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Pressure versus ability: Evidence from penalty shoot-outs between teams from different divisions

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ABSTRACT

This study utilizes data from 586 shoot-outs between teams from different divisions in national cups of the top five European soccer countries. We find that a difference in one league between the teams increases the gap between probabilities of winning by 8 percentage points in favor of a team from a higher division. This result contradicts the widespread belief that penalty shoot-outs are a game of chance, highlighting the importance of ability even in a simple mechanical task that takes place in high-pressure situations.

1. Introduction

One of the important features of any tournament is the fairness criteria according to which the probabilities of winning the tournament are naturally ordered according to the players' ranking (Groh, Moldovanu, Sela & Sunde, 2012). A penalty shoot-out is the culmination of a tied soccer (football) game that involves large stakes and high pressure (Jordet, Hartman, Visscher & Lemmink, 2007). It is widely believed that either team has the same probability of winning a penalty shoot-out, regardless of its ranking. If this is indeed the case, then the method of penalty shoot-outs does not satisfy the fairness criteria, since better teams do not have a higher probability of winning.

Our aim in this study is to investigate whether penalty shoot-out between teams from different abilities is indeed a complete game of chance. To do this, we utilize data from penalty shoot-outs in the national cup competitions of the top five European soccer countries (Germany, Italy, Spain, England, and France) according to the ranking of the Union of European Football Associations (UEFA). More specifically, we use data from games between teams from different divisions, since, by definition, a team from a higher division is regarded as a higher ranked team. We also assume that rankings and abilities are highly connected. This assumption is intuitive, since teams from higher divisions are able to attract better field players, goalkeepers, and coaches. Therefore, we can test whether higher-ranked teams have a higher probability of winning in penalty shoot-outs. In total, there were 586 games between teams from different divisions, starting from the year in which these countries introduced a one-leg cup structure.[1]

There are three possible predictions in a shoot-out between a team from a higher and lower divisions. As already mentioned, a shoot-out is a situation where the stakes are high. Therefore, the first prediction is based on economic theory, according to which, agents with higher ability are supposed to enhance their performance when the stakes are greater (Ehrenberg & Bognanno, 1990; Lazear, 2000; González-Díaz, Gossner & Rogers, 2012; Jetter & Walker, 2015; Cohen-Zada, Krumer & Shapir, 2018; Iqbal & Krumer, 2019). In addition, professional kickers/goalkeepers randomize their actions during penalty kicks (Palacios-Huerta, 2003). However, according to survey presented in Palacios-Huerta (2014a), players from lower ability

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[1] For England, we use data from the England Football League Cup. See discussion in Section 3 on why we chose only a one-leg structure.

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distribution (MLS league) would prefer to kick to the same side more frequently than more skilled players from the top European leagues. Such a preference is likely to affect the success rate in favor of the more skilled players.[2]

On the other hand, higher-ranked teams are expected to win even before the shoot-out and such high expectations may put additional pressure on these teams, since they have more to lose. Such high stakes may provoke "choking" under pressure (Baumeister, 1984; Baumeister, Hamilton and Tice, 1985; Ariely et al., 2009; Jordet, 2009; Hickman & Metz, 2015; Harb-Wu & Krumer, 2019). Therefore, according to the choking literature, the lower-ranked team actually has a higher probability of winning. The third prediction is based on widespread beliefs that both teams would have the same probability of winning a shoot-out.

It is important to note that in a recent paper, Arrondel, Duhautois & Laslier (2019) used a binary variable "higher level" as one of the controls to estimate the probability of winning in shoot-outs in French Cups. This variable indicated whether a team is from a higher division than its opponent. The authors briefly report a positive coefficient without further discussion, suggesting that teams from higher divisions have a higher probability of winning.

We used a different measure in the present study, namely a difference in leagues between the two teams. In addition, we used data from five countries. We find that, on average, a difference of one league between the teams increases the higher division team's probability of winning the shoot-out by about 4 percentage points. To put this finding into perspective, if the probability of each of two equal teams from the same division winning the shoot-out is 50 percent, a difference in one division creates a gap of 8 percentage points between the teams' probabilities of winning (54 percent relative to 46 percent). Interestingly, a team from the higher division won in five out of the six shoot-outs that took place in the cup finals (the only exception was Hannover 96, who won against Borussia Mönchengladbach in 1991 – 92).

Our findings suggest that teams from different divisions do not have equal probabilities of winning. Rather, teams with higher ability perform better in the most critical moment of the game. This result is in line with several previous studies that have used data from sport to show that higher ability contestants enhance their performance when it matters most. For example, Cohen-Zada, Krumer & Shapir (2018) studied tennis tiebreaks, which, like penalty shoot-outs, are the culmination of tennis matches. The authors found that the most important factor affecting the probability of winning is a player's ability, as measured by his or her world rankings. This result is in line with González-Díaz, Gossner & Rogers (2012), who found that higher-ability tennis players respond positively to the importance of points. Similarly, Jetter & Walker (2015) found a clutch-player effect in professional tennis, according to which top players perform better in the most important tournaments. Similarly, Iqbal & Krumer (2019) showed that higher stakes improved the performance of higher ranked tennis players in Davis Cup tournaments.

Our study contributes to the literature in several ways. First, it investigates the performance on a team level rather than the performance on the individual level, as described in the previous paragraph. Second, we emphasize relative performance rather than absolute performance in interactive contests. Previous studies on interactive contests such as tennis and soccer have shown that high stakes could actually harm the absolute performance of players. For example, Paserman (2010) and Cohen-Zada et al. (2017) found that tennis players choke more in the most important junctures of tennis match. Jordet et al. (2007) and Arrondel, Duhautois & Laslier (2019) illustrated that the probability of scoring in a penalty shoot-out is negatively affected by the stakes involved. Dohmen (2008) found a higher probability of missing the goal without the goalkeeper's inference when playing at home. Finally, Jordet (2009) showed that superstars had a lower probability of scoring a penalty compared to other players.

In addition, it is possible that in non-interactive tasks, abnormal stakes would provoke choking, as Harb-Wu & Krumer (2019) showed using a task of shooting in professional biathlon. Hickman & Metz (2015) found that higher stakes in professional golf increase the likelihood of missing a shot on the final hole. Cao, Price & Stone (2011), as well as Toma (2017), presented evidence of choking under pressure in free-throw shots of close professional basketball games.[3]

Although we cannot say anything about the absolute performance of the teams, we find that, on a team level, the relative performance of the higher ranked team is better in the most important moment of the game.

The remainder of the paper is organized as follows. Section 2 describes the penalty shoot-out setting. Section 3 presents the data and descriptive results, before Section 4 presents the estimation strategy and results. Finally, we offer concluding remarks in Section 5.

2. Description of penalty shoot-outs in national cups

A penalty shoot-out normally takes place in elimination-type tournaments, where a winner advances to the next stage and the loser is eliminated. This structure appears in national cup tournaments where teams from different divisions compete against each other. With some exceptions, it does not appear in the league matches that adopt the round-robin structure, where each team competes against all the others. The winner of a national cup participates in the European Cup tournament in the following season.[4] As a result, national cups provide teams from lower divisions with an opportunity to participate in the inter-European club competitions that are organized by UEFA.[5]

A shoot-out only takes place in games that end in a draw.[6] Before the advent of shoot-outs, such games were decided by the toss of a coin or by a replay. In 1968, Yosef Dagan, the Israel Football Association's secretary at the time, proposed penalty shoot-outs after his team lost by the drawing of lots at the 1968 Olympics. The International Football Association Board (IFAB) approved the proposal in 1970.

Each team takes turns shooting at goal from the penalty spot, with the goal only defended by the opposing team's goalkeeper. Five different kickers from each team that execute the task, such that each team takes one kick, then the other team takes a kick, and so on. If the score is still tied after five pairs of kicks, then each team has to kick one more time each until one of the teams wins.

3. Data and variables

3.1. Data

To estimate the effect of difference in teams' abilities on the probability of winning a shoot-out, we only used data on games between

[2] See also Azar & Bar-Eli (2011) for additional evidence on randomization in penalty kicks. It is also worth mentioning Bar-Eli et al. (2007) who showed an overestimation of a jumping strategy among goalkeepers.

[3] For additional references on the link between incentives and performance, see the comprehensive review by Gneezy, Meier & Rey-Biel (2011). Also, see Beilock & Gray (2007) for a psychological review of choking in sports.

[4] Up until the 1998 – 99 season, the winners of the national cups (or in some cases, the runners-up) participated in the UEFA Cup Winner's Cup. After that, the winners (or in some cases, the runners-up) participated in the UEFA Cup (later called the Europa League).

[5] There were several cases where teams from lower divisions won the national cups, including En Avant de Guingamp from France in 2008 – 09 and Hannover 96 from Germany in 1991 – 92.

[6] In a best-of-two type of game (for example, the Champions League), a penalty shoot-out takes place if the overall result of the two games is the same for both teams.

Table 1
Description of the dataset.

Competition	Seasons	Observations
Germany: DFB-Pokal	1991 – 2018	150
Spain: Copa del Rey	1986 – 2018	58
France: Coupe de France	1981 – 2018	183
Italy: Coppa Italia	1979 – 2018	80
England: Football League Cup	1997 – 2018	115
Total		586

Note: The final game of the 1973 – 74 season in Coppa Italia had a one-leg structure and is therefore included in our dataset.

teams from different divisions. This makes it easier to disentangle the abilities of the teams and define a stronger and a weaker team. We only used data on games with a one-leg structure to avoid the possible asymmetry that may stem from different winner-loser effects, which may be driven by the result of the second game (for evidence on winner-loser effects, see Malueg & Yates, 2010; Cohen-Zada, Krumer & Shtudiner, 2017; Page & Coates, 2017).

We used data from games in the domestic cups of the top five European soccer countries starting from the year in which these countries introduced a one-leg cup structure. Table 1 describes the relevant competitions and the years.[7] In total, there were 586 games between teams from two different divisions.

For every game, we have information available regarding the names of the teams, the location, and the round of the game in the tournament, the total number of rounds in the tournament, and the division of each team in the respective season. The higher the division, the higher the ability of the club. These data are available from www.rsssf.com.

3.2. Variables

For each match in our dataset, we randomly picked one of the teams and denoted it as *Team A* and the other team as *Team B*. Thus, our outcome variable takes the value of one if *Team A* won the shoot-out and zero otherwise. We can see from Table 2 that a random *Team A* won 48.8 percent of the shoot-outs (see Appendix A for descriptive statistics for each league separately).

We use the difference between teams' divisions to estimate the effect of difference in abilities on probability of winning the shoot-out. Note that a lower number of a team's division represents a higher ability; for example, a first division is higher than a second division. Therefore, if *Team A* is from a higher division than *Team B*, the difference between teams' divisions will be a negative number. Fig. 1 shows that, on average, a higher division team has a 10 percentage points higher probability of winning (55 percent versus 45 percent).

We also controlled for home advantage. The variable that indicates having a home advantage by *Team A* gets the value of one if *Team A* competes at home and zero otherwise. In addition, since there were final games in a neutral field, the variable that indicates having a home advantage by *Team B* gets the value of one if *Team B* competes at home, and zero otherwise.[8] We also controlled for the ratio between the round of the game in the tournament and the total number of rounds. Interestingly, teams from the higher division won in five out of six finals in

[7] We did not include English FA cup since, according to the rules of this tournament, in order to reach the shoot-outs, teams have to play twice, which makes it difficult to assume that a team from a lower division that did not lose twice to a team from a higher division is really a lower-ability team.

[8] There were two French Cup finals (Metz vs. Sochaux in 1987 – 88 and Strasbourg vs. Amiens in 2000 – 01), one German (Hannover 96 vs. Borussia Mönchengladbach in 1991 – 92), one Italian (Bologna vs. Palermo in 1973 – 74), and two English Football League finals (Liverpool vs. Birmingham City in 2000 – 01 and Liverpool vs. Cardiff City in 2011 – 12) that were played on neutral fields.

Table 2
Descriptive statistics.

	Mean	Standard deviation	Min	Max
Variable Name				
Team A wins	0.488	0.500	0	1
Team A home advantage	0.505	0.500	0	1
Team A division	2.410	1.150	1	6
Team B division	2.372	1.130	1	6
Difference in divisions between teams A and B	0.038	1.708	-4	4
Observations	586			

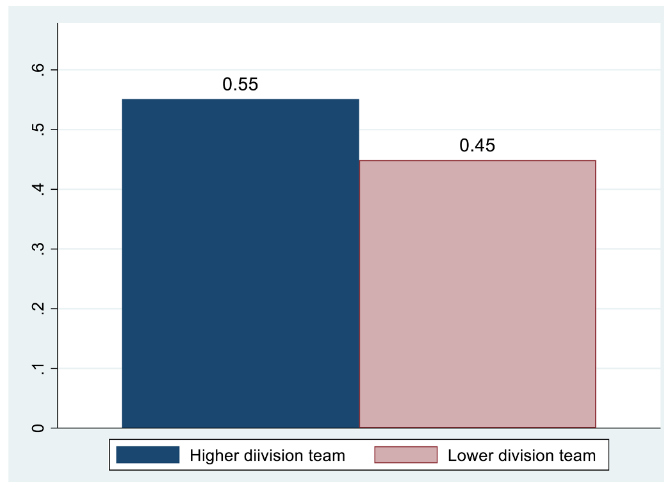

Fig. 1. Share of wins as a function of teams' divisions.

our data. The only exception was Hannover 96, which won against Borussia Mönchengladbach in the final of 1991 – 92 DFB-Pokal.

As we randomized the identity of teams *A* and *B*, they are not expected to be different in any of their characteristics. Table 3 compares the means of each characteristic of the two teams and tests whether the difference between them is significant. In Columns 3 and 4 of Table 3, we report the difference and the *P-values* of the paired *t-test*, respectively. We can see that teams *A* and *B* do not differ in any of their characteristics, implying that the randomization process was successful.

4. Estimation strategy and results

Since our outcome variable is a binary one, we estimate a logit model of the probability of *Team A* to win the shoot-out as a function of difference in divisions between the teams. Our basic set of controls includes a dummy variable for whether each of the teams has a home advantage, and the relative round of the tournament. In addition, since the rules of penalty shoot-outs changed several times over the years, we use year dummies.[9] Finally, we also use country dummies as well. Formally, this specification takes the form:

$$Log\left(\frac{\pi_{AByc}}{1-\pi_{AByc}}\right) = \beta_0 + \beta_1 \cdot DiffDiv_{AByc} + \beta_2 \cdot X_{AByc} + \varepsilon_{AByc} \quad (1)$$

Where the dependent variable is the probability of *Team A* to defeat *Team B*, given the country *c* and year *y*, X_{AByc} is our set of controls, and ε_{AByc} is an error term. As described above, if the difference in divisions between the teams *A* and *B*, $DiffDiv_{AByc}$, is negative, then *Team A* is from the higher division.

[9] See Dohmen (2008) and Apestigua & Palacios-Huerta (2010) for additional details on the rules of the penalty kicks.

Table 3
Comparison of teams' pre-treatment characteristics.

	Team A (1)	Team B (2)	Difference (3)	P-value (4)
Team wins	0.488	0.512	-0.024	0.563
Home advantage	0.505	0.485	0.020	0.619
Division	2.410	2.372	0.038	0.595

Notes: Columns 1 and 2 present the average value of each of the characteristics of Teams A and B respectively. The differences between these values appear in Column 3. Column 4 reports the P-values of paired t-test.

Column 1 of Table 4 presents the results, from estimating Eq. 1 without a list of controls. Standard errors appear in parentheses. The results show that the coefficient β_1 is negative and significant at the 1% level. This implies that *Team A* has a significantly higher probability of winning a shoot-out if it is from a higher division. Next, we add to Eq. (1) the home advantage and relative round variables. Column 2 shows that a difference in one division in favor of *Team A*, increases the *Team A*'s probability of winning by 4 percentage points. The results are robust to including year and country dummies, as appear in Columns 3 and 4, respectively.

In this specification, the effect of being a team from a higher division (relative to being from a lower division) on the probability of *Team A* to win the shoot-out is $2\beta_1$. To illustrate the magnitude of this estimate, the probability of each of two equal teams from the same division winning the shoot-out is 50 percent. However, according to the results in Column 4, a team from the first division increases its probability of winning against a team from the second division to 54 percent, which is 8 percentage points higher than the probability of the other team winning (54 percent relative to 46 percent).

In Column 5, we add interactions between *DiffDiv* and a dummy variable for *Team A*'s a home advantage, and separately between *DiffDiv* and the relative round of the tournament. The marginal effect of *DiffDiv* becomes larger, but also the standard errors, increasing the significance level to 5.2%. However, it is important to note that the most significant interaction term has the p-val of 0.49, suggesting that these interactions only add a statistical noise.

In Column 6, we restricted the data to cases where a higher-division team is from the top division. We see a very similar magnitude as previously. If we take an underdog team from the third division, the probabilities of winning would be 59.2 percent versus 40.8 percent in favor of a team from the top division, which is a very large difference. This gap is even wider when we use a team from the second division as a higher division team, as shown in Column 7. The result indicates that, in a game between teams from the second and fourth divisions, the probabilities of winning would be 61.4 percent versus 38.6 percent in favor of a second division team.

One additional control that would have been worth to add is the identity of the first kicking team. For example, Apesteguia & Palacios-Huerta (2010) found that the first kicking team had a significant margin of 21 percentage points over the second kicking team. Although, Kocher, Lenz & Sutter (2012) as well as Arrondel, Duhautois & Laslier (2019) challenged that result, Palacios-Huerta (2014b) reproduced this first-mover advantage using a significantly larger sample size than in the two challenging papers (including the entire data of Kocher, Lenz & Sutter (2012)). More recently, González-Díaz & Palacios-Huerta (2016) obtained a similar result in a multi-stage chess contest (chess matches) between two players, and found that the player playing with the white pieces in the odd games was much more likely to win the match than the player playing with the white pieces in the even games. Therefore, omitting the identity of the first-kicking team may bias the results. However, it was not possible to obtain the information on the identity of the first kicking team in games that took place in the period of more than 40 years (many of them between teams from low divisions). Nevertheless, based on a very plausible assumption that teams from higher division did not have a significantly larger probability of being the first kicking team, our results remain unbiased.

Taken together, our results suggest that, on average, higher-ranked teams outperform their opponent in penalty shoot-outs. This does not mean that individual players from the highest level do not choke, as was described by Jordet (2009). However, since soccer is a team sport, it is more natural to look at the team's overall performance. Finally, despite our findings, it still seems reasonable for lower-division teams to reach a penalty shoot-out, since they are likely to have a better chance of winning in a shoot-out than during regular time.

5. Conclusion

In this study, we have found that higher-ranked soccer teams perform a simple mechanical task better in a situation that involves high pressure. These results contradict a widespread belief that penalty shoot-outs are a "lottery" in which teams have equal probabilities of winning. Our results also suggest that penalty shoot-outs satisfy the fairness criteria according to which the probabilities of winning the tournament are ordered naturally according to the teams' rankings. Our findings are in line with economic theory, according to which higher ability agents are supposed to enhance their (relative) performance when the stakes are larger.

Finally, the findings of this study may help coaches and players from lower divisions prepare better for shoot-outs. For example, coaches should not refer to shoot-outs as a game of chance, but instead invest more time in preparing for penalty shoot-outs, both technically and psychologically. Doing so might increase their probability of winning.

Table 4
Logit average marginal effect of difference in divisions on the probability of winning a penalty shoot-out.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Difference in divisions	-0.033***	-0.040***	-0.041***	-0.040***	-0.061*	-0.046***	-0.057**
	(0.012)	(0.014)	(0.014)	(0.013)	(0.031)	(0.017)	(0.028)
Basic controls	No	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	No	No	Yes	Yes	Yes	Yes	Yes
Year dummies	No	No	No	Yes	Yes	Yes	Yes
Interactions with basic controls	No	No	No	No	Yes	No	No
Number of obs.	586	586	586	585	585	309	192

Note: The list of basic controls includes whether a team has home advantage and the round of the match in the tournament relative to the total number of rounds. Columns 1 – 4 include all the data. In Column 5, we add interaction of *DiffDiv* with basic controls. In Column 6, a higher-division team is from the top division only. In Column 7, a higher-division team is from the second division only. Standard errors are in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

Appendix A. descriptive statistics per country

Tables A1–A5.

Table A1
Descriptive statistics for Germany.

	Mean	Standard deviation	Min	Max
Variable Name				
Team A wins	0.520	0.501	0	1
Team A home advantage	0.513	0.501	0	1
Team A division	2.206	0.985	1	4
Team B division	2.120	0.933	1	4
Difference in divisions between teams A and B	0.087	1.634	-3	3
Observations	150			

Table A2
Descriptive statistics for Spain.

	Mean	Standard deviation	Min	Max
Variable Name				
Team A wins	0.517	0.504	0	1
Team A home advantage	0.500	0.504	0	1
Team A division	2.586	1.093	1	4
Team B division	2.552	1.095	1	4
Difference in divisions between teams A and B	0.034	1.600	-3	3
Observations	58			

Table A3
Descriptive statistics for France.

	Mean	Standard deviation	Min	Max
Variable Name				
Team A wins	0.481	0.501	0	1
Team A home advantage	0.497	0.501	0	1
Team A division	2.672	1.379	1	6
Team B division	2.486	1.378	1	6
Difference in divisions between teams A and B	0.186	1.952	-4	4
Observations	183			

Table A4
Descriptive statistics for Italy.

	Mean	Standard deviation	Min	Max
Variable Name				
Team A wins	0.500	0.503	0	1
Team A home advantage	0.575	0.497	0	1
Team A division	2.113	0.871	1	4
Team B division	2.125	0.753	1	3
Difference in divisions between teams A and B	-0.013	1.237	-2	3
Observations	80			

Table A5
Descriptive statistics for England.

	Mean	Standard deviation	Min	Max
Variable Name				
Team A wins	0.435	0.498	0	1
Team A home advantage	0.461	0.500	0	1
Team A division	2.374	1.055	1	4
Team B division	2.600	1.083	1	4
Difference in divisions between teams A and B	-0.226	1.712	-3	3
Observations	115			

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