

How are the salaries of NFL quarterbacks and running backs related to their age, experience, performance and position?

**Regan Hadreas**  
[rhadreas@hotmail.com](mailto:rhadreas@hotmail.com)  
**ECON 482**  
**December 11, 2002**

### **The Problem**

In relation to 2001 salaries, what weights are placed on the salary of, the age of, years of NFL experience achieved by, number of touchdowns scored by, number of yards gained (or lost) by, and number of interceptions thrown by NFL quarterbacks and running backs in the 2000 season.

### **The Data**

Data on 2000 statistics for NFL quarterbacks and running backs active in both the 2000 and 2001 seasons was collected from <http://www.quickstats.com>. Salary information for 2001 was collected from <http://www.theredzone.org>. Age information was collected from <http://www.nfl.com>. Salary information for 2000 was collected from <http://www.footballguys.com>.

### **The Results**

As expected a player in both positions gains a considerable amount of salary (40% for quarterbacks and 66% for running backs) for gaining another year of age, but they also lose ½% and almost 1%, respectively, for their age squared. Also as expected quarterbacks can expect either no change based on the number of interceptions thrown or a loss of up to 7.5%. Both positions receive only 1/10<sup>th</sup> of a percent increase for an additional yard gained, but this adds up quickly when you consider that the average total yards gained across both positions is 1100 yards. I could not reject the hypotheses that the percentage gained for another year of experience might actually equal zero, perhaps because this is already accounted for in gaining a year of age. Unexplainably the coefficients for number of touchdowns scored by each position may actually be negative. My only explanation is that perhaps by considering yards gained and touchdowns I've done a bit of double counting since the only way to score touchdowns is to gain yards. Somewhat surprisingly a player can lose or gain a considerable amount due to their position, most likely explained by the various individual differences, such as personal marketability, team marketability, team salary caps, etc. This coefficient may also prove that quarterbacks and running backs are equally important to a team.

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### **The Problem**

I began this investigation thinking there would be a relationship between a National Football League (NFL) running back's height and weight and his number of rushing yards (yards gained by physically carrying the ball). While collecting data I got a little carried away and decided that without a doubt there has to be other things involved while "the success" of a running back is established such as games played, rush attempts, age, years of NFL experience, longest run, rushing touchdowns, and every possible combination of the aforementioned statistics. Once thousands of statistics were collected I found myself completely overwhelmed and somewhat without purpose. I then shifted my focus to one with more economic value and tried to compare running backs to quarter backs and ended up with more than twice as much data that was more than twice as overwhelming. Ultimately I decided to regress salary against what I consider some of the deciding factors including the previous year's salary, position, age and offensive yards, among other statistics in order to see how quarterbacks and running backs are compensated.

### **The Data**

I collected my data from four websites: <http://www.nfl.com/>, <http://www.theredzone.org> (please don't confuse this with theredzone.com – I did and it was a big mistake), <http://www.quickstats.com>, and <http://www.footballguys.com/>. Growing up during the age of the internet has taught me both that the internet can be a valuable resource, but also that anyone can publish whatever they want on the world wide web. I think it would be widely agreed upon that the official site of the NFL is a reliable source for NFL statistics. Unfortunately I was unable to get all of my data there so I had to branch out and

brave the web. I found player salary information for 2001 on <http://www.theredzone.org> which was written about by Tony Guadagnoli in the September 6, 2002 edition of the Seattle Times in an article recommending websites specifically for finding NFL statistics. Mr. Guadagnoli wrote “This site, run by Don Maier of St. Louis, is a compendium of NFL news in one convenient place.” The third site, <http://www.quickstats.com>, was where I was able to locate player statistics for the 2000 season (NFL.com only has older statistics for players still active), and I base my opinion of it’s reliability on the fact that you have to pay a \$50 subscription to get the most current statistics and also because the company, Quick Stats Service, has been in business since 1987. The final site, <http://www.footballguys.com/>, was where I was able to locate player’s salaries for the 2000 season. This site is aimed at fantasy football players and mentions a staff of 25+, and honestly, what would they gain from publishing incorrect salaries?

I found figures for the following statistics: salary for the 2000 season, age at the end of the 2000 season (age), years of NFL experience as of the 2000 season (years\_exp), total offensive yards for the 2000 season: passing yards plus receiving yards plus rushing yards minus sack yards (yards00), total interceptions for 2000 (int00), total number of touchdowns: again passing plus receiving plus rushing (tds00), 2001 salary (salary) and then created ‘dummy’ variables for being a quarterback (qb) or running back (rb) and variables for the natural log of the 2000 and 2001 salary (lnsalary00, lnsalary01) in order to get my regression in terms of an approximate percentage increase or decrease. I chose to collect 2001 salaries and compare that to 2000 performance statistics because I felt that realistically a player’s salary should depend on previous performance. I also ran a regression that included the 2000 salary, because in reality most players are on a contract that often extends several years, so their current salary most likely also depends on their previous salary. Once I eliminated players who hadn’t played in both the 2000 and 2001 seasons I had collected the above data for 123 NFL players, 67 running backs and 56 quarter backs.

## The Regression Models

For my ideal world, one which performance is the sole factor in determining compensation, I chose a regression model that would control for age, age squared, years of NFL experience, interceptions, touchdowns and offensive yards all set up as interaction terms with position. I included an interaction term both for age and age squared to account for a diminishing return to age as I suspected an older player may be less effective and therefore paid less. I also included a quarterback-interceptions term thinking it would have a negative effect on salary. The EViews command for the 'ideal' regression is:

```
ls lnsalary01 c qb*age qb*age^2 rb*age rb*age^2 qb*years_exp rb*years_exp qb*int00 qb*tds00 rb*tds00 qb*yards00 rb*yards00.
```

In other words if you are a running back:

Percentage increase in salary  $\sim a + \beta_1 (\text{age}) + \beta_2 (\text{age})^2 + ? (\text{years\_exp}) + d_1 (\text{tds00}) + d_2 (\text{yards00})$ .

And for quarterbacks:

Percentage increase in salary  $\sim a + \beta_1 (\text{age}) + \beta_2 (\text{age})^2 + ? (\text{years\_exp}) + d_1 (\text{tds00}) + d_2 (\text{yards00}) + e (\text{int00})$ .

For the real world regression, where contracts are most likely involved and 2000 salaries help determine 2001 salaries, I used all of the terms in the ideal regression, plus added a term for the natural log of the 2000 salary, `lnsalary00`, and also a term just for position, `qb`. The EViews command for this 'real world' regression is:

```
ls lnsalary01 c lnslary00 qb qb*age qb*age^2 rb*age rb*age^2 qb*years_exp rb*years_exp qb*int00 qb*tds00 rb*tds00 qb*yards00 rb*yards00.
```

## The Results

As feared, my ideal world regression, according to the R-squared statistic, accounted for only 68% of the 2001 salary, while my real world did quite a bit better

with an R-squared statistic of 81%. Following are the results according to the real world regression.

An anticipated result was the large coefficient for the previous year's salary. Between 59% and 73% of the 2000 salary adds to the 2001 salary.

Another anticipated result was that a player in both positions gains a considerable amount of salary (40% for quarterbacks and 66% for running backs) for gaining another year of age, but they also lose approximately a ½% and almost 1% respectively for their age squared. As seen in [figure 1](#), the return to age begins to decrease at age 24 for running backs and not until age 34 for quarterbacks. I think the difference in percentage gained for age is due to the fact that quarterbacks often play until they are much older than do most running backs so their salary increases over a longer period of time, and also because a running back's peak is while he is still young and quick, while a quarterback often peaks after much training and experience.

Also as expected quarterbacks can expect either no change based on the number of interceptions thrown or a loss of up to 7.5%

At first it seemed surprising that both quarterbacks and running backs receive only 1/10<sup>th</sup> of a percent increase for an additional yard gained, but this adds up quickly when you consider that the average total yards gained across both positions is 1100 yards.

An unpredicted result was the lack of significance of coefficients for years of experience. At confidence levels of 90% higher I could not reject the hypotheses that the percentage increase (or decrease) in a player's salary based on years experience equals zero. This might be due to the fact that I accounted for age and since most players begin a career in the NFL around the same age, another year older equals another year of experience.

Another hard to explain result is that the 90% confidence interval for the position term: (-9.27426667, 13.85343). So you can lose up to 927% or gain up to 1,385% for being a quarterback. I think this statistic shows that both positions are

equally important and most likely vary on an individual basis taking into account the team's marketability and salary cap as well as the individual's marketability, endorsements and other things unknown.

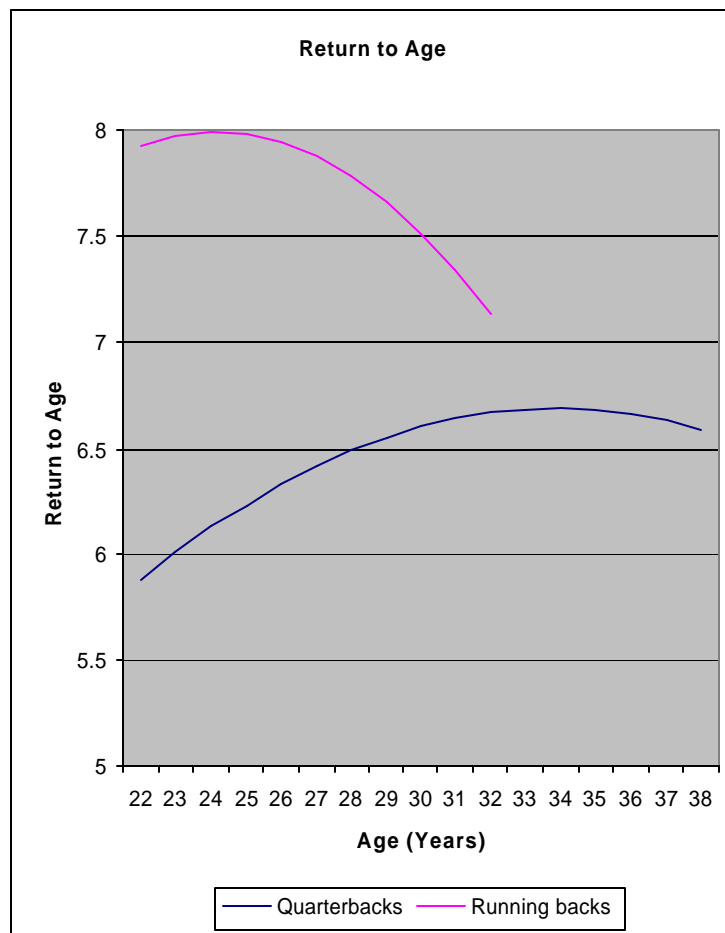
The last two coefficients were for number of touchdowns scored by each position. Unexplainably these may actually be negative. A 90% confidence interval for the coefficient for the  $rb*tds00$  term is  $(-0.0880, 0.004185)$  and  $(-0.142286404, -0.023447596)$  for  $qb*tds00$ . Now why on earth would players lose money for scoring touchdowns? My only thought is that perhaps by considering yards gained and touchdowns I've done a bit of double counting since the only way to score touchdowns is to gain yards.

## **Conclusion**

If you are a young boy, or an adventurous young girl, trying to decide what you want to be when you grow up and you're choosing between an NFL quarterback and running back then to make the most money you need to consider how long you'd like your career to be. If you want it to be quick and prosperous, then go for the running back, if you plan to have a long career in the NFL go for the quarterback position (they're usually more famous as well).

If you're already in the NFL then congratulations and keep gaining those yards, years older (if you're a quarterback and under 34, or a running back under 24), and lay off the interceptions, and of course sign favorable contracts.

**Figure 1.**



$$\text{Quarterbacks} = 0.395420(\text{age}) + (-0.005841)(\text{age})(\text{age})$$

$$\text{Running backs} = 0.662150(\text{age}) + (-0.013723)(\text{age})(\text{age})$$