



**AgEcon** SEARCH  
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

Give to AgEcon Search

AgEcon Search  
<http://ageconsearch.umn.edu>  
[aesearch@umn.edu](mailto:aesearch@umn.edu)

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

## THE DETERMINANTS OF ANNUAL EARNINGS FOR PGA PLAYERS UNDER THE NEW PGA'S FEDEX CUP SYSTEM

*Jonathan K Ohn<sup>\*</sup>, William Bealing<sup>\*\*</sup> and Dan Waeger<sup>\*\*\*</sup>*

**Abstract:** *There have been numerous studies that examined the earnings determination of Major League Baseball (MLB) and National Football League (NFL) professional athletes, but relatively little attention has been paid to the earnings determination of professional golfers. The important difference between the two is: the earnings of MLB and NFL athletes are determined by past and expected future performance, while the earnings of professional golfers depend strictly on their current performance. In this paper, we reexamine the structure and determination of the PGA golfers' tour earnings in the new era, which started with the introduction of the FedEx Cup Championship in 2007. We use two determination models – the first with a set of traditional skill variables, and the second with the skill variables along with two additional variables which reflect the monetary and psychological effect of a player's timely performance at the majors, and the measure of a player's consistency and persistency throughout the regular season. Overall, the second model appears to be a superior model, explaining the earnings determination of PGA players better.*

**JEL classifications:** J3; J7; M5

**Keywords:** *Determination of Professional Golfers' Earnings; Performance Variables; Earnings-Efficiency*

### 1. INTRODUCTION

Much attention has been paid to the study on the performance and earnings structure of professional sports players, especially in Major League Baseball (MLB) and National Football Leagues (NFL). However, relatively little attempt has been made to study the earnings structure of professional golfers. There is an interesting difference in the earnings determination of the MLB or NFL players and professional golfers. The current earnings of the MLB or NFL players are primarily determined by two factors: (1) players' past performance and (2) their expected

<sup>\*</sup> Bloomsburg University of Pennsylvania, 400 E 2nd St, Bloomsburg, PA 17815, US, E-mail: john@bloomu.edu; john@bloomu.edu

<sup>\*\*</sup> Shippensburg University of Pennsylvania, 1871 Old Main Drive, Shippensburg, PA 17257, US, E-mail: WBealing@ship.edu

<sup>\*\*\*</sup> Wagner College, One Campus Rd, Staten Island, NY 10301

future performance and contribution to the team. For the studies on the MLB, see Scully, 1974; Zech, 1981; Sommers and Quinton, 1982; and Gustafson and Hadley, 1995, and for the NFL, see Scahill, 1985; Kahn, 1992; Gius and Johnson, 2000; and Massey and Thaler, 2005. The earnings of professional golfers, however, depend strictly on their current performance in the tournaments held during the tour season. Moreover, unlike the MLB and NFL players, professional golfers are usually responsible for their own expenses such as travel, caddies, and meals. In order to improve their earnings and performance, professional golfers' investment decisions on time and effort should be on improving the critical aspects of their game which lead to the greatest increase in their earnings.

Although few attempts have been made to study this issue, there are several previous studies to note. Davidson and Templin (1986) present one of the first statistical analyses of the major determinants of a professional golfer's success (overall score). Davidson and Templin identify some key shot skills such as hitting greens in regulation, putting, and driving. Ehrenberg and Bognanno (1990) found that the level and structure of tournament prize money influences golfers' performance. This occurs primarily in the later rounds of a tournament, especially for players that have exemptions to play on the tour in the following year. Orszag (1994), however, shows that the level of PGA tournament money has an insignificant effect on performance. Based on an earnings determination equation using performance variables, Moy and Liaw (1998), based on an earnings determination equation using performance variables, identify several determining skills that lead to an increase in golfers' official earnings including driving distance, greens in regulation, putting, and sand saves. Nero (2001) also tests the significance of selected performance variables in determining the PGA golfers' earnings and finds some important determinants including driving distance, fairway hits, putting and sand saves. Shmanske (2008), using individual, tournament-level data, shows that there exists tournament-level idiosyncrasies such as the effect of altitude on driving distance which causes some skill measurement error.

In 2007, the PGA Tour entered a new era in golf with a season-long points system called the FedEx Cup Championship. This dramatically changed the PGA Tour over its entire 38-week season. The PGA Tour season is now divided into two periods: 1) the Tour regular season – 34 weeks, and 2) the Playoffs period for the FedEx Cup – 4 weeks. During the regular season from the beginning of January to the middle of August, players accumulate FedEx Cup points which determine their seating for the PGA Tour Playoffs for the FedEx Cup. The PGA Tour Playoffs (FedEx Cup) consist of four events between late August and mid-September - Barclays, Deutsche Bank Championship, BMW Championship, Tour Championship by Coca Cola. These four events determine the FedEx Cup champion. Additionally, the top 30 ranked golfers, based on FedEx Cup points scoring are guaranteed exception for the following year. The PGA Tour Fall series between late September and early November, on the other hand, are conducted to finalize the following year's eligibility for players who do not finish ranked in the top 30 of the FedEx Cup. The PGA Tour has made a series of important rule changes regarding the procedure of the playoffs games in February and November of 2008.

In this paper, we examine the structure and determination of the tour earnings for the PGA golfers in the new era of game - first, based on the traditional set of performance variables, and, then, with two additional variables that are expected to partially reflect the new PGA Tour system.<sup>1</sup> We first discuss the descriptive statistics of the players' earnings and skill variables for

the period 2008-2009 comparatively. We then estimate two versions of earnings determination models using the 2008-2009 performance variables for the PGA players. We finally compute two measures of the level of each top golfer's relative efficiency based on the estimation results by the second model (our measure vs Nero's), and check which golfers played more efficiently (competitively) given their level of performance skills. The structure of this paper is as follows. In the next section, we will examine the descriptive statistics of the golfers' annual tour earnings and their performance (skill) variables for the PGA players during the 2008-2009 seasons. In Section III, the regression estimation results for the two determination models, 2008 – 2009, will be discussed for the PGA golfers. In Section IV, we will compute the relative performance efficiency of the golfers by comparing their actual and estimated tour earnings given their level of performance skills.

## **2. DATA DESCRIPTION AND EARNINGS DETERMINATION MODEL<sup>2</sup>**

Part A in Table 1 shows the descriptive statistics of the PGA golfers' annual tour earnings and their performance variables in 2008. The data for the PGA golfers were obtained from the website of The PGA Tour ([www.PGATOUR.com](http://www.PGATOUR.com)). Only those golfers with complete data on the official database are included in our data sets. The performance variables include driving distance (DD), driving accuracy (DA), greens in regulation (GIR), proximity to the hole (PROX), sand saves (SS), putting average (PUTT), and the number of tour events that each golfer played (START). The average annual tour earnings for the PGA golfers are \$1,292,010 in 2009, and \$1,289,125 in 2008. In 2009, the PGA golfers' average driving distance is 288.11 yards, and driving accuracy is 63.18%. Their greens in regulation is 65.02%, and proximity to the hole is 35.27' while their sand save is 49.65% and their average number of putts is 29.13 per round. The average number of events that they participated in 2009 was 24.36. DD, DA, GIR, and PROX slightly improved in 2009, while SS, PUTT, and START slightly decreased.

Part B of Table 1 shows the correlation matrix between the performance variables. It is shown that some variables have relatively high correlation. DD and DA have a high correlation, -0.62, implying that the players are trying to achieve longer distances often at the expense of lowering driving accuracy, which is often the case for the low-performing players. This high correlation might cause the co-linearity issue, which means that, if we include both variables in the same model, it would remove statistical significance of both variables even though one or both are statistically significant. It shows, however, that DA is statistically insignificant, largely dominated by DD, and does not create the issue (see the results). The correlation between GIR and PROX, GIR and PUTT, SS and PUTT are -0.53, 0.50 and -0.51, respectively, but it appears that it is not high enough to create the co-linearity issue. The other measures are not very high.

Part A of Table 2 shows the distribution of the PGA players' earnings in 2008 and 2009. Vijay Singh was the top winner in 2008 with \$6.6M and Tiger Woods in 2009 with \$10.5M. The 25<sup>th</sup> and 50<sup>th</sup> Percentile of the PGA earnings in 2009 were \$1,725,237 and \$953,664, respectively. Part B of Table 2 shows the degree of earnings concentration among the top PGA golfers. Comparing the earnings concentration of the PGA players in 2008 and 2009, it appears that the "Tiger Woods" effect generally pushed up the PGA concentration ratios in 2009. It is generally known that the LPGA has a higher earnings concentration than that of the PGA, which has some important implications on the intensity of competitiveness between the two

**Table 1**  
**Descriptive Statistics for the Performances of PGA Players, 2008-2009**

**A. Summary of Descriptive Statistics of the Variables**

	<i>PGA 2008</i> <i>Mean (STDEV)</i> <i>Maximum - Minimum</i>	<i>PGA 2009</i> <i>Mean (STDEV)</i> <i>Maximum - Minimum</i>
EARN	\$1,289,125 (1,070,214) \$6,601,094 – 36,583	\$1,292,010 (1,263,880) \$10,508,163 – 34,324
DD	287.57yds (8.56) 315.10 – 261.40	288.11yds (8.49) 312.30 – 258.90
DA	63.41% (5.42) 80.42 – 49.01	63.18% (5.39) 74.76 – 48.36
GIR	64.79% (2.64) 71.10 – 57.84	65.02% (2.55) 70.89 – 51.26
PROX	35.52' (1.63) 39.58 – 31.17	35.27' (1.61) 40.25 – 30.67
SS	49.67% (5.63) 63.71 – 36.80	49.65% (6.64) 64.43 – 30.77
PUTT	29.31 (0.53) 30.86 – 27.92	29.13 (0.55) 30.74 – 27.91
START	25.77 (4.46) 36.00 – 15.00	24.36 (3.98) 32.00 – 15.00
# Players	196	188

**B. Correlation Matrix for the Performance Variables**

	<i>DD</i>	<i>DA</i>	<i>GIR</i>	<i>PROX</i>	<i>PUTT</i>	<i>SS</i>	<i>START</i>
DD	1.00	-0.62	0.24	0.22	0.16	-0.16	-0.05
DA		1.00	0.40	-0.57	0.12	0.03	0.08
GIR			1.00	-0.53	0.50	-0.11	0.02
PROX				1.00	-0.09	-0.10	0.16
PUTT					1.00	-0.51	-0.11
SS						1.00	0.10
START							1.00

DD: Driving distance in yards

DA: Driving accuracy (% of the time a player's drive is in the fairway)

GIR: Greens in regulation

PROX: Proximity to the hole (in feet)

SS: Sand Save %

PUTT: Number of putts per 18 hole round

START: Number of tournaments started

groups. A significantly higher concentration for the LPGA compared to the PGA suggests that the competitiveness in the PGA Tour is significantly more intense than that of the LPGA tour.

### 3. TEST MODELS AND ESTIMATION RESULTS

The specification of the basic earnings determination model (Model I) for the PGA golfers is as follows: controlling for the number of events that a PGA player participated in during the season, his annual tour earnings is a function of key major performance variables:

**Table 2**  
**Earnings Distribution and Concentration, PGA, 2008 - 2009**

**A. Earnings Distribution, 2008-9**

<i>Percentile</i>	<i>2008</i>	<i>2009</i>
Maximum	\$6,601,094	\$10,508,163
25%	\$1,652,400	\$1,725,237
50%	\$1,035,831	\$953,664
75%	\$496,876	\$484,757

**B. Earning Concentration Among Top PGA Players, 2008 - 2009**

	<i>2008</i>	<i>2009</i>
Top 5 Players	10.28	12.90
Top 10 Players	18.30	20.85
Top 20 Players	29.33	33.01
Top 30 Players	38.51	42.79

$$\ln(\text{EARN}) = b_0 + b_1 \ln(\text{DD}) + b_2 \text{DA} + b_3 \text{GIR} + b_4 \ln(\text{PROX}) + b_5 \text{SS} + b_6 \ln(\text{PUTT}) + b_7 \ln(\text{START}) + e \quad (1)$$

where EARN is a golfer's annual tour earnings, DD is driving distance in yards, DA is the percentage of driving accuracy, GIR is the percentage of greens in regulation, PROX is proximity to the hole after an approach shot, SS is the percentage of sand saves, PUTT is the average number of putts per round of 18 holes, and START is the number of tour events that each golfer played in. One important possibility is that driving distance (DD) and driving accuracy (DA) are negatively correlated, which is quite expected, given golfers try to reach longer driving distances usually at the cost of lower driving accuracy, especially for golfers of a lower competency level. Indeed, the correlation between DD and DA is quite high for the PGA players, -0.62, (high enough to create a co-linearity issue), but it turned out that DD is a dominating factor over DA without creating such an issue.

Table 3 shows the estimation results of the above earnings determination model (Model I) for the PGA players in 2008 and 2009. Three variables, DA, GIR, and SS, are in the percentage terms, while EARN, DD, PROX, PUTT, and START are included in the natural log form because they are in levels. Hence the estimated coefficients are interpreted as net percentage change in tour earnings resulting from one percent change (improvement) in the performance variables.

From the estimation results for the 2008-2009 period, we find four significant factors – driving distance (DD), greens in regulation (GIR), proximity to the hole (PROX), and average number of putts per round of 18 holes (PUTT). Based on the 2009 results, a one percent increase in a player's driving distance resulted in a 10.745% increase in his tour earnings, while a one percent increase in a player's greens in regulation resulted in a 13.705% increase in his earnings. On the other hand, a one percent decrease (improvement) in a player's proximity to the hole after his approach shot resulted in a 3.267% in his tour earnings, while a one percent decrease (improvement) in a player's number of putts per game of 18 holes resulted in a 28.189% increase in his tour earnings. Obviously, the most important factor is the average number of putts per round of 18 holes (PUTT), two factors including greens in regulation (GIR) and driving distance (DD) follow next, and then comes proximity to the hole (PROX). It implies that, in order to

**Table 3**  
**Regression Results for the Performance (Skill) Variable, 2008 – 2009**

	2008	2009
CONST	70.182** (20.486)	46.588* ( 24.005)
LOG(DD)	11.156** ( 3.024)	10.745** ( 3.041)
DA	-1.368 ( 1.625)	-0.485 ( 1.819)
GIR	12.301** ( 3.413)	13.705** ( 3.988)
LOG(PROX)	-7.200** ( 1.523)	-3.267* ( 1.662)
SS	1.206 ( 1.136)	2.466 ( 2.153)
LOG(PUTT)	-30.526** ( 4.486)	-28.189** ( 4.764)
LOG(START)	0.459 ( 0.315)	0.710 ( 0.328)
Adj-R <sup>2</sup>	0.396	0.469

\*\* Significant at 1%, \* Significant at 5%, + Significant at 10%.

- Standard errors are for each estimated parameters in parenthesis.

achieve a player's annual tour earnings most effectively, the player's investment in terms of time and efforts should be focused on his improvement in PUTT, GIR, DD, and then PROX in the same order. On the other hand, the driving accuracy (DA), sand saves (SS), and the number of events that a player played in (START) are not statistically significant, which is not consistent with the findings by other studies such as Moy and Liaw (1998) and Nero (2001).

As mentioned before, the PGA entered a new era of game by introducing the FedEx Cup Championship in 2007, and the Tour made a series of rule changes in 2008. In our next model (Model II), we estimate earnings determination based on all the skill variables except driving accuracy (DA), which is not statistically significant, and two additional variables that we introduce, which are expected to partly reflect the effect of the new era of the PGA Tour. The first measure is the number of a player's quality performance at the PGA major championships (MAJORS). The PGA Tour has four Major Championships – Masters, US Open Championship, The (British) Open Championship, and The PGA Championship. A player's quality performance at the majors has important effect on the player in two ways. First, the money prizes of the majors are generally higher than the other events (although they are surpassed by five to six other championships. See below). Second, a possibly more important effect is psychological. Elite players from all over the world participate in the majors, and the reputations of the greatest players in golf history are largely based on the number of major championship victories they accumulate. The top prizes are not actually the largest in golf, being surpassed by THE PLAYERS Championship, three of the four World Golf Championships events, and one or two invitational events. However, winning a major boosts a player's career far more than winning any other tournament. If he is already a leading player, he will probably receive large bonuses from his sponsors and it will add to the player's pride and confidence significantly. To reflect these

effects, we measure the number of a player's (timely) performance at the PGA Majors in top five ranking for the players and include the variable in Model II.

Second, the newly introduced FedEx Cup Championship is the playoff system of four events, based on the year-long point system for each player. Based on the ranking of the points that the players accumulate during the regular season, the top 125 players on the points list move on to the FedEx "playoffs." The playoffs are a series of four tournaments (the Barclays, Deutsche Bank Championship, BMW Championship, Tour Championship by Coca Cola) culminating in the Tour Championship, after which the FedEx Cup points champion is crowned and awarded \$10 million from a \$35 million prize pool. The other important things to note are that point values are quintupled in the playoff events, and are also reset prior to the Tour Championship. The players should have consistent quality performances throughout the regular season to get in the FedEx playoffs. To measure a player's consistency and persistency in his competitive performance in his year-long season, we count the number of a player's performance in top 5 ranking in the four FedEx playoffs (FEDEX), and it will be our second variable to be included in Model II. The specification of Model II is:

$$\ln(\text{EARN}) = b_0 + b_1 \ln(\text{DD}) + b_2 \text{GIR} + b_3 \ln(\text{PROX}) + b_4 \text{SS} + b_5 \ln(\text{PUTT}) + b_6 \ln(\text{START}) + b_7 \text{MAJORS} + b_8 \text{FEDEX} + e \quad (2)$$

**Table 4**  
**Earnings Regression Results for All Performance Variables, 2008 – 2009**

	2008	2009
CONST	61.461** (15.669)	47.018** (16.343)
LOG(DD)	10.624** (2.124)	8.261** (1.989)
GIR	9.924** (2.997)	13.059** (3.179)
LOG(PROX)	-6.393** (1.416)	-3.158* (1.516)
SS	0.314 (1.070)	1.803* (0.924)
LOG(PUT)	-27.894** (4.214)	-24.159** (3.967)
LOG(START)	0.765* (0.298)	0.978** (0.304)
MAJORS	0.658** (0.208)	0.750** (0.232)
FEDEX	0.423** (0.141)	0.380** (0.114)
Adj-R <sup>2</sup>	0.431	0.530

\*\* Significant at 1%, \* Significant at 5%, + Significant at 10%.

- Standard errors are for each estimated parameters in parenthesis.

Table 4 shows the estimation results on Model II, which includes all the skill variables in Model I except driving accuracy (DA) and two additional variables – MAJORS: the number of times ranked in the top five at a major championship, and FEDEX: the number of tournaments



ranked in the top five during the FedEx playoffs, the measure of a player's consistency and persistency throughout the year-long season. The results show that of the six performance variables included in the model, all are significant except one - sand saves (SS) in 2008. Although all the skill variables are highly significant, the effect of DD, PROX, and PUTT has decreased in 2009, while the effect of GIR, SS, and START has increased. The two additional variables measuring a player's timely performances at the majors (MAJORS) and a player's consistent and persistent quality performances throughout the season (FEDEX) are shown to be significant at the 1% level. On average, a player who achieved one or more quality performances (top 5 finish) at the majors has earnings that are 75 percent higher than a player without such performances. It seems that a winning or high ranked performance at the majors has a significant effect on the player monetarily and psychologically. Additionally, a player who achieved one of more quality performance in the FedEx playoffs has earnings that are 35 percent higher than a player who did not. This implies that a player's consistency and persistency of performance does pay in the improvement of their tour earnings. The  $R^2$  of the two models increased from 0.396 (Model I) to 0.431 (Model II) in 2008, and from 0.469 (Model I) to 0.530 (Model II) in 2009. For Model II, the one that includes the skill variables as well as the two additional variables measuring consistency of performance (MAJORS and FEDEX) fits the data better in both years.

### **3.1. Level of Relative Earnings Efficiency**

In the previous section, we discussed the estimation results for the earnings determination model for the PGA golfers and analyzed the marginal effect of a one percent improvement in each of the performance variables on a player's annual earnings. This led us to identify critical skill variables that each player should concentrate on in order to improve his or her annual earnings. Our final question is: Given a golfer's current level of skills and performance, how efficiently did a player play during the year? This is done by comparing a golfer's actual earnings and expected earnings computed based on the estimated determination model (fitted earnings). Given the golfer's level of performance, if the actual level is higher than the expected level, it can be said that the golfer was earnings-efficient during the year and vice versa. Two measures of efficiency are computed here. The first is a simple straightforward measure of efficiency. First, the difference between the natural log of actual earnings and the natural log of expected (predicted) earnings is computed:

$$\text{Difference} = \ln(\text{actual earnings}) - \ln(\text{expected earnings})$$

Then, we rescale the differences by dividing them by the maximum of the differences:

$$\text{Efficiency} = \text{Difference} / \text{Max}(\text{Difference})$$

The size of the computed measure (Efficiency) indicates the efficiency level relative to the golfer with the highest level of efficiency (1.000), so that a higher efficiency measure means that the player was more earnings-efficient given his or her level of skill performance. When a player's actual earnings are lower than his or her expected earnings, on the other hand, the efficiency measure turns negative. The result for this measure (Efficiency) is reported on the third column of Table 5.

To compute the second measure of efficiency, we follow the procedure that was employed by Nero (2001). We first compute the difference between the natural log of actual earnings and

predicted earnings of a player, with the resulting error term in the estimated regression model. We then compute each golfer's frontier earnings:

$$\ln(\text{frontier earnings}) = \ln(\text{expected earnings}) + \max(\text{error terms})$$

The efficiency measure is the ratio of actual earnings to frontier earnings. Again, the size of the efficiency measure indicates the efficiency level relative to the golfer with the highest level of efficiency (1.000) – a higher efficiency measure means that the player was more earnings-efficient given the current performance level, and vice versa. The second measure is reported on the fourth column of Table 5.

**Table 5**  
**Level of Efficiency (Competitiveness) of Top 30 PGA Players in 2009**

<i>Player</i>	<i>Earnings</i>	<i>Eff</i>	<i>Eff_N</i>	<i>Player</i>	<i>Earnings</i>	<i>Eff</i>	<i>Eff_N</i>
Rory Sabbatini	\$ 2,752,291	1.00	1.00	Y.E. Yang	\$ 3,489,516	0.37	0.45
Geoff Ogilvy	3,866,270	0.99	0.99	David Toms	3,047,198	0.37	0.45
Retief Goosen	3,232,650	0.90	0.88	Ryan Moore	2,222,871	0.34	0.43
Ian Poulter	2,431,001	0.87	0.85	John Senden	2,305,492	0.32	0.42
Zach Johnson	4,714,813	0.76	0.74	Matt Kuchar	2,489,193	0.30	0.41
Brian Gay	3,201,295	0.75	0.73	Angel Cabrera	2,625,472	0.29	0.40
Mike Weir	2,379,422	0.70	0.68	Hunter Mahan	2,941,349	0.26	0.39
P. Harrington	2,628,377	0.69	0.68	Dustin Johnson	2,977,901	0.25	0.38
Nick Watney	3,221,421	0.67	0.66	Justin Leonard	2,232,378	0.23	0.37
John Rollins	2,269,475	0.64	0.63	Kenny Perry	4,445,562	0.20	0.36
Sean O'Hair	4,316,493	0.58	0.59	Tim Clark	2,235,105	0.10	0.30
Stewart Cink	2,821,030	0.49	0.52	Lucas Glover	3,692,580	0.09	0.27
Jerry Kelly	2,562,648	0.47	0.51	Jim Furyk	3,946,515	0.02	0.24
Kevin Na	2,724,825	0.43	0.48	Steve Stricker	6,332,636	-0.16	0.23
Phil Mickelson	5,332,755	0.42	0.48	Tiger Woods	10,508,163	-0.57	0.10

Table 5 summarizes the computed efficiency measures for the top 30 PGA earners in 2009. Interestingly, our efficiency measure and the measure by Nero (2001) are uniformly consistent in terms of efficiency ranking. Rory Sabbatini, Geoff Ogilvy, and Retief Goosen are the three most earnings-efficient players among the top 30 earners in 2009 with the efficiency measure greater than or equal to .90. Rory Sabbatini, for example, was projected to earn around \$770,000 given his level of performance skills, but his actual earnings were \$2,752,291, which is why he was ranked the most earnings-efficient player in 2009. Jerry Kelly, Kevin NA, Phil Mickelson, Y. E. Yang, and David Toms were among the middle-range efficiency level. Jim Furyk, Lucas Glover, Steven Stricker, and Tiger Woods (top earner) are among the lowest level of efficiency among the top 30 earners. Steve Stricker was expected to earn around \$8M given his level of game skills, but ended up with \$6,332, 636 in 2009. Tiger Woods, on the other hand, was supposed to earn more than \$20M given his level of performance skills in his best days, but his final tour earnings in 2009 were \$10,508,590 (top earner), which was why he was ranked last among the top 30 earners in terms of relative efficiency.

#### 4. CONCLUSION

In this paper, we examine the structure and determination of the annual earnings for PGA golfers in the new FedEx Cup era that started in 2007. The first determination model is based on the traditional set of skill variables, 2008-2009, while the second model is based on the combination of the skill variables and two additional variables that are expected to partially reflect the new PGA Tour system.

In the first model, we find four significant factors –driving distance (DD), greens in regulation (GIR), proximity to the hole (PROX), and average number of putts per round of 18 holes (PUTT). The most important areas where a player should concentrate his time and efforts include PUTT, GIR, DD, and PROX in the same order. The second model, Model II, includes all the skill variables included in Model I except driving accuracy (DA) and two additional variables - MAJORS (the number of timely performance in rank five at the major championships) and FEDEX (the measure of a player's consistency and persistency throughout the year-long season, measured by the number of plays in rank five in the FedEx playoffs) are included. We find that all six performance variables as well as the majors and FedEx variables in Model II are statistically significant. This implies that a player who achieved one or more quality performances (top 5 finish) at the majors have earnings that are 75 per cent higher, on average, than a player without a top 5 finish at a major. It seems that winning or having a "quality finish" at the majors has a significant effect on the player both monetarily and psychologically. Additionally, a player who achieved one or more quality performances in the FedEx playoffs has earnings that are 35 percent higher than a player without the same performance. This implies that a player's consistency and persistency in his performance does pay in improving his tour earnings. The  $R^2$  of Model II is higher than that of Model I for the two years, showing that the model that includes the skill variables as well as the two additional variables (MAJORS and FEDEX) fits actual data better in both years. While Nero's results show that an improvement in PUTT by 1.61 per round (5%) results in \$387,956 increase in earning, our results show that an improvement in PUTT by 1.456 (5%) results in \$361,763 in earnings on average. It shows that the two results are comparable and consistent.

Finally, the computed efficiency measures for the top 30 PGA earners in 2009 show how efficient the top 30 earners' play was in 2009. Interestingly, our efficiency measure and the measure by Nero (2001) are uniformly consistent in terms of efficiency ranking. Rory Sabbatini, Geoff Ogilvy, and Retief Goosen are the three most earnings-efficient players among the top 30 earners in 2009. Jerry Kelly, Kevin NA, Phil Mickelson, Y. E. Yang, and David Toms were among the middle-range efficiency level, while Jim Furyk, Lucas Glover, Steven Stricker, and Tiger Woods (top earner) are in the lowest level of relative efficiency among the top 30 earners in 2009. These players, especially Tiger Woods, could have achieved much higher earnings given their level of performance skills in 2009. It appears that the PGA has achieved its goal when it created a "playoff" type event in order to crown a champion for the season. The players that produce quality (top 5) performances during the FedEx Cup events do positively impact their season long total earnings.

## NOTES

1. The motivation of this paper is: we base our paper on previous studies such as Moy and Liaw (1998) and Nero (2001) and try to find an adjusted model that makes more sense under a new era in golf with a season-long points system called the FedEx Cup Championship. We are not trying to find a new (technical) model for the era. There was a more direct motivation to this study, which cannot be included in the paper.
2. The golfers' earnings analyzed in this paper are the official tour earnings only (PGA.com), not including other types. Hence, the estimated result is the relationship between a player's performance variables and his tour earnings, which is our focus in this paper.

## REFERENCES

- Davidson, J. and Templin, T. J. (1986), "Determinants of Success among Professional Golfers," *Research Quarterly for Exercise and Sport*, 57: 60-67.
- Ehrenberg, R. and Bognanno, M. (1990), "Do Tournaments Have Incentive Effects?" *Journal of Political Economy*, 98-61: 1307-1324.
- Gius, M. and Johnson, D. (2000), "Race and Compensation in Professional Football," *Applied Economics Letters*, 7-2: 73-75.
- Gustafson, E. and Hadley, L. (1995), "Arbitration and Salary Gaps in Major League Baseball," *Quarterly Journal of Business and Economics* (Summer 1995), 34-3: 32-46.
- Kahn, L. (1992), "The Effects of Race on Professional Football Players' Compensation," *Industrial and Labor Relations Review*, 45-2: 295-310.
- Massey, C. and Thaler, R. (2005), "Overconfidence vs. Market Efficiency in the National Football League," *NBER working paper*.
- Moy, R. and Liaw, T. (1998), "Determinants of Professional Golf Tournament Earnings," *American Economist*, 42: 65-70.
- Nero, P. (2001), "Relative Salary Efficiency of PGA Tour Golfers," *American Economist*, 45: 51-56.
- Orszag, J. (1994), "A New Look at Incentive Effects and Golf Tournaments," *Economics Letters*, 46: 77-88.
- Scahill, E. (1985), "The Determinants of Average Salaries in Professional Football," *Atlantic Economic Journal*, 13-1: 103.
- Scully, G. (1974), "Pay and Performance in Major League Baseball," *American Economic Review*, 915-930.
- Shamanske, C. (2000), "Gender, Skill, and Earnings in Golf," *Journal of Sports Economics*, 1: 385-400.
- Sommers, P. and Quinton, N. (1982), "Pay and Performance in Major League Baseball: The Case of the First Family of Free Agents," *The Journal of Human Resources*, 17-3, 426-436.
- Zech, Z. E. (1981), "Empirical Estimation of a Production Function: Major League Baseball," *American Economist*, (Fall 1981), 25-2: 19-23.