The Economics of Golf: An Investigation of the Returns to Skill of PGA Tour Golfers

Kelsey L. Rinehart

ABSTRACT. Golfers on the Professional Golfers Association (PGA) Tour make up an elite labor market. The earnings of a PGA Tour golfer are determined by his performances in tournaments. Using PGA Tour data from 2002 and 2008, this paper explores returns to skill of PGA golfers and changes in returns to skill over the time period. Greens in regulation (GIR), putts per GIR, and sand saves are found to be statistically significant. The analysis in this paper does not provide any support to the idea that returns to skills for PGA golfers have changed over time.

I. Introduction

Sports provide more measures of worker performance than any other labor market. At a click of a mouse one has access to an athlete's demographic information, experience, salary history, and most importantly, performance statistics. For most workers, performance can be difficult to measure because many times it is subjective in nature. This is not true with sports. Every outcome resulting from an athlete's action is a measurable event (Kahn 2000, 75).

Some may question the economic significance of sports. The professional sports industry is only a drop in the bucket of United States's gross domestic product. Although professional sports do not play a large role in GDP, they are what Fort refers to as "big business" (2003, 2). The country's interest in sports goes far beyond a contribution to GDP. The infatuation with sports is revealed everyday in newscasts, newspapers and magazines. Media popularity aside, professional sports are like any operating business. There is a supply of and a demand for the output, and money to be exchanged (Fort 2003, 2).

Professional golfers make up an elite labor market. Golf is a great sport to study because of all the available statistics. A professional golfer's skill is measured through the statistics kept by either the Professional Golfers Association (PGA) or the Ladies Professional Golf Association (LPGA). The statistics are accurate and available The earnings of a golfer are determined by his performance against other competitors in a tournament setting (Scully 2002, 236). After each professional tournament, winnings are reported along with the golfer's

statistics for the tournament. This paper will explore how various golf skills affect a PGA Tour golfer's earnings.

II. The Economics of Golf

In the business world there are inputs, outputs, and various negotiations that must take place before a final product is produced; professional golf is no exception. There are groups that must interact in order for one to enjoy a golf tournament from the comfort of his living room. The most important group is the golfers. Then there are tournament sponsors who provide the prize money and arrange tournament locations and television contracts. The body that mediates between golfers and the sponsors is an association of professional golfers, such as the PGA or LPGA.

Golfers are the main input to professional golf. For those golfers with exceedingly high levels of skill, the decision to become a professional golfer is easy. Due to the tournament pay of golf, marginal players may be better off economically finding work elsewhere. That is because the PGA Tour does not cover travel, clothing, and lodging for tournaments. Entering tournaments and not taking home prize money could become a very expensive hobby (Shmanske 2004, 194).

There are people who are able to make it as golf professionals and join the tours. The golfers then must decide which events to enter. Tournaments take place every weekend between January and November. Most top performers will enter between 20 and 30 events each year (Shmanske 2004, 195). Shmanske identifies multiple variables that affect the number of events a golfer enters, including location, earnings up until the event, total prize money (purse), health, and tournament competition. Golfers who are lower in rankings will normally enter all the events they are able (2004, 198).

Tournaments are put on by sponsors. The sponsor may be a company, individual, organization, or golf course. The sponsor will negotiate to set prize money, dates, and location. The sponsor will make deals with television networks in an attempt to promote the event and sell advertisement space. The sponsor takes on the risk of all the payouts, including prize money and other labor costs, in hope that the revenue will surpass costs.

The association for male touring profession golfers is known as the PGA Tour. The PGA Tour acts as an agent for the golfers and performs

negotiations between golfers and event sponsors (Shmanske 2004, 199). The PGA Tour is a cartel, acting on behalf of the golfers. The PGA Tour sets the regulations for events. There are no appearance fees. The prize structure is as follows:

TABLE 1

Place	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
% of Purse	18%	10.8%	6.8%	4.8%	4%	3.6%	3.35%	3.1%	2.9%	2.7%

Prize money is awarded down to 70th place, which receives 0.2% of the purse (Shmanske 2004, 204). The tournament structure of earnings is special to individual professional sports. Fort identifies such a circumstance as a "winner-take-all situation." Although a tournament winner does not receive 100% of the prize money, the payout structure is called winner-take-all due to the relatively large amount of prize money first place receives. The winner-take-all situation can be used to explain the earnings within individual sports such as racing, golf, and tennis (2003, 202).

The demand for the sport originates from fans who desire to see the best players competing with one another. When the best players compete within a single event, such as a golf tournament, there will be only a marginal difference between players. As the best compete for a share of the prize, there needs to be some sort of assurance that the best competitor will take home the majority of the earnings. The Lorenz curve of golf illustrates that a small percentage of competitors earn the majority of the purse money. The top 10% of players earn close to 55% of the event purse. There is a reason for the highly unequal distribution of earnings (Fort 2003, 203).

Suppose there were not a huge payoff for the top competitors at a tournament and the differences in pay for the positions narrowed. Without a large discrepancy in winnings for the different places, the players may decide that it is easier to take turns winning tournaments. Players may throw off a stroke here and there, allowing the previously determined winner to take home the week's check. The current prize structure for professional golf resembles X in Table 2. If the prize structure were changed to Y there would be a smaller difference in prize money for the top competitors.

TABLE 2–Expected Value Example

	Prize Structure X	Prize Structure Y
1st	$100,000	$100,000
2nd	$60,000	$90,000
3rd	$40,000	$80,000
4th	$30,000	$70,000
Expected Value	$57,000	$85,000

The relatively high expected value of prize structure Y may encourage colluding. When the prize structure resembles X, players would have a larger incentive to cheat, or not collude. The players would be encouraged to produce their best performance.

Professional golf would be particularly susceptible to colluding if the payouts resembled Y because it is very difficult to produce consistent performances. The golfers, especially if risk adverse, may choose to collude in an effort to "guarantee" earnings they may not have received under normal tournament conditions. The player collusion would undermine the goal of the tournament organizers: maximize the value of the purse and TV contracts. If players begin to collude and share purses, fan confidence will diminish. The diminishing confidence leads to decreases in demand and, in turn, decreases in revenue from any given event (Fort 2003, 203). The concentration of earnings prevents such a problem. The incentive to collude is reduced through the prize structure because the value of outperforming the top performers is so high. The high competition within professional sports is what brings the buyers, or fans, into the market for professional golf (Fort 2003, 203).

Because the top golf professionals are competing against one another for the few, high- paying positions, the marginal improvement of golf skills becomes very important. Players use their scarce time to practice their golf skills as a means to improve their human capital. The human capital theory of labor explains the value of practice time to professional golfers. Within a labor market, workers earn money by selling their skills to employers (Shmanske 2004, 218). Golfers earn money by "selling" their skills to tournaments. Outside of professional sports, laborers

typically seek education and training as a means to acquire human capital. The laborers invest in the education or training in hopes that the increased human capital will result in higher earnings, all else equal. A golfer that spends time practicing over other activities believes that the payoffs he will receive from practicing will be greater than the opportunity cost of the time sacrificed.

A golfer spends his time practicing to increase his skill level. The improvements of golf skills will more than likely result in an increase in pay for the top professional golfers. The small discrepancy in skills among players and large discrepancy in pay makes marginal skill improvements important. Previous empirical studies have revealed that the returns to certain skills are more valuable than others. The difference in returns means that a player may enjoy a higher payoff from allocating practice time to the relatively high "paying" skills.

III. Previous Research

Empirical studies have been conducted to research the monetary returns to skill of professional golfers. These studies have included tournament winnings as the dependent variable in the regression. The independent variables used are measures of golf skills that can be divided into short game and long game skills. The long game is comprised of a golfer's drives and approach shots while the short game includes chip shots and putting. Further explanation of the different shots is presented within the empirical model section of the paper.

Shmanske, who has done various economic studies of golf, evaluates the relationship between skills and earnings of golfers on the1998 PGA and LPGA tournaments (2000, 385). He uses a multiple regression technique involving five skills to offer an explanation of earnings. The skills are: driving distance, driving accuracy, approach shot accuracy, sand bunker shots, and putting. In Shmanske's model, putting and driving distance are the most significant skills for males. For women it is putting and approach shot accuracy. The results show that once skills are accounted for, women are not underpaid compared to men. His final conclusion is that through the predicted earnings of the male and female model, either sex is better off staying within their tournament where returns to their skills are higher (2000, 397).

Most recently, Shmanske has used PGA Tour micro data to create an

empirical model regressing skills and performance on earnings (2008). The objective of Shmanske's empirical research is to improve upon previous models through the use of tournament-level data. His focus is not specifically on the return to various skills of PGA golfers, but on the formulation of possible empirical models. The tournament-level data Shmanske uses is not provided by the PGA. To obtain the data, Shmanske tracked the weekly performances of the 2005 PGA Tour top 100 money earners throughout the 2006 PGA Tour. Shmanske recorded six statistics throughout the season. He recorded the golfers' scores and measures of five different golf skills exhibited throughout the Tour (2008, 647).

In order to evaluate the effects of PGA micro data as a replacement for the usual yearly averages, Shmanske examines various models. He tests the model with the micro level data and with the yearly averages to allow for comparisons. The use of tournament-level data can help to account for the different levels of difficulty of the courses on the PGA Tour. An example of this is Tiger Woods's scoring average. While Tiger may have a yearly scoring average that is lower than his competitors, this score does not fully convey his competitive advantage. He is scoring lower on the most difficult courses of the PGA Tour. If he entered exactly the same events as his competitors, the gap between his score and theirs would be even wider. Shmanske is able to eliminate some measurement error by using tournament-level data (2008, 646).

Another advantage of micro data is that Shmanske is able to examine skewness and variance of the PGA Tour golf skills. A golfer's yearly earnings are not solely a function of scoring average. Shmanske shows that variance and skewness of the year's scores also affect earnings (2008, 647). By adding measures of variance and skewness, Shmanske's model increases its predicting power. The micro data and inclusion of variance and skewness allows Shmanske to estimate a multi stage model that improves his adjusted R^2 from 0.36 to 0.90 (2008, 644). Because the weekly data is not published by the PGA, using micro data is not feasible for this paper.

Another approach to the subject of empirical studies of professional golf is evaluating the change in the returns to skills over time. Alexander and Kern's study focuses on an old golf saying: "Drive for show and putt for dough". The saying implies that, while fans may be in awe at the sight of a long drive in professional golf, tournaments are won on the putting green. If the saying holds true, a player should allocate the majority of his practice time to his short game, where payoffs are greater. The wisdom

of the saying has come into questions over the past few years as some golf analysts believe driving distance is becoming relatively more important to success on the PGA Tour (2005, 46).

Alexander and Kern present both sides of the argument about the relative importance of driving and putting skill. There is evidence that favors putting, or short game, as the dominant skill in professional golf. The majority of a professional golfer's shots are taken within a 100 yards of the hole. Roughly 40% of a PGA golfer's strokes are taken on the putting green. A skilled golfer may use a driver a maximum of 14 times in a par 72 round. Because the short game requires the majority of strokes a PGA golfer takes, there is ample reason for him to focus his time on the club used most often, the putter (2005, 47). There is also evidence that has led to the belief that driving now overpowers the short game on the PGA Tour. There has been an increase in the length of courses on the PGA Tour in recent years. New courses are made longer and old ones are lengthened. This places short-gamers at a disadvantage, holding all else equal. One example of this is Corey Pavin. Pavin won the U.S. Open in 1995 and was the top earner of 1991. He improved his average drive by 17 yards in 2001 compared to 1991. Pavin remained one of the best putters on the Tour throughout the time period, but his driving ability was not enough to place him in the top of the 2001 Tour. Pavin finished 111th in earnings in 2001 (2005, 47).

The purpose of Alexander and Kern's study is to analyze whether returns to various golf skills have changed over time or if the old golf wisdom still holds true. They examine the determinants of earnings for PGA Tour golfers from 1992 to 2001 (2005, 46). The model's dependent variable is the inflation-adjusted annual earnings of PGA Tour golfers from official PGA Tour events. Alexander and Kern use measures of golfer skill, number of events played during a season, a measure of time, and a control for changes in prize money over the years as their explanatory variables.

The skill variables Alexander and Kern include in their model can be divided into short game and long game skills. The long game skills are average driving distance, driving accuracy, and iron accuracy. The short game skill Alexander and Kern include in their model is average putts made per greens in regulation (2005, 51). The time variable is used to account for the rapid change in golf-equipment technology over the past 15 years. Golf clubs and balls have been designed to increase driving distance and accuracy. Some people speculate that these improvements

are changing the relative payoffs associated with various skills, particularly in favor of the long game where this technology is most put to use. On the other side, courses have been lengthened in recent years. The study includes the time variable to account for these changing factors. The events variable is included because all golfers do not enter the same number of events during a season. When a golfer plays additional events, he increases his earnings opportunities. Alexander and Kern use a prize variable to control for any changes in the total prize money from year to year within their sample (2005, 53).

Alexander and Kern's regression results reveal that average driving distance and putting have the largest impact on PGA Tour golfers' earnings. The time variable has a negative sign. A possible explanation of this may be that golf courses have been lengthened over time to counteract the new technology. Finally, their results show that there has been a small increase in the marginal value of driving distance over the period examined whereas the marginal value of putting has declined. The single most important determinant of earnings is still putting. According to Alexander and Kern's study, an improvement in putting is the quickest way to improve pay on the PGA Tour (2005, 59). The empirical model presented in this paper is similar to Alexander and Kern's, with the goal to assess returns to skill of PGA golfers and changes in the returns to skills over a select time period.

IV. Data and Model

The sample used for the regression is comprised of PGA Tour golfers competing in one or both of the 2002 and 2008 seasons. The skill and earnings statistics are kept by the PGA Tour and are available at PGATOUR.com. Golfers are included in the sample if they have available skill statistics for at least one of the two years. The sample includes 197 observations from 2002 and 196 from the 2008 season.

The model examines the influence of various golf skills on pay within the PGA Tour. Pay is measured in 2008 dollars and includes winnings from a year's PGA Tour events only. In unreported results, earnings are logged, as is typical in models with salary as the dependent variable. The log of earnings produced results nearly equivalent to the reported model, which has no transformations.

In order to compare the 2002 observations to 2008, interaction terms are included. The interaction terms consist of the 2002 and 2008 skill and

events variables. Each of the variables has 393 observations. The observations from 2008 retain their original values within the interaction terms. All observations from 2002 have a value of zero. An example is the AvePutt08 interaction term calculation:

AvePutt08= (AvePutt)*(1 or 0)
1 for 2008 AvePutt observations
0 for 2002 AvePutt observations

Each interaction term provides a direct comparison of the change in the average return to a specific skill from 2002 to 2008. If an interaction term has a positive coefficient then the skill represented within the interaction term has a higher return for marginal improvement in 2008 compared to the same improvement in 2002. A negative coefficient signifies that the returns to skill are smaller in 2008 than in 2002. A dummy variable is also included to control for any possible technological or course changes from 2002 to 2008.

The empirical model is written as follows:

$$2008\$ = \alpha + \beta_1 AvgDr + \beta_2 DrAccr + \beta_3 GIR + \beta_4 SS + \beta_5 AvePutt + \beta_6 Events + \beta_7 Yr2008 + \beta_8 AvgDr08 + \beta_9 DrAccr08 + \beta_{10} GIR08 + \beta_{11} SS08 + \beta_{12} AvePutt08 + \beta_{13} Events08 + \varepsilon$$

The object of golf is to hit the ball into the hole in the fewest strokes possible. A typical par four hole is designed so it takes a player two shots to reach the putting green. From the green in regulation it should take two putts to finish. The typical round is played in 18 holes with a par of 72. It is not uncommon for a professional golfer to score a 70 within a round. A tournament typically has four, 18-hole rounds (Shmanske).

Each time a golfer takes a stroke they are attempting to execute a skill. This skill could range anywhere from a drive to a putt. There is data available for each skill the golfer attempts within the Tour. The long game skills measured in the model are AvgDr, DrAccr, and GIR. The first stroke a player uses is a drive. Drives are measured by distance and accuracy. AvgDr is the average drive distance for a golfer over a period of one year. Driving accuracy measures a golfer's aim and consistency in driving. The goal of the first drive is to hit the fairway, which is the best position for the next stroke. The DrAccr variable is the percentage of times the initial drive lands on the fairway.

The second shot is used to land on the green, near the hole. This is called an approach shot. The player's approach shot is measured through greens in regulation. GIR is the percent of attempts a player was able to hit the green in regulation. This is calculated by dividing the number of greens hit in regulation for the year by the number of holes played. According to the PGA, a green is considered hit in regulation if any portion of the ball stays on the green after the GIR stroke. The GIR stroke is the stroke taken before the final two strokes within par. For example, on a par four hole it would be the second stroke.

The final two skill variables are SS and AvePutt. Both are measures of a golfer's short game. In golf, not every stroke is played to perfection. Some shots land in obstacles known as bunkers. Bunkers are normally sand traps. The bunkers make it difficult to make par. Sand saves occur when a golfer hits a bunker but is still able to make par. The SS variable is a measure of sand saves. It is the number of times, in a given year, that a golfer made par or better after hitting a bunker divided by the number of bunkers hit.

The final strokes a golfer takes are putts. The PGA reports the average number of putts a golfer takes after reaching the green in regulation. By using putts resulting from greens in regulation rather than total putts, driving and approach shot ability is factored out of the measure. The AvePutt variable is a golfer's year long average of putts taken on greens in regulation. Because AvePutt is the only variable that is a measure of strokes taken by a golfer, the coefficient is expected to be negative.

EVENTS accounts for the number of tournaments the golfer participates in a year. The dummy variable, YR2008, is included to pick up any changes from 2002 to 2008. These changes include course length, golf equipment technology, and other variables that have not been accounted for. The skills measures with "08" endings are the model's interaction terms. Again, these interaction terms account for the changes in the returns to the skill in 2008 compared directly to 2002.

Each stroke a player takes has the ability to place him at either an advantage or disadvantage for the next stroke. This means, for example, if a player is able to drive long, accurate distances it will make it "easier" for him to make a green in regulation. Alexander and Kern control for such events within their model. Approach shots, putting, chipping, and sand saves are controlled for in order to obtain a pure measure of each skill. The measures are created through multiple stage regression, using

residuals as the skill variables (2008, 51). Such regression techniques are not included in this study.

V. Regression Results

Table 3 presents the summary statistics for the variables used in the regression. The average golfer on the Tour during the two years earned $1,320,800 per year and entered an average of 25.6 events. The golfer's average driving distance is 288.27 yards. Approximately 64% of the time the average PGA Tour golfer will reach the fairway with his initial drive. A green in regulation is reached, on average, 65% of the time. After making a GIR, the golfer averages 1.79 putts to finish the hole. The mean of the sand save percentage is 49%.

TABLE 3–Summary Statistics

	Mean	Standard Deviation	Maximum	Minimum
2008$	1,320,800	1,179,300	11,320,000	36,583
AvgDr	288.27	8.5634	315.2	261.4
DrAccr	63.44	5.335	80.42	41.86
GIR	64.671	2.5685	71.1	54.33
SS	49.412	5.8482	68.103	34.454
AvePutt	1.7882	0.024452	1.871	1.718
Events	25.606	4.5355	36	14
YR2008	0.50127	0.50064	1	0
AvgDr08	144.1	144.04	315.1	0
DR Accr08	31.761	31.955	80.42	0
GIR08	32.473	32.485	71.1	0
SS08	24.875	25.162	63.71	0
AvePutt08	0.89645	0.89546	1.844	0
Events08	12.911	13.274	36	0

The regression results are presented in Table 4. The GIR, AvePutt, and Events variables are significant at the 1% level and SS is significant at the 5% level. The only perverse sign is on the Events variable. The coefficient is interpreted as a decrease in annual earnings of $44,725 for each event entered. Intuition would predict that as a golfer enters more events, his earnings will increase.

TABLE 4–Regression Results

	2008$	Significance
AvgDR	$2,775	
DrAccr	-$29,578	
GIR	$168,300	**
SS	$33,859	*
AvePutt	-$19,784,000	**
Events	-$44,725	**
Yr2008	-$8,404,000	
AvgDr08	$15,563	
DrAccr08	$10,952	
GIR08	-$57,992	
SS08	-$4,598	
AvePutt08	$3,820,700	
Events08	$10,906	
Adjusted R2	0.2434	
N	393	
Constant	$26,417,000	**

**-significant at 1% level
*-significant at 5% level

The negative sign implies otherwise. The coefficient may be negative because the number of events entered by any given golfer normally depends on the earnings he has already accumulated for the season. Tiger

Woods only enters select events on the Tour. If he is able to win enough events by August, he would be reluctant to enter more events toward the end of the Tour. His time may be better spent resting. The superior golfers within the PGA Tour usually enter fewer events, which may explain the negative sign on the Events coefficient. To put it differently, worse golfers have to play more events to make enough to live on. The model's adjusted R^2 is 0.2434. The adjusted R^2 is consistent with labor studies but may be considered low for a regression involving professional golf. The relatively low adjusted R^2 is most likely a result of the simplified model used.

One of the purposes of the regression is to evaluate the marginal effects of improvements in skills on a golfer's earnings. If a golfer was able to improve his GIR by ten percentage points, which would take him from the minimum GIR to the mean, his earnings would increase by $1,683,000. Further, if a golfer could increase his sand saves percentage from the minimum 34% to the sample mean of 49%, his earnings would increase by $507,885. For a golfer to improve his average putts per green in regulation from the sample maximum to the mean, he would need to decrease his average by .0828 putts. The decrease would result in an additional $1,638,115 in annual earnings.

None of the model's interactions terms are significant. That implies that, comparing 2002 to 2008, there is not a significant difference in the returns to any of the measured skills. Had AvgDr08 been significant, for example, the coefficient would be interpreted as how much an additional average drive yard added to a player's earnings in 2008 compared to 2002.

VI. Summary and Conclusions

The analysis in this paper does not provide any support to the idea that the returns to skills for PGA golfers are changing over time. Further analysis, which would include all of the most recent data, may improve the study. Putting, as in previous studies, continues to be a highly significant variable. Driving and driving accuracy are not significant in the model as they have been in previous studies. A player's driving ability may be reflected in the significant GIR variable. The insignificance of driving may also be a reflection of the golfers in the two sample years. These golfers may already be accustomed to the long drives of today. The physical size of professional golfers has increased and today's golfers

have had sophisticated golf equipment readily available for the majority of their professional lives. The group's strong drives may place them on a more equal playing field than golfers in previous studies. The result would be a weaker impact on earnings. It seems that the wisdom of yesterday remains today: "Drive for show and putt for dough". A wise professional golfer will focus his time on his short game, where the returns to marginal improvements are greatest.

References

Alexander, Donald L. and Kern, William. 2005. Drive for Show and Putt for Dough?. *Journal of Sports Economics* 6, no. 1:46-60.

Fort, Rodney D. 2003. *Sports Economics*. Upper Saddle River: Prentice Hall.

Kahn Lawrence M. 2000. The Sports Business as a Labor Market Laboratory. *Journal of Economic Perspectives* 14, no. 3: 75-94.

PGA TOUR, http://www.pgatour.com/r/stats/

Scully, Gerald W. 2002, The Distribution of Performance and Earnings in a Prize Economy. *Journal of Sports Economics* 3, no. 3:235-244.

Shmanske, Stephen. 2000. Gender, Skill, and Earnings in Professional Golf. *Journal of Sports Economics* 1, no. 4:385-400.

Shmanske, Stephen. 2004. *Golfonomics*, River Edge: World Scientific Publishing Company.

Shmanske, Stephen. 2008. Skills, Performance, and Earnings in the Tournament Compensation Model: Evidence From PGA Tour Microdata. *Journal of Sports Economics* 9, no. 6: 344-662.