The Effect of Play Style on NBA Revenues

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Abstract

Contemporary literature demonstrates the effects of performance, star power, and franchise characteristics on consumer demand in the National Basketball Association (NBA). Most works use gate revenue or attendance as a proxy for consumer demand. This paper extends existing literature on sporting demand by analyzing the effect of play style on gross revenues. This paper argues that the increased proportion of three-point shots is a defining characteristic of contemporary play style and uses three-point attempt rate as a proxy. Three-point attempt rate was found to have a negative effect on revenues that was statistically significant at the 2.0 percent level.

1 Introduction

The three-point line was introduced to the National Basketball Association (NBA) in the 1979 season[1], shortly after the league merged with the American Basketball Association (ABA) in 1976[2]. The ABA was established in 1967, and quickly gained popularity due to novelties that included a red, white, and blue basketball, dunk contest, and a three-point line[3]. Former NBA player and ABA commissioner, George Mikan, dubbed the three-point line a "home run" and suggested it was a factor in the league's early success[4]. Mikan's claim suggests that fan interest is responsive to stylistic elements of sports. There is theoretical justification to this idea. For example, Sutton and Parrett (1992) consider play style an essential component of sporting product. One of the defining characteristics of modern play style is the emphasis on three-point shooting. According to ESPN[5], NBA teams made a collective 27,955 three-point shots during the 2018-19 regular season. By comparison, a total of 23,871 were made during across all seasons in the 1980s combined. Three-point shooters stretch the defense away from the rim, opening up space for drives, passes, and cuts to the hoop. This spacing effect is demonstrated by Gannaway et al. (2014), who found that frontcourt players (play close to the basket) benefitted the most from the introduction of the three-point line. The shift to perimeter-oriented offense has occurred largely in part to the three-point shot's efficiency. For example, the expected value of a three-point shot with a 33.33 percent probability of completion is equal to the expected value of a two-point shot with a 50 percent probability of completion. Despite the efficiency of the three-pointers, San Antonio Spurs coach, Gregg Popovich, believes that this play takes the beauty out of basketball[6]. The rest of league may not agree, however, because the total number of three-pointers attempted by NBA teams has grown 6.75 percent on average over the last six

[1]Wood (2011)
[2]The Editors of Encyclopaedia Britannica (2013)
[3]The Editors of Encyclopaedia Britannica (2013)
[4]Wood (2011)
[5]Goldsberry (2019)
[6]Goldsberry (2019)

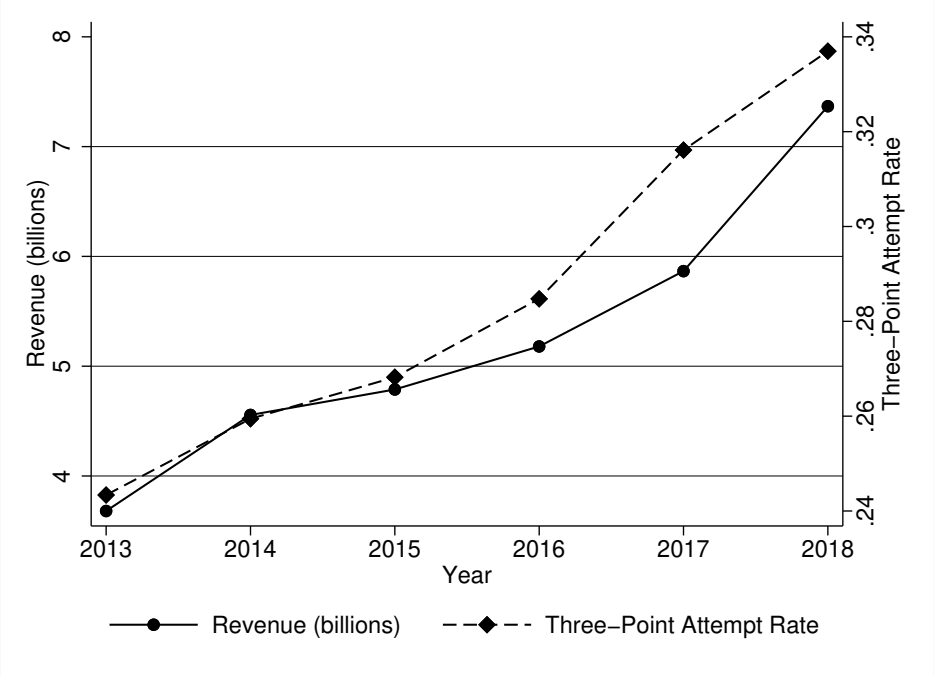

Figure 1: League-wide team revenue (gross) and three-point attempt rate from the 2012-13 through 2017-18 season.

seasons[7]. It is interesting to note that throughout the same time period, NBA revenues have increased at 15.17 percent on average[8].

The three-pointer is a definitive characteristic of modern play style and it is plausible that play style is a determining factor of revenue. Research evaluating how play style affects team revenues is lacking. There is no theoretical explanation of how the three-pointer influences fan psychology or consumer demand. Consequently, the fundamental question that this work endeavors to answer is: Does the percentage of shots that are three-pointers affect the level of consumer demand for NBA teams?

This paper adds to existing literature on consumer demand by demonstrating the effect of modern play style on team revenues. This paper previously argued that the most defining aspect of the modern style of play is increased proportion of three-pointers shot. Consequently, three-point attempt rate is the play style of interest for the purposes of this analysis. First, a relevant literature concerning three-pointers, consumer demand for sports,

[7]data from collected from basketball-reference.com
[8]data from collected from basketball-reference.com

and NBA revenues are discussed in the context of this research. Experimental design, data discussion, and functional form of the regression follow the literature review. Lastly, the paper concludes with a discussion of empirical results and conclusions.

2 Literature Review

Borland and Macdonald (2003) review literature on consumer demand for sports and provided an important literary guide for this paper. They refer to theoretical work by Sutton and Parrett (1992) who state that stylistic elements of gameplay are a part of sporting product. This is theoretical justification for researching the effect of play style on consumer demand.

Literature within the genres of management science[9] and labor economics[10] analyze the effects of the three-point line. There are very few academic works concerning three-pointers, but those most relevant to this paper are discussed. Gannaway et al. (2014) analyzed how player productivity was affected by the introduction of the three-point line. They found that productivity gains from this new technology were biased to forwards, a position group that includes small forwards, power forwards, and centers. These players generally play closer to the basket and shoot less three-pointers than guards[11]. As the number of three-pointers shot across the league has skyrocketed, teams with star forwards have likely gained the most production. To optimize productivity, teams may decide to allocate less shot attempts to guards and more shot to forwards. Intuition suggests that this would result in lower three-point attempt rates. If this truly optimized productivity, it would imply that decreasing three-point attempt rates would lead to productivity gains that may positively affect revenues. McCormick and Clement (1992) use evidence from NBA coaching decisions to analyze managerial efficiency. They describe coaching decisions regarding the optimal three-point attempt rate in the context of investments. The optimal three-point attempt rate

[9] McCormick and Clement (1992)
[10] Gannaway et al. (2014)
[11] Gannaway et al. (2014)

equalizes the marginal rates of return across both shot types, and they find that coaches who do this well achieve more wins. This work suggests that optimizing play style has positive effects on performance. Gannaway et al. (2014) also cite this work, and assume that coaches optimally allocate shots for the purposes of their analysis. McCormick and Clement (1992) note that coaches tend to increase their three-point attempt rate over time. If a similar optimality assumption to Gannaway et al. (2014) is made, this would suggest higher three-point attempt rates are optimal from a performance perspective. It is likely that fans notice this performance, and have more interest as a result. This implies that they would prefer teams that shoot a high proportion of three-pointers.

This paper also contributes to the literature on consumer demand in sports. Borland and Macdonald (2003) refer to works related to consumer preference by Kahn and Sherer (1988) and Brown et al. (1991). Their works do not concern play style, however they provide evidence that demand is sensitive to the ethnic makeup of teams. Borland and Macdonald (2003) mention that consumer demand research for the NBA is not as developed as in other sports leagues. Most literature researches consumer demand in the context of other professional leagues, but the most influential paper for this research was an analysis of NBA revenues by Berri et al. (2004). The authors synthesized consumer demand models from different leagues to build a model for NBA gate revenues. They were hoping to evaluate the effects of star power and competitive balance on demand for the NBA. The independent variables of interest in their work were all-star votes, dummy variables for certain superstars, and competitive balance measures. Although the fundamental objective of this paper and Berri et al. (2004) differs, the authors provide the most comprehensive consumer demand model for the NBA. For the purposes of this paper, it is the best starting point for empirical analysis. Revenue data for Berri et al. (2004) was gate revenue, or income from ticket sales. Their rationale was that increases in consumer demand cannot not be seen through attendance data for teams that sell out every game. Teams have the ability to change prices however, enabling gate revenues to fluctuate as prices change due to the forces of

supply and demand. Another reason Berri et al. (2004) used gate revenue, was that the Financial World, the primary publisher of revenue data until the 1995-96 season, reported revenue as gate revenue. The dependent variable of interest in this paper is not gate revenue, but gross revenue, a second major difference from the work of Berri et al. (2004). Gross revenue includes revenue from sponsorships, TV deals, and other non-attendance income. Borland and Macdonald (2003) paraphrased Neale (1964), and claimed fan interest manifests in attendance, viewing or listening to live broadcasts, purchases of team merchandise or products advertised by sponsors, and consumption of related media. The assertion of Neale (1964) that fan interest goes beyond attendance and provides justification for the use of gross revenues. Income from all sources of fan interest are represented in gross revenues, making it the broadest measure of fan interest. The lack of empirical research on gross revenues and play style creates an opportunity for new research. The estimates obtained from a gross revenue model analyzing play style would be relevant for NBA coaches, players, and executives. This paper attempts to fill this gap in the literature by expanding on the aforementioned work by Berri et al. (2004).

3 Experimental Design

The method of identification is most similar to Berri et al. (2004) but differs in impactful ways. Like Berri et al. (2004), this paper uses multiple linear regression to control for the effect of performance characteristics, franchise characteristics, and market characteristics on team revenues. The independent variable of interest for this paper is play style, not measures of star power. Additionally, the time period of interest in Berri et al. (2004) is the 1992-93 season through the 1995-96 season, but this paper is from the 2013-14 season through the 2017-18 season. The choice of time period is important to this paper, because the league has changed considerably during this period. Over the last twenty years, revenue streams have diversified and grown substantially. Three-point attempt rates have increased substantially

between the sample periods. Highlight plays reach global audiences in seconds through social media, increasing exposure and offering new avenues for income. Overseas audiences have grown, partially due to an increasingly international pool of players[12]. This paper argues that gross revenues are more relevant for analysis than gate revenues in this contemporary setting. The model in this paper includes all statistically significant control variables from the model or Berri et al. (2004), however additional performance characteristics are also controlled for. The first regression output incorporates all statistically significant variables from Berri et al. (2004), but adds this paper's measure of play style, three-point attempt rate, to estimate its effect on revenues. Three-point shooting percentage was a control for shooting accuracy in the second regression, while offensive rating was an efficiency control added for regression three. The results from the first test were intended to estimate the effect of three-point attempt rate without modifications to the core of the model proposed by Berri et al. (2004). The justifications for each regression specification resides in the Data section. Each variable is expected to be a statistically significant determinant of revenue. Variables are summarized in the table at the end of the data section. The regression form is discussed in the Functional Form section and is presented in equation form. All regressions were run with the inclusion of fixed effects and heteroskedasticity-robust standard errors.

4 Data

4.1 Dependent Variable - Consumer Demand

The dependent variable of interest in this paper is gross revenue (from all income sources) for NBA teams from the 2013-2014 season through the 2017-2018 season. Revenue data was collected from Rodney Fort's Sports Economics website[13] and is from reports published annually by Forbes. Data was available for all thirty NBA franchises and measured in

[12]Nath (2019)
[13]see Fort (2019)

millions.

4.2 Independent Variable of Interest - Play Style

Three-point attempt rate, a measure of a team's use of the three point shot, is the statistic used for play style in this analysis. Play style statistics that are not the primary interest of this paper include pace, passing rate, and assisted basket percentage. As previously mentioned in this paper, the prevalence of the three-pointer is arguably the most dramatic difference between contemporary play style and historical approaches to offense. In a study of Major League Baseball, Knowles et al. (1992) found that attendance is maximized when the home team has a sixty percent chance of winning. This paper hypothesizes there is an optimal play style that best engages fans and translates to revenue, much like competitive balance. Three-point attempt rate is defined as the proportion of a team's total shot attempts that were launched from behind the three point line and is reported as a percentage. This data is available for all thirty NBA teams during the experimental setting, and was collected from basketball-reference.com. Theory suggests that this variable may be a statistically significant determinant of revenue[14]. Since productivity gains were biased to frontcourt players[15], one may postulate that increased three-point attempt rates would result in lower revenues. This paper argues, however, that it is more likely that coaches and front offices are getting better at optimizing their use of this shot. The dramatic increase in attempts from beyond the three-point line is a plausible manifestation of this improvement, implying that higher three-point attempt rates are optimal for franchises. If higher three-point attempt rates are ideal from a performance standpoint, it is likely that high rates are favored by fans and result in higher revenue. Consequently, this paper hypothesizes a statistically significant and positive effect on revenues.

[14]Sutton and Parrett (1992)
[15]Gannaway et al. (2014)

4.3 Team Performance Characteristics

Intuition suggests fans prefer it when their favorite team is performing at a high level, and it is no surprise that positive performances are widely hypothesized to result in higher revenues. League structure even ensures that franchises are rewarded for good performance: the franchises with the top eight records in each conference make the playoffs, earning them more revenue. Berri et al. (2004) demonstrated the effect of performance on revenue in their work, and this paper follows their example by controlling for team performance. Wins, playoff wins, and lagged playoff wins are the standard performance measures incorporated in this model. They are expected to have a positive effect on revenues as in Berri et al. (2004). These statistics were gathered from basketball-reference.com. Since lagged playoff wins are included, data from the 2012-13 season was also collected.

Following the example of Berri et al. (2004), this paper employs a statistic called weighted championships. This variable captures the effect of championships won in the past 20 seasons, but is weighted so that the value of a championship diminishes over time. It is calculated by assigning a value to each championship won in the last twenty years. The value is 20 for a championship during the prior season, but the value diminishes by 1 for each year additional year removed. For example, if a team won a championship two seasons prior, the team's value of weighted championships for that season would be 19. If that team also won a championship eighteen years ago, their value would be 22 (19 plus 3). Teams with no championships in the last twenty years have a value of zero. Data on past NBA champions was gathered from basketball-reference.com. Past championships had a positive effect on revenues in previous work Berri et al. (2004).

This paper also controls for individual performance statistics. This borrows from the method of Berri et al. (2004) who used all-star votes to estimate the effect of star power on revenues. In addition to being a measure of star power, it is an indicator of individual performance that is directly related to fan preference. It was statistically significant in Berri et al. (2004), and is expected to be the case in this analysis of gross revenue. Fans have

more access to out of market broadcasts, and the effect of star players on revenue may be more significant in the modern day. Until the 2016-17 season, the NBA only published voting numbers for the top ten guards and top 15 frontcourt players (small forwards, power forwards, and centers). Consequently, only votes for players within these rankings are considered for the 2016-17 and 2017-18 seasons.

Additional controls are proposed by this paper that are not found in relevant literature. Three-point shooting percentage is the percentage of three point attempts that are made. Teams who have higher three-point shooting percentages are likely to shoot three-pointers at higher rates. If modern play style (as measured by three-point attempt rate) affects revenues, it is likely that the effectiveness of those plays (three-point shooting percentage) also affects revenue. Consequently, this paper controls for three point shooting percentage. This data is collected from basketball-reference.com and available for all teams in this analysis. This paper controls for offensive rating, a statistic that measures the offensive efficiency of players and teams. Offensive rating is defined as the average number of points produced (for a player) or points scored (for a team) for each 100 possessions. The three-pointer is widely credited for having positive effects on NBA scoring. As a result, three-point attempt rates may correlate with more efficient offensive teams. Additionally, fans may simply prefer better offensive teams to average offensive teams. These reasons suggest the need for an offensive performance control, and the standardized nature of this statistic makes it an ideal choice. This data is also collected from basketball-reference.com.

4.4 Franchise Characteristics

Franchise characteristics that have a demonstrated effect on revenue include season attendance, arena capacity, and arena age [16]. The first two variables (season attendance and arena capacity) are expected to have a positive effect on revenues. The age of an arena is expected to have a negative effect on demand. Additionally, a dummy variable for ex-

[16] Berri et al. (2004)

pansion teams is added for new franchises or rebrands. It takes a value of one if the team rebranded or was created in the last five years. The Charlotte Bobcats rebranded to become the Charlotte Hornets in 2016-17, and the New Orleans Hornets became the Pelicans in 2013-14. As a result, there are seven observations for the expansion dummy variable. Berri et al. (2004) found a positive effect of the expansion variable in their work, and this paper hypothesizes that a similar effect will be found. Expansion data, attendance, and arena data were collected from basketball.ballparks.com.

4.5 Market Characteristics

This paper follows the example of Berri et al. (2004) by controlling for a population factor. Higher populations mean more potential fans for a local franchise. Market size is considered when TV deals are signed and has a positive influence on gross revenues. Berri et al. (2004) found this variable to have a positive and statistically significant effect on revenue. Instead of metropolitan-statistical-area data, this paper uses Nielsen TV household data. The reason for this choice is twofold: this is the population data considered in TV deals, and is reported annually for US TV markets. However, this choice alters the sample of franchises that can be used in analysis. Since the Toronto Raptors are located in Canada, there is no Nielsen TV population estimates available. Consequently, five observations (5 teams) have been removed from consideration. All data was gathered from nielsen.com.

4.6 Time Fixed Effects

The addition of time fixed effects is extremely important in the NBA. These yearly dummy variables account for changes to revenue that affect all teams. Previous works have included these variables[17]. New TV deals, revenue sharing agreements, or official merchandise providers come into effect at the beginning of new seasons and effect league-wide income. These dummies were statistically significant in the analysis of Berri et al. (2004) and are

[17]Jennett (1984); Berri et al. (2004)

expected to be in this model. One reason for this hypothesis is that a new TV deal went into effect in the 2016-17 season[18], considerably boosting revenues in that year and in 2017-18.

Table 1: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Revenue	185.186	59.971	109	426	145
Three-Point Attempt Rate	0.293	0.055	0.171	0.502	145
Three-Point Shooting Percentage	0.356	0.018	0.312	0.416	145
ORtg	107.086	3.537	95.5	115.6	145
Wins	40.6	12.598	10	73	145
Playoff Wins	2.869	4.399	0	16	145
Weighted Championships	5.669	12.575	0	57	145
All-Star Votes	918709.793	1226033.704	0	7634533	145
Attendance	726957.524	75784.436	552067	894659	145
Arena Capacity	19471.669	1192.703	17317	22076	145
Arena Age	18.959	10.084	0	51	145
Population	2344871.793	1815798.224	633140	7461030	145
Expansion	0.048	0.215	0	1	145

5 Functional Form

The choice of functional form for Berri et al. (2004) was the multiplicative, or double-logged form. They borrowed their reasoning from Scully (1974) who argued that this functional form enables the value of an additional win (while holding all else constant) to vary from team. Berri et al. (2004) also justified this test empirically by using the Box-Cox test[19]. Consequently, a logged specification is the appropriate choice for this paper. Revenues, three-point attempt rate, all-star votes, three-point shooting percentage, offensive rating, arena capacity, population, and attendance are all logged. The coefficients on the independent variables will be interpreted as elasticities. Other variables, like wins, were not transformed because interpreting the effect of a one unit increase in a discrete variables makes more sense than a one percent change. This paper theorizes that the population regression equation is

[18] Adgate (2018)

[19] see Box and Cox (1964) and Zarembka (1968)

comprised of the explanatory variables and transformations previously discussed. It is shown below.

Figure 2: Hypothesized population regression equation

$$
\begin{aligned}
\log(\textit{gross revenue}) = \beta_0 & \\
& + \beta_1 \times \log(\textit{three-point attempt rate}) \\
& + \beta_2 \times \log(\textit{three-point shooting percentage}) \\
& + \beta_3 \times \log(\textit{offensive rating}) \\
& + \beta_4 \times \textit{wins} \\
& + \beta_5 \times \textit{playoff wins} \\
& + \beta_6 \times \textit{lagged playoff wins} \\
& + \beta_7 \times \textit{waited championships} \\
& + \beta_8 \times \log(\textit{allstar votes}) \\
& + \beta_9 \times \textit{expansion dummy} \\
& + \beta_{10} \times \log(\textit{attendance}) \\
& + \beta_{11} \times \textit{arena age} \\
& + \beta_{12} \times \log(\textit{stadium capacity}) \\
& + \beta_{13} \times \log(\textit{population}) \\
& + \beta_{14} \times \textit{2015 dummy} \\
& + \beta_{15} \times \textit{2016 dummy} \\
& + \beta_{16} \times \textit{2017 dummy} \\
& + \beta_{17} \times \textit{2018 dummy}
\end{aligned}
$$

6 Results and Discussion

As previously mentioned, this logged model was estimated under three regression specifications. The first regression is most similar to the model of Berri et al. (2004) and incorporates all of their statistically significant explanatory variables, however the focus of this model is the effect of three-point attempt rate on gross revenues. Regression two includes three-point shooting percentage as an accuracy control, while regression three adds offensive rating as an offensive efficiency control. The table below summarizes regression results. The remaining paragraphs in this section discuss regression results for each specification.

Table 2: Regression results

	(1) Log Revenue	(2) Log Revenue	(3) Log Revenue
Log Three-Point Attempt Rate	-0.0892*	-0.0829	-0.103*
	(0.0426)	(0.0446)	(0.0414)
Wins	-0.000613	-0.000480	-0.00182
	(0.000820)	(0.000813)	(0.00118)
Playoff Wins	0.00111	0.00118	0.000649
	(0.00203)	(0.00212)	(0.00191)
Lagged Playoff Wins	0.00935***	0.00929***	0.00962***
	(0.00141)	(0.00141)	(0.00124)
Weighted Championships	0.00356***	0.00364***	0.00337***
	(0.000725)	(0.000819)	(0.000641)
Log All-Star Votes	0.00161	0.00151	0.00175
	(0.00128)	(0.00134)	(0.00126)
Expansion Dummy	0.00522	0.00895	-0.0225
	(0.0130)	(0.0139)	(0.0201)
Log Attendance	-0.123	-0.118	-0.132
	(0.102)	(0.104)	(0.106)
Arena Age	-0.00599***	-0.00621***	-0.00665***
	(0.000576)	(0.000663)	(0.000700)
Log Arena Capacity	-0.310	-0.390	-0.433
	(0.185)	(0.262)	(0.218)
Log Population	0.0345	0.0292	0.107
	(0.290)	(0.295)	(0.300)
Dummy 2015	0.0744***	0.0726***	0.0833***
	(0.0118)	(0.0125)	(0.0108)
Dummy 2016	0.166***	0.164***	0.171***
	(0.0127)	(0.0146)	(0.0124)
Dummy 2017	0.291***	0.290***	0.282***
	(0.0190)	(0.0185)	(0.0193)
Dummy 2018	0.544***	0.543***	0.539***
	(0.0183)	(0.0185)	(0.0188)
Log Three-Point Shooting Percentage		-0.0764	
		(0.178)	
Log Offensive Rating			0.690
			(0.385)
_cons	9.147	9.870	6.258
	(4.739)	(5.256)	(5.177)
N	145	145	145
adj. R^2	0.9504	0.9505	0.9523

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The results from the first regression were intended to be a baseline estimate of the effect of three-point attempt rate on revenues. The model fit the data strongly, and had a within-group adjusted r-squared of 0.9504. In this most basic model, three-point attempt rate was statistically significant at a five percent confidence level (p-value 0.046). The coefficient was -0.0891832, implying that a one percent increase in three-point attempt rate should result in a 0.089 percent decrease in revenues when holding all else equal. This interesting finding may be explained by managerial inefficiency[20] or efficiency gains by forwards[21]. Many of the explanatory variables were statistically significant as expected, however some significant variables from Berri et al. (2004) were no longer statistically significant when their effect on gross revenues was evaluated. This paper found that lagged playoff wins, weighted championships, arena age, and seasonal dummy variables were statistically significant at a 0.1 percent significance level. Each variable had a positive coefficient, reflecting results found in previous literature. Unlike Berri et al. (2004), wins, playoff wins, all-star votes, expansion, attendance, arena capacity, and population were not statistically significant at any conventional significance levels. It is interesting to note, however, that arena capacity had a p-value of 0.103 and a negative coefficient. Additionally, attendance had a negative coefficient, but its p-value was 0.235. If the true effect of capacity or attendance had this direction, it would suggest NBA teams price along the inelastic portion of the demand curve (revenue is increased when prices are raised and quantity lowered). Berri et al. (2004) did not find this to be the case in their analysis, however they cited these studies that provide evidence of this pricing behavior[22]. The choice of dependent variable could explain the statistical insignificance of population. Although it demonstrated a statistically significant effect on gate revenues[23], the effect may be too small to be statistically significant for gross revenues (a broader measure of income that includes gate revenue).

[20] McCormick and Clement (1992)

[21] Gannaway et al. (2014)

[22] see Burdekin and Idson (1991), Demmert (1973), Fort and Quirk (1995), Jennett (1984), and Medoff (1986)

[23] Berri et al. (2004)

The second regression adds a control for three-point shooting percentage. The within-group r-squared was 0.9505, only 0.0001 higher than regression one. The estimated coefficient for three-point attempt rate was weakly statistically significant. The coefficient was -0.0828967 and significant at the ten percent confidence level (p-value 0.074). The coefficient on three-point shooting percentage was not statistically significant at any conventional significance levels. The p-value for the estimated coefficient on three-point shooting percentage was 0.672. All other variables from regression one maintained their approximate magnitude, direction, and level of significance. This specification did not improve the model's fit with the data, find statistical significance for three-point shooting percentage, nor did it increase the significance of the coefficient on three-point attempt rate. Since teams who shoot three-pointers very accurately likely also shoot a higher proportion of these shots, multicollinearity may be at play. These findings suggested that another control variable that captures offensive quality should be included instead of three-point shooting percentage. Offensive efficiency is closely related to three-point shooting accuracy, but is likely to have a lower correlation with three-point attempt rate. As a result, this paper controls for offensive rating in regression three.

In the final regression specification, a control variable for offensive rating is added as an alternative to three-point shooting percentage. The within-group adjusted r-squared was 0.9523. This is a notable increase over the previous two specifications. Additionally, three-point attempt rate was statistically significant at a 2.0 percent confidence level (p-value of 0.019). The coefficient was -0.1025499, implying that a one percent increase in three-point attempt rate should result in a 0.103 percent decrease in revenues. In practical terms, this implies that the average NBA team would have lost $252,968 in revenues in the 2017-18 season by increasing their three-point attempt rate by one percent. Offensive rating was statistically significant at the ten percent level (p-value 0.084), and had a coefficient of .6903566. Although this is not the strongest significance level, there is some reason to believe that this variable has a statistically significant effect on revenue. Similarly to regression two,

all other variables from regression one maintained their approximate magnitude, direction, and level of significance.

Given the results of the three regressions, this paper argues that offensive rating belongs in the model. This variable controls for quality of offense, a factor that, if omitted, could bias the coefficient on three-point attempt rate. The coefficient for three-point attempt rate remained negative, but increased in magnitude relative to regression one. This suggests that the omission of offensive rating positively biased the coefficient on three-point attempt rate in regression one. Not only does the third regression specification fit the data better than regression one (0.9523 r-squared versus 0.9504 r-squared), it adds a statistically significant regressor and restricts confidence level for the effect of three-point attempt rate. This paper concludes that this regression specification is the most appropriate for discussion. Although a statistically significant effect of play style was identified, there are potential issues with this that analysis stem from data decisions. The lack of literature evaluating the determinants of gross revenue necessitates reasonable skepticism of this paper's results. Income from all manifestations of fan interest (Neale, 1964) are represented in gross revenues, offering some support the conclusions of this article. Additionally, there is theoretical and empirical justification for the inclusion of each variable. Consequently, this paper argues that the results of this analysis are reasonably robust.

7 Conclusion

An increasing proportion of NBA shot attempts are from behind the three-point line. This change in play style is a defining characteristic of contemporary offense and leads one to question whether this stylistic change influences fan behavior. Theoretical work by Sutton and Parrett (1992) argues that play style is a component of professional sporting product, providing motivation for analyses of play style and revenues. This paper augments existing consumer demand literature by evaluating the effect of play style on gross revenues.

Following the work of Berri et al. (2004), this paper controls for franchise, market, and performance characteristics. This paper also proposed using two additional performance characteristics (three-point shooting percentage and offensive rating) as control variables. The model estimates demonstrated that offensive rating was a weakly statistically significant determinant of NBA revenues and concluded that it belongs in the gross revenue model. This updated model best fit the data and revealed a statistically significant effect of the independent variable of interest (three-point attempt rate) on revenues. This result was significant at the 2.0 percent confidence level and was a negative relationship. This paper's most important empirical result was that increasing the three-point attempt rate by one percent should result in a decrease in revenues of about 0.1 percent when holding all else equal. This translates to a loss of about $252,968 for the average team in 2017-18 NBA season. This paper found that lagged playoff wins, weighted championships, arena age, and seasonal dummy variables were statistically significant at a 0.1 percent significance level. Each variable had a positive coefficient, reflecting results found in previous literature. Unlike Berri et al. (2004), wins, playoff wins, all-star votes, attendance, arena capacity, and population were not statistically significant at any conventional significance levels. These results may imply that gross revenue models have different determinants than gross revenues. The lack of similar analyses of gross revenue poses some concern regarding the validity of results, however this paper follows the convention of other consumer demand work. Future research may identify the effect of play styles in other sports or extend research on the determinants of gross revenue in the NBA.

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