An Empirical Analysis of Prime Performing Age of NBA Players; When Do They Reach Their Prime?

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Abstract:

This empirical research paper investigates the prime performing age of NBA players from the perspective of General Managers. The study aims to identify the age range in which players are most effective on the court and to determine if there is a significant relationship between age and player performance. Player performance statistics data was collected from ESPN and analyzed to help determine at what age players reach their prime productivity levels for a team. The findings suggest that the prime performing age of NBA players is between 27 and 31 years old, with a slight decline in performance after the age of 32. The results have important implications for team management and player recruitment strategies.

JEL Classification: Z2

Keywords: Prime Performing Age, NBA, Star Players

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1.0 INTRODUCTION

The NBA is one of the most popular professional sports leagues in the world, with millions of fans following their favorite teams and players each year. One of the most important factors that determine the success of an NBA team is the performance of its players, and the age of the player is a crucial factor in this regard. Over the years, NBA teams and General Managers have used various strategies to acquire and retain players in their prime, with the aim of building a successful and competitive team. This empirical analysis aims to examine the effects of prime performing age of NBA players and how this affects their value in the eyes of the General Managers' player acquisition and team building strategies.

The prime performing age of an NBA player is a topic of much debate and speculation among fans, players, coaches, and General Managers. Some argue that players peak in their early 20s, while others believe that players can continue to perform at a high level well into their 30s. However, determining the prime performing age of an NBA player requires empirical analysis that considers various factors such as player statistics, team performance, and injury history. The results of such analysis can provide valuable insights to General Managers when making decisions about player acquisitions and team building strategies.

General Managers play a critical role in the success of an NBA team, as they are responsible for identifying and acquiring players that fit into the team's overall strategy and goals. This requires an understanding of the prime performing age of NBA players and how it affects their performance on the court. By analyzing the effects of prime performing age on NBA players, General Managers can make informed decisions about player acquisitions and roster management, which can ultimately lead to a more successful and competitive team. Overall, this empirical analysis aims to provide a comprehensive understanding of the prime performing age of NBA players and its effects on General Managers' player acquisition and team building strategies.

By using statistical models to analyze player performance data from the 2000-2010 seasons, this study can provide valuable insights into how a players age can influence player overall value and help General Managers make more informed decisions about player acquisitions and roster management. Ultimately, this research can contribute

to the ongoing debate surrounding the prime performing age of NBA players and provide valuable information to NBA teams and General Managers as they strive to build successful and competitive teams.

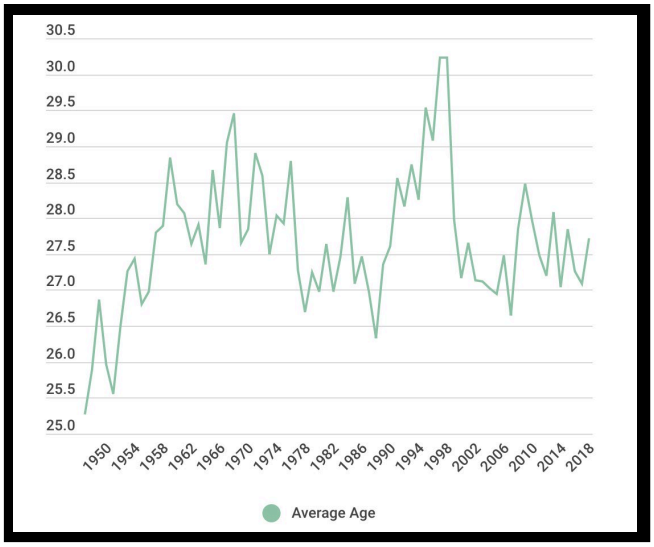
This paper is guided by the ongoing studies to that investigate player value based on performance age and other factors such as movement in the market. Specifically aiming to correlate players age to their performance and when they hit their "prime age."

The rest of the paper is organized as follows: Section 2 gives a brief literature review. Section 3 outlines the empirical model. Data and estimation methodology are discussed in section 4. Finally, section 5 presents and discusses the empirical results. This is followed by a conclusion in section 6.

2.0 Evolution of Player Age

Figure 1 shows a graph of the NBA All-Star selected players and their age for the past 70 years. We see that the most talented players are usually in the age range of 26-29, however there are years in which the average age has risen and fallen tremendously. This range remains quite similar to the expected ranges from the articles above.

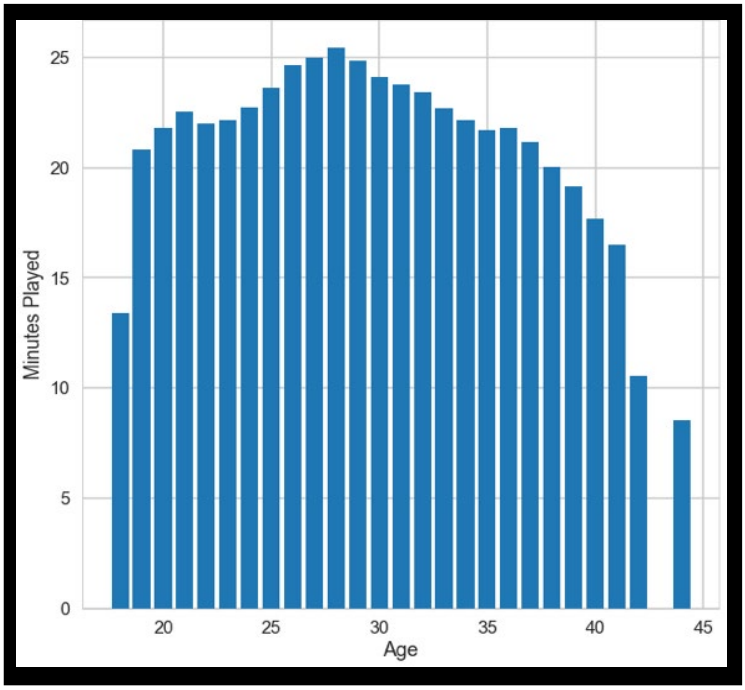
Figure 1: All-Star Players Average Age



Source: Hoop Hall Data Base

In the NBA, there have been several trends over the years regarding the prime performing age of players. Traditionally, players were thought to reach their peak performance in their late 20s or early 30s, but recent trends suggest that players are hitting their prime at a younger age. This is believed to be due to increased training at a young age and better player development.

Figure 2: Minutes Played by Age (2006-2017)



Source: Harvard Sports Analysis Collective

One trend that has contributed to this shift is the increased focus on player development and training from a young age. Many NBA players now enter the league after playing in high-level AAU and college programs, where they receive top-notch coaching and access to advanced training facilities. In Figure 2 we see that more minutes are being played by younger athletes with the most minutes being played by players age 29.

Another theory that has contributed to younger players reaching their prime is the evolution of the game itself. The NBA has become more focused on athleticism, speed, and skill, and players who possess these qualities are now more highly valued than ever

before. This has led to teams placing greater emphasis on acquiring and developing younger players who have the potential to become elite athletes.

In recent years, the NBA has also seen a rise in the use of advanced analytics and data-driven decision making. Teams are using sophisticated algorithms and statistical models to evaluate player performance, which has led to a greater emphasis on finding and developing players who have the potential to become elite athletes at a young age.
Overall, the trends in the NBA suggest that players are reaching their prime at a younger age, and that teams are placing greater emphasis on player development and data-driven decision making in order to find and develop the next generation of elite athletes. As the game continues to evolve and change, it will be interesting to see how these trends continue to shape the NBA and the way we think about player development and performance.

3.0 LITERATURE REVIEW

The National Basketball Association (NBA) is a highly popular and profitable professional sports league worldwide, with teams and players attracting significant attention and financial rewards. Among various factors that determine player salaries, player age plays a crucial role, with teams and players placing great emphasis on the concept of the "prime age" in the NBA. This literature review will explore several articles that examine the relationship between age and performance, with a particular focus on the prime age period, and its implications for player development and team success.

Arkes and Karolak (2019) conducted an analysis of NBA salaries and player age using data from the 2016-2017 season. They found that player age had a statistically significant negative effect on salary, with older players earning lower salaries than younger players. Additionally, the authors found that the relationship between age and salary varied by position, with point guards experiencing the smallest decline in salary as they aged, and centers experiencing the largest decline.

Similarly, Schmidt and Berri (2018) studied the relationship between age and productivity in the NBA using data from the 2013-2014 season. They found that while older players do tend to experience declines in productivity, the effect is relatively small, and many players continue to perform at a high level well into their 30s. The authors

suggest that teams may be too quick to let go of older players, and there may be a market inefficiency that could be exploited by teams willing to invest in older players.

Lavoie and Ehrmann (2016) used a nonparametric statistical approach to examine the relationship between player age and productivity in the NBA. They found that older players tend to experience declines in productivity, but the decline is not as steep as previously thought. The authors suggest that teams may be underestimating the value of older players and may be too quick to replace them with younger players.

Taken together, these articles suggest that age is an important factor in determining NBA player salaries, but the relationship between age and productivity is complex. The prime age period represents the period when players are generally believed to be in their physical prime and able to perform at their highest level. As the Arkes and Karolak (2019) study showed, teams may be willing to pay a premium for players in this age range, while players may be more likely to negotiate for higher salaries during this period.

The findings of Lee et al. (2017) have implications beyond salary determination, as they highlight the importance of the "prime age" window for athlete success. Understanding the factors that contribute to athlete success during this period could inform player development strategies, team recruitment and retention practices, and other related issues. Therefore, the intersection of age and performance in sports economics is an important area of research with significant implications for both athletes and sports organizations. Teams and players need to be thoughtful and strategic in their approach to age and performance, considering individual factors such as position, playing style, and injury history to maximize the benefits of the prime age period for player development and team success.

4.0 DATA AND EMPIRICAL METHODOLOGY

4.1 Data

The study uses data from the 2000 to 2010 NBA seasons that has been collected from ESPN and Basketball-Reference.com which are two sports databases where players in-game statistics can be found. Summary statistics for the data are provided in Table 1.

Table 1 Summary Statistics

Variables	*PER*	*Age*	*Age^2*	*GP*	*WS*	*BPM*
Mean	21.0	26.2	696.2	77.6	9.5	3.1
Median	20.8	26.0	676.0	80.0	9.3	2.7
Mode	18.9	27.0	729.0	82.0	7.3	2.3
Standard Deviation	3.6	3.4	182.2	5.4	3.4	2.6
Minimum	13.7	19.0	361.0	53.0	0.9	-3.2
Maximum	31.7	38.0	1444.0	83.0	20.3	13.0
Count	360.0	360.0	360.0	360.0	360.0	360.0

From authors Calculations

4.2 Empirical Model

The Empirical Model used in this study follows models creates by Lee et al. (2017) and Schmidt and Berri (2018) and highlights the relationship between Performance and Age as follows:

To analyze the prime performing age of NBA players over the last 10 seasons, the following empirical model can be used:

$$\mathbf{PER = \beta 0 + \beta 1 AGE + \beta 2 AGE\text{^}2 + \beta 3 GP + \beta 4 WS + \beta 5 BPM + \varepsilon}$$

PER is the Player Effecicey Rating which is a method of determining a player's impact on the game by measuring their per-minute performance. The formula for PER considers the player's positive contributions, such as points, assists, rebounds, steals, and blocks, as well as their negative contributions, such as turnovers, missed shots, and fouls. The formula is quite complex and involves many different variables, including made three-pointers, made field goals, made free throws, offensive and defensive rebounding percentages, steals, blocks, and personal fouls. It also factors in the value of each possession and adjusts for the number of assists based on the team's shooting percentage. To calculate PER, you need to use the complete formula, but the idea is that a higher PER indicates a more efficient and effective player. PER can be used to compare the performances of different players within a team or across the league. It is a useful tool for coaches, scouts, and fans to evaluate player performance and make decisions about

strategy, playing time, and roster moves. However, we were able to gather the calculated PER from the databases. Using the PER as the dependent variable derived directly from the work done by Lee et al. in their study in 2017 to help get a better understanding of player efficiency similar to this study.

Independent variables consist of five variables obtained from basketball-reference.com "NBA Statistics" dataset. Appendix A provides acronyms, descriptions, and justifications for using the variables. First, *Age* represents the age of the player in the current season that the data is being collected in. Next, *Age^2* (age squared) represents the player development, knowledge, and skillset that must be accounted for as players mature in the league and have a better understanding of the game. *GP* represents the number of games played by each player each season. Fourth, *WS* represents the win share which is a statistic used in the NBA to measure a player's overall contribution to their team's wins. It calculates the number of wins that a player contributes to their team above what a replacement-level player would contribute, taking into account a player's offensive and defensive performance that contributed to the team's performance. Lastly, *BPM* represents Box Plus Minus which evaluates players' quality and contribution to the team from a play-by-play regression.

5.0 EMPIRICAL RESULTS

The empirical estimation results are presented in Table 2. The empirical estimation shows a positive relationship throughout all the variables that are present in the regression, however only a few are statistically significant. We see that Age, WS (Win Share), and BPM are all statistically significant and influence a player's overall value to their team.

Table 2: PER Regression Results

Variable	Result
Age	**.00014* (.001)**
Age^2	**.46013 (.0006)**
GP	**.57601 (.0141)**
WS	**.00096* (.0673)**
BPM	**.00019* (.086)**

Note: * denotes variables that are significant at the 1%. Standard errors in parentheses
Source: From authors calculation

The findings in this study show similarities to the studies done by Lee et al. (2019) and Lavoie and Ehrmann (2016) finding that PER, AGE, and WS were all significant factors in analyzing prime performance. To further analyze at what age is "Prime" performing age we take the significant variables and look at pivot charts to see what age range we find the most productivity from players.

Figure 3: Win Share by Age

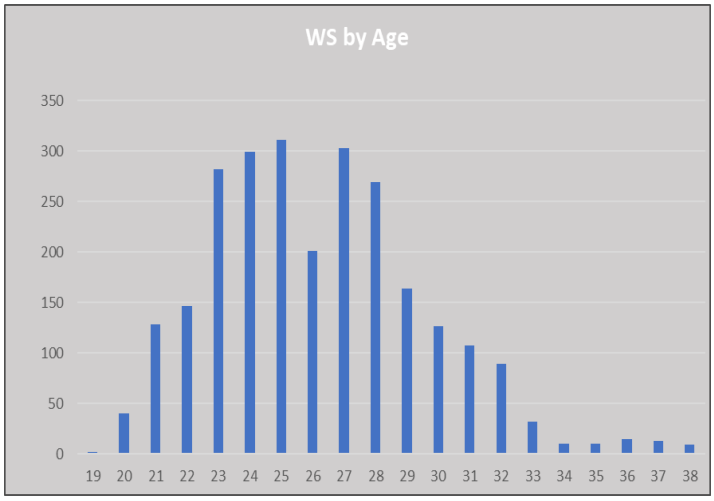


Figure 4: Player Effiency Rating by Age

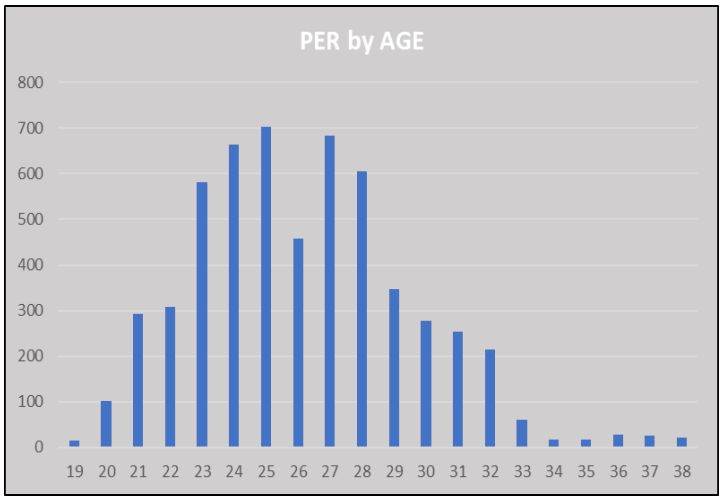
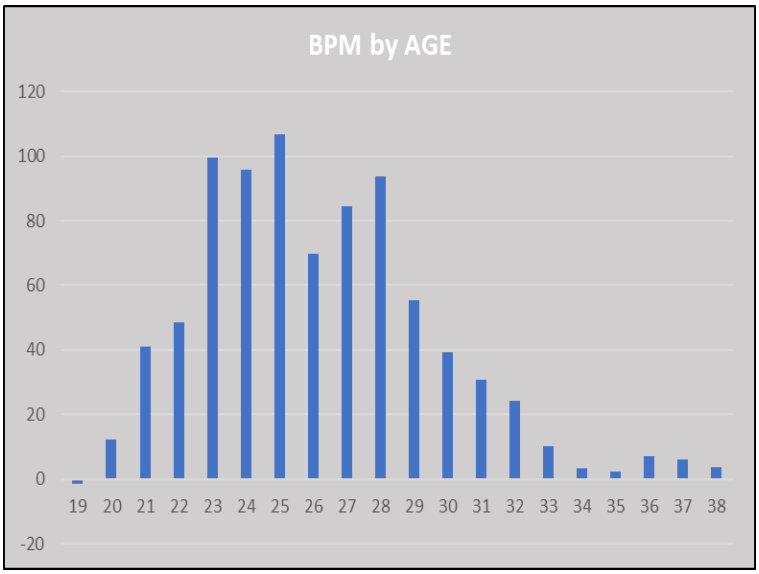


Figure 5: Box Plus Minus by Age



All figures from authors calculation

From analyzing the data and regressions we are able to find an age range that we can statistically prove to be the "Prime" age range in the NBA. We see from Figures 3,4,&5 that the most productive ages in the NBA range from 23-27, with a sharp decline at age 29. The findings align with the predictions from Arkes and Karolak (2019) in which they proved that coaches are willing to pay premium for players in this age range since they believed this was the prime age range.

5.1 LIMITATIONS

The study on the factors of prime performing age in the NBA faces several significant limitations that could affect the validity of its findings. Firstly, the sample size used in the study is relatively small, which may limit the validity of the results.

Secondly, the data used in the study is susceptible to selection bias. For example, we used an initial quantile regression to find the top 30 players from each season to further examine. Moreover, the sample of players used in the study may not be an accurate representation of the entire population of NBA players, which could affect the validity of the results.

Finally, the study lacks control variables that could influence the age at which NBA players perform at their best. While the study analyzed several factors that could affect prime performance age, other variables, such as injuries, team chemistry, and player psychology, could also influence performance but were not included in the analysis. This omission may lead to omitted variable bias, potentially affecting the accuracy of the conclusions drawn.

While the study provides insights into the factors that could affect prime performing age in the NBA, its limitations highlight the need for further research that accounts for a larger sample size, more diverse teams and players, and a wider range of control variables to enhance the generalizability and reliability of the findings.

5.2 Policy Implications

Furthermore, the research indicates that the prime age of talent is getting younger over time, which may have implications for the league's policies. The "one-and-done" rule was implemented to give players more experience before entering the league, but our findings suggest that younger players are prevailing in the league. It will be interesting to see what policies the NBA may put into place next to address this trend and ensure a balance between experience and youth. An idea that may help with player development league wide is waiving this one and done rule so that younger talent (if seen as NBA ready) can enter the league right after completing high school.

6.0 CONCLUSION

The purpose of this empirical analysis was to contribute to the ongoing research of data-driven decision making in identifying and developing young talent in the National Basketball Association (NBA). Through an examination of player statistics and various performance indexes over five seasons, we have found that the prime performing age in the NBA ranges between 24-27 years old, with a slight decline in productivity at the age of 29. Our findings confirm the notion that basketball is a sport where players tend to peak in their mid-20s, which has important implications for NBA general managers in terms of talent acquisition and roster construction.

Our study has shown that general managers should take player age into consideration as a bigger factor in their overall value to the team. By altering their approach to talent acquisition based on the prime performing age range, teams can maximize player development and improve their chances of success. Additionally, our analysis suggests that younger players are becoming increasingly valuable in the NBA due to the evolution of the game, which is now valuing athleticism and speed more than ever before.

In conclusion, this study provides valuable insights into the prime performing age in the NBA, which has practical implications for general managers and the league. By using data-driven decision making and considering the prime age range when acquiring talent, teams can optimize their chances of success. Future research should continue to examine the evolving relationship between age and performance in the NBA to ensure that teams remain competitive, and the league continues to evolve.

Appendix A: Variable Description and Data Source

Acronym	Description	Data source
PER	Player Efficiency Rating: a method of determining a player's impact on the game by measuring their per-minute performance.	Kaggle Sports Database ESPN
AGE	Player's age used to interpret age of player each season to help identify prime age	Kaggle Sports Database
AGE^2	Age Squared accounts for all other aspects that come with aging such as gained knowledge, skill development and maturation	Kaggle Sports Database
GP	Games Played: Represents the number of games that a player take part in each season	Kaggle Sports Database
WS	Win share: a secondary measure of player value to a team and the success that must be accredited to an individual for each win	Kaggle Sports Database
BPM	Box Plus Minus: evaluates players' quality and contribution to the team from a play-by-play regression	Kaggle Sports Database ESPN

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