

Evolution of 3-Point Usage and Effect on Win Percentage in NBA

Will Rice

University of Georgia

March 24, 2023

Table of Contents

- 1 Introduction
- 2 Current Knowledge
- 3 Data Selection & Methodology
 - Data Selection
 - Method
- 4 Findings and Figures
- 5 Discussion
- 6 Final Remarks
- 7 Citations

Overview

- Like every professional sports game, the NBA has undergone massive changes in its play style and the required skill to excel over the last several decades.
- Changes can be attributed to a multitude of factors, including rule changes, overall average skill level, and analytics.
- It has been noted that by the early 2010's, Stephen Curry rose to prominence along with the Golden State Warriors with their success and unique playing style.
 - The Warriors played "positionless" basketball, where there were no formal guards, forwards, and centers within the lineup
 - The Warriors relied heavily on 3-point shooting from it's two "Splash Brothers," Curry and Klay Thompson.
- Over the next few years, teams would adjust to this success and base their team-building and play style around smaller, shooting-centric rosters using analytics to show 3-pointers are more favorable in the long-run than two-pointers.

Current Knowledge on the Evolution

- The general understanding with the evolution of the game:
 - 1 Overall skill has never been higher. Bench players are (while not proven quantitatively) more skilled than in previous years with a larger need to be able to shoot at a higher percentage, and defend at a high-level for competitive playoff games (Hence the necessity for "3-and-D wings").
 - 2 3-Pointers attempted continue to increase, contributing to the "death of the mid-range jumper." The game is completely spaced with few true rim protecting big men and post players without shooting skills playing significant minutes in the NBA anymore.
- Yet, does shooting (and making) more 3-pointers lead to a higher probability to succeed? Or does this drastic change in the NBA not reflect the unique talent of some of the top individual shooters (i.e., Curry, Thompson, Damian Lillard, etc)?

NBA Selection of Statistics

- I used a master data set collected via an online source that tracks major NBA team statistics for every season between 1976 to 2023.
- I used `r` to filter the data into according data sets split up by decades.
- The data worked with has statistics on team scoring total/percentages, assist, rebound, and other team metrics, as well as win percentage and whether the team made the playoffs.
- I am looking to find the effect 3-pointers made has on the win percentage of each team over time, as the evolution of the NBA has clearly enhanced this effect. I am controlling for statistics regarding free throws and 2-pointers, as well as other non-scoring statistical metrics per 100 possessions.

Multi-Variable Linear Regression

- I ran several multi-variable OLS regressions using the same model setup, using different data for each decade.
- Each regression looks to find how 3-pointers made have some effect on win percentage, controlling for other team statistics, such as 2-pointers made and attempted, as well as free throws made and attempted, and other defensive/offensive quantitative metrics.
- Each statistic is based in per 100 possessions.
- An example of the model regression is as follows:
$$\text{Win Percentage}_{i,t} = \beta_0 + \gamma_1 3pm_{i,t} + \gamma_2 3pa_{i,t} + \gamma_3 2pm_{i,t} + \gamma_4 2pa_{i,t} + \gamma_5 ftm_{i,t} + \gamma_6 fta_{i,t} + \gamma_7 orb_{i,t} + \gamma_8 drb_{i,t} + \gamma_9 blk_{i,t} + \gamma_{10} tov_{i,t} + \gamma_{11} stl_{i,t} + \gamma_{12} ast_{i,t} + \varepsilon_i$$
 Where we are looking at win percentage for the i 'th individual in the t 'th year.

Multi-Variable Linear Regression

- Notes on the coefficients (all in per 100 possessions):
 - 3pm = 3-pointers made
 - 3pa = 3-pointers attempted
 - 2pm = 2-pointers made
 - 2pa = 2-pointers attempted
 - ftm = free throws made
 - fta = free throws attempted
 - orb = Offensive rebounds
 - drb = Defensive rebounds
 - blk = Blocks
 - tov = Turnovers committed
 - stl = Steals
 - ast = Assists made

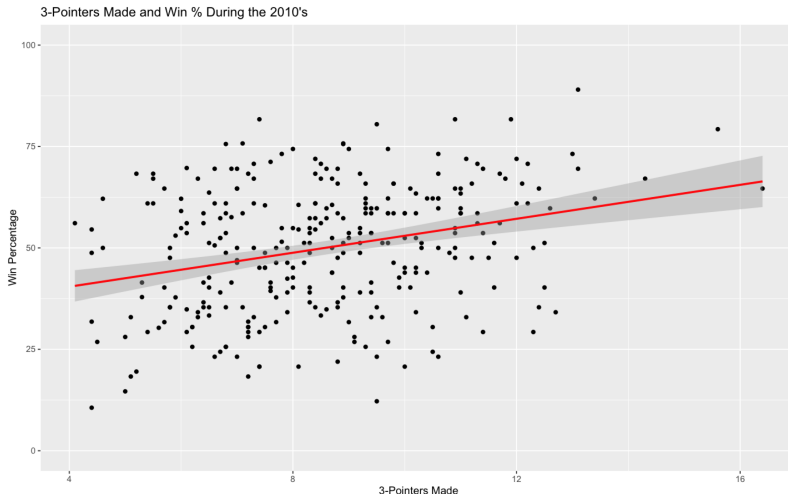
Multi-Variable Linear Regression

- I am looking for a few things within the regressions important to the timing and effect of 3-pointers on win percentage:
 - 1 Does an increase in 3-pointers made have any positive, significant effect on a teams win percentage
 - 2 Has this effect become more prevalent (a larger, positive number), and has it's significance level changed, if it ever was a significant effect?
 - 3 If the hypothesized relationship is true that more 3-pointers made became more significantly effective on win percentage beginning in the later 2000's/early 2010's, what other scoring variable's effect has been diminished? Is this effect significant?
 - 4 Can this change in the other variable be attested to an increase in prevalence and significance in the 3-pointer? Are they negatively correlated?
- After programming for the regressions in r, I uploaded them to Excel for better visualisation of the results. A full r script will be included in a separate file.

Notes on Findings

- I constructed six different regressions for each of the following decades: 1970's, 1980's, 1990's, 2000's, 2010's, 2020's.
 - For 1970's, data was missing on 3-pointers attempted/made and percentages until the three-point line was introduced in 1979, so that regression does not include 3-pointers made or attempted.
 - For 2020's data set, I used data only on first 3.5 years of NBA statistics available.
- I also constructed plots of win percentage related to three pointers made within each decade to find a rough estimate of the relationship between the two main variables.
- An example of the latter type of finding is shown on the following slide.

Figure 1: 2010's Win Percentage and 3-Pointers Made



Results

- 3-pointers made had a statistically significant positive effect on win percentage to the .001 level in decades 1980-2020.
- Free throw attempts in turn, have gone from positive, statistical significant effect on win percentage to negative, insignificant effects.
- Non-shooting metrics used for controlling show significant effects on win percentage, namely defensive rebounds and steals made.
- The full table is shown on the next slide

Figure 2, Results from Regressions

Column1	Seventies Regression	Eighties Regression	Nineties Regression	Oughts Regression	Tens Regression	Twenties Regression
(Intercept)	-1040.27 *** (269.39)	-1093.30 *** (144.48)	-675.99 *** (139.17)	-470.81 ** (150.77)	-443.96 * (173.06)	-95.25 (339.91)
x3p_per_100_poss	N/A	13.85 *** (3.63)	9.55 *** (1.32)	9.54 *** (1.28)	12.23 *** (1.09)	8.25 *** (1.44)
x3pa_per_100_poss	N/A	2.76 (1.85)	1.33 (1.37)	-0.82 (1.48)	-2.46 (1.60)	-3.86 (3.29)
x2p_per_100_poss	4.90 *** (0.93)	5.95 *** (0.47)	5.44 *** (0.34)	4.25 *** (0.39)	3.72 *** (0.46)	5.85 *** (0.91)
x2pa_per_100_poss	6.42 * (2.59)	6.35 *** (1.37)	2.22 (1.31)	0.27 (1.44)	0.21 (1.66)	-3.64 (3.33)
ft_per_100_poss	0.94 (0.93)	1.65 * (0.72)	0.95 (0.50)	1.10 * (0.52)	2.35 *** (0.58)	3.79 ** (1.40)
fta_per_100_poss	4.03 (2.59)	3.65 *** (0.91)	2.51 *** (0.71)	1.28 (0.85)	0.64 (0.92)	-2.23 (1.83)
orb_per_100_poss	-7.83 *** (1.52)	-7.20 *** (1.60)	-3.05 * (1.48)	-0.76 (1.72)	0.64 (1.99)	2.01 (3.92)
drb_per_100_poss	4.80 * (1.52)	4.80 *** (0.39)	5.67 *** (0.25)	5.80 *** (0.29)	5.11 *** (0.33)	4.62 *** (0.60)
blk_per_100_poss	1.59 (2.79)	1.79 *** (0.45)	-0.48 (0.37)	0.98 * (0.42)	1.01 (0.56)	0.16 (1.21)
tov_per_100_poss	7.30 * (0.69)	6.31 *** (1.46)	1.79 (1.38)	-0.16 (1.43)	0.01 (1.71)	-1.90 (3.24)
stl_per_100_poss	3.93 ** (0.98)	6.05 *** (0.52)	5.38 *** (0.36)	6.58 *** (0.45)	6.58 *** (0.52)	6.75 *** (1.11)
ast_per_100_poss	0.01 *** (2.73)	-0.10 (0.36)	0.21 (0.24)	0.92 *** (0.23)	0.85 ** (0.29)	-0.63 (0.55)
N	72	231	278	295	300	90
R2	0.62	0.82	0.88	0.85	0.82	0.83
Significance Level	*** p < 0.001	** p < 0.01	* p < 0.05			

Discussion

- The important aspect to note is that while the value on the 2020's intercept decreased by nearly five fold, the positive, statistically significant value of 3-pointers made only declined by about 33 percent of its 2010's effect.
 - Or, looking at the 2010's and 2020's at large, the effect of the 3-pointer relative to other statistics continues to show a massive, statistical importance on winning.
- The 2010s (where Steph Curry's/Warriors play supposedly evolved the game towards threes) heavily back ups the notion of the three points importance on winning.
 - Each 2-pointer made increases win percentage by 3.72 percent, while each 3-pointer does so by 12.23 percent, holding all else equal. Even adjusting for the difference in point totals and controlling for possessions by using a set 100 average, the 3-pointer has a much more massive importance on modern winning than the normal field goal.
- I believe that based on these findings, while it is clear scoring more points helps win more games, 3-pointers have had a more clear, significant effect on the game than 2-pointers and more of an effect than they had at a time when 3-pointers were not as prevalent.

Final Remarks

- Overall, a change in the way basketball has been played through an eye-test is backed up analytically, specifically showing the 3-pointers positive effect on a team's winning percentage.
 - While the number players who were around prior to Curry and the explosion of the 3-pointer continues to diminish, the game will increasingly cater towards 3-pointers and free throw attempts on driving layups.
 - This evolution is eerily similar to the new wave of the "3-outcome" game baseball has taken on, driven by math and analytics, proving its effectiveness yet lacking an entertaining style of play. The MLB has pushed back on this approach, banning shifts and implementing a pitch clock, potentially to rekindle the public's dwindling interest in the sport and the way the game is played.
 - Will the NBA ever have to step in and implement rules, or ban playing techniques if the game becomes more predictable and less entertaining for fans? Based on the continuing increase in effectiveness and volume of the 3-point shot, they may at least have to make that decision.

Final Remarks, Continued

- There is some clear limitations regarding non-quantitative/omitted factors that most analysts agree play a factor in a teams win percentage (injuries, home-court advantage, etc).
 - I did not have the relevant data to be able to completely control for any of the non-statistical factors not listed, or else a more comprehensive regression may been used.
- Using decades as a threshold for running different regressions may not have been the best marker for finding effective, significant results.
 - Would using Curry's first year in the league have been more effective at seeing modern effects of 3-point percentage? His first all-star game?

Citations

- Andy. (2022, April 12). The history and evolution of the three-point shot. The Hoops Geek. Retrieved March 22, 2023, from <https://www.thehoopsgeek.com/history-three-pointer/>
- Cohen, B. (2016, April 6). The Golden State Warriors have revolutionized basketball. The Wall Street Journal. Retrieved March 22, 2023, from <https://www.wsj.com/articles/the-golden-state-warriors-have-revolutionized-basketball-1459956975>
- Datta, S. (2023, March 1). NBA stats (1947-present). Kaggle. Retrieved March 22, 2023, from <https://www.kaggle.com/datasets/sumitrodatta/nba-aba-baa-stats?select=Team>
- Lisa, A. (2019, June 5). 25 ways the NBA has changed in the last 50 years. Stacker. Retrieved March 22, 2023, from <https://stacker.com/basketball/25-ways-nba-has-changed-last-50-years>
- Ziller, T. (2019, June 14). The Golden State Warriors Changed the NBA Forever. SB Nation. Retrieved March 22, 2023, from <https://www.sbnation.com/2019/6/14/18678643/golden-state-warriors-nba-finals-2019-legacy-future>