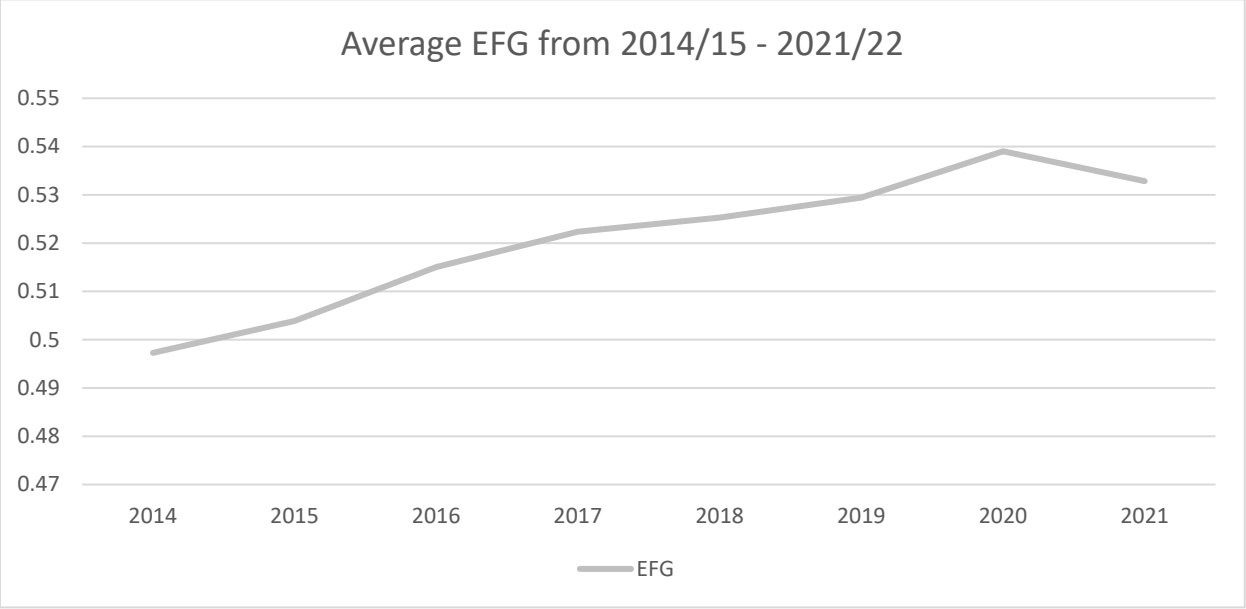

Fig. 1, Effective Field Goal % from 2014/15 – 2021/22 (NBA)

The consistent improvement in EFG highlights the impact SportsVU technology has had on NBA basketball. One might assume that the increase is due to better shooting, but that is not the case. Traditional field goal percentage has stayed mostly constant over the time span (NBA). Rather, the increase is primarily due to better *shot selection.* Teams have foregone low-efficiency mid-range jumpers in favor of 3-pointers, and the results are paying dividends. Figure 2 shows how a higher diet of 3-point shots results in better scoring:

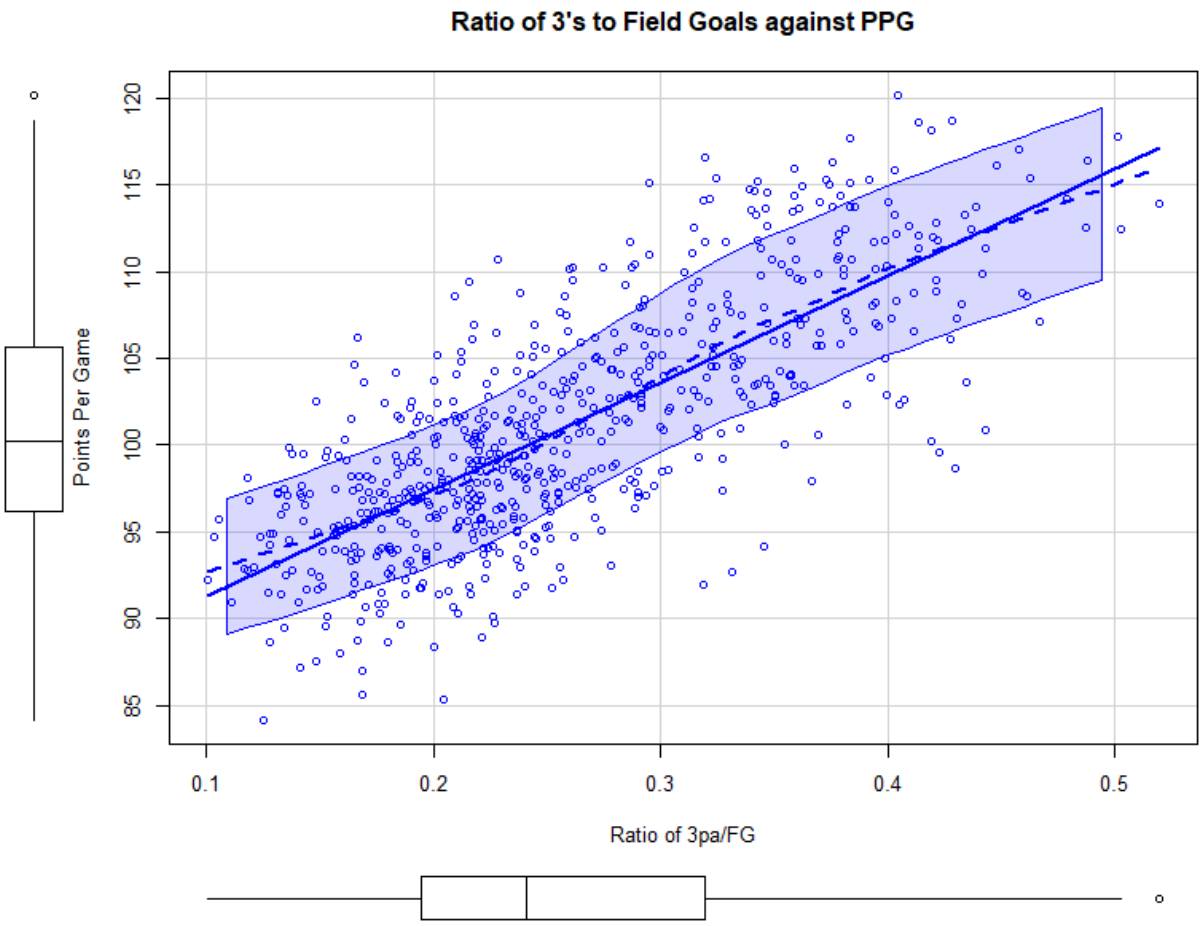

Fig. 2, 3-point Ratio to Points Per Game (Basketball Reference)

Teams clearly score more when they shoot a higher ratio of 3's to 2's. Accordingly, teams have increased the number of 3-pointers taken per game every year since 2014. This has resulted in better scoring year-over-year until 2021/22 (see figure 3):

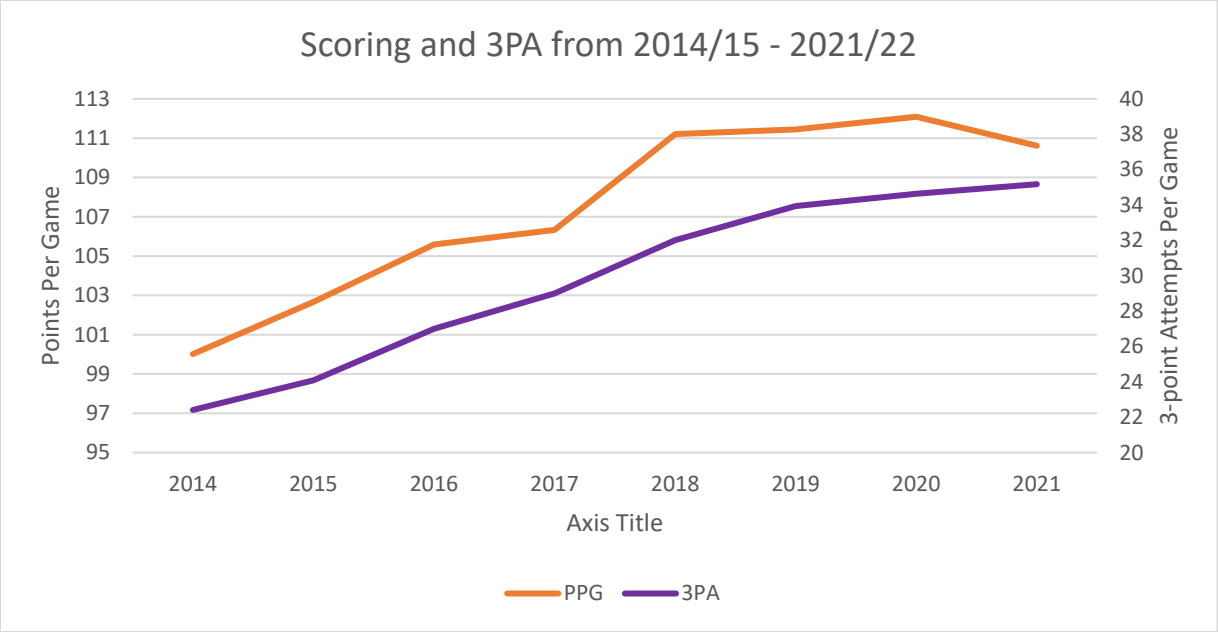

Fig. 3, Points Per Game and 3-point Attempts from 2014/15 – 2021/22 (NBA)

It is clear the increased number of 3's that teams take has improved scoring and efficiency. At the same time, teams have reduced the number of 2's they have attempted. This is important to bear in mind, as I am interested in whether the rule change has affected shot selection.

Free throw attempts (FTA) are how Oliver measures a team's ability to get to the free throw line. I would expect this to be the factor most influenced by the rule change. The past few seasons have been a rollercoaster for this stat, as shown in figure 4:

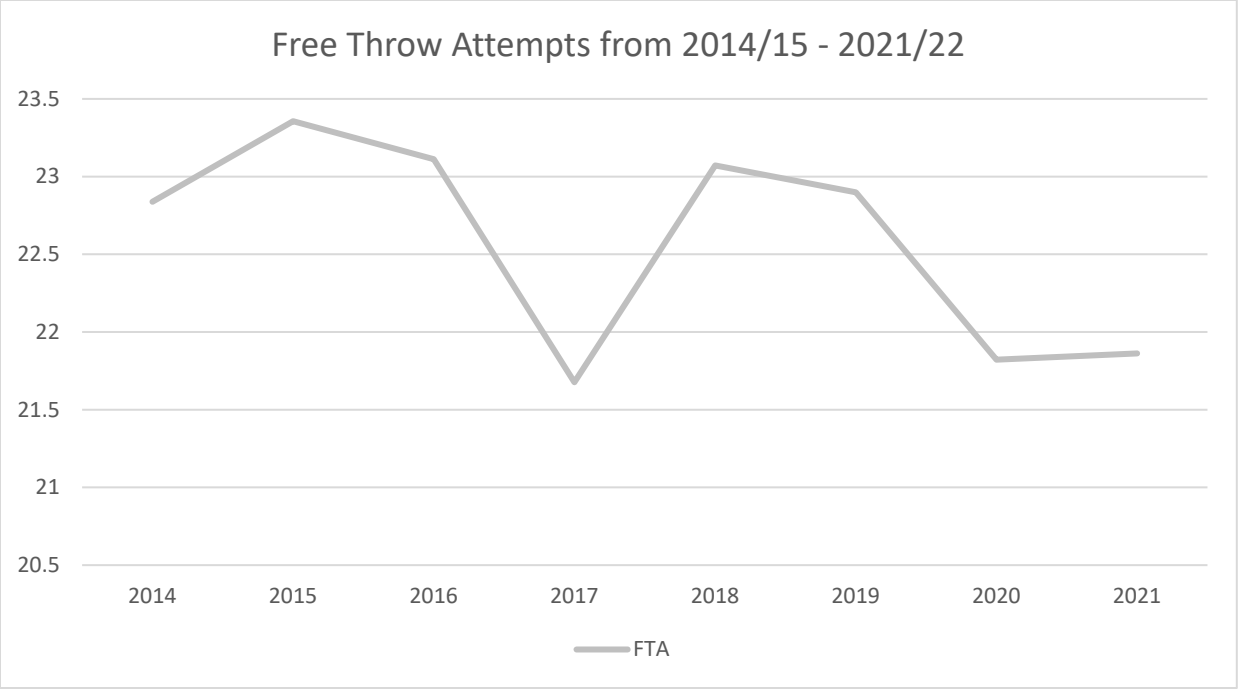

Fig. 4, Free Throw Attempts from 2014/15 – 2021/22 (NBA)

There is no clear time trend. This makes some sense, as free throws are a volatile stat that can vary depending on a ref's mood. Players consistently attest to officiating varying from game to game, so we should not expect consistency across seasons.

What is surprising is the slight increase in FTA from the '20/21 to '21/22 seasons. The rule change was introduced to curb the number of free throws players drew, but that effect is not evident in the most fundamental free throw statistic. Surprisingly, worker productivity measured by free throw attempts rose slightly after the rule change. This could be evidence of the rule change's ineffectiveness, or simply due to the long-term trend of free throw volatility. I investigate this further in subsequent sections.

Oliver's remaining factors are rebounding and turnovers. The new rules are not likely to have a direct effect on rebounding; we would only expect this stat to shift in response to changes in shot selection. Turnovers, however, represent a useful metric to evaluate the rule change's impact on

defensive productivity, though the effect here may also be indirect. Both statistics are as volatile as FTA, as shown in figures 5 and 6:

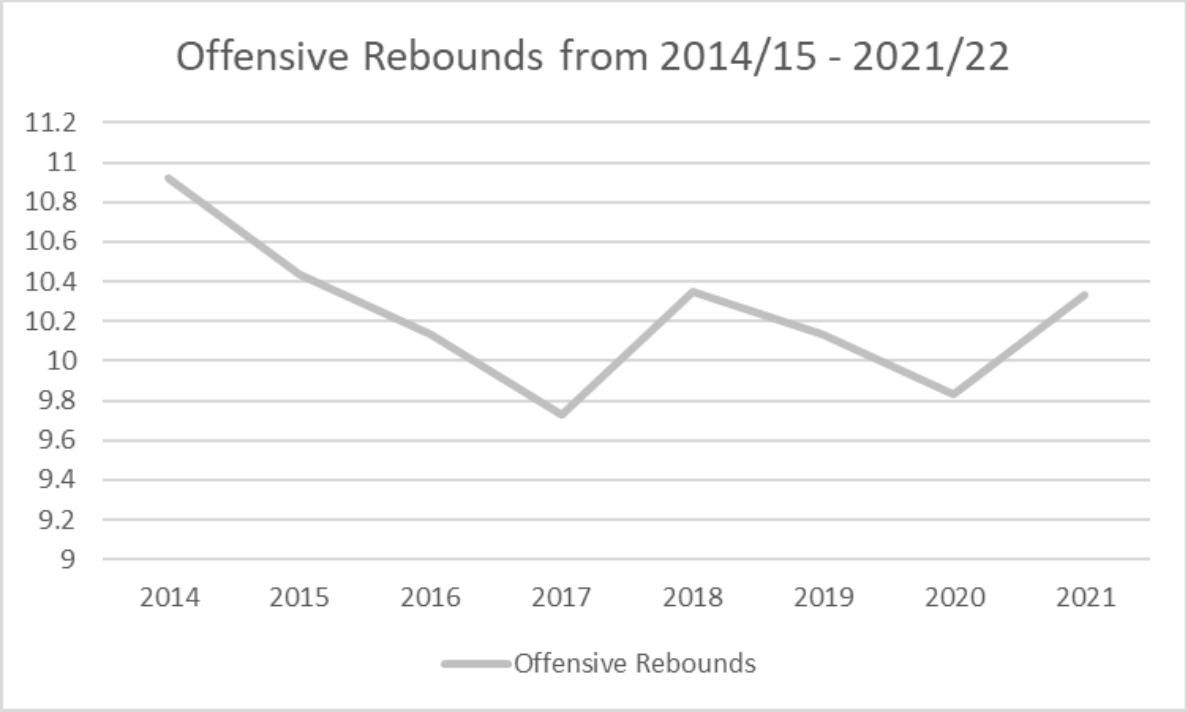

Fig. 5, Offensive Rebounds from 2014/15 – 2021/22 (NBA)

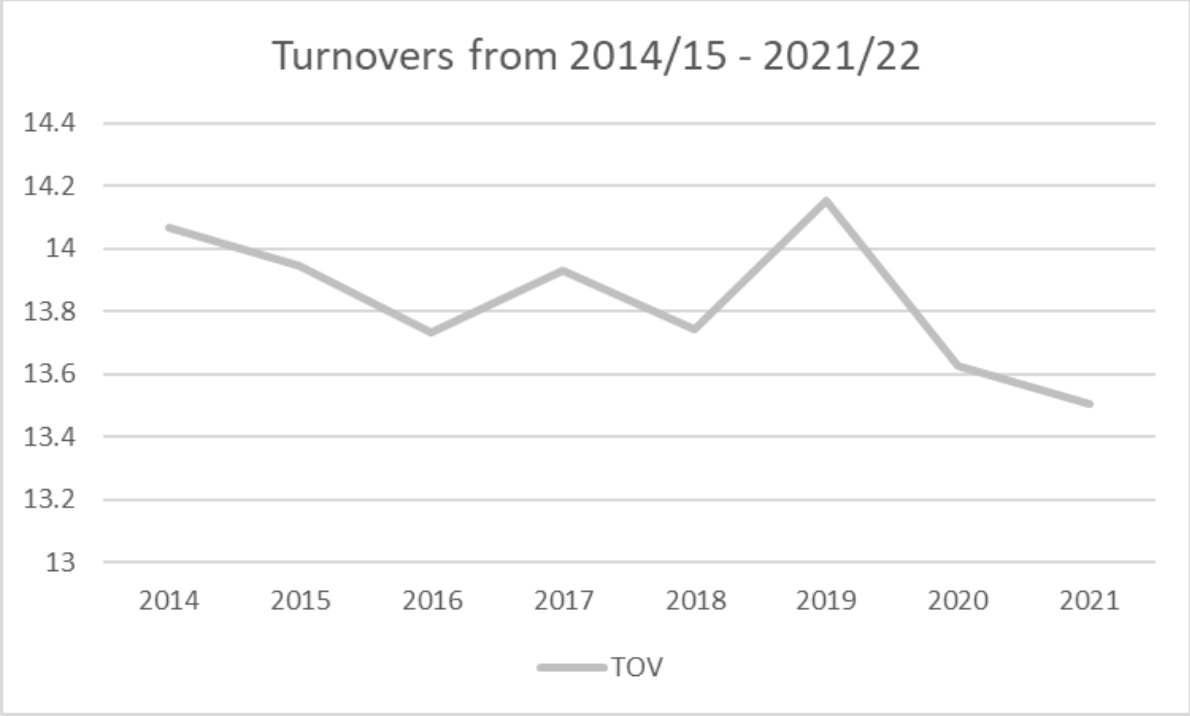

Fig. 6, Turnovers from 2014/15 – 2021/22 (NBA)

A downward trend is plausible in both graphs, but the volatility limits our ability to investigate the direct effect of the rule change. For this reason, it is more straightforward to investigate the effects on Oliver's other two factors. Turnovers and rebounds are key components in evaluating offensive and defensive productivity in basketball, but they are less likely to be directly impacted by the new rules than shooting and free throw attempts.

I am interested in investigating the rule change's impact on offensive productivity via EFG and FTA, and the impact on defensive productivity via turnovers. The decrease in EFG in the 2021/22 season makes sense given the new rules, but FTA did not take an expected plunge. Furthermore, teams turned the ball over less in '21/22, indicating that defensive productivity did not improve. The results are not intuitive and imply that either the rule change is playing out in unexpected ways, or there are other factors impacting productivity.

2. A Volatile Season, the Historic Uptick in Production During The 2021/22 Season

The 2021/22 NBA season saw a historic uptick in scoring from the beginning of the season to the end. In fact, stats across the board rose meteorically after the first two months of the season. This is atypical, to say the least. Scoring rose from 107.2 PPG in November '21 to 115.7 in April of the same season. Teams generally perform better in the second half of the season, but the trend here is unique. The range in '21/22 was 3 points larger than any other in the dataset, and no other season demonstrated such a clear upward scoring trend throughout the season. Regular Season scoring trends for each year in our data are shown in figure 7:

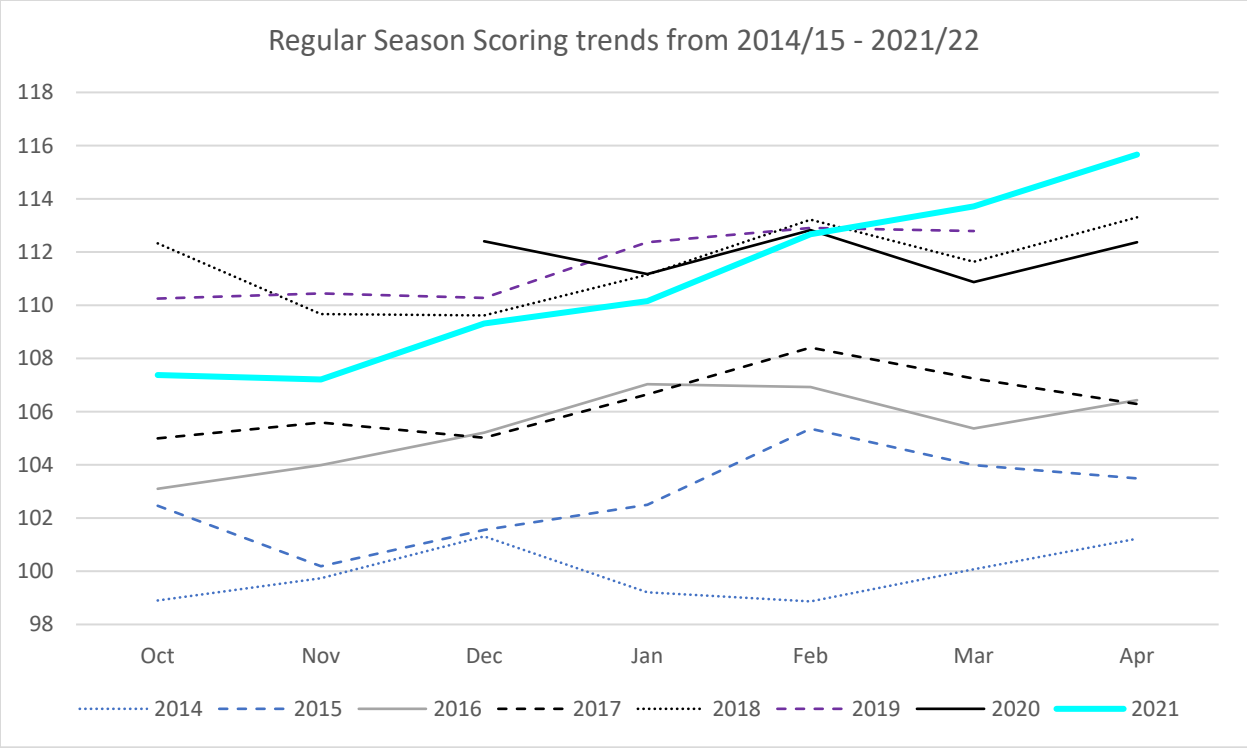

Fig. 7, Regular Season Scoring Trends from 2014/15 to 2021/22 (NBA); Note: 2019 Regular Season data ends in March and the 2020 data starts in December due to the Pandemic

Points per game skyrocketed after November in 2021; the question is why? From a basic statistical perspective, teams improved their shooting percentages. Made field goals increased over the course of the season, but field goal attempts generally decreased over the same span (see figure 8):

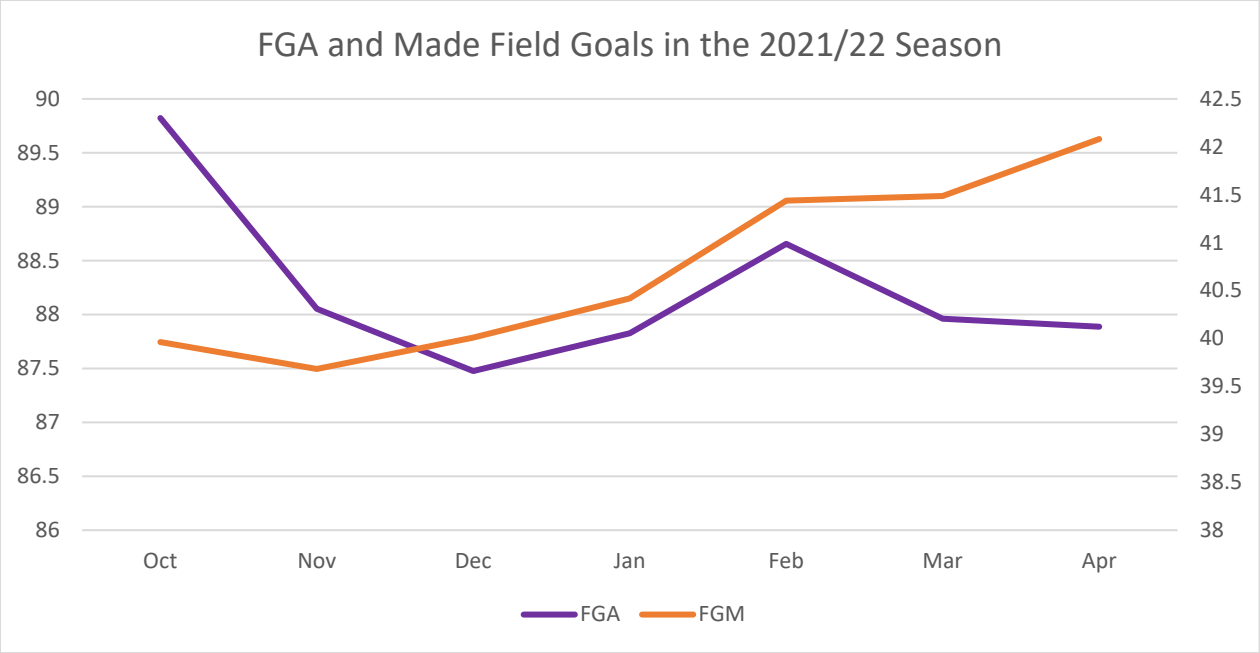

Fig. 8, Field Goals Made and Attempted in 2021/22 (NBA)

This does little to explain the root cause of the shifts. It is unlikely that a drastic, league-wide increase in player skill is solely responsible for the uptick in scoring. The shift could be interpreted as evidence of short and long run effects of the rule change, as players adjusted their behavior to the new rules after an initial depression in scoring. There are other possible explanations, however. Figure 9 shows a similar trend for free throw attempts in '21/22:

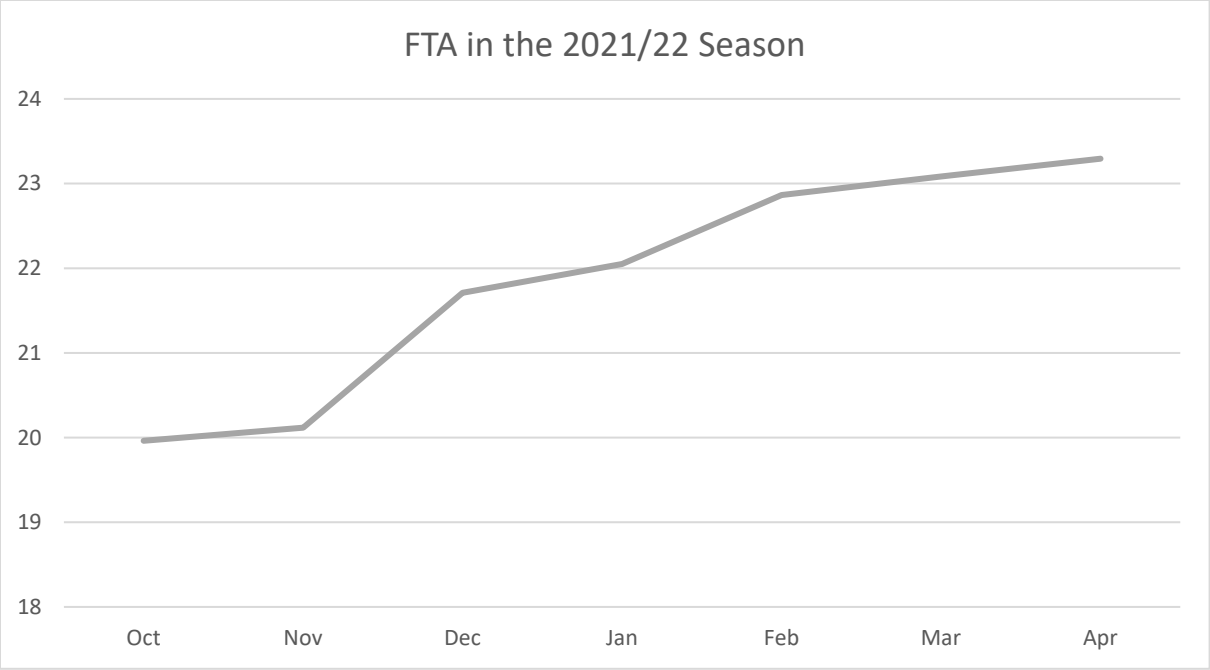

Fig. 9, Free Throw Attempts Per Game in 2021/22 (NBA)

Free throws follow the same upward trend, ultimately resulting in a higher number of attempts than the previous season. Players drew 16.7% more free throws by the end of the season than the beginning, highlighting a huge increase. It is unlikely that players would adjust to the rule change quickly enough to produce more FTA than the previous season. While players might have adjusted their foul-hunting strategies by the end of the season, there is likely more at play. One explanation is that adjustments in officiating are responsible for the increase in free throw attempts, and possibly scoring as a whole.

There is no shortage of evidence showing that referees making biased calls in professional sports. Referees in various soccer leagues have been shown to make biased calls if they do not have a financial incentive to call the game by the book (Sauer). Similarly, NBA refs were fixing games as recently as 2007 (Eden). Suffice to say, this would not be the first instance of inconsistent officiating.

The NBA's preferences influence referees' decisions, since the refs serve as the league's way of ensuring a consistent style of play. Research from Price et. al.'s *Subperfect Game: Profitable Biases of NBA Referees* finds evidence that referees make biased calls in favor of the NBA's bottom line (Price et. al.). After the first two months of the '21/22 season, scoring was on pace to revert to '17/18 numbers, and free throw attempts would have been the lowest in the SportsVU era. High scoring games have long been a staple of the NBA's brand, so the league might have worried for its revenue after seeing a sudden drop off in scoring at the beginning of the '21/22 season. In this case, I would expect the league to favor a more relaxed interpretation of its new rules, allowing offensive players to draw more free throws.

The effect of officiating on the game of basketball is difficult to quantify outside of foul numbers. I have limited resources to evaluate referee performance, so I cannot control for inconsistent officiating in my analysis. This is unfortunate, as refs have tremendous influence over the game, and I would like to observe their impact on productivity.

In summation, the shifting scoring trends in the 2021/22 season make it difficult to isolate the effect of the rule change. Whether the refs caused the shifts or not, the driver of these trends is responsible for much of the variation in scoring and productivity in the '21/22 season. It is still possible the changes are related to the rule change, which I investigate in subsequent sections

3. A Quick Note on the Playoffs

While scoring exploded by the end of the 2021/22 season, that trend did not carry into the playoffs. Scoring dipped below its marks from the past two seasons (Basketball Reference). I might expect free throws to dip as well as a result of the rule change, but they increased from last season. This is further evidence of the rule change's limited impact in the '21/22 season.

The playoffs offer too small of a sample size to draw firm conclusions, and they are also unique because they only involve games between the NBA's best teams. It seems like the rule change's impact was on par with the regular season going off scoring and free throw numbers. For these reasons, it is not worth digging too deeply into the outcomes of the playoffs.

POSSIBLE CONFOUNDING FACTORS

Here, I investigate different factors that could affect productivity in 2021/22 besides the rule change. These consist of other unique factors in the NBA between the '21/22 season and past seasons that could present confounding variables in my analysis of the rule change. Many of these differences stem from the wake of the Covid-19 pandemic. They include the return of fans to stadiums, the NBA's shortened offseason, and time players missed due to Covid itself. Additionally, I look into the effects of the NBA's new ball and possible changes in referees' behavior during the season.

1. Games Missed Due to Covid Protocols

The impact of the Covid-19 pandemic cannot be discounted when considering factors that influenced the 2021/22 season. It caused schedule changes in the two prior seasons, and a shorter offseason for '21/22. Additionally, it directly impacted the game as players missed time due to illness or protocols. I compare the spikes in time missed due to Covid with scoring trends in the 2021/22 season. Figure 10 shows how many players missed time due to Covid-19 protocols in each month of the season:

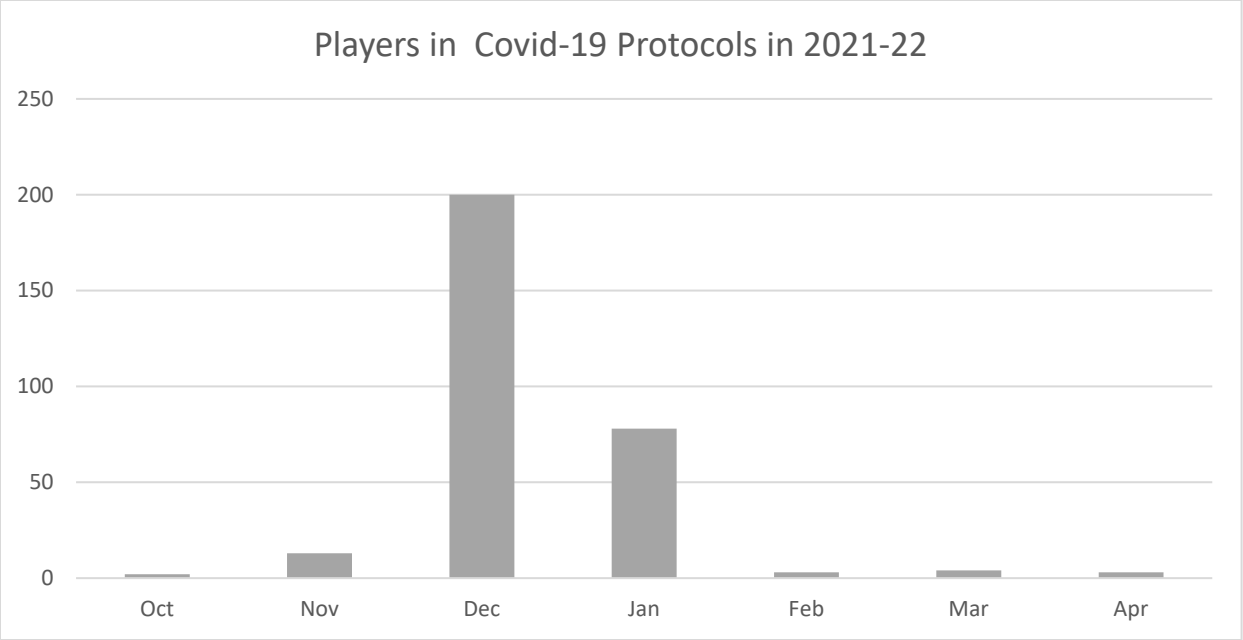

Fig. 10, Players Missing Time Due to Covid-19 Protocols in 2021/22 (Hashtag Basketball)

NBA players dealt with Covid alongside the rest of society, as cases peaked in December and January across the United States (CDC). I would expect teams to perform worse on both sides of the ball in those months, as players missed time. This does not align with the period when offenses performed at their worst, however. Teams started their upward scoring trend in December, when protocols peaked. Scoring continued to increase steadily through the rest of the season as well, so it is unlikely that the time missed due to protocols was depressing scoring significantly. Defensive performance might have declined more than offensive performance with players out. If Covid impacted worker productivity via missed time, that impact is ambiguous.

2. The Shorter Offseason

The time between the '20/21 and '21/22 seasons was shorter than usual, as the league rushed to get its schedule back on track after the pandemic disrupted it. The previous NBA Finals ended in July, with the '21/22 season starting in October; the offseason was about a month shorter than usual. This was the second season in a row where players had less time to rest, as the NBA shortened the prior

offseason even more drastically. The shorter off seasons caused concern for player health and conditioning. The 2020/21 season featured the most injuries since 2009, according to Bleacher Report (Zucker).

While the shorter offseason certainly affected players' conditioning and preparation for the '20/21 and '21/22 season, there is not an easy way to measure its effect. Other NBA off seasons have historically been consistent in terms of length, so there is not much to compare it to. The '20/21 season's scoring numbers did not trend upward within the season like they did in '21/22 so it is unlikely that the shorter 2021 offseason was responsible for the shift. I can use the shorter offseason to help explain aspects of the 2021/22 season qualitatively, but I cannot control for it in statistical analysis.

3. Attendance

The Covid-19 pandemic did not just affect players; it also affected fans who could not attend games. Attendance is likely to impact players' shooting, as fans cause distractions. This is particularly relevant when considering the effects of the Covid-19 pandemic, since NBA stadiums were at reduced capacity or completely empty throughout it. This had an obvious impact on attendance in the 2020/21 season, as shown in figure 11:

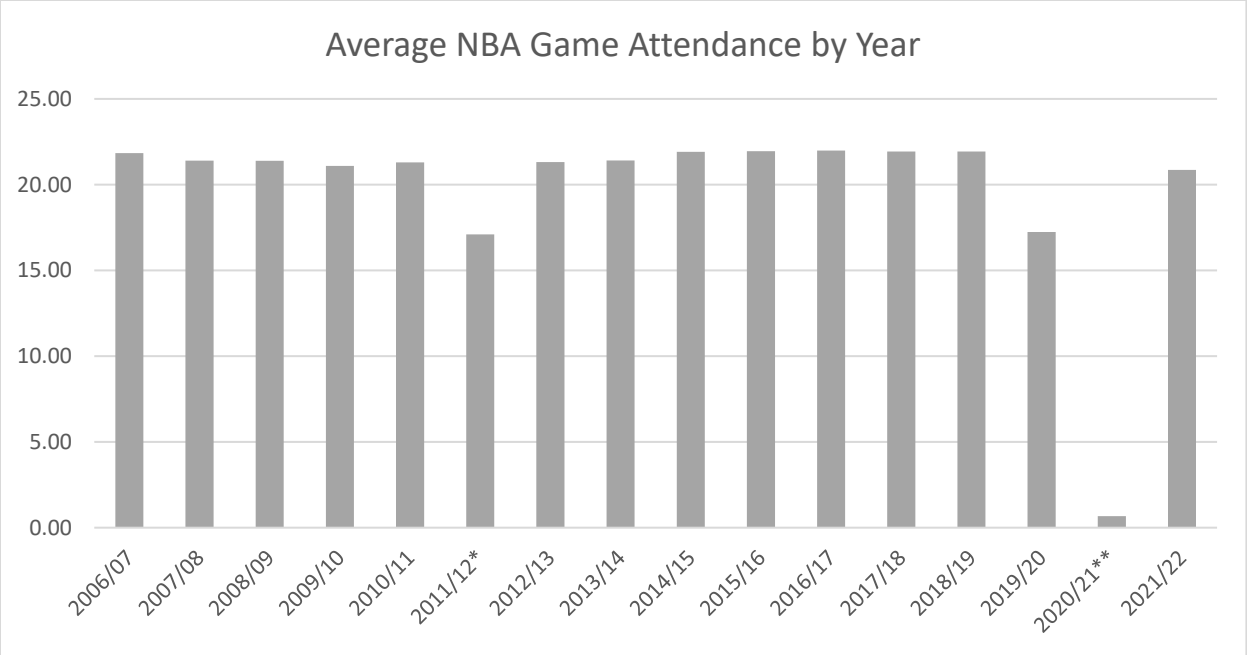

Fig. 11, Average NBA Attendance by Year (Gough)

Attendance has yet to return to pre-pandemic levels. The low attendance in 2020/21 might partially explain the high shooting percentages in that season. A graph of 3-point percentage (3p%) in different seasons is shown in figure 12:

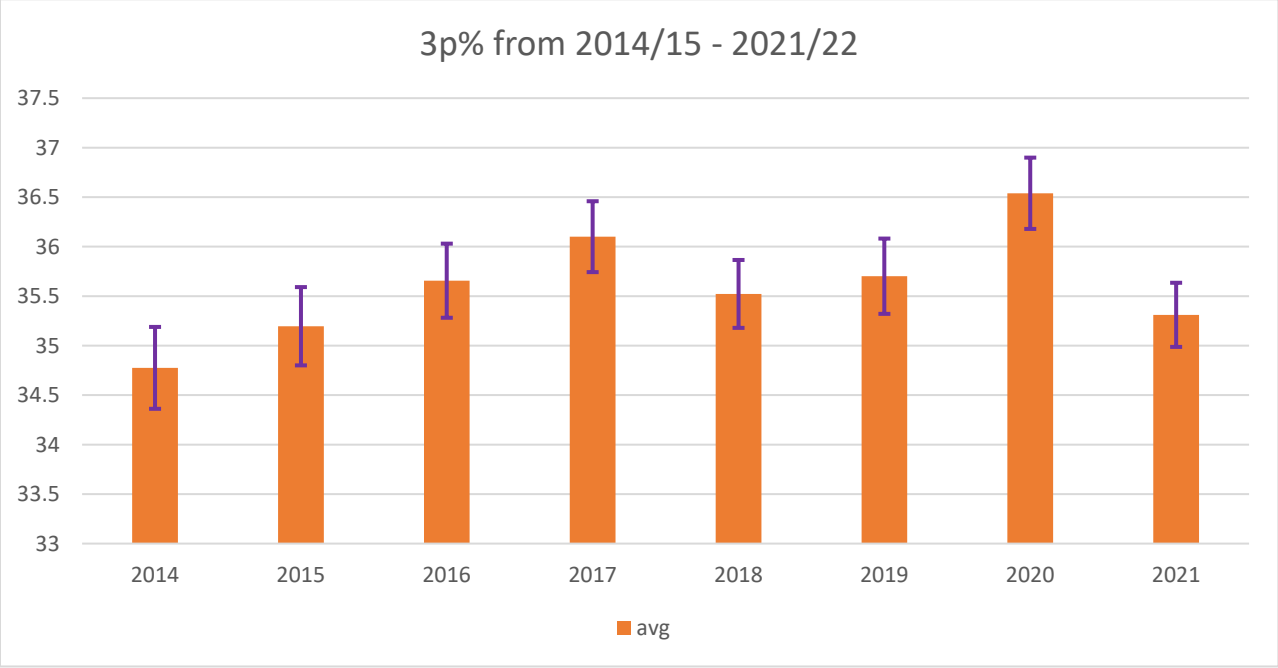

Fig. 12, 3-point % from 2014/15 – 2021/22 (NBA); Note: includes 95% confidence intervals for each season

Teams shot significantly better in 2020/21 than they did in any season but 2017/18 at the 95% confidence level. Seeing this, it is important to control for the effect of attendance. I control for attendance with my approximated data, which admittedly leaves room for error. This method still controls for most of the effects of the pandemic on attendance though, as attendance was steadily near zero in 2020/21.

4. The New Ball

Another possible confounding factor for the 2021/22 season is the NBA's new ball. After 38 years with the iconic Spalding ball, the NBA switched over to Wilson and their ball (Sundaresan). Several players made complaints about the new ball amid a sluggish start to the season. All-star Paul George, who posted his worst 3-point percentage since 2010, was quoted as saying, "It's a different basketball. It don't have the same touch and softness that the Spalding ball had" (Sundaresan). Wilson, for their part, claims that their new ball is identical to the Spalding ball.

This was not the first time the NBA introduced a new ball. In 2006, the NBA introduced a new synthetic ball to replace the classic leather one. Players were even more upset about the new ball in 2006, causing the NBA to reverse course just halfway into the season. Dallas Mavericks owner Mark Cuban commissioned research on the 2006 ball to analyze differences in player performance and qualities of the ball (Julian). While the full extent of the methods used in that investigation is beyond the scope of this research, I can borrow their usage of two key stats to evaluate the impact of the ball: free throw shooting and turnovers.

It is possible that players were affected by the new ball and needed time to adjust. Free throw shooting is particularly useful in isolating the effect of the new ball, as it is the only major difference in

free throws from years past. If players were truly adjusting to the new ball as the season went on, I would expect improved performance during the season. Figure 13 shows evidence of this, though there were not statistically significant differences in shooting percentage from the beginning of the season to the end:

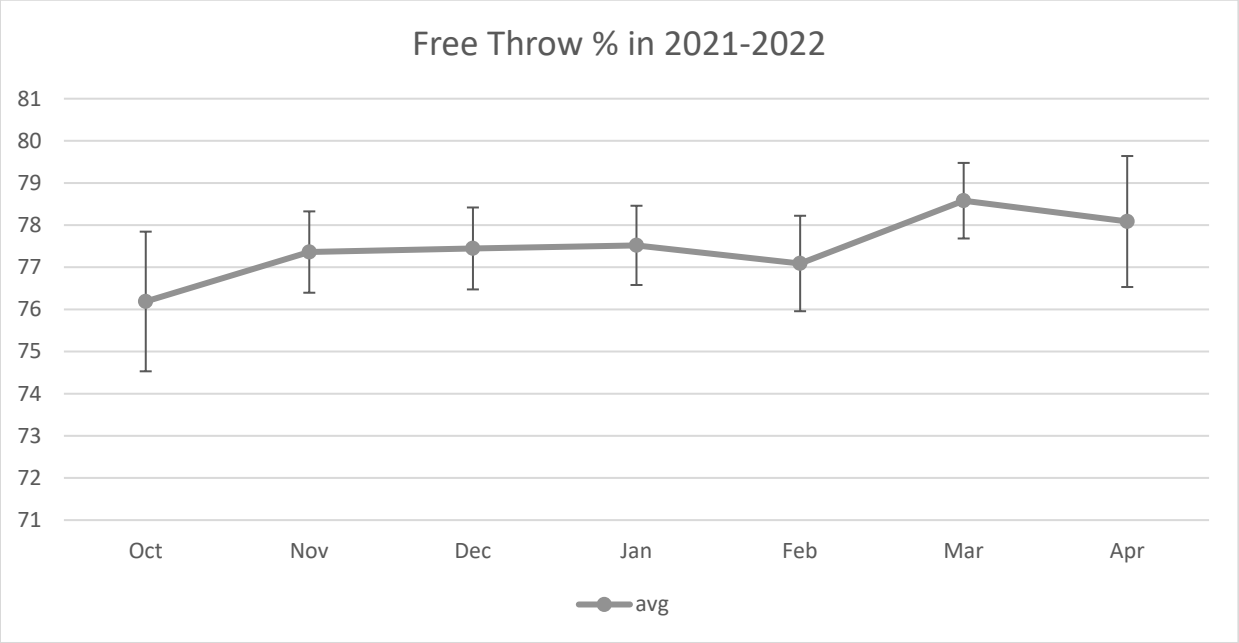

Fig. 13, Free Throw % in 2021/22 (NBA); Note: includes 95% confidence intervals for each month

The lack of significant differences in shooting suggests that if players were adjusting to the new ball over the course of the season, it did not have a large impact on performance. Furthermore, players shot just as well or better than they had in recent seasons, as shown in figure 14. This further indicates that players were not adversely affected by the new ball:

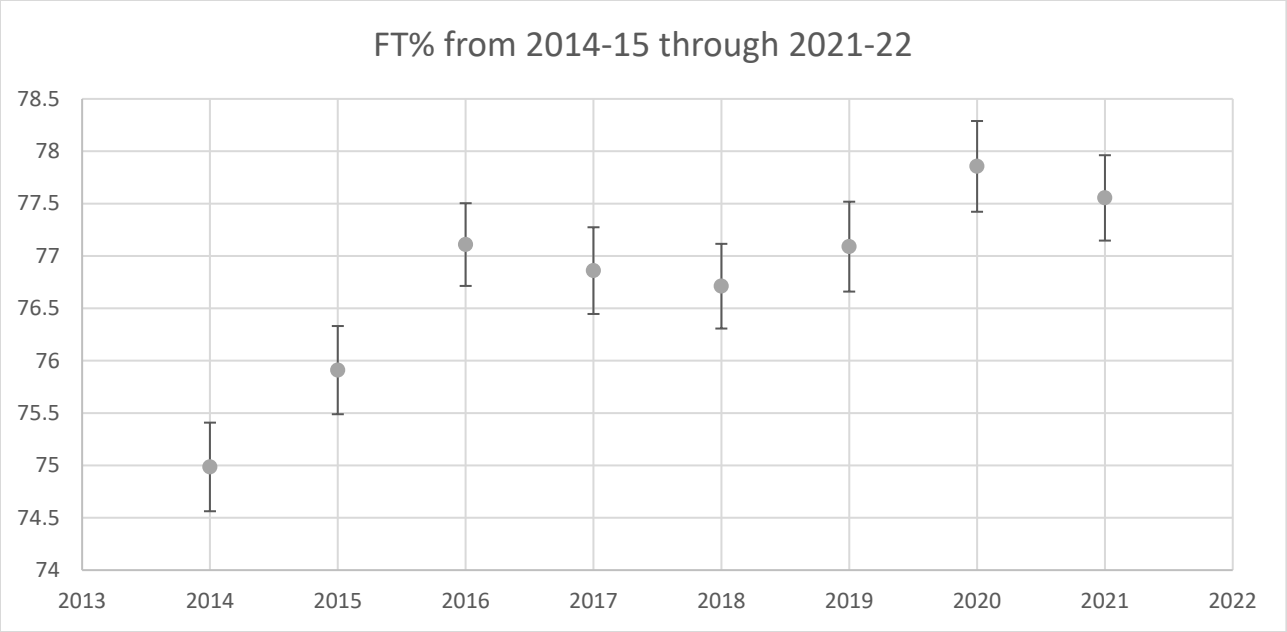

Fig. 14, Free Throw % from 2014/15 - 2021/22 (NBA)

Free throw percentage only gives a partial view as to the effects of the new ball. Turnovers help contextualize how players adjust to the new ball's grip; an adverse effect in grip-ability should manifest in more turnovers. Of course, there are several other facets of the game where the new ball could affect play. Still, free throw shooting and turnovers help to partially control for the effect of the new ball with the data at my disposal.

EVIDENCE OF THE RULE CHANGE'S IMPACT: STRATEGIC CHANGES AND WORKER PRODUCTIVITY

1. A Decrease in 3-point Foul Calls

To gauge expectations for how the new rules impact fouling, I look to the work of McCormick and Tollison in their paper *Crime on the Court*. This paper analyzes the decrease in "crime," or fouls committed, after the introduction of a third ref in college basketball. They found crime's supply elasticity of demand to be relatively elastic and inferred that increased surveillance results in a significant decrease in fouling and "nonproductive behavior" (McCormick, 1984). Put simply, players foul less when the risk of getting caught increases.

In the case of the rule change, the NBA changed the definition of crime to be fairer to defenders. With this change, defenders are free to play tighter defense, while shooters cannot force contact to gain fouls. I expect players to respond to this change by seeking fewer fouls, and for defensive shooting fouls to drop significantly. In particular, I expect that offensive players will not draw as many fouls on 3-point shots, where non-basketball moves were exploited the most.

The rule change was introduced to stop "non-basketball moves" on shot attempts. These non-basketball moves were most prevalent on 3-pointers. There are several reasons as to why shooters tried to force contact more on 3's than 2's. The main reason has to do with the opportunity cost of drawing contact in that manner.

Unnatural shooting motions naturally lead to worse shots and more misses; however, a player was often willing to sacrifice his odds of making a field goal for the chance at taking 3 free throws. This is amplified by the fact that 3's already have a lower chance of going in than 2's, so players sacrificed less to potentially gain more points at the free throw line. With the new rule change, the opportunity cost of taking unnatural shots has increased. There was a significant drop in the rate at which players drew fouls on 3-pointers in 2021/22, shown in figure 15:

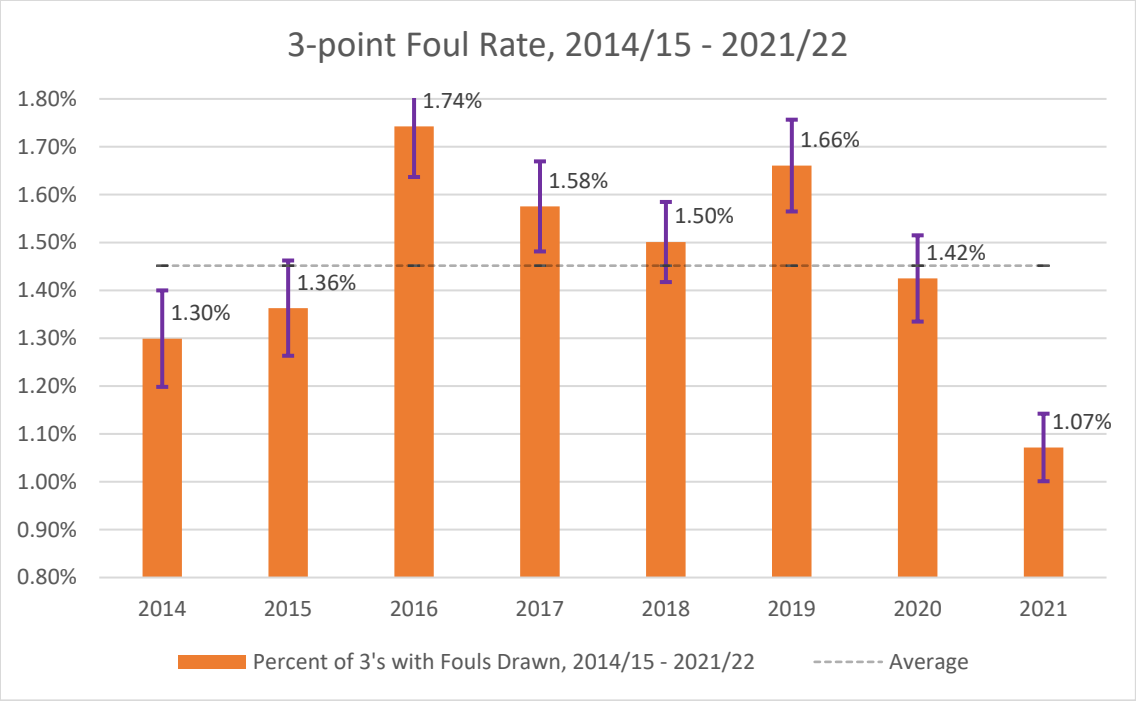

Fig. 15, 3-point Foul Rate from 2014/15 - 2021/22 (PBP Statistics); Note: includes 95% confidence intervals for each year

The 3-point foul rate declined by nearly 25% from 2020/21 to 2021/22. It was also significantly lower in '21/22 than any prior season, at the 95% confidence level. Aside from inconsistent officiating, none of my confounding factors should significantly affect this metric, so I am confident the rule change is responsible for it. The time trend highlights how teams exploited the ability to draw fouls on three-point attempts prior to the rule change, and their inability to afterwards.

I expected the 2-point foul rate to decrease as well, but this was not the case. While it briefly dipped below historic levels in October and November of 2021, it eventually returned to slightly higher levels than the previous season. 2-point Fouls contribute much more to FTA than 3pt Fouls, as they are far more common (see figure 16):

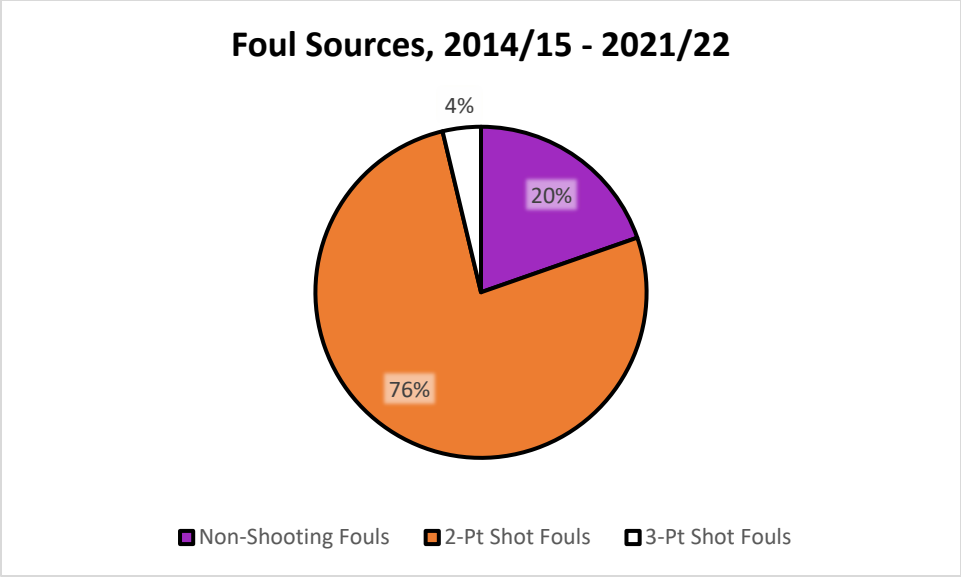

Figure 16: Percent of Fouls per Source from 2014/15 - 2021/22 (PBP Statistics)

As a result, foul numbers increased in 2021/22, despite the rule change's introduction. It is possible that the 2-point foul rate was affected to some degree by the rule change. To test this, I performed a multiple linear regression on 2-point foul rate. The results of that regression are shown in Table 2:

Regression Coefficients: 2pt Foul Rate				
OLS Estimates (F-Ratio = 751.9; R^2 = .305)				
	Coefficient	Std Error	t-Ratio	*p* -value
constant***	25.311	0. 712	35.54	0.000
3pt Foul Rate***	-0.122	0.012	-10.15	0.000
Rule Change Dummy*	0.163	0.087	1.88	0.061
Effective Field Goal %***	0.082	0.008	10.30	0.000
Opponent's Points***	0 .101	0.002	42.47	0.000
3 Point Attempts***	-0.323	0.007	-43.38	0.000
2 Point Attempts***	-0.476	0.006	-74.97	0.000
Attendance, Dif. From Avg***	-1.61E-05	5.32E-06	-3.03	0.002
Free Throw %	0.001	0.003	0.33	0.741
Offensive Rebounds***	0.410	0.013	32.77	0.000
Opponent's Defensive Rebounds***	0.211	0.011	19.87	0.000
Turnovers***	-0.032	0.006	-5.30	0.000

Table 2, Multiple Linear Regression Results- 2-point Foul Rate

I used the 3-point foul rate as a proxy for the impact of the rule change. I controlled for the impact of varying fan attendance with a regressor for a game's difference in attendance from the mean attendance. I controlled for the impact of the new ball via the Free Throw % and Turnover regressors, though free throw percentage does not appear to have a statistically significant relationship with 2-point foul rate.

The model has useful predictive capabilities, as it predicts 30.5% of the variation in the data for 2-point foul rate; it is jointly significant as shown by the high F-statistic. As a result, it allows us to gain a sense of the impact of the relevant variables. I find a negative, inelastic change in 2-point foul rate as 3-point foul rate increases. The effect is quite small in practice, as 3-point foul rate varies by less than a percentage point season to season. The change in 3-point foul rate from the '20/21 season to '21/22 is associated with a .043 percentage point increase in 2-point foul rate, ceteris paribus, according to this model. This effect is not economically significant.

The 2-point foul rate rose in 2021/22, as indicated by the positive coefficient for the rule change dummy. This is not necessarily attributable to the rule change though, as other confounding differences in the '21/22 season could be responsible. It is possible that more aggressive defense sparked by the rule change is behind the increase in 2-point foul rate, but there is not enough evidence to attribute any significant shifts in the 2-point foul rate to the rule change.

Though we see a significant decrease in the number of 3-point fouls after the 2021 Rule Change, the effect did not extend to the 2-point foul rate. Since a relatively small number of 3-point fouls are called anyway, the overall number of fouls called remains largely unaffected by the rule change. It appears that the effects of the rule change on FTA are limited to how many 3-point fouls are called.

2. Analyzing Changes in Worker Productivity

I attempt to measure the impact of the rule change on three of Oliver's Four Factors: turnovers, free throw attempts (FTA) and shooting, measured by effective field goal percentage (EFG). These serve as my relevant metrics for NBA players' worker productivity.

My findings from the effects of the new rules uncover the impact, or lack thereof, of the rule change on FTA. There is a statistically significant decrease in FTA from 3-point fouls in response to the rule change. The decrease is not economically significant though, as only 4% of free throw attempts come from 3-point fouls. The rule change had a nearly inconsequential effect on 2-point foul rate. Since 2-point fouls are the main source of free throws in the NBA, the drop-off in 3-point foul calls does little to affect FTA. Thus, the rule change's impact on worker productivity via FTA is minimal.

Oliver himself calls shooting the most important factor of basketball success, making it an important gauge of worker productivity (Oliver). To measure the impact of the rule change on shooting, I perform a multiple linear regression with EFG as the dependent variable. It includes variables like 3-point ratio which are known to improve EFG; variables like attendance to control for possible confounding effects; and of course, 3-point foul rate to identify the effect of the rule change. The data used comes from my game-by-game dataset and the results are shown in Table 2:

Regression Coefficients: Effective Field Goal %				
OLS Estimates (F-Ratio = 4267; R2 = .773)				
	Coefficient	Std Error	t-Ratio	*p* -value
constant***	41.541	1.080	38.48	0.000
3pt Foul Rate***	0 .103	0.011	9.65	0.000
2pt Foul Rate***	0.081	0.009	9.03	0.000
Rule Change Dummy***	-0.197	0.076	-2.61	0.009
3pt Ratio***	0 .111	0.003	32.50	0.000
Win %***	0.021	0.002	13.02	0.000
Attendance, Dif. From Avg	.873e-6	4.68e-6	-1.47	0.142
Assists***	0. 345	0.006	61.13	0.000
Pace***	0. 072	0.010	6.99	0.000
Field Goal Attempts***	0.260	0.006	44.12	0.000
Opponent's Defensive Rating***	0.114	0.008	13.84	0.000
Free Throw %***	-0.081	0.002	-35.30	0.000
Offensive Rebounds***	-0.845	0.009	-94.75	0.000
Opponent's Defensive Rebounds***	-0.884	0.006	-143.30	0.000
Turnovers***	-0.065	0.005	-13.01	0.000
Free Throw Attempts	-0.002	0.005	-0.38	0.702

Table 3, Multiple Linear Regression Results- Effective Field Goal %

Like the previous regression, I took special care to avoid stats that would introduce severe endogeneity issues. In this case, that meant abstaining from regressors like points, field goal percentage, etc. that are directly tied to shooting efficiency. Again, it impossible to eliminate all concerns on that front, as basketball stats are all linked in some form or fashion. This model does a good job minimizing those issues while maximizing performance. I use 3-point foul rate as a proxy for the rule change's impact and include a year dummy for the rule change, FT%, and the same attendance data as before to control for possible confounding factors.

The model is an accurate predictor of EFG, as it explains 77.3% of the variation in the data. It is also jointly significant as demonstrated by the F-Statistic of 4267. All the coefficient estimates are significant at the .01 level except for the attendance control and free throw attempts.

Out of the variables used to control for confounding factors, free throw % improved the model's performance the most. Omitting the foul rate and attendance variables lowers the R Squared value by less than a percent, while the F-statistic rises significantly. This implies that while there is a statistically significant relationship between them and EFG, they are not primary drivers of shooting efficiency.

I am still interested in the impact of 3-point foul rate on EFG, as it could potentially reveal the effects of the rule change on offensive productivity. The coefficient for 3-point foul rate, while small, is significantly greater than zero at the .01 level, so I infer that there is a positive, inelastic relationship between it and EFG. A one percentage point increase in 3-point foul rate is associated with a .05 percentage point increase in EFG, ceteris paribus. Since the yearly variation in 3-point foul rate is much less than a percentage point, that effect would explain very little of the variation in EFG. Therefore, the relationship between 3-point foul rate and EFG is not economically significant.

The dummy variable for the rule change indicates that teams shot less efficiently in the 2021/22 season. It is statistically significant and is associated with a decrease of .197 percentage points in EFG, which is notable. While this could be an effect of the rule change, it would make just as much sense if the shift was related to the new ball or shorter offseason. We cannot control fully for these confounding variables, so it is unclear whether that decrease is attributable to the rule change. Thus, we find no evidence suggesting that the rule change affected shooting performance.

To approximate the impact of the rule change on defensive productivity, I performed a regression with turnovers as the outcome variable. If the rule change improved defensive productivity, we would expect offensive teams to turn the ball over more in response to increased defensive pressure. Regressions results with turnovers as the dependent variable are shown in figure 5:

Regression Coefficients: Turnovers				
OLS Estimates (F-Ratio = 375.3; R^2 = .218)				
	Coefficient	Std Error	t-Ratio	*p* -value
constant***	-30.082	1.740	-17.29	0.000
3pt Foul Rate***	0.053	0.015	3.59	0.000
2pt Foul Rate***	0.061	0.011	5.31	0.000
Rule Change Dummy	-0.074	0.097	-0.76	0.449
Efficient Field Goal %***	-0.152	0.010	-15.88	0.000
Minutes***	0.158	0.005	31.73	0.000
Attendance, Dif. From Avg*	-1.05E-05	6.09E-06	-1.72	0.086
Assists***	0.062	0.009	7.28	0.000
Pace***	0.440	0.013	32.69	0.000
Field Goal Attempts***	-0.322	0.009	-36.93	0.000
Free Throw %***	-0.018	0.003	-5.60	0.000
Defensive Rebounds***	0.162	0.006	26.41	0.000
Offensive Rebounds***	0.233	0.015	15.70	0.000
Opponent's Defensive Rebounds***	-0.225	0.012	-19.12	0.000
Free Throw Attempts***	-0.128	0.007	-18.16	0.000

Table 4, Multiple Linear Regression Results- Turnovers

Turnovers are a particularly noisy stat. They are influenced by a variety of factors, many of which are not included in the model. The model's limitations are apparent in the R Squared value, as it predicts just 21.8% of the variation in the data.

There is once again an economically insignificant relationship between 3-point foul rate and the outcome variable. An increase in 3-point foul rate is associated with a fractional increase in turnovers, which indicates that the decrease in 3-point foul rate in '21/22 would not lead to a meaningful increase in turnovers. Additionally, the rule change dummy is not statistically significant, so we would not expect additional shifts from the rule change to affect turnovers. It appears that the new rules have not improved defensive productivity, at least through turnovers.

The regression results provide little evidence of an impact on offensive or defensive productivity in basketball. None of the factors I analyzed reacted to a change in the 3-point foul rate, which is the only strong point of evidence of the rule change's impact. The only tangible effect is the slight reduction in FTA as players drew fewer 3-point fouls in '21/22. This is still easily overshadowed by other factors, so I conclude that the rule change did not have a meaningful effect on worker productivity.

3. Investigating Strategic Changes

Teams went to the foul line less from 3-point fouls in '21/22. The reason for the decrease in 3-point fouls is two-fold. As discussed in *Crime on the Court*, when surveillance increases, not only does the percentage of correct calls increase, but the willingness of players to commit crime decreases (McCormick, 1984). The decrease in willingness to commit crime here is due to the higher opportunity cost of crime, as players are less likely to score on non-basketball moves while foregoing other scoring options. Thus, players are incentivized to score through other means.

While players had less incentive to commit non-basketball moves, how they substituted away from those moves is unclear. I attempted to reveal the impact of the rule change on shot selection by using 3-point foul fate as a proxy variable in Simple Linear Regressions. I found that 3-point foul rate explains just a thousandth of the variation in the data for 2-point attempts and 3-point attempts. The results are shown below in tables 2 and 3:

Regression Coefficients: 2-point Attempts				
OLS Estimates (F-Ratio = 15.6; R^2 = .001)				
	Coefficient	Std Error	t-Ratio	*p* -value
constant***	57.253	0.076	751.47	0.000
3pt Foul Rate***	-0.11	0.028	-3.95	0.000

Table 5, Simple Linear Regression Results- 2-point Attempts

Regression Coefficients: 3-point Attempts				
OLS Estimates (F-Ratio = 9.7; R^2 = .001)				
	Coefficient	Std Error	t-Ratio	*p* -value
constant***	29.706	0.070	422.22	0.000
3pt Foul Rate***	-0.080	0.026	-3.11	0.000

Table 6, Simple Linear Regression Results- 3-point Attempts

Though we see a statistically significant, negative relationship between 3-point foul rate and both types of shot attempts, there is not an economically significant relationship. Additionally, the miniscule R Squared value indicates that 3-point foul rate does a poor job of predicting 2 and 3-point shot attempts by itself. Therefore, there is no evidence that the rule change has affected shot selection through its impact on the 3-point foul rate.

The scope of the rule change is probably too narrow to spark specific strategic changes in the short run. While players drew 25% fewer fouls on 3-point shots in 2021/22 than the prior season, that only equates to losing a 3-point foul call every few games. Many players might not even notice such a small difference at first. Besides cutting down on non-basketball moves, players appeared to make very few adjustments to their offensive strategies in 2021/22.

NBA teams have a history of being slow to adapt to changes. McCormick and Clement's *Intrafirm Profit Opportunities and Managerial Slack* demonstrates that it often takes longer than a season for coaches to adjust to new information (McCormick, 1992). This makes sense as investing time in new strategies and risking worse performance can lead to a coach getting fired. The opportunity cost to making any adjustments is huge for a coach, and they must spend their time wisely. Clippers assistant coach Dan Craig appears unconcerned with the rule change, and was quoted by Sports

Illustrated as saying, “has there been a carryover because of the rule changes and the way I coach? That’s not something we honed in on” (Nadkarni). This shows that at least some coaches are not yet adjusting to the rule change, which explains part of why I have not seen strategic changes in response to the rule change.

It is hard to blame coaches for being slow to react to new information, especially in a season like 2021/22 where the statistical trends of the game varied wildly. The 3-point foul rate stood below 1% at the beginning of the ‘21/22 season but eventually rose along with Points and EFG. A large part of that inconsistency has to do with officiating, as there is a learning curve with the rule change for referees as well as players. I also speculate that the refs backed off calling the new rules as aggressively as they did in the first couple months of the season.

As a result, it is not entirely surprising that we see such little evidence of strategic adjustments to the rule change. It is plausible that teams and players will adjust in the coming seasons, but it could be years before the full effects of the rule change are realized.

Players were forced to set aside their strategy of trying to draw fouls through unnatural motions after the introduction of the rule change. The assumptions I can make about strategic responses to it end there, however. The rule change affects only a small subset of possessions, making it difficult to observe exactly when or if players are adjusting their behavior. Between that, the short time the rule change has been implemented, and coaches’ reluctance to adjust to changes, there are no discernible trends stemming from the rule change besides a reduction in 3-point fouls.

After the 2021/22 season, it appears that the NBA successfully limited the ability of players to draw shooting fouls, at least on 3-pointers. There is no evidence of strategic changes or resulting shifts in worker productivity. It seems that the NBA’s new rules have addressed foul hunting in a niche area without affecting other areas of the game. The isolated effect of the rule change is unusual in basketball

and stands apart from more connected strategic changes like we observe from the Hot Hand phenomenon (Dixit). If the NBA's goal was to reduce 3-point foul hunting and nothing else, it seems that they were quite successful.

LIMITATIONS AND RECOMMENDATIONS FOR FURTHER STUDY

I am confident in my findings regarding the 2021 Rule Change, but there is much that remains unclear. Access to more detailed data and a longer time period could reveal trends that I was unable to uncover in this research. Here, I make recommendations for further study on the subject, and elaborate on the lacking aspects of this paper.

1. Larger Sample Size

This paper analyzed just one season's worth of data where the rule change was active. While this provided over 2,400 observations, it is still a relatively short time span. On top of that, my subject season demonstrated historically unusual intra-season trends in scoring, free throw attempts, and other areas. As such, I am interested in seeing the effects of the rule change over additional seasons. Not only will this provide a larger sample size, but it also allows researchers to differentiate between the rule change's short and long-run effects.

2. Access to SportsVU Data

SportsVU's motion-tracking technology offers the potential to observe players' behavior at a physical level. Unfortunately, the general public does not have access to its insights. Someone with access could reveal the extent to which players were foul-hunting before and after the rule change and show when the refs made the right calls.

Gauging referee performance would be particularly pertinent to my research, as it would show how strictly the refs are calling the rules at any given point. my lack of a proxy for referee performance

is a major shortcoming in my analysis. This information, along with many other insights offered by SportsVU, would allow us to develop a more sophisticated model to analyze the rule change's effects. I call for interested NBA teams or others with access to SportsVU data to investigate the rule change and how well the refs called the new rules in the 2021/22 season.

3. Player-level Data

Our research used team-level data on a game-by-game basis to analyze NBA trends. It is possible to get even more granular by using player-level data. This poses the benefit of controlling for players' attributes like height, shooting ability, position, etc. Access to this data is difficult to find, however.

While season-long averages for players are readily available, single-game data is harder to come by in a usable format. When considering the number of games in my sample, the work effort involved in accumulating data from multiple sources adds up quickly. Additional data on individual player attributes would also be necessary to make the data worthwhile.

Creating a game-by-game cross sectional dataset of player-level performance could reveal insights beyond the capabilities of this research. The resources to create such a dataset are sadly also beyond those capabilities. I recommend for future researchers to accumulate player-level data, as it would add tremendous value to their findings and allow them to answer questions I have not even thought to ask.

4. Labor Market Analysis

Due to the timing of this research, I have no evidence of the rule change's impact on the labor market in basketball. Teams can acquire players in three ways: through trades, the Draft, and via Free Agency signings. The players that teams target, and their corresponding compensation paint a picture

of the traits NBA teams find valuable. If teams think the rule change has impacted productivity, I would expect winners and losers in the NBA's labor market. Identifying those winners and losers can help us back into some of the rule change's effects.

Gannaway's *Technological Change, Relative Worker Productivity, and Firm-Level Substitution: Evidence From the NBA* lays out the framework for analyzing labor market effects from changes in scoring technology, at least via the draft (Gannaway). I could follow his methodology to see if the draft stock of players of certain heights, skillsets, or positions benefitted more from the new rules. This process would be replicable in terms of salary too. Once enough data in this realm is available, say several seasons' worth, I can truly dig into the effects and identify how team behavior changed in response to the rule change.

CONCLUSION

The 2021/22 season was historic. Aside from featuring new rules and being the first "normal" season after the Covid-19 pandemic, teams increased their productivity within the season at an unprecedented rate. Teams scored less than they had in previous seasons, but the last few months of the season marked record highs in scoring and productivity. My analysis suggests that the 2021 Rule Change had little to do with this; however, as it seemed to only significantly drive changes in the 3-point foul rate.

The NBA's 3-point foul rate dropped significantly in 2021/22, as players drew fouls on 3-point shots 25% less frequently than the prior season. However, further analysis revealed that stats associated with worker productivity, turnovers; EFG; and FTA, demonstrated insignificant responses to changes in 3-point foul rate. I attribute the decrease in 3-point foul rate to the 2021 Rule Change, but it appeared to have a minimal effect on productivity in 2021/22.

Aside from a reduction in successful non-basketball moves, I find no evidence of specific strategic adjustments to the rule change. It does not appear to be a point of emphasis for coaches, who are more concerned with improving productivity in proven facets of the game like 3-point shooting. Perhaps innovative teams and players could find opportunities made possible by the new rules, but there are no signs of broad strategic adjustments in '21/22. The rule change appears to have affected players foul-hunting capabilities on 3-pointers without negatively affecting other aspects of the game. In this way, the NBA caused a desired change with minimal offsetting consequences.

Any long-term strategic adjustments to the rule change are largely dependent on how the NBA officiates the rules going forward. Free throws varied wildly throughout the '21/22 season, so more consistency is required before teams can fully take in the new rules. The extent of teams' potential adjustments depends on how strictly the refs enforce the new rules in future seasons.

The NBA's 2021 Rule Change seems to have limited effects. The reduction in the 3-point foul rate offers optimism that the NBA's bid to reduce foul-hunting was successful. The new rules did not appear to spark broad-scale changes in player behavior or productivity, however. I hope to see a more consistent picture of the rule change's impact in the coming seasons, as the first two months of the '21/22 season show its long-term impact could reach beyond the findings of this research.

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