

Computer Evaluation Model and Data Analysis on Salary Distribution the NBA

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Abstract. This paper will analyse and compare the salary structure between the big firms and the nba teams. As shown in this context, the salary distribution in NBA is a totally different story, each team manager need to focus on salary cap and team's performance at the same time. By evaluating the data from previous seasons in the National Basketball Association, the paper can provide more information on whether team manager should pay the most to the superstar or pay all players equally.

Keywords: GINI coefficient, GDP, Salary Cap, sample mean, sample std, correlation coefficient.

1. Introduction

“Stars are often underpaid, while average performers are often overpaid,” said Herman Aguinis.¹ At first glance this sounds like a conclusion from a sports commentator. However, Aguinis is a business management professor from George Washington University describing the payment of CEOs in the top firms. CEO salaries have attracted quite a bit of attention in policy circles and the press. Companies have tried for years to tie chief executive compensation to the results they deliver, but the results of these strategies have been mixed. For instance, Leslie Moonves, chief of CBS, received 69.3 millions dollars, while the total shareholder return for the company was negative 6.2%.² However, not all “superstars” have provided poor results. Adobe shareholders have approved an executive compensation package that handed CEO Shantanu Narayen a \$7m pay bump during fiscal 2020. Added to his base salary and in total, Narayen earned \$45.9m in 2020. However, this seems to be well deserved. He did a great job to maintaining a total shareholder return of 39% over the last year. In addition, the TSR over five years, coming in at 46% per year, is even more impressive.

In this paper we investigate the extent to which NBA teams are run in a similar fashion. A common compensation strategy is to have a pay structure where the best players earn salaries far in excess of the average. The question for these teams is the same as it is for large corporations. Does this type of pay structure lead to optimal results or are there other strategies that might be preferred?

2. Income and Wealth Distribution Across Countries

2.1 The GINI Coefficient

Considering income distribution from a macroeconomic view, we focus on countries around the world. Income distribution within countries has been a dominant topic of debate attracting quite a bit of attention. Figure 1 shows that the world's richest 1 percent own 43.4 percent of the world's wealth. It also shows that adults with less than \$10,000 in wealth make up 53.6 percent of the world's population but hold just 1.4 percent of global wealth. This vast economic inequality means an extreme difference in living conditions which has been exaggerated with the onset of Coronavirus. Medical care and vaccinations are much more available to those with greater wealth. It has been far easier for those “global top 1” and middle-class people to survive this pandemic physically, mentally, and economically.

¹ [Wall street journal-- CEO Pay and Performance Often Don't Match Up]

² [Constanza Naguib. The Relationship Between Inequality and Growth: Evidence from New Data Swiss Journal of Economics and Statistics, Sep. 2017.]

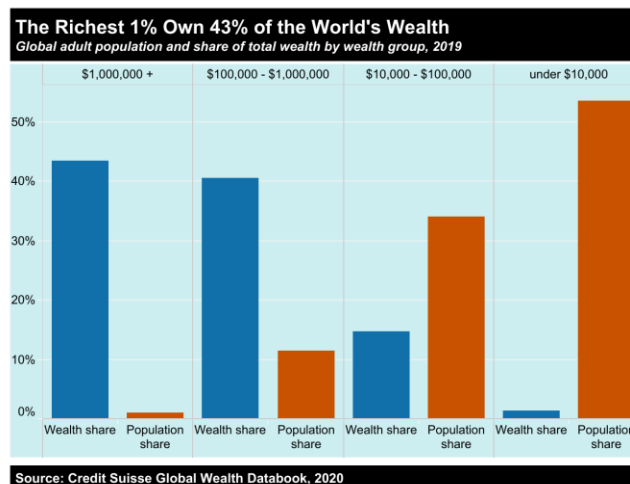


Figure 1. Worldwide Wealth Distribution

It has been argued by some that those who are in the lower or middle class contribute the same effort to society as those in the top one percent. They are also saying that there's too much economic inequality from a normative point of view. But how does this income inequality affect a country's economic development? What negative or positive macroeconomic consequences can be identified from differences in income distribution across countries?

The most common method of measuring wealth and income distribution is the GINI coefficient. A GINI coefficient of zero indicates that income is divided equally among all residents, while a coefficient of one means that all income is concentrated with a single individual. While many have argued that increases in income inequality hampers economic growth, the evidence is mixed. Figure 2 plots income inequality, as measured by the GINI coefficient of income, against per capita GDP for 154 countries between 1990 and 2014. There seems to be little trend between countries with higher GINI coefficients and their economic growth.

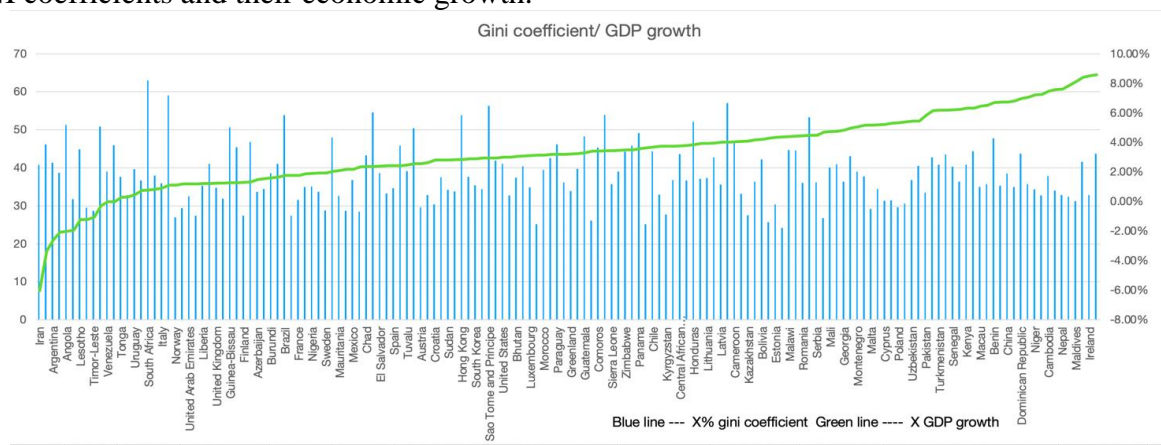


Figure 2. Income GINI Coefficient and Per Capita GDP Growth³

We also gathered OECD data on the GINI Coefficient and per capita GDP growth for 156 countries in 2020. These are illustrated in Figure 3.

Once again, there is no obvious relationship between income inequality and growth. While a statistical analysis did show a small negative relationship between the two, this was not significant. Based on our analysis, there is little evidence to show that countries with a more unequal distribution of income have significantly slower rates of growth in per capita GDP.

While there may be egalitarian reasons for arguing that the current distributions of income and wealth are unfair, these arguments do not seem to extend to the more fundamental macroeconomic measures of the economy.

³ Worldpopulationreview.com, gini coefficient by country in 2020

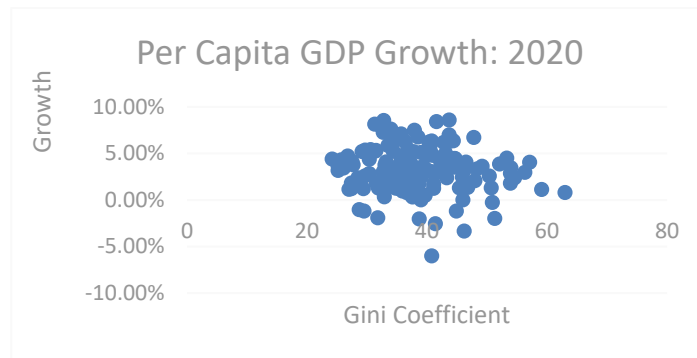


Figure 3. Income GINI Coefficient and Per Capita GDP Growth: 2020⁴

2.2 CEO Salaries and Corporate Performance

The CEO as the most important administrator in the management board directly influences the productivity of a company. As a result, corporate boards have tried to tie chief executive compensation to attain a balance between firm performance and CEO salary. They want to use the high salaries and compensation to stimulate better performance. A number of investigations and data show that the best-performing companies are not always run by the best-paid CEOs. The performance of CEOs does not form a strong positive association with their salaries. Thus, To the chagrin of many shareholders, they have discovered that higher salaries do not necessarily produce good executives and therefore performance. For instance, Allergan PLC’s Brent Saunders received a 700% raise in 2017 to \$32.8 million, despite total shareholder return of negative 21%. The strategy used by many companies is an important part of this mismatch. Most of the boards often set CEO pay by benchmarking the average compensation for leaders of a peer group of similar companies and setting performance targets accordingly. But a study co-written by Herman Aguinis⁵ and published in the journal *Management Research* found that, much like with professional athletes, there were vast differences in the performance of CEOs.

There is little overlap between the top 1 percent of CEOs by salary and the top 1 percent of CEOs by shareholder returns. Only one in five of the top 10 per cent of returns is in the top 10 per cent in terms of pay. In 2017, only two out of the 20 highest-paid CEOs landed in the top 20.



Figure 4. CEO Salaries and Corporate Performance⁶

⁴ Worldpopulationreview.com, gini coefficient by country in 2020

⁵ MyLogIQ research

⁶ Wall Street Journal analysis of data from My LogIQ LLC and Institutional Shareholder Services.

In Figure 4, the equity incentive pay of 800 CEOs at 429 large-cap U.S. companies is compared to shareholder returns over the past decade.⁷ This shows an incredible result, higher- paid CEOs underperformed lower-paid CEOs. Also, CEOs leading the best performing S&P 500 companies last year received the lowest median pay. None of the ten highest-paid CEOs ran any of the ten best-performing companies.

This misalignment has perplexed long-term institutional investors. They will bear the cost of this mismatch until the shareholders figure out a better method to match compensation with performance.

2.3 The NBA (National Basketball Association)

The NBA is the most prominent and famous basketball league in the world. In recent years, the league has made a concerted effort to change the game and make it more appealing to the general public, attracting a larger and more diverse viewership. This has created a surge of capital resulting in increased salaries for players and staff as well as higher profits for ownership. There has been a great deal of talk about how the NBA’s commercialization has emerged in recent years. The league has long been the most prominent basketball league in the world but has not always attracted the financial attention that exists today. Product advertisements everywhere from the rafters to the programs to the bench, and company labels stitched into players uniforms and sneakers is the New Testament of commercialization achieved by the league. A comparison of the 1995 logo for the NBA Finals with that from 2020 is one illustration of how this corporate sponsorship has grown.

The result of these efforts has been a large increase in television revenue. In recent years, the league has also taken advantage of the relaxation in gambling laws, entering into agreements with online gambling concerns, which has further increased revenues. Additionally, in June 2015, the NBA ended its partnership with Adidas and signed an eight-year, \$1 billion contract with Nike.⁸ This represented a 245% annual increase from its previous deal with Adidas. Using this increased exposure offered by sponsors, teams are now able to scout and develop players more systematically from around the world.

The most visible aspect of these new revenues has been the rise in player salaries. The NBA has a salary cap, which is the maximum total amount that a team can pay its’ players in each season. The salary cap is tied to revenues, so the players and ownership are in essence partners, where both have an interest in the growth of the league. The salary cap era began in 1984, and although there has been some fluctuation, salaries have been increasing almost steadily. Since 1984-85 the salary cap has increased from \$3,600,00 to \$112,414,000 per team, an increase of 312%. This is shown in Figure 5.

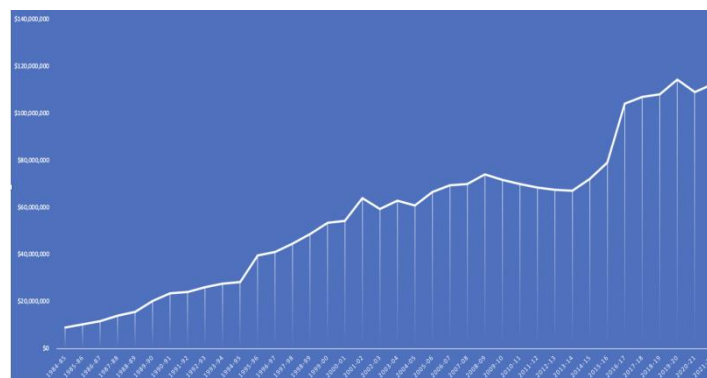


Figure 5. NBA Salary Cap: 1984 – 2022⁹

2.4 A Case Study: Salary Distribution in the NBA

This increase in player salaries under the salary cap has led to competing theories regarding the best pay structure for building a team. Should a team allocate its’ salary cap in an egalitarian fashion,

⁷ CEO Pay and Company Performance 29 July 2019 Nicholas J Price

⁸ NBA signs deal with Nike; logo to appear on uniforms----ESPN

⁹ Basketball-reference.com

which would allow them to have a larger number of ‘good’ players? Or is it a better strategy to put ‘all of their eggs in one basket’ by allocating the bulk of their available salary resources to one or two superstars and fill the rest of their roster with more mediocre players? These questions mirror those of corporations trying to determine if large CEO salaries are warranted by corporate performance, or if some other sort of strategy might lead to better results.

For our case study, we used data from 3 NBA seasons as our sample. This encompasses the years 2018-2019 through 2020-2021. Due to the effect of covid-19, the 2019-2020 and 2020-2021 seasons are special cases. Players played in the “Bubble” with no fans in the playoffs in 2019-2020. In addition, the 2020-21 season was shortened to 72 games. The 30 NBA teams and their season records over this three-year period are the observation points of our investigation..

2.4.1. Team Variables

2.4.1.1. Average Salaries

Average salaries are the most straightforward way to measure the player payment of each team. The salary cap limits the total salary, and therefore the average player salary for each team.

However, there are ‘loopholes’ that allow teams to exceed the salary cap under certain circumstances. This means that the average salaries will not be the same for every team. For example, in 2019-2020, the salary cap was \$109,140,000 but 28 of the 30 teams exceeded that limit. This is illustrated for the 2019-2020 season in Figure 6.

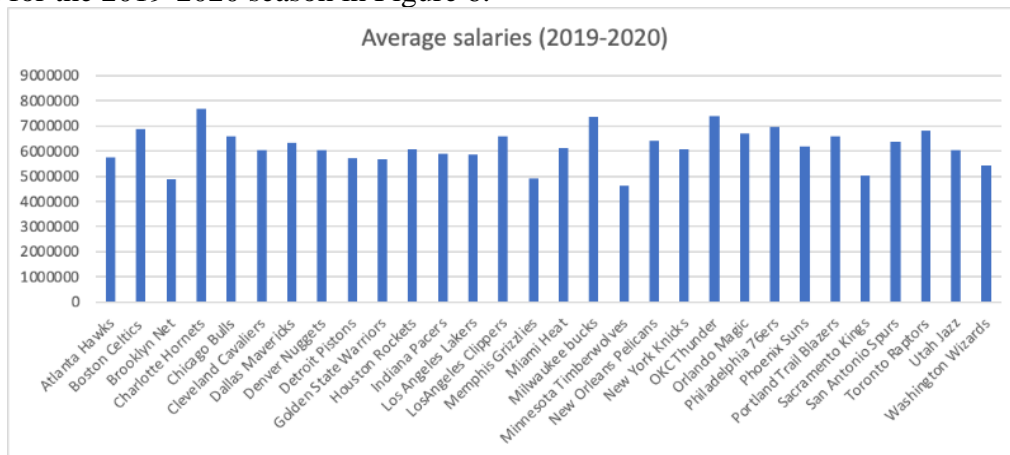


Figure 6. NBA Salaries by Team: 2019-2020¹⁰

The standard deviation measures the dispersion of team’s salaries relative to its average. A larger standard deviation indicates a larger difference between player’s salaries. This tells us whether the team is paying most of the money to their superstar or paying salaries that are more equal across players.

2.4.1.2. Player and Stats Positions

The players are the basic building block that influences the performance of their teams. For our study, the highest paid player is like the CEO in that we are comparing the distribution of his salary relative to that of the other players on the team.

For example, Lebron James, (right) is the highest paid player on the Los Angeles Lakers, with 33.2% percent of the entire team payroll. We refer to the position of the highest paid player on a team as that team’s player position. Individual Teams put a different emphasis on which position is most important, which can affect the success of the team. We use the position of players to find out each franchise’s

“Building block” which makes the salary structure clearer. We separate the players into five positions, Point Guard (PG), Shooting Guard (SG), Small Forward (SF), Power Forward (PF) and Center (C). These are shown in Figure 7.

¹⁰ Basketball-reference.com

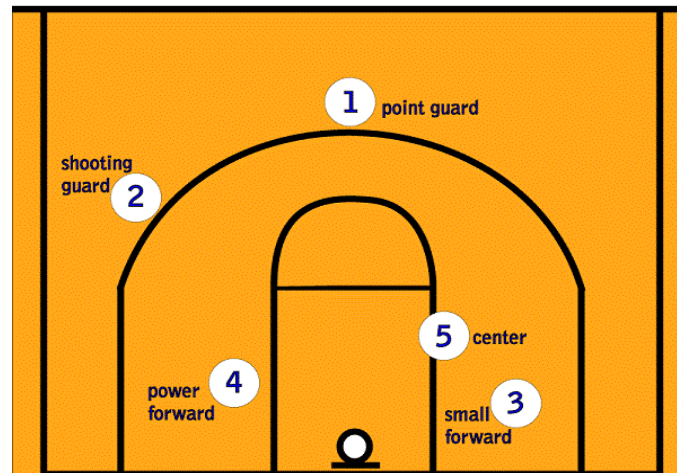


Figure 7. NBA Player Positions

The stats position is an index of player performance based on a variety of productivity measures. These include points, rebounds, assists as well as a number of other statistical measures of performance. The extent to which the player positions and stats positions are similar indicate how well a team is allocating its scarce salary resources. The salary position and stats position allow for comparisons that indicate whether the salary and performance of players match up.

2.4.1.3. Regular Season Winning Percentage

In a typical season, each NBA team plays 82 games. Due the covid epidemic, teams played only 72 games during the 2020-2021 season. Our dependent variable is the winning percentage of each team during the three seasons from 2018 – 2021. For example, in 2019-2020 the highest winning percentage was The Milwaukee Bucks (76.7%) and the lowest was the Golden State Warriors (23.1%).

3. Results: Team Performance and Salary Allocation

3.1 Performance & Average salaries

Is team performance associated with average team salary? We set the average salaries as the independent variable and team winning percentage as the dependent variable of interest. Figure 8 is a scatterplot that ranks average salary on the X- axis and the team’s winning percentage on the Y- axis. From this graph we can see that there appears to be a positive association between the average salaries and winning percentage for the three seasons, 2018 - 2021 season. The correlation between these variables was .399 which is significantly different from zero at the 1% level of significance.

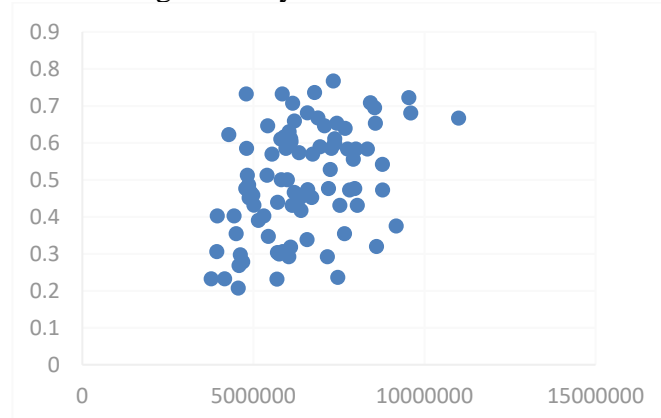


Figure 8. Average Salary and Winning Percentage

Using data from all three seasons (2018 – 2021), we ran a regression that included the salary position and average salary for each team. The results are reported in Table 1. None of the salary

positions have a significant effect on team performance. However, the average salary is statistically significant with a t-Stat of 3.91 and a p-value less than .001.

Table 1. Average Salary and Winning Percentage 2018 -2021

Sample Size: n = 90

Variable	Coefficient	Standard Error	t-Stat	p-Value
Intercept	.299	.071	4.232	.000
Point Guard	-.007	.045	-1.53	.129
Small Forward	.003	.051	.063	.949
Shooting Guard	-.082	.047	-1.752	.083
Center	-.004	.051	-.747	.457
Avg Salary	.0381	.010	3.91	.000

3.2 Standard Deviation & Winning Percentage

The standard deviation of the three year's data shows the difference between player salaries within each team. This allows us to check the association between standard deviation and winning percentage. We can then figure out if the strategy of paying most of the money for one player is better strategy of allocating their salaries more evenly. The graph of the three year's data is shown in Figure 9. There appears to be a slightly positive relationship between the two variables. The correlation between the standard deviation of salaries and winning percentage is .412, which is again significantly different from zero at the 1% level of significance.

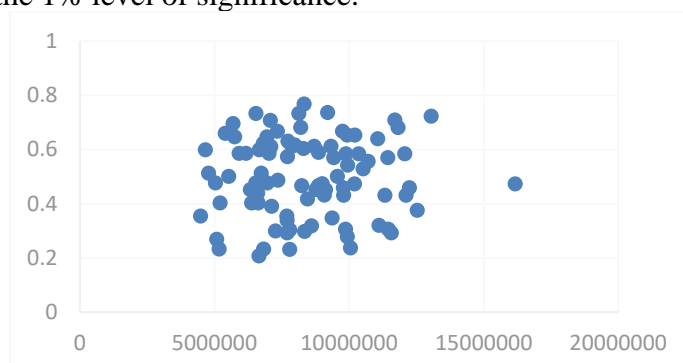


Figure 9. Standard Deviation of Salaries and Winning Percentage

The results for the three -year regression are reported in Table 2. Similar to the results for average salary, none of the player positions are significantly different from zero. However, the effect of the standard deviation of player salaries within a team is positive and significantly different from zero. This indicates that teams with a less equal distribution of salaries tend to have higher winning percentages.

Table 2. Standard Deviation and Winning Percentage 2018 -2021

Sample Size: n = 90

Variable	Coefficient	Standard Error	t-Stat	p-Value
Intercept	.356	.065	5.45	5.87 E
Point Guard	-.058	.045	-1.28	.129
Small Forward	.001	.053	.022	.949
Shooting Guard	-.084	.047	-1.761	.083
Center	-.043	.051	-.827	.457
SD of Salary	.022	.006	3.37	.000

3.3 Average Salaries, Standard Deviation and Performance

Since both average salaries and the standard deviation of salaries seems to affect team performance it is necessary to consider them together. Which one is more important in determining the performance of a team? One difficulty in answering this question is the relationship between average and standard deviation of salaries. The correlation coefficient between these is .525, which is significantly different from zero at the 1% level of significance.

This makes separating the individual effects of average and standard deviation of salaries somewhat difficult. The strong correlation between them means that teams with higher average salaries will tend to have a larger standard deviation of salaries as well. In Table 3 we report the results for a model that includes both the average team salary as well as the standard deviation. In this example, average team salary still has a positive and significant effect, with a p-value of .014. However, the effect of the standard deviation while still positive, is no longer significant.

Table 3. Average Salary, Standard Deviation and Winning Percentage 2018 -2021

Sample Size: n = 90

Variable	Coefficient	Standard Error	t-Stat	p-Value
Intercept	.288	.072	4.06d	.000
Point Guard	-.067	.045	-1.489	.140
Small Forward	-.0004	.052	-.007	.995
Shooting Guard	-.082	.047	-1.748	.084
Center	-.041	-.086	-.423	.423
Avg Salary	.029	.014	2.07	.042
SD of Salary	.008	.009	.881	.380

4. Conclusions

Income distribution has been a topic of debate at many levels. At the national level it has been analyzed both as an economic phenomenon and as a measure of fairness. A similar discussion of CEO pay has also been undertaken, with firm performance and egalitarian distribution of earnings as topics. Using these as examples, we investigated how salary levels and salary distribution in the NBA has influenced team performance.

Using team winning percentage as a measure of performance, we investigated three determining factors. First, we looked at which position where the team placed the highest single salary (stats position). Next we looked at the average salary for all players on the team. Finally, we investigated income distribution as measured by the standard deviation of player salaries within each team.

All of our models included the stats position. The first model included this as well as average team salary. None of the stats positions were significant, but average salary had a positive and significant affect on team winning percentage.

We obtained similar results in our second model. In this case we included stats position and the standard deviation of salaries. Once again, the stats positions were not significant, but the standard deviation of salaries had a positive and significant effect on team performance. This indicates that the strategy of “putting all the eggs in one basket” by playing higher salaries to the superstars and far less to the rest of the team is better than paying all players more equally.

Finally, we estimated a model that included both average and standard deviation team salaries along with stats position. Once again, stats position was not a significant determinant of team performance. Average salary once again had a positive and significant effect on team performance. However, the standard deviation while still positive, was not statistically significant.

Of note was the fact that the average and standard deviation of salaries are closely linked. This means that teams that have higher average salaries also tend to have a higher standard deviation.

Ultimately, we conclude that average salaries definitely have an effect on team performance, while the results for paying superstars very high salaries are mixed.

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