Universität St.Gallen

First In First Win: Evidence on Unfairness of Round-Robin Tournaments in Mega-Events

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July 2016 Discussion Paper no. 2016-11

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Electronic Publication: Fax +41 71 224 31 35
http://www.seps.unisg.ch

Midweek Effect on Performance:
Evidence from the German Soccer Bundesliga

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Abstract

The order of actions in contests may have a significant effect on performance. In this study we examine the role of schedule in round-robin tournaments with sequential games between three and four contestants. Our propensity-score matching estimation, based on soccer FIFA World Cups, UEFA European Championships and Olympic wrestling events, reveals that there is a substantial advantage to the contestant who competes in the first and third matches, which is in line with game-theoretical predictions. Our finding implies that the round-robin structure with sequential games is endogenously unfair, since it systematically favours one of the contestants.

Keywords

Performance, schedule effects, soccer.

JEL Classification

D00, L00, D20, Z20.

1 Introduction

The economic, cultural and political significance of the FIFA World Cup, the UEFA European Championship and the Olympic Games is enormous. For example, 3.6 billion viewers around the globe watched the 2012 London Olympic Games and 3.2 billion viewers watched the 2014 FIFA World Cup.[1] Not surprisingly, the outcomes of these mega-events have a large effect on various important aspects of life. For example, the World Cup qualification match between El Salvador and Honduras was a build-up for the so-called "Football war" between the countries in 1969. Russia initiated the annexation of Crimea three days after the most victorious sports event for Russian athletes ever, the 2014 Winter Sochi Olympic Games. Edmans, Garcia and Norli (2007) found that a loss in the World Cup leads to a next-day abnormal lower stock return in the losing country. Witte et al. (2000) reported a significantly higher mortality from acute myocardial infarction following Netherland's elimination in the 1996 European Championship. Carroll et al. (2002) who reported a higher number of heart attacks after England lost in the 1998 World Cup found a similar result. However, Berthier and Boulay (2003) found significantly lower myocardial infarction mortality in the day the French national team won the 1998 World Cup.

When we come to the question of what determines the success in sporting events, the most intuitive answers would be the economic resources, natural talent and home advantage (Bernard and Busse, 2004; Balmer et al., 2003; Moskowitz and Jon Wertheim, 2011). However, the aim of this paper is to show that the (typical) design of many contests in such events may also have a crucial effect on the winning probabilities.

[1] From: http://www.fifa.com/worldcup/news/y=2015/m=12/news=2014-fifa-world-cuptm-reached-3-2-billion-viewers-one-billion-watched--2745519.html, http://www.olympic.org/Documents/IOC_Marketing/Broadcasting/London_2012_Global_%20Broadcast_Report.pdf. Last accessed on 29/02/2016.

More specifically, we investigate whether the order of matches in the group stages of the most important sporting events in the world affect the probability to qualify to the next round. These group stages are organized as round-robin tournaments in which each contestant (individual or team) competes against all the others in sequential games. This structure may create an asymmetry in interim rankings, because some competitors may have a different number of games at different stages of the tournament, which in turn creates an advantage to one of the contestants (Apesteguia and Palacios-Huerta, 2010; Genakos and Pagliero, 2012; Palacios-Huerta, 2014; Genakos, Pagliero and Gabri, 2015; Krumer, Megidish and Sela, 2016a). Therefore, our aim is to test whether one of the contestants has an advantage that stems from the order of games in which he or she competes. For that end, we investigate two completely different sports. The first is a team sport, soccer, where the groups are composed of four teams. The second is an individual sport, wrestling, where the groups are composed of three wrestlers.

For the case of soccer, we utilized data on all the group stages from all FIFA World Cups and UEFA European Championships from 1996 to 2014. As noted previously, these tournaments are the most prestigious soccer tournaments that involve the best soccer nations. Despite some natural asymmetry between teams, these events are most likely to be the most balanced out of all existing international soccer tournaments, with regard to the abilities among teams.[2] Our econometric analysis that is based on propensity score matching reveals a large and significant first mover advantage. We find that a team that plays in the first match of each round, namely in the first and the third matches, has a significantly higher probability to qualify to the next stage than the other teams. The effect of this schedule on the qualifying (success) probability is about 17% points, which is relatively large. The results are robust to different

[2] In the World Cups and European Championships, a team's average ranking is 21.5 with standard deviation of 17.4. In tournaments with the same round-robin structure, such as CAF Africa Cup of Nations and AFC Asian Cup, the corresponding numbers are 57.2 and 27.3 respectively (CAF Africa Cup of Nations), and 89.6 and 31.1 respectively (AFC Asian Cup).

specifications as well as to controlling for possible confounders such as teams' rankings, home advantage, seeding and rest hours.

For the case of wrestling, we had a unique opportunity to observe perfectly random contests that occurred in the Greco-Roman and freestyle wrestling Olympic events in Sydney 2000 and Athens 2004. As in the case of soccer, in wrestling we find that a wrestler who competes in the first and the third matches has a significantly higher probability to win the group than the other contenders do. The effect of competing in such a favourable schedule on the winning probability is approximately 10% points.

Our results are in line with a recent theoretical study of Krumer, Megidish and Sela (2016a). They modelled each match as an all-pay contest and showed that in round-robin tournaments among three or four symmetric contestants, there is a first-mover advantage driven by strategic effects arising from the subgame perfect equilibrium. More specifically, they found that a contestant that competes in the first and third matches has the highest probability to win the first match as well as the entire round-robin tournament.[3]

One of the alternative explanations of our result is the asymmetry in fatigue that stems from the schedule. However, we can rule out this explanation for both sports considered, soccer and wrestling. We find that a team or wrestler that competes in the first and the third matches has a significantly higher winning probability already in the first match when contestants are supposed to be symmetric with regard to fatigue. A possible mechanism behind this result, as described by Krumer, Megidish and Sela (2016a), is that, for example in the specific three contestants' case, a contestant who competes in the first and third matches has a positive probability that his opponent in the third round lost his previous match. However, a contestant who competes in the first two matches has to compete in both rounds against contestants, who

[3] This theoretical finding applies to all round-robin tournaments, whether the tournament is only 'a group stage' or the tournament itself.

still have not lost a single match. This allocation creates an asymmetry in the future expected values already in the first game, such that even in the asymmetric case a weaker contestant may have the highest probability to win the contest and the dominant contestant's probability is considerably lower if he does not compete in the first and the third matches (Krumer, Megidish and Sela, 2016b). Therefore, even in the a-priori symmetric case, a win in the first game changes contestants' expected values, whether they compete against the winner in the next round or not. As a result, a contestant that competes in the first and the third matches has a higher expected value and a higher probability to win the contest than his or her opponents do.

This paper contributes to the literature on the effect of scheduling on the individual and team performance in competitive environments. Previous studies highlighted the possible role of different psychological motives on performance driven by scheduling, such as ahead-behind asymmetry (Apesteguia and Palacios-Huerta, 2010; Palacios-Huerta, 2014; Krumer, 2013), memory related issues (Page and Page, 2010; De Bruin, 2005) or psychological momentum (Cohen-Zada, Krumer and Shtudiner, 2016). Although our finding is in line with certain theoretical predictions of a strategic allocation of efforts, we cannot rule out additional psychological motives that may affect performance in round-robin tournaments. In any case, our results, obtained in two completely different settings, increase the evidence for the claim that winning probabilities are endogenously determined. Therefore, this paper shows that the usual round-robin structure is unfair because it systematically favours one of the contestants. Of course, this raises questions about alternative tournament structures.

The remainder of the paper is organized as follows: Section 2 describes the round-robin tournaments. The data and descriptive results are presented in Section 3. Section 4 presents the estimation strategy. The results are contained in Section 5. Finally, in Section 6 we offer concluding remarks.

2 Round-robin tournaments

A round-robin tournament is a multi-stage tournament in which the number of contestants is $n > 2$. If n is even, then in each of the $(n-1)$ rounds, $\frac{n}{2}$ games take place, and if n is odd, there will be n rounds with $\frac{n-1}{2}$ games in each round, with each contestant resting in one of the rounds.

In this paper, we study round-robin tournaments with sequential games with either four teams (in soccer) or three contenders (in wrestling) which are part of larger tournaments that features later elimination stages. In the case of *four* teams, there will be three rounds with two sequential matches in each of the first two rounds, in total 6 matches. Table 2.1 describes the structure of such a tournament. We can see that in the last round both matches are played simultaneously. Hereafter we refer to *Team 1* as the team that competes in the first matches of the first two rounds, namely matches 1 and 3. *Team 2* is the team that competes in matches 1 and 4. *Team 3* is the team that competes in matches 2 and 3. Finally, *Team 4* is the team that competes in matches 2 and 4. In the end of the group stage, the two best teams according to the results of all matches qualify to the next stage.

Table 2.1: Schedule of sequential matches in round-robin of 4 teams in soccer

Round 1	Game 1: Team 1- Team 2 Game 2: Team 3- Team 4
Round 2	Game 3: Team 1- Team 3 Game 4: Team 2- Team 4
Round 3	Game 5-6: Team 1- Team 4 Game 5-6: Team 2- Team 3

In the round-robin tournament with *three* wrestlers with a sequential order of the games, there will be three sequential rounds with one match in each round and in total three matches. Table 2.2 describes the structure of this tournament. Hereafter we refer to *Wrestler 1* as to

wrestler who competes in the first and the third matches of the tournament. *Wrestler 2* is the wrestler who competes in matches 1 and 2. Finally, *Wrestler 3* is the wrestler who competes in matches 2 and 3. In the end of the group stage, the best wrestler according to the results of all matches qualifies to the next stage.

Table 2.2: Schedule of sequential matches in round-robin of 3 contenders in wrestling

Round 1	Game 1: Wrestler 1- Wrestler 2
Round 2	Game 2: Wrestler 2- Wrestler 3
Round 3	Game 3: Wrestler 1- Wrestler 3

3 Data and descriptive results

3.1 Data base

For the case of four teams in soccer, we collected data on all the group stages of the FIFA World Cups and UEFA European Championships soccer tournaments in the period from 1996 to 2014. The data includes ten such tournaments, namely five FIFA World Cups (France in 1998, South Korea and Japan in 2002, Germany in 2006, South Africa in 2010, and Brazil in 2014) and five UEFA European Championships (England in 1996, Holland and Belgium in 2000, Portugal in 2004, Austria and Switzerland in 2008, and Poland and Ukraine in 2012).

The choice of these years and tournaments was made for three major reasons. The first reason is that starting from December 1992 the FIFA, world football's governing body, introduced a ranking system for men's national teams, which can be used as the proxy of a team's ability. This ranking captures a team's performance over the last five years, where results that are more recent have a higher weight.[4] The second reason is that up to 1994, there were more than two teams that could qualify from the group stage in the FIFA World Cups. However, starting from 1996, only two teams qualify from the group stage in both types of tournaments.

[4] For additional information, see http://www.fifa.com/fifa-world-ranking/ranking-table/men/. Last accessed on 29/02/2016.

Therefore, starting from 1996, we could observe both, teams' rankings and homogeneous groups with regard to the number of qualifying teams in the FIFA and UEFA competitions. The last reason is related to the low variance in abilities among teams. Therefore, we choose the above-mentioned tournaments since the composition of the groups is much more balanced than in other Continental soccer tournaments such as, for example, the CAF African Cup of Nations or the AFC Asian Cup, where groups are usually consist of very asymmetric opponents, where some teams consist of professional players while others are amateurs.

For every team, information was available regarding its schedule of matches, whether a team qualified to the next stage, its most current world rankings prior to the beginning of the tournament, whether the team was top seeded in the group, the resting hours between each match, and finally whether a team had home advantage in the particular tournament. In all, the data covered 240 teams that participated in 60 different groups.

Concerning the order of the matches, it is important to note that in the UEFA European Championships one of the host nations traditionally plays in the first match of the tournament. Starting from 2006, the same rule applies to the FIFA World Cups. In 1998 and 2002, the champion of the previous tournament played in the opening match. In addition, in the 2014 FIFA World Cup, in 7 out of 8 groups, the seeded team played in the first and the third matches. The only exception was Spain, which played in the second and the forth matches. In total, we have 18 groups with non-random order of matches, in which the identity of *Team 1* was predetermined in 12 cases and the identity of *Team 2* was predetermined in six cases.[5]

For round-robin tournaments with three contestants, we found a unique case where contestants were allocated into groups randomly with one winner who qualified to the next stage to compete for the medals. This case occurred in two wrestling Olympic tournaments in

[5] We address the issue of non-random allocation of matches in the empirical section of this paper.

Sydney 2000 and Athens 2004. According to the Official report of the XXVII Olympiad: Sydney 2000 Olympic Games: "…Wrestlers were paired off for each round according to the numerical order determined by the drawing of lots at the weigh-in…" (p. 295).[6]

We collected data on all the group stages of two Olympic tournaments in Sydney 2000 and Athens 2004 for both different styles of wrestling, namely the Freestyle and the Greco-Roman style. For every wrestler, information was available regarding his or her gender, weight category and style, schedule of matches, whether a wrestler qualified to the next stage, and whether a wrestler had home advantage. In all, the data covered 480 wrestlers that participated in 160 different groups.

3.2 Descriptive statistics

To estimate the possible effects of match scheduling we use the event of qualification from the group stage as the outcome variable. In the four teams' case, Table 3.1 shows that a team that competes in the first and third matches (*Team 1*) qualifies to the next stage in two thirds of the cases. The second best team is *Team 3*, which plays in the second and third matches of the group stage. It qualifies to the next stage in only slightly less than half of the cases. The group stage of three wrestlers, described in Table 3.2, reveals a similar picture. *Wrestler 1*, who competes in the first and third matches, qualifies to the next stage in 40% of the cases. The two other wrestlers share approximately the same winning probability of 30%.

3.3 Variables

To estimate the effect of playing in the first and the third matches on the probability of qualifying, we create a dummy variable that gets the value of one if a team (soccer) or wrestler

[6] Available at http://library.la84.org/6oic/OfficialReports/2000/2000v2.pdf . Last assessed on 29/02/2016. We would like to thank former World Champion in Men's Wrestling Greco-Roman style, Gotsha Tsitsiashvili, for providing us with information about the draw procedure of wrestling tournaments.

(wrestling) competes in the first and the third matches of the tournament. As already mentioned, in the case of soccer this variable is defined as *Team 1* and in the case of wrestling it is defined as *Wrestler 1*.

It is important to note that the composition of teams in the group stage in soccer is determined according to the seeding system, where the best teams are top seeded and cannot meet each other in the group stage. These teams are determined according to the FIFA World Ranking. In addition, home teams are always top seeded. Moreover, as already discussed, in some cases the order of the matches for the seeded team in the group was predetermined. In this case without a completely randomly assigned group composition, the probability to qualify from the group stage is obviously a function of teams' (current and past) abilities. Therefore, we use two different measures to characterise teams' abilities. The first one, *Top Seeded*, gets the value of 1 if a team is top seeded team in the group and zero otherwise. The second measure is $log_2(Rank)$, where *Rank* is the most current World ranking of a team prior to the beginning of a tournament. The main advantage of this measure is that the differences in teams' quality are not linear but rather grow at an increasing rate as we move up the ranking. This implies that a difference of one position in the ranking list corresponds to a smaller difference in quality if the teams are at the bottom of the list, but to a more substantial difference when we compare the top teams (Klaassen and Magnus 2001; González-Diaz, Gossner and Rogers, 2012). Table 3.1 shows that *Team 2* has the lowest measure of $log_2(Rank)$ as well as the highest measure of *Top Seeded* which is associated with a higher ability. In other words, on average *Team 2* is a priori the stronger team in the group. However, as we can see in Table 3.1, its qualifying probability is the lowest among teams.

Since our data include teams that host the tournament, we also use the home advantage characteristic, which was found to play a significant role in previous soccer (Sutter and Kocher, 2004; Garicano, Palacios-Huerta and Prendergast, 2005; Pettersson-Lidbom and Priks, 2010)

and combat related studies (Krumer, 2014). Hence, the *Home Advantage* variable is assigned the value of one if a team hosts the tournament and zero otherwise. In addition, since differences in schedules may create asymmetry in resting hours, we also use the rest hours between each match as teams' characteristics. We observe that only between the second and the third matches *Team 1* (and *Team 3*) had more rest hours than two other teams.

Unlike soccer, in wrestling the composition of the groups as well as the order of matches was completely random. In this case, we use wrestlers' characteristics with regard to their home advantage, weight, tournament, style and gender. These characteristics are presented in Table 3.2.

Table 3.1: Descriptive statistics of round-robin of 4 teams (soccer)

Variable	Team 1 (N=60)	Team 2 (N=60)	Team 3 (N=60)	Team 4 (N=60)
Qualified	66.7%	41.7%	48.3%	43.3%
$\log_2$(Rank)	3.746 (1.382)	3.669 (1.548)	4.075 (1.326)	4.023 (1.355)
Top seeded (dummy variable)	0.300	0.350	0.150	0.200
Home advantage (dummy variable)	0.100	0.083	0.017	0.033
Average rest hours	118.4 (15.058)	118.4 (15.058)	113.3 (15.057)	113.3 (15.057)
Rest hours between first two rounds	121.9 (19.645)	132.8 (22.631)	111.8 (20.414)	122.8 (18.818)
Rest hours between last two rounds	114.9 (17.834)	103.9 (18.069)	114.9 (17.834)	103.9 (18.069)
FIFA World Cup (dummy variable)	0.667	0.667	0.667	0.667
UEFA European Championships (dummy variable)	0.333	0.333	0.333	0.333

Note: Two teams qualify from each group. Standard deviations for non-binary variables are reported in brackets.

Table 3.2: Descriptive statistics of round-Robin of 3 contenders (wrestling)

Variable	Wrestler 1 (N=160)	Wrestler 2 (N=160)	Wrestler 3 (N=160)
Qualified	40%	31.2%	28.8%
Home advantage (dummy variable)	0.025	0.031	0.031
Women (dummy variable)	0.088	0.088	0.088
Sydney 2000 Olympics (dummy variable)	0.438	0.438	0.438
Athens 2004 Olympics (dummy variable)	0.562	0.562	0.562
Wrestling freestyle (dummy variable)	0.581	0.581	0.581
Wrestling Greco-Roman style (dummy variable)	0.419	0.419	0.419

Note: One wrestler qualifies from each group.

4 Econometrics

4.1 The causal question

We are interested in learning the effect of playing in the first and third matches of the group stage on the success of the contestants in terms of the probability to qualify to the next stage. If the allocation of the games in the group stage were entirely random, as it happens in the wrestling case, then we would compare the means of these probabilities for *Team/Wrestler 1* to the means obtained by other teams/wrestlers. The difference would be a consistent estimate of the desired effect. However, in the case of soccer, scheduling is only partially random, since, as discussed above, other factors also determine a group's schedule, like allocating a home team or another seeded team to a certain order of matches. The distribution of the characteristics shown in Table 3.1 already point to some deviations from randomness. Such deviations need to be taken into account in any estimation strategy if they are correlated with the outcomes of interest (e.g. Imbens and Wooldridge, 2009), which are measures of the success of *Team 1*. In our case, we know the procedures according to which the composition of the groups are determined as well as the variables driving the deviation from randomness. Therefore, we opt for a selection-on-observable strategy to identify the causal effect. As described previously, since the schedule of the soccer tournaments takes into account the identity of the seeded team as well as the identity of the host team, we control for ability related characteristics, such as *Top Seeded*, log_2*(Ranking)* as well as for *Home Advantage*. In addition, a potential worry would be the difference in the rest hours between the matches, which we also take into account.

4.2 Estimator used

Since the previous section suggests that controlling for observable characteristics will be sufficient to identify a causal effect, we face a heterogeneity challenge. Namely, the effect of playing in the first and third matches may be different for different teams (depending on their

ranking, for example). Since the exact kind of heterogeneity is unknown, and since a very flexible way of controlling for the various confounding factors appears to be called for, we use a matching approach. To be more specific, we employ the radius-matching-on-the-propensity-score estimator with bias adjustment as suggested by Lechner, Miquel and Wunsch (2011) because it showed its superior finite sample and robustness properties in the large scale empirical Monte Carlo study conducted by Huber, Lechner and Wunsch (2013). The inference for the matching estimator is based on the weighted bootstrap (see also the empirical Monte Carlo results on the performance of different inference procedures investigated in Bodory, Camponovo, Huber and Lechner, 2016).[7]

5 Results

Although the purpose of the propensity score estimation is only a technical one, namely to allow easy purging of the results from selection effects, it is nevertheless interesting to see what drives selection. Generally, as already apparent from Table 3.1, selection effects are limited. In the soccer case, these effects are driven by rest hours. The detailed results can be found in Appendix A.

Tables 5.1 and 5.2 show the key results of this paper, namely the effect of playing in the first and third matches compared to playing any other order on the qualifying probability. In the soccer case, being *Team 1* leads to an effect of about 17% points, which is statistically significant with and without clustering the standard errors at the group level. When we control for rest hours, the effect becomes even larger. However, of course, this partially reflects the schedule itself. Lastly, we drop all the groups that involve home teams and groups in which the seeded team was allocated to a certain order of matches. This leaves 160 teams in the groups in

[7] We also used a standard bootstrap, which did not change the results. These results are available upon the request.

which the matches were allocated randomly. In this case, we still find a statistically significant effect of 14.4% points.[8]

Table 5.1: Levels and effects of competing in the first and third games in soccer

Qualified	Expected value when scheduled as Team 1	Expected value when not scheduled as Team 1	Effect of being scheduled as Team 1	Standard error of the effect	p-val. of the effect
Basic specification (99%)	0.629	0.461	0.168	0.038	0.000
Clustered at the group level (99%)	0.629	0.461	0.168	0.035	0.000
Basic with rest hours (97%)	0.704	0.452	0.252	0.041	0.000
Only random and without home teams groups (93%)	0.613	0.469	0.144	0.049	0.000

Note: Inference for average treatment effect is based on bootstrapping (4999 replications) p-values. The reported standard errors is the standard error of the effects obtained from the bootstrap. The percentage of remaining observations in common support are reported in brackets.

Table 5.2: Levels and effects of competing in the first and third fights in wrestling

Qualified	Expected value when scheduled as Wrestler 1	Expected value when not scheduled as Wrestler 1	Effect of being scheduled as Wrestler 1	Standard error of the effect	p-val. of the effect
All data (100%)	0.400	0.300	0.100	0.026	0.000
Sydney Olympics (100%)	0.429	0.286	0.143	0.046	0.000
Athens Olympics (100%)	0.380	0.310	0.070	0.037	0.015

Note: Inference for average treatment effect is based on bootstrapping (4999 replications) p-values. The reported standard errors is the standard error of the effects obtained from the bootstrap. The percentage of remaining observations in common support are reported in brackets.

We find similar results for wrestling. The schedule of *Wrestler 1* has an effect of 10% points when we analyse all data. Although the effect in the 2004 Athens Olympics is smaller than in the Sydney Olympics, it is still large and statistically significant. To sum up, for the wrestling case that refers to the round-robin tournament with three contestants, the treatment and control groups were determined by explicit randomization so that there is no need to control

[8] Our results are also robust to controlling for the distance between the cities in which each team played. Interestingly, there is no correlation between this measure, which may serve as a proxy for fatigue, and the outcome of interest (qualifying probability). The results of this specification are available upon the request.

for covariates. Therefore, we conclude that competing in the first and the third matches in such a contest positively and significantly affects the probability to qualify to the next stage.

It is also interesting to investigate the path of each contestant during the tournament. For the soccer case, we provide a more detailed description for the results of each team in each round and qualifying status in Table 5.3. For the first round, we also show the average number of points.[9]

We can see that in the match between *Team 1* and *Team 2* the average number of points of *Team 1* is 1.77, which is significantly higher than 0.92, the average number of points of *Team 2*. Thus, a win in the first round provides a team with a clear advantage to qualify to the next stage. In 78% of the cases, a team that won in the first round eventually advanced to the next stage. However, in only 53% of the cases, a team that drew in its first match qualified to the next stage. Not surprisingly, a team that lost in the first stage managed to qualify in only 20% of the cases. In addition, the only team that had a significantly higher probability to win in the first round is *Team 1*. In the second match, between *Team 3* and *Team 4*, no team accumulated a significantly higher number of points. These results highlight the important role of winning in the first round and is in line with game-theoretical results in Krumer, Megidish and Sela (2016a).

A significantly higher number of points obtained by *Team 1* in the first match emphasizes the insignificant effect of additional rest hours. This is because both teams played their first match. Therefore, they were symmetric with regard to fatigue.[10] Moreover, this result highlights the significant role of the future order of actions that affect the team's current performance.

[9] Note that each team is awarded with three points for a win, one point for a draw and no points in case of a loss.

[10] The elimination of the fatigue explanation is in line with Scoppa (2015), who investigated all FIFA World Cups and UEFA Championships and found no effect of additional rest days on teams' winning probabilities.

Table 5.3: Qualifying probabilities by result in each round for each team in soccer.

	Team 1	Team 2	Team 3	Team 4	Total
Round 1					
Win in round 1	29	12	27	19	87
Qualified	24	10	18	16	68
Draw in round 1	19	19	14	14	66
Qualified	12	10	6	7	35
Lose in round 1	12	29	19	27	87
Qualified	4	5	5	3	17
Average number of points in Round 1	1.77	0.92	1.58	1.18	
H_0: Points are equal in each pair (p-val)	0.007		0.241		
Round 2 After Winning in Round 1					
Win in round 2	13	7	9	11	40
Qualified	13	7	9	11	40
Draw in round 2	10	1	8	7	26
Qualified	9	1	5	5	20
Lose in round 2	6	4	10	1	21
Qualified	2	2	4	0	8
Round 2 After Drawing in Round 1					
Win in round 2	6	8	3	6	23
Qualified	5	6	3	6	20
Draw in round 2	5	7	5	1	18
Qualified	4	3	2	0	9
Lose in round 2	8	4	6	7	25
Qualified	3	1	1	1	6
Round 2 After Losing in Round 1					
Win in round 2	6	8	5	5	24
Qualifies	4	3	4	2	13
Draw in round 2	3	7	5	7	22
Qualifies	0	2	1	1	4
Lose in round 2	3	14	9	15	41
Qualified	0	0	0	0	0

Notes: For each team, the numbers of wins, losses and draws are reported in each round. In the second round, we report the results conditional on the first round outcome. For each result, we also report the number of times that a team qualified from the group stage. In addition, for the first round for each team, we calculate the average number of points as $\frac{3 \cdot Wins + 1 \cdot Draws}{60}$. For the first round for each match (between teams 1 and 2 and between teams 3 and 4) we report the p-value of the paired t-test that the number of points is equal for each team.

A similar analysis for the wrestling case is presented in Table 5.4. We can see that in the first fight in the tournament between *Wrestler 1* and *Wrestler 2*, the former has a significantly

higher winning probability. This result rules out possible claims that fatigue plays a role in wrestlers' performance, since similarly to the soccer case, in the first fight both contestants are symmetric with regard to their fatigue levels. Therefore, a significant winning probability of *Wrestler 1* in the first fight can be attributed to the effect of the future order of fights on contestants' expected values and their winning probabilities.

Table 5.4: Qualifying probabilities by result in each round for each wrestler.

	Wrestler 1	Wrestler 2	Wrestler 3	Total
First Fight				
Win in first fight	91	69	81	241
Share of wins	57%	43%	49%	
Qualified	62	48	45	155
Lose in first fight	69	91	79	239
Qualified	2	2	1	5
H_0: Share of wins are equal for wrestlers 1 and 2 (p-val)	0.082			
Second fight after winning previously				
Win in second fight	59	46	41	146
Qualified	59	46	41	146
Lose in in second fight	32	23	40	95
Qualified	3	2	4	9
Second fight after losing previously				
Win in fight 2	31	33	29	93
Qualified	2	2	1	5
Lose in fight 2	38	58	50	146
Qualified	0	0	0	0

Notes: For each wrestler, the number of wins and losses are reported in each fight. For the second fight (Round 2 for wrestler 2, Round 3 for wrestlers 1 and 2) we report the results conditional on the first fight outcome. For each result we also report the number of times that a wrestler qualified from the group stage. In addition, for the first round for wrestlers 1 and 2, we calculate the share of wins as $\frac{Wins}{160}$. For this case, we report the p-value of the paired t-test that the share of wins is equal for each wrestler.

6 Conclusion

In this paper, we test whether the order of games affects the probability of success in round-robin tournaments. In two different settings, namely the group stage of four teams in soccer and the group stage of three contenders in wrestling, we find a substantial advantage to

the team/wrestler who competes in the first and the third games. This result is in line with theoretical predictions of the first mover advantage in round-robin tournaments presented in Krumer, Megidish and Sela (2016a). Our findings imply that the round-robin structure with sequential games is endogenously unfair.

To put our results into perspective, the most influential sporting mega-events, such as FIFA World Cups, UEFA European Championships and some events of the Olympic Games, are designed as round-robin tournaments with sequential games. These tournaments have a "built-in bug" of unfairness. Of course, if the goal of a contest designer is to maximize the qualifying probability of the home and other seeded contestants, then these contestants should be allocated to play in the first and third matches. As evidence, all the seeded teams, except for Spain in the 2014 FIFA World Cup, played in the first and the third matches.

However, if the goal of the designer of the contest is to reduce any advantage driven by the particular schedule of matches, there are several possible remedies. First of all, no groups with odd number of contestants should be composed. Second, all the games in the group stage should be played simultaneously. This, however, may reduce revenues from the TV rights. This loss of revenue may be reduced by applying the 'Swiss system', used for example in chess tournaments, according to which starting from the second round, the winners of the first matches compete against each other. In the same way, the losers of the first matches compete against each other as well. In fact, in each round, each game will feature contestants who had exactly the same performance until that point. In the end of the group stage, the results of all the competitors are pooled and the ranking will be made among all the contestants.[11] The obvious advantage of this structure is that it allows symmetry between contestants in each round

[11] One possible concern is that this structure can harm fans who buy tickets in advance, since they do not know where and when their team should play. However, current advances in marketing like "Follow my Team" ticket packages offered at the EURO 2016, allow fans to have tickets to the matches of their team regardless the date and location of the matches.

and therefore makes a contest fairer, which may outweigh some possible costs of not knowing the pairings more than one round ahead.

7 References

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Appendix A: Propensity score estimation

Table A.1 contains the detailed estimation results of the propensity in soccer case.

Table A.1: Estimation of propensity score in soccer case (mean marginal effects)

Variables	Basic (not clustered at the group level)	Clustered at the group level	Basic with rest hours	Basic in random and without home advantage groups
$\log_2$(Rank)	-0.005	-0.005	0.002	-0.007
Rank	-0.002	-0.002	-0.002	-0.004
Top seeded	-0.019	-0.019	0.002	-0.181***
FIFA World Cup	0.024	0.024	-0.077	0.036
Home advantage	0.276	0.276	0.204	
Not random group	-0.022	-0.022	-0.032	
Rest hours between last two rounds			0.005***	
Number of observations	240	240	240	160

Note: Mean marginal effects presented. *, **, *** denotes significance at the 10%, 5%, 1% level respectively. Inference based on bootstrapping (4,999 replications) standard deviation and using asymptotic normal distribution for inference.

Table A.2 contains the detailed estimation results of the propensity in wrestling case.

Table A.2: Estimation of propensity score in wrestling case (mean marginal effects)

Variables	All data	Sydney Olympics	Athens Olympics
Home advantage	-0.049		0.070
Gender	0.002		-0.002
Wrestling Greco-Roman style		0.000	0.003
Number of observations	480	210	270

Note: Mean marginal effects presented. *, **, *** denotes significance at the 10%, 5%, 1% level respectively. Inference based on bootstrapping (4999 replications in all data and 499 replications in Sydney and Athens Olympics) standard deviation and using asymptotic normal distribution for inference.

Appendix B: List of Sources

www.uefa.com

www.fifa.com

https://en.wikipedia.org/wiki/Wrestling_at_the_2000_Summer_Olympics

https://en.wikipedia.org/wiki/Wrestling_at_the_2004_Summer_Olympics