A Personal Odyssey to Greece and the 2004 Olympic Games

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Abstract

An extensive body of research examines the importance of a golfer's shot-making skills to the player's overall performance, where performance is measured as either tournament money winnings or average score per round of golf. Independent of the performance measure, existing studies find that a player's shot-making skills contribute significantly to explaining the variability in a golfer's performance. To date, this research has focused exclusively on the professional golfer. This study attempts to extend the findings in the literature by examining the performance determinants of amateur golfers. Using a sample of NCAA Division I male golfers, various shot-making skills are analyzed and correlated with average score per round of golf. Overall, the findings validate those dealing with professional golfers. In particular, the results suggest that, like professional golfers, amateurs must possess a variety of shot-making skills to be successful. Moreover, relative to driving ability, putting skills and reaching greens in regulation contribute more to explaining the variability in a player's success.

Introduction

Davidson and Templin (1986) present one of the first statistical investigations of the major determinants of a professional golfer's success. Using U.S. Professional Golf Association (PGA) data, these researchers find that a player's shot-making skills explain approximately 86 percent of the variability in a player's average score and about 59 percent of the variance in a player's earnings. Based on these results, Davidson and Templin conclude that a professional golfer must possess a variety of shot-making skills to be successful as a tournament player. They further offer strong empirical support that hitting greens in regulation and putting were the two most important factors in explaining scoring average variability across players, with driving ability showing up as a distant third.

Following Davidson and Templin (1986), a number of researchers have continued to investigate the determinants of a professional golfer's overall performance. Examples include Jones (1990), Shmanske (1992), Belkin,

Gansneder, Pickens, Rotella, and Striegel (1994), Wiseman, Chatterjee, Wiseman, and Chatterjee (1994), Engelhardt (1995, 1997), Moy and Liaw (1998), and more recently Nero (2001), Dorsel and Rotunda (2001), and Engelhardt (2002). Overall, these studies support the major conclusion presented by Davidson and Templin (1986), which is that a professional golfer must exhibit a variety of shot-making skills to be successful as a touring professional. While the relative importance of these skills to player performance is not uniform across these studies, there is a developing consensus that shot-making skills like putting and hitting greens in regulation are more important to a player's success than driving distance.

Interestingly, while there is an accumulating literature investigating professional golfers, no analogous studies have examined the amateur player, despite the fact that Davidson and Templin (1986) explicitly state that this avenue of investigation would be a useful direction for future research. More recently, Belkin, et al. (1994) specifically raise this point, suggesting that:

> *"It would also be intriguing to examine whether the same skills which differentiate successful professionals also contribute in the same manner to the fortunes of amateurs of differing capabilities."*
> *(p. 1280).*

By way of response, this study fills that particular void in the literature by empirically estimating the relationship between an amateur golfer's overall performance and various shot-making skills. To facilitate direct comparisons to the existing literature on the determinants of professional golfers' performance, we employ the basic approach used by Davidson and Templin (1986) and Belkin, et al. (1994), among others.

Method

Sample

The sample used for this analysis is a subset of NCAA Division I male golfers who participated in at least one tournament during the 2002–2003 season. Table 1 presents a listing of the colleges and universities represented in the study and the number of players from each institution. The specific data on these collegiate golfers are obtained from Golfstat, Inc. (2003) (accessible on the Internet at www.golfstat.com), and/or from the respective colleges and universities directly. The colleges and universities included in the analysis are a subset of the college teams participating in National Collegiate Athletic Association (NCAA) Division I Men's Golf. While it would be preferable to examine all Division I teams, the individual player statistics needed to perform the analysis are not available. However, since it is reasonable to assume that the schools listed in Table 1 are a representative sample of all Division I men's teams, the data

sample is appropriate for this study.

TABLE 1
Sample of Schools Included in the Study

School	Number of Golfers	Conference	Golfweek/Sagarin Ranking
Clemson University	5	Atlantic Coast	1
University of Arizona	11	Pacific 10	7
University of Southern CA	9	Pacific 10	23
Duke University	8	Atlantic Coast	25
Vanderbilt University	7	Southeastern	31
California State - Fresno	9	Western Athletic	33
University of Kentucky	9	Southeastern	45
Georgia State University	8	Atlantic Sun	51
Texas A&M University	9	Big 12	60
Southeastern Louisiana Univ.	8	Southland	71
Coastal Carolina University	10	Big South	76

Sources: Golfstat, Inc. (2003) "Customized Team Pages-Men." www.golfstat.com/2003-2004/men/mstop10.htm, (accessed June 16, 2003), various teams; Golfweek. (2003) "Golfweek/Sagarin Performance Index - Men's Team Ratings." www.golfweek.com/college/mens1/teamrankings.asp, (accessed July 1, 2003).

Measures

For the schools represented in this study, Golfstat, Inc. collects and reports individual player statistics necessary to complete a performance analysis. For this study we used statistics for the 2002 – 2003 NCAA Division I tournament season. Among the available data are the average score per round (AS) for each amateur player in the sample. This statistic provides the performance measure needed for the dependent variable in this study, since earnings are not relevant to amateurs. Specifically, according to the United States Golf Association (2003, p. 1) and the Royal and Ancient Golf Club of St. Andrews (2003, p.1), an amateur golfer is defined as:

> *" .one who plays the game as a non-remunerative and non-profit-making sport and who does not receive remuneration for teaching golf or for other activities because of golf skill or reputation,*

except
as provided in the Rules."

Although studies of professional golfers examine scoring average and/or earnings as performance measures, Wiseman et al. (1994) argue that correlation results are stronger when scoring average is used. Hence, the use of scoring average for this study of amateurs is soundly supported by the literature examining professional golfers.

Statistics for the primary shot-making skills typically used in the literature are collected and reported by Golfstat, Inc. and by some colleges and universities. These include measures of driving accuracy, greens in regulation, putting average, sand saves, and short game.

To capture amateurs' long game skills, we use one of the classic measures, which is driving accuracy. Specifically, we use the variable Fairways Hit, which is defined as the percentage of fairways hit on par 4 and par 5 holes during a round of golf. Data on driving distance for the amateur sample are not available. However, Dorsel and Rotunda (2001) present evidence suggesting that the number of eagles (i.e., two strokes under par on any hole) a player makes is positively correlated with the player's average driving distance. Hence, we use the variable Eagles, the total number of eagles a player makes during the season, to control for each player's average driving distance. Following the literature, we also include the variable Greens in Regulation (GIR) to measure the percentage of greens a player reaches in regulation for the season. This is defined as one stroke for a par three, two strokes or less for a par four, and three strokes or less for a par five. As discussed in Belkin et al. (1994), this GIR variable captures a player's iron play and their success at reading a green within the regulation number of strokes.

With regard to the short game, several variables are used in the analysis.
In keeping with the literature, we use two measures of putting skill – Putts per Round, defined as the average number of putts per round, and GIR Putts, which is the average number of putts measured only on greens reached in regulation. Belkin, et al. (1994) is one study that uses the former measure, while Dorsel and Rotunda (2001) is an example of a study using the latter. Interestingly, Shmanske (1992) argues that the latter statistic, GIR Putts, is superior because it correctly accounts for the longer putting distances associated with a player who achieves a higher number of greens in regulation. By including one of these measures in different regression models, we can assess the validity of that argument.
We also include the variable Sand Saves (SS), which measures the percentage of time a golfer makes par or better when hitting from a sand bunker.
In certain specifications of our regression analysis, we experiment with the variable Short Game as an alternative measure to Sand Saves. Short Game measures the percentage of time a player makes par or better when not reaching the green in the regulation number of strokes.

In addition to a player's shot-making skills, Belkin, et al. (1994) and others note the importance of experience in determining a player's success. To control for this factor, two experience measures are used. First, we define the variable Rounds as the number of tournament rounds completed by each player during the 2002–2003 season. In a sense, this measure captures a player's short-term experience, in that it measures how each additional round played in a season increases the experience that a player can call upon in subsequent rounds. Second, to control for longer-term cumulative experience, we construct a set of dummy variables to reflect the player's academic age, (i.e., Freshman, Sophomore, Junior, or Senior). It is hypothesized that the higher a player's academic age, the more collegiate golfing experience has been gained, and therefore the lower the expected average score.

Finally, since golf at the collegiate level is a team sport, it is important to capture any associated team effects. That is, a player's performance might be affected by the team with which they are associated. At least two plausible explanations for this team effect are viable – one relating to the team's coach and the other relating to the courses played. With regard to the former, each team's coach is expected to uniquely affect the success of each team member through mentoring, leadership, instruction, and overall direction. In fact, Dirks (2000) and Giacobbi, Roper, Whitney, and Butryn (2002) present evidence supporting the importance of a coach's influence on the performance of a collegiate athlete. Primarily, the coach acts as the team leader and instructor. As a leader, the coach is responsible for the overall team strategy and for ultimately determining a player's tournament participation. As an instructor, the more experienced coach may be better able to teach players and to motivate them to improve their play.

As for courses played, we expect a player's scoring average to be affected by the specific golf courses played, which in turn are not consistent across collegiate teams. Indeed, it is highly plausible that some teams might, for example, play easier courses throughout a given tournament season, which may lower a team member's score. To account for these team effects, dummy variables are constructed, whereby each dummy variable identifies the team to which each player belongs.

Procedure

Following the literature, multiple regression analysis is used to estimate the relationship between an amateur golfer's average score and various shot-making skills. In addition, each regression model is specified to control for player experience and team factors. Ordinary least squares (OLS) is used to derive the regression estimates for four different models. These models are distinguished by the selection of shot-making skill statistics used for certain variables. Specifically, each model is distinguished by its use of Sand Saves (SS) versus Short Game and Putts per Round versus GIR putts. We also generate simple Pearson correlation coefficients

between
the measure of player performance and each of the independent variables
in the study.

Results and Discussion

Basic descriptive statistics for the sample of 93 golfers are presented in Table 2. At the collegiate level, most tournaments consist of three rounds of golf, and, like the professionals, each round comprises eighteen
holes. The average NCAA Division I male golfer in the sample participated
in approximately nine tournaments, played slightly less than 26 rounds
of golf, and had an average score per round of approximately 75 strokes
during the 2002 – 2003 season.

TABLE 2
Basic Descriptive Statistics

MEASURES	Mean	Std. Dev
Tournaments	8.72043	4.22818
Rounds	25.78495	12.62318
Average Score (AS)	75.04548	2.20730
Fairways Hit	0.68033	0.08356
Greens in Regulation (GIR)	0.60471	0.07985
Putts per round	31.02602	1.23018
GIR Putts	1.87653	0.07043
Sand Saves (SS)	0.41998	0.12239
Short Game	0.51377	0.08947
Eagles	1.50538	1.80352
Academic Age Dummy Variable	**Mean**	**Std. Dev**
Senior	0.19355	0.39722
Junior	0.23656	0.42727
Sophomore	0.31183	0.46575
Freshman	0.25806	0.43994
Team Dummy Variables	**Mean**	**Std. Dev**
University of Arizona	0.11828	0.32469
Clemson University	0.05376	0.22677
Duke University	0.08602	0.28192
California State -Fresno	0.09677	0.29725
Georgia State University	0.08602	0.28192
University of Kentucky	0.09677	0.29725
Southeastern Louisiana University	0.08602	0.28192
University of Southern CA	0.09677	0.29725
Texas A& M University	0.09677	0.29725
Vanderbilt University	0.07527	0.26525
Coastal Carolina University	0.10753	0.31146

With regard to specific shot-making skills, the average amateur hits approximately 68 percent of the fairways and reaches the green in the regulation number of strokes 60 percent of the time. Of the greens reached
in regulation, the average player needs 1.88 putts to finish a hole, and

over the course of a round, each needs to take slightly more than 31 putts.

On average, an amateur golfer makes par or better when hitting from a sand bunker 42 percent of the time and makes par or better when not on a green in regulation 51 percent of the time. Over the course of the 2002 – 2003 season, the average player made 1.5 eagles.

Table 3 presents the results of the correlation analysis among an amateur's average score (AS) and various shot-making skills, experience, and team effects. Notice that all shot-making skills are significantly correlated with a player's average score. Somewhat predictably, GIR is the variable that is most highly correlated with an amateur golfer's average score. This finding is analogous to what has been found for professional golfers by Davidson and Templin (1986) and others. We also find that the Short Game variable and GIR Putts rank second and third respectively in terms of the strength of correlation among shot-making skills. Notice that across the two putting measures – GIR Putts and Putts per Round, the correlation for GIR Putts is higher, which may support Shmanske's (1992) assertion that this is a more accurate measure of putting skill. We also find that both the short-term and long-term experience measures are statistically correlated with a player's performance. With regard to the Rounds variable, the correlation shows a significant negative relationship with a player's average score, which follows our expectations. Also, as anticipated, the dummy variable for academic age is positively correlated with the player's average score for freshmen and negatively correlated for seniors. Lastly, for certain colleges and universities, there is a significant correlation between a team effect and a player's average score.

TABLE 3
Pearson Correlation Coefficients

MEASURES	Correlation with Average Score (AS)
Fairways Hit	-0.42884***
Greens in Regulation (GIR)	-0.77499***
Putts per Round	0.35983***
GIR Putts	0.58234***
Sand Saves (SS)	-0.32141***
Short Game	-0.61039***
Eagles	-0.48784***
Rounds	-0.68418***
Academic Age Dummy Variables	
Senior	-0.22301**
Junior	-0.12563
Sophomore	0.07899
Freshman	0.23974**
Team Dummy Variables	

University of Arizona	-0.14242
Clemson University	-0.29896***
Duke University	-0.02609
California State - Fresno	-0.01887
Georgia State University	-0.02679
University of Kentucky	0.15855
Southeastern Louisiana University	-0.10522
University of Southern CA	-0.10022
Texas A& M University	0.18837*
Vanderbilt University	-0.03283
Coastal Carolina University	0.31977***

* significant at the 0.10 level
** significant at the 0.05 level
*** significant at the 0.01 level

In Table 4, we present the multiple regression results for four alternative models. As previously noted, these models vary by which putting statistic is used and by whether Short Game or Sand Saves is used in the estimation. Model 1 uses Putts per Round and Sand Saves (SS), Model 2 uses Putts per Round and Short Game, Model 3 uses GIR Putts and Sand Saves (SS), and Model 4 uses GIR Putts and Short Game.

TABLE 4
Regression Analysis (Standardized Beta Coefficients in parentheses)

MEASURE	Model 1	Model 2	Model 3	Model 4
Fairways Hit	-0.28 (-0.01)	-0.43 (-0.02)	-0.99 (-0.04)	-0.53 (-0.02)
Greens in Regulation (GIR)	-22.34*** (-0.81)	-21.60*** (-0.78)	-15.73*** (-0.57)	-14.97*** (-0.54)
Putts per Round	1.00*** (0.56)	0.94*** (0.52)	-----	------
GIR Putts	-----	-----	13.27*** (0.42)	8.92*** (0.28)
Sand Saves (SS)	0.67 (0.04)	-----	-0.32 (-0.02)	-----
Short Game	----	-0.70 (-0.03)	-----	-7.09*** (-0.29)
Eagles	0.01 (0.01)	0.01 (0.01)	-0.01 (-0.01)	-0.02 (-0.02)
Rounds	-0.01 (-0.04)	-0.01 (-0.04)	-0.02** (-0.12)	-0.01 (-0.07)
Academic Age Dummy Variables				
Senior	-0.40*	-0.42*	-0.20	-0.19
Junior	-0.33*	-0.36*	-0.22	-0.20
Sophomore	-0.48**	-0.50**	-0.46*	-0.51**
Team Dummy Variables				

University of Arizona	-0.02	0.01	-0.23	-0.11
Duke University	-0.06	-0.01	-0.33	-0.17
California State -Fresno	-0.11	-0.10	-0.11	0.00
Georgia State University	-0.79**	-0.71*	-1.25**	-0.66
University of Kentucky	1.44***	1.43***	0.85*	1.18**
Southeastern Louisiana University	-0.11	0.04	-0.50	0.40
University of Southern CA	-0.13	-0.15	-0.45	-0.29
Texas A& M University	-0.26	-0.20	-0.49	-0.14
Vanderbilt University	0.28	0.25	-0.37	-0.27
Coastal Carolina University	0.78**	0.79**	0.42	0.84*
F-Statistic	46.73***	46.23***	21.78***	32.09***
R-Square	0.92	0.92	0.85	0.89
Adjusted R-Square	0.90	0.90	0.81	0.87
F-Statistic (full versus reduced)	4.38***	4.16***	1.93**	2.78***

* significant at the 0.10 level, assuming a one-tailed test of hypothesis
** significant at the 0.05 level, assuming a one-tailed test of hypothesis
*** significant at the 0.01 level, assuming a one-tailed test of hypothesis

Overall, we observe that shot-making skills, player experience, and team effects collectively explain a large proportion of the variability in an amateur's scoring average independent of the model specified. Specifically, the adjusted R2 statistics across the four models range from 0.81 to 0.90, values that are similar to those reported in Davidson and Templin (1986) and Belkin, et al. (1994).

Of the specific shot-making skills, GIR and putting (either Putts per Round or GIR Putts), are the most consistent predictors of an amateur's average score across the four models. In each case, GIR is significant at the 1 percent level, as are both putting variables. However, the standardized beta coefficients show that GIR is the most important predictor, as was the case for the models estimated by Davidson and Templin (1986) and Belkin, et al. (1994). Both putting variables also are significant at the 1 percent level, though the standardized beta coefficients suggest that Putts per Round might be a superior measure of amateur putting, which runs counter to Shmanske's (1992) view of these variable definitions, as noted previously.

Interestingly, Short Game is a significant predictor of average score, but only when the variable GIR Putts is included in the model, which is Model 4 specifically. With regard to Sand Saves (SS), we find that it is not a significant factor in predicting a player's performance in either Model 1 or Model 3. Davidson and Templin (1986) and, more recently, Moy and Liaw (1998) find analogous results for their respective samples of professional golfers. One explanation put forth by Moy and Liaw is that all golfers have similar abilities in this skill category. Another more likely justification is one presented by Dorsal and Rotunda (2001), which is that bunker play is less frequent and, as a result, has a negligible

effect on a player's overall performance.

To the extent that the number of eagles over the season captures driving distance, the results indicate that driving distance is not a major factor in determining a player's performance. In general, this conclusion agrees with the findings of Davidson and Templin (1986), Belkin, et al. (1994), and Dorsel and Rotunda (2001). Hence, this finding seems to be independent of whether the golfer is an NCAA amateur or a professional player. However, such an assertion has to be made with caution, since no direct measure of driving distance was available to include in this amateur study.

In addition to a player's shot-making skills, experience and team effects appear to have an influence on an NCAA golfer's performance. With regard to the experience measures, the total number of rounds played in the 2002-2003 season improves a player's overall performance. This assertion is based on the consistently negative coefficient on Rounds across models, though the result is statistically significant only in Model 3. As for longer-term experience, sophomore players consistently achieve a lower average score than their freshman counterparts, and this effect is statistically significant across the four models. Juniors and seniors are found to enjoy the same performance effect linked to experience, but the influence is found to be statistically significant only in Models 1 and 2.

As for individual team effects, the results suggest that a statistically significant influence exists for certain collegiate programs. For example, holding all else constant, all four models indicate that players on the University of Kentucky team have higher and statistically significant average scores relative to players on the Clemson team (the suppressed dummy variable), who are the 2002-2003 NCAA Division I Champions. Conversely, players at Georgia State University achieve lower average scores than players at Clemson, independent of individual shot-making skills or experience, and three of the four models show this finding to be statistically significant. The absence of statistical significance for the other teams might be attributable to limited variability of team effects within a single NCAA division.

Finally, an F-test comparing the full model to a reduced version was conducted across each model specification, where the reduced model assumes that the academic age and team effects are jointly zero. As noted in Table 4, the null hypothesis was rejected across all four models, indicating that these two experience variables collectively help to explain the variability of an amateur player's performance. This outcome validates the belief of other researchers, including Belkin et al. (1994) and Shmanske (1992).

Conclusions

The importance of shot-making skills to a professional golfer's success has been well documented in the literature. In general, research studies point to the fact that a variety of shot-making skills are important to a player's overall performance. More specifically, four shot-making skills – GIR, putting, driving accuracy, and driving distance – are responsible for the majority of variation in a professional golfer's scoring performance. Of these four, GIR and putting have consistently been found to be the more important factors. On occasion, driving accuracy and driving distance have been found to statistically impact a professional golfer's average score, but typically the influence is weaker than for GIR and putting skills.

Despite an accumulating literature seeking to validate or refine these results, we know of no study that has extended this analysis beyond the realm of professional golfers. To that end, we attempt to fill this void in the literature by empirically identifying performance determinants for amateur golfers. Using a sample of NCAA Division I male golfers, we hypothesize that a variety of shot-making skills along with player experience and team membership are expected to influence an amateur golfer's performance measured as average score per round. Using multiple regression analysis, our results indicate that all these factors collectively explain a large percentage of the variability in an NCAA golfer's average score. This is evidenced by R-squared values ranging from 0.81 to 0.90 across four different models distinguished by varying variable definitions.

We further find that the amateur golfer's shot-making skills measured through GIR and putting are the most important factors to explaining average score per round. These findings offer an important contribution to the growing literature on professional golfer performance in that they validate and extend much of what has been shown in existing studies. Future research should attempt to further extend these findings to other amateur data, as they become available.

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