DOES SHOOTING EFFICIENCY MATTER IN EXPLAINING NBA SALARIES?

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Paul M. Sommers

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DEPARTMENT OF ECONOMICS
MIDDLEBURY COLLEGE
MIDDLEBURY, VERMONT 05753

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Paul M. Sommers

Department of Economics
Middlebury College
Middlebury, Vermont 05753
psommers@middlebury.edu

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Numerous measures of player performance have been used to explain pay in the NBA: points scored, rebounds, assists, steals, blocked shots, and turnovers. A single comprehensive measure of a player's efficiency (hereafter *NBA Efficiency*) is defined at the NBA's official Web site (www.NBA.com) as follows:

Points + Rebounds + Assists + Steals + Blocks – Turnovers

– Missed Field Goals – Missed Free Throws

Berri, Schmidt, and Brook (2007) argue that a better metric would neither give equal value to an assist and a point scored nor count a missed field goal the same as a missed free throw. A blocked shot should not offset a turnover. A more accurate measure of a player's shooting efficiency would explicitly include the number of shot attempts, not missed shots. Their revised comprehensive measure dubbed *Win Score* is defined [Berri *et al.*, p. 121] as follows:

Points + Rebounds + ½ Assists + Steals + ½ Blocks – Turnovers

– Field Goal Attempts – ½ Free Throw Attempts

– ½ Personal Fouls

A cursory look at both metrics – *NBA Efficiency* and *Win Score* – reveals four common elements (with identical weights) which will henceforth be called *Core Score*:

Points + Rebounds + Steals – Turnovers

In this brief note, we examine which of the three metrics – *NBA Efficiency*, *Win Score*, or *Core Score* – does best at explaining the variation in NBA salaries in 2007-08.

The Data

All 2007-08 NBA salaries (the dependent variable, expressed in millions of dollars) are from the Web site of Patricia Bender (www.eskimo.com/~pbender/misc/salaries08.txt). The independent variables include, first, the player's number of years (*YEARS*) as a pro in the NBA prior to the 2007-08 season. A player's performance and pay are likely to increase with experience, but only up to a point. Eventually, as mental acuity depreciates with age and reflexes slow, performance and pay will ultimately increase at a diminishing rate or even decrease. Since salary does not monotonically increase with experience, years as a pro squared ($YEARS^2$) was included as a regressor. One of the three metrics of player performance for the 2006-07 season – *NBA Efficiency* per game, *Win Score* per game (see www.winsproduced.com), and *Core Score* per game – was included in each of the three different models. The player's performance the year before was then interacted with *YEARS* the player has been in the league. One would expect that the more experienced of two players with about the same performance metric last season would receive a higher salary the following season. Finally, binary variables were added for white players, blacks, East Europeans (from Croatia, Georgia, Latvia, Lithuania, Russia, Serbia and Montenegro, and Slovenia), and other foreign-born players who did not play either high school or college basketball in the United States.[1]

The sample included all NBA players who averaged at least 12 minutes per game and who appeared in at least 20 games (in the previous, namely, 2006-07 season). The sample was further restricted to players with at least two years of pro experience who were on NBA rosters on February 22, 2008.[2] In all, 269 players met these criteria.

The Results

Table 1 summarizes the regression results for the three models, each using a different comprehensive per game metric of player performance. Model (1) employs *NBA Efficiency*; model (2) employs *Win Score*; and model (3) employs *Core Score*. In all three models, NBA

salaries rise with experience at a diminishing rate and then reach a peak between the fifth (seventh) and sixth (eighth) year using *NBA Efficiency* (*Win Score*).[3] Of the three per game measures of player performance, *NBA Efficiency* was significant at better than the .05 level; *Win Score* and *Core Score* were not (p = .220 and p = .063, respectively). All three interaction terms were, however, statistically significant at better than the .01 level. As for the racial group binary variables, two of the three models suggest that blacks were paid lower salaries (relative to the excluded group, whites) for equivalent productivity. Judging from the R^2 values, there is little difference between models (1) and (3); the model employing *Win Score* per game performs less well.

Table 2 shows the regression results when a semilog functional form is employed (that is, the dependent variable is now the natural log of salary). Experience again matters. And, here each measure of player productivity is statistically significant at better than the .01 level. The interaction term is significant in only the model employing *Win Score*. In two of the three models, there is again evidence of some salary discrimination by race (against blacks). The three R^2 values are marginally lower after the semilog transformation, but no one model emerges as clearly best.

Concluding Remarks

Three different summary measures of each NBA player's per game statistical production – *NBA Efficiency*, *Win Score*, and *Core Score* – are employed to explain variation in 2007-08 NBA salaries. Despite their differences, all three measures explain about 60 to 70 percent of the variation in salaries (and a smaller percent of the variation in the natural log of salaries). The consistency is, in large part, due to the fact that, for the 269 NBA players included in our sample, the correlation between *NBA Efficiency* per game and *Win Score* per game is 0.830, while the correlation between *Core Score* per game and *NBA Efficiency* per game is 0.965. (The correlation between *Win Score* per game and *Core Score* per game is 0.746.) Scoring totals and

rebounds drive all three measures. When, for example, points and rebounds are deducted from *NBA Efficiency* and *Win Score* the correlation between these two measures falls to .696 for our sample of 269 players.

NBA salaries are determined in a fashion consistent with any one of the three measures of a player's per game production. Salary determination is (judging from the coefficient of determination) only marginally better for *NBA Efficiency* per game than it is for *Win Score* per game. Apart from points, rebounds, steals, and turnovers, all other facets of a player's performance (like shooting efficiency) used to explain variation in NBA salaries are either less important or just not relevant. And, if currently they are not, some might argue that in the future they should be.

Table 1

Salary Determination Models

Dependent Variable: NBA Salary			
Independent Variables	(1)	(2)	(3)
Years	**.6328** [.2314][a]	**1.2275** [.2486]	.4348 [.2281]
Years squared	**-.0572** [.0130]	**-.0801** [.0149]	**-.0467** [.0126]
NBA Efficiency/game	*.1383* [.0634]		
Years * NBA Efficiency/game	**.0590** [.0084]		
Win Score/game		.0781 [.0635]	
Years * Win Score/game		**.0495** [.0084]	
Core Score/game			.0814 [.0436]
Years * Core Score/game			**.0444** [.0058]
Black	*-1.0307* [.4925]	-.2208 [.5717]	**-1.6147** [.4770]
East European	-.2422 [.8244]	-.3618 [.9556]	-.5142 [.7952]
Other Foreign	.0440 [.8099]	.8680 [.9357]	-.1388 [.7825]
R^2	.692	.586	.713

[a]Numbers in brackets are standard errors and numbers in boldface (italics) are significant at better than the .01 (.05) level.

Table 2

Salary Determination Models

Dependent Variable: ln(NBA Salary)			
Independent Variables	(1)	(2)	(3)
Years	**.3503** [.0531][a]	**.3926** [.0511]	**.3269** [.0538]
Years squared	**-.0209** [.0030]	**-.0237** [.0031]	**-.0195** [.0030]
NBA Efficiency/game	**.0608** [.0145]		
Years * NBA Efficiency/game	.0028 [.0019]		
Win Score/game		**.0379** [.0131]	
Years * Win Score/game		*.0039* [.0017]	
Core Score/game			**.0405** [.0103]
Years * Core Score/game			.0023 [.0014]
Black	-*.2755* [.1130]	-.1514 [.1176]	**-.3557** [.1124]
East European	-.0921 [.1891]	-.1067 [.1965]	-.1288 [.1874]
Other Foreign	.0445 [.1858]	.1496 [.1924]	.0330 [.1844]
R^2	.530	.492	.537

[a]See Footnote a, Table 1.

Reference

Berri, D.J., Schmidt, M.B., & Brook, S.L. (2007). *The Wages of Wins*. Stanford, CA: Stanford University Press.

Footnotes

1. The 2006 population of the NBA team's host "census metropolitan statistical area" was also included as a regressor. But, in no case was this proxy for market size of the host team statistically significant.

2. The inclusion of rookies and players with one year of NBA experience increased the sample size to 302. But, these players (some handsomely paid, some not) muddied the relationship between salary and years of experience. Under these circumstances, the coefficient on *YEARS* was positive and statistically significant only for the model with *Win Score*.

3. Set $\partial Salary/\partial Years$ in each regression equal to zero and solve for *Years*.