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Measuring an NBA Player's "Value"

Introduction

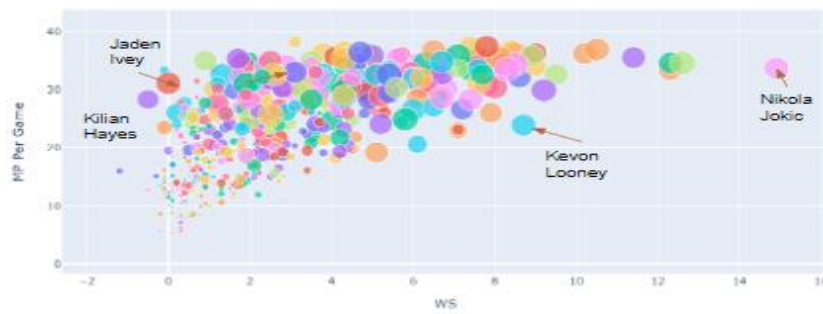
In professional sports, the question of a star player's impact on team success remains a subject of fervent debate and intrigue. This research embarks on a quest to unravel the intricate relationship between individual player performance and overall team outcomes, with a keen focus on the National Basketball Association (NBA). Our central objective is to find out which players in the NBA are worthy of the money and prestige they possess.

To accomplish this, we will be using two different data sets, both from Pro Basketball Reference. The first is a compilation of individual player stats that cover everything from season total stats, to per 36 possession stats, to advanced stats. The second includes player contract information for the 2023-24 season and total guaranteed money on the contract. Using these data sets, we will evaluate which players deserve more or less minutes per game, which players are making an impact beyond what their primary box score statistics show, and which are being overpaid or underpaid depending on their 2022 production.

Topic 1: Who Deserves More/Less Minutes?

In the dynamic landscape of professional basketball, optimizing player minutes is a critical aspect of coaching strategy. Teams seek to balance the court time of their players to maximize individual contributions and overall team success. To address concerns about players potentially receiving either too many or too few minutes, our analysis on this topic focuses on advanced statistics, particularly Win Shares (WS), VORP (Value Over Replacement Player), and BPM (Box Plus-Minus).

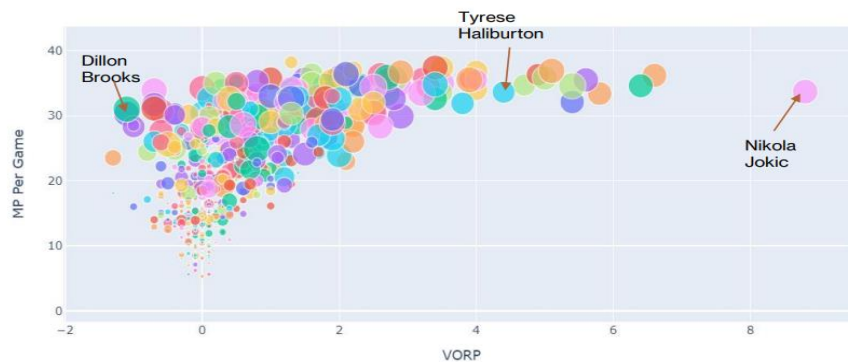
Win Shares as a Metric:



Win Shares is a valuable metric that allocates team success to individual players. By dissecting the contributions of each player to the team's victories, it becomes a key tool in assessing the correlation between performance and playing time. The visual representation of Win Shares, incorporating the size of bubbles to account for games started, provides a nuanced perspective on player efficiency. In summary, the Win Shares metric highlights disparities in player performance and minutes played. It supports the notion that certain players, like Jokic and potentially Looney, deserve their minutes, while others, like Ivey, might be receiving more minutes than their performance justifies based on this specific metric.

Value Over Replacement Metric:

The second metric under consideration for optimizing player minutes is Value Over Replacement Player (VORP), a statistic that quantifies a player's contribution in points to their team during an NBA game, adjusted for playing time using box score statistics.



The visual representation of VORP, employing a format similar to the previous analysis, provides crucial insights into the correlation between player value and the minutes they play. Notably, Nikola Jokic once again emerges as a standout player, demonstrating his exceptional value on the court. The high correlation between Jokic's VORP and his playing time suggests that his contributions significantly impact his team's success. At the other end of the spectrum, Dillon Brooks is highlighted as a player whose presence may not positively contribute to team success, as indicated by a lower VORP. The analysis suggests that Brooks might be receiving more minutes than his contribution justifies, prompting a reevaluation of his role within the team and potential adjustments in playing time allocation for optimal team performance. This examination underscores the importance of considering multiple metrics, such as VORP, in making informed decisions about player minutes to enhance overall team success.

Box Plus/Minus Metric:

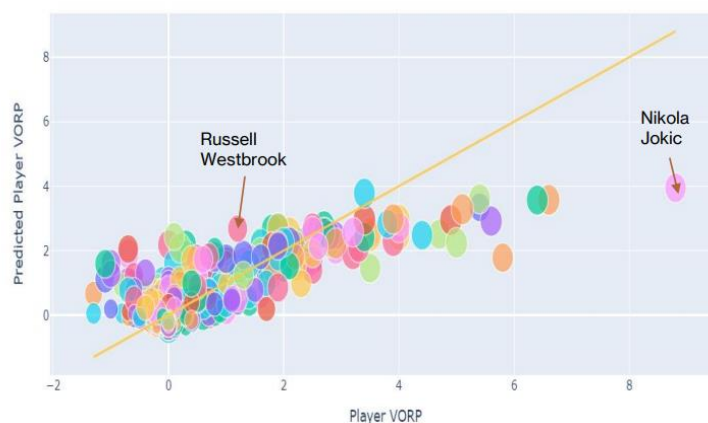
Nikola Jokic, yet again, stands out as a dominant force in the game, reinforcing his well-deserved minutes on the court. His consistently high BPM underscores his all-around excellence. On the other hand, emerging players like Malaki Branham may find room for improvement in their BPM, signaling areas of their game that could use refinement. These advanced metrics offer a nuanced perspective on player performance, guiding both fans and analysts in assessing the diverse skills and impact of basketball athletes. (See Figure 1 in the Appendix section to see the visual).

Topic 2

Our next topic focused on the relationship between primary box score stats (points, assists, rebounds, blocks, steals) and a player's true impact on the court, which we represented using the Value Over Replacement Player (VORP) measure; we decided to use this variable as the response variable due to it being the best metric within the data set in terms of addressing a player's performance on the court. This topic was worth examining, as while box score stats are important, they should not be the primary method of determining how great or valuable a player is. An early issue we ran into when analyzing this

topic was to determine which version of primary box score stats to use (season total, per game, per 36 minutes, per 100 possessions); to solve this issue, we took the linear regression of each version of the box score stats and fit them to the player's VORP value. The version that possessed the best fit was season total box score stats, which had a fit score of 0.617. While the score only showcased a moderately strong relationship, our group saw this as encouraging, as it helped show that primary box score stats are not error-proof ways to assess a player's impact on the court.

The regression model was then plotted by a player's VORP measure and a player's predicted VORP measure based off the predictors, with the size of each point being determined how many minutes that designated player plays per game; we thought this would allow for a strong connection to our first topic and allow for further analysis as to which players deserved more playing time during the 2022-23 NBA season.



The first thing that pops out in this visual is how far ahead Nikola Jokic is in this category, especially relative to his peers. When highlighting Jokic's point, it shows his predicted VORP to be about 3.95, which is less than half of his actual VORP value of 8.8; this shows how little his raw box score stats indicate his true impact on the court. Russell Westbrook is on the other extreme, as his actual VORP value of 1.2 is less than half of his predicted 2.68 VORP value; this shows that players like Westbrook may put up quality numbers in the box score, but they do not greatly benefit their teams in a way that players like Nikola Jokic do. This effect compounds when knowing that Jokic and Westbrook play similar

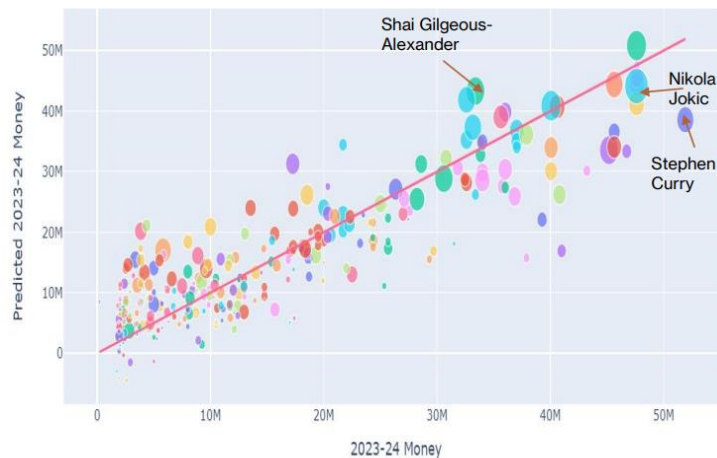
minutes (33 and 29 respectively). To relate to the first topic, when looking at this visual, it may benefit the Clippers to play Westbrook less minutes as a result.

Topic 3

The third topic we decided to address was the relationship between the statistical output of NBA players and the money that they are owed through contracts. Since the introduction of the super-max contract in 2017, which was created as a response to Kevin Durant joining the Golden State warriors in the summer of 2016, NBA players have been signing contracts at rates that would have been impossible to fathom even a few years ago. While super-max contracts do allow a franchise to keep their best players, it can often lead to struggles to successfully build a competitive team around them, as impactful role players require a fair amount of money to be spent on them. This inspired us to figure out which players are being overpaid or underpaid based on their level of production during the 2022 season.

To accomplish this task, we merged the player-by-player data set with the player contract data by player name and kept the columns that showed their 2023-24 contract salary and the total amount of guaranteed money on their contract, regardless of contract length. We chose to focus on these two categories because there were many players, particularly those who were not stars, that were not signed to contracts in the 2024-25 and subsequent seasons; it also allowed for greater focus as to highlight players that should be extended to more lucrative contracts, as well as players who probably should not have been signed to the extensions they were signed to.

We first addressed the relationship between 2022 player production and their salaries in the 2023-24 season using a linear regression model. The salaries for the 2023-24 season were the response variable, while the numerical columns in the player data set served as the predictors. The fit of the model produced a score of 0.818, indicating a strong relationship between 2022 performance and player salaries for the 2023-24 seasons. Individual players were then plotted by the money they will receive in the 2023-24 season and the predicted money they would earn based on the model; the size of each point being determined by the player's VORP value, as it would allow for greater observation as to which high-impact and low-impact players are being overpaid or underpaid.



The above visual shows players like Stephen Curry earning more money in the 2023-24 season than their 2022 production would deem necessary, as Curry is making about \$9 million more than his predicted value based on his individual stats. On the other hand, players like Shai Gilgeous-Alexander are being quite underpaid, making \$7 million less than his 2022 production warrants; when also seeing his fairly high VORP value, it shows Gilgeous-Alexander as a very valuable player in the NBA and his team-friendly salary allows his team (Oklahoma City Thunder) to properly construct a competitive roster around him. Players who are close to the line like Nikola Jokic represent players who are roughly being paid the amount that they should base on their 2022 production and represents the ideal relationship between the franchise and player, as the player receives fair compensation, while the franchise does not have to waste money on production that does not command it.

Our group moved on to the relationship between 2022 player production and the total amount of guaranteed money in their contracts and was set up in a similar way to the previous regression, which had the numerical columns in the player data act as predictors and guaranteed money act as the response variable. The fit of the model was not as strong as the previous regression, but it still produced a respectable score of 0.708, which shows that there is a fairly strong relationship between 2022 player production and the guaranteed money they are signed to. Like the last regression, individual players were plotted by the money they are guaranteed to and the predicted amount of money they are guaranteed to,

with the size of each point being indicated by that player's VORP value, allowing us to see which high-impact players are deserving of more lucrative and extensive contracts and vice versa. (See Figure 2 in the Appendix section to view the variable).

This visual showcases far more outliers than the 2023-24 visual, due in part to numerous players signing record breaking contracts during the most recent offseason. Jaylen Brown is an example of a player that signed this type of contract, signing the most lucrative contract in NBA history during the offseason. Brown also is the most egregious example of players who are receiving more money than their 2022 production would dictate they deserve, as Brown is projected to earn twice as much guaranteed money over what his 2022 production state he deserves. Giannis Antetokounmpo is the opposite, as he deserves far more guaranteed money than what he is owed; coupled with his high VORP value, he should be signed to a lucrative contract this offseason. Shai Gilgeous-Alexander in this scenario goes from being underpaid to being properly paid, as his point is one of the closest to the equilibrium line of actual vs predicted guaranteed money.

Conclusion

After going through each topic, our recommendations for executives, analysts, and journalists when evaluating NBA players is to use advanced statistics to determine which players deserve more or less minutes, figure out which players' value goes beyond primary box score stats, and properly pay players using individual production from recent seasons. Making decisions using a combination of the three recommendations will allow for players to properly receive the money and prestige they deserve and allows for practical uses like roster construction to be far more productive.

Despite the usefulness of our findings, our project could have produced far more robust results if there was easy access to tracking data and advanced defensive stats. Many of the commonly used NBA advanced stats do not deeply address either of these important aspects, which does limit the completeness of measuring a player's impact.

Appendix

Figure 1

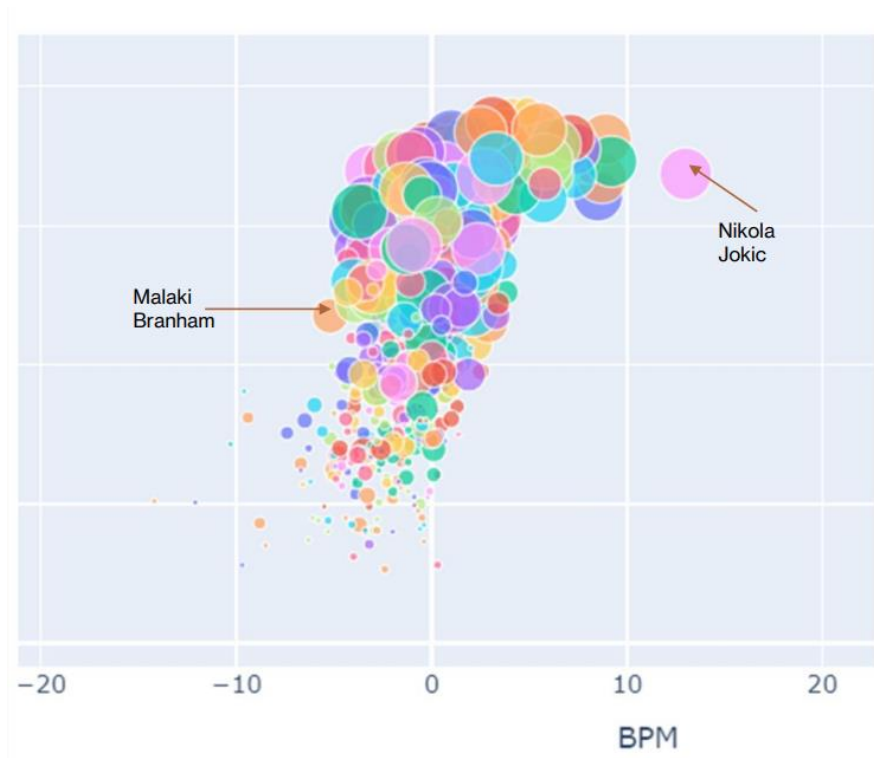


Figure 2

