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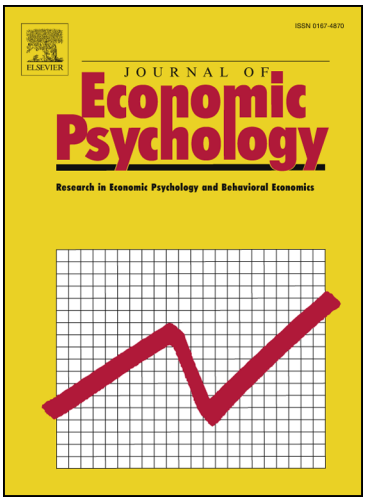

Brief Report

No evidence of first-mover advantage in a large sample of penalty shootouts

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No Evidence of First-Mover Advantage in a Large Sample of Penalty Shootouts

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Abstract

Conflicting evidence exists regarding a first-mover advantage in soccer shootouts, where increased pressure on second-moving teams may lead to choking. While some studies support this claim, others refute it, with the lack of consensus likely due to limited sample sizes. An analysis of around 7,000 soccer penalty shootouts and 74,000 kicks finds no evidence of a first- or second-mover advantage in winning probability. Equivalence testing further rejects any deviation greater than 1.8 percentage points from a 50% win probability for first-kicking teams. A parallel analysis of ice hockey shootouts finds no significant advantage or disadvantage for either the first- or second-moving team.

JEL Codes: Z20, D91, J01, L83

Keywords: First-Mover Advantage, Choking, Penalty-Shootout, Soccer, Ice Hockey

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1 Introduction

The ability to perform under psychological pressure can have profound effects on career trajectories and life outcomes, influencing promotions, R&D competitions, academic admissions, and championship victories in sports (Beilock, 2010). However, the intricate dynamics of many of those processes are highly complex, uncertain, and laden with unobserved variables, presenting challenges for direct study. With their transparency, well-defined rules, objective measurability, and rich data, sports offer an ideal setting for studying key phenomena in economic psychology (Balafoutas et al., 2019). In particular, sports provide a natural laboratory for analyzing choking under pressure (McGarry and Franks, 2000; Dohmen, 2008; Bar-Eli et al., 2020; Palacios-Huerta, 2023).

Choking under pressure is theorized to arise in situations that demand automatic execution, with increased pressure leading to disrupted automaticity as individuals overly focus on their performance (Baumeister and Steinhilber, 1984). Penalty shootouts exemplify such high-pressure scenarios where automatic shooting execution is vital, often carrying substantial implications for season results and potentially the financial health of clubs. In soccer, the team kicking first is thought to heighten psychological pressure on the opponent by being the first to score, increasing the stress of falling behind (Baumeister, 1984; Lieberman and Montgomery, 1988; Beilock and Carr, 2005; Jordet et al., 2007; Ariely et al., 2009). This dynamic is often cited as the basis for a first-mover advantage.

Despite considerable study, the discourse on a first-mover advantage in penalty shootouts remains unresolved. While the pioneering examination by Apesteguia and Palacios-Huerta (2010) found evidence for a sizable first-mover advantage amounting to roughly a 60:40 advantage for the first-kicking team analyzing 129 soccer shootouts, Kocher et al. (2012), using a superset of the first examination, reported non-significant results with points estimates of roughly 53:47, covering 540 soccer shootouts. In their conclusions, Kocher et al. (2012) called for a large sample approach to clearly answer this question, stating that one could only answer "*[...] whether a first-mover advantage would become significant or whether one would even obtain evidence for a second-mover advantage if one were able to collect data on the kicking order of many more shootouts in many more tournaments.*" Their call highlights the importance of statistical power, given the inconsistent results. Moreover, it emphasizes the need to analyze a broader set of shootouts, because a low-scoring environment, such as in ice hockey, may favor the second team, as suggested by Kolev et al. (2015).

The present analysis shows no significant first- or second-mover advantage in either soccer or ice hockey: The observed win ratios for the first and second mover are 50.2:49.8 in soccer and 48.9:51.1 in ice hockey, suggesting that earlier findings of an advantage may, at least in part, result from selection bias or random fluctuations in smaller samples. Mean equivalence tests reject that the first-mover's winning probability deviates by more than 1.6 percentage points in soccer (1.8 percentage points when combined with data from Kocher et al. (2012)) or 2.9 percentage points in hockey from a 50:50 split, supporting the absence of a significant

first-mover advantage. Additionally, the analysis reveals no significant gender differences in performance under pressure, nor any evidence in soccer or ice hockey that lagging behind affects individual shot conversion rates, consistent with the match-level findings.

This paper primarily contributes to the investigations of first-mover advantage in shootouts. Responding to the replication challenges highlighted by Kocher et al. (2012) regarding the initial study by Apesteguia and Palacios-Huerta (2010), Palacios-Huerta (2014, pp. 68-85) corroborated the initial findings of a 60:40 first-kicking team advantage and reported a consistent first-mover advantage before and after the 2003 rule change allowing the coin toss winner to choose whether to start the shootout. Similarly, Rudi et al. (2020) identified a 55:45 probability of victory for the first-kicking team across 1,623 shootouts. In contrast, Vollmer et al. (2024) find no significant first-mover advantage in 1,759 European shootouts. Among these studies with substantial datasets, two out of three report a notable first-mover advantage (Palacios-Huerta, 2014; Rudi et al., 2020), indicating the issue remains unresolved.

Smaller-scale studies also contribute diverse findings. Da Silva et al. (2018) observed a 59:41 first-mover advantage in 232 soccer shootouts, with no parallel finding in tennis tiebreaks. Santos (2023) reported no significant first-mover advantage in an analysis of 663 soccer shootouts, a finding echoed by Arrondel et al. (2019) in their study of 252 French soccer shootouts. However, Santos (2023) finds that while a first-mover advantage is generally absent, in women's competitions, the order of shooting does influence outcomes, with the first-shooting team paradoxically having a reduced win probability, albeit based on a limited dataset of 64 instances. Palacios-Huerta (2014, pp. 164-173) examines a natural experiment in Argentina during the 1988–89 season, where each tied match was followed by a penalty shootout to award bonus points. This setup increased the incentives for teams to train for shootouts. Analyzing 131 shootouts from that season, Palacios-Huerta found no significant advantage for either the first- or second-kicking team, with raw numbers showing first-kicking teams winning only about 46% of the time. Despite the limited sample size, these results are interpreted as evidence that professional players can mitigate their emotional responses through training, practice, and investments in mental fortitude (Palacios-Huerta, 2014).

Anbarcı et al. (2021) theoretically demonstrate that standard shootout procedures are order-dependent and advocate for alternating the order based on interim scores. However, summarizing data from existing studies (Kocher et al., 2012; Palacios-Huerta, 2014), they note that the first-mover advantage apparently present in some country-samples diminishes in major football tournaments as the sample size increases. Relatedly, Vandebroek et al. (2018) demonstrate that the conflicting results in the literature concerning a first-mover advantage can be attributed to small sample sizes, as revealed by their theoretical model incorporating several psychological effects.

Survey-results in Apesteguia and Palacios-Huerta (2010) suggest that players and coaches strongly believe in a first-mover advantage, with over 90% stating to prefer shooting first when given the choice. However, Kassis et al. (2021) nuanced this view by showing that

only 56.3% of captains opted to shoot first after winning the coin toss. While there was no significant advantage for first-kicking teams, winning the initial coin toss provided a distinct 60:40 advantage in the outcome of the 96 shootouts they examined.

Unlike in soccer, Kolev et al. (2015) suggest that lower scoring rates in ice hockey increase pressure on the first-shooting team, potentially giving the second-shooting team a tactical advantage if their goalkeeper makes an early save. A similar second-mover advantage can also arise in the theoretical framework of Apesteguia and Palacios-Huerta (2010, Online Appendix B) if the second team benefits from a psychological edge, increasing its conversion probability due to having more remaining attempts after the first team's typically unsuccessful opening shot. Kolev et al. (2015) analyze 1,138 National Hockey League (NHL) shootouts following a rule change that allowed home teams to choose whether to shoot first. Their findings show that home teams opting to shoot first win only 47.68% of the time, significantly lower than the 51.72% win rate for home teams previously required to shoot second. This suggests that while shooting order may influence outcomes, teams did not adapt optimally to the rule change—potentially due to overconfidence in their scoring abilities (Kolev et al., 2015). Additionally, they found that the home team's win probability dropped below 50% when given the choice to shoot first. However, when home teams chose to shoot second, they even won only 43.7% of the time, contradicting the idea of a second-mover advantage. The findings of the present paper align with Kolev et al. (2015) in that no significant order effect was detected.

Arrondel et al. (2019), while not substantiating a first-mover advantage, highlight the role of anxiety and stakes. They observe that performance in kicking is adversely impacted not from the onset but as the shootout progresses, hinting that pressure from being behind manifests after the initial kick. This could reflect escalating pressure or the participation of less adept players as the shootout extends. Moreover, Arrondel et al. (2019) pinpoint a decline in scoring probabilities when a kick can determine the match's outcome, highlighting the impact of high stakes and the impending threat of defeat.

Choking under pressure is observed in athletes beyond just shootouts (Genakos and Pagliero, 2012; Feri et al., 2013; Genakos et al., 2015; González-Díaz and Palacios-Huerta, 2016; Cohen-Zada et al., 2017; Klein Teeselink et al., 2020; Bühren and Steinberg, 2019; Bühren et al., 2024; Dietl et al., 2025). Genakos and Pagliero (2012) study the impact of interim rankings on performance in professional weightlifting tournaments. Their findings show that athletes trailing just behind the leaders tend to take greater risks when informed of their relative standing, while those further behind do not. Moreover, competitors systematically underperform when ranked closer to the top, despite having higher incentives to excel. A similar outcome is observed by Genakos et al. (2015) in diving sports. Cohen-Zada et al. (2017) find that men consistently choke under competitive pressure in professional tennis, while results for women are mixed—an asymmetry that aligns with findings from alpine skiing by Bühren et al. (2024). Bühren and Steinberg (2019) find evidence of a second-mover

advantage in a field experiment on amateur tennis, linking it to high self-esteem as a psychological trait. Dietl et al. (2025) analyze "clutch time" in professional basketball—the final minutes of a game when the outcome is uncertain and pressure is at its peak—as an objective measure of performance pressure. Their findings suggest that players who perform well in these high-stakes moments earn a salary premium. Finally, González-Díaz and Palacios-Huerta (2016) analyze chess matches where the color assignment is randomly determined. Despite each player having an equal number of games with white and black pieces, they find that the player starting with the white pieces, which are strategically advantageous, has about a 60:40 winning probability - likely due to the increased likelihood of leading during the match.

Beyond choking, sports data have been used to study various psychological phenomena, including momentum effects (Morgulev et al., 2019), behavior in social dilemmas (Brouwer and Potters, 2019), effort in teams (Chapsal and Vilain, 2019), reference-dependent decision making (Bartling et al., 2015; Allen et al., 2017; Soetevent, 2022), as well as broader implications for (national) well-being (Kavetsos and Szymanski, 2010; Janhuba, 2019).

Section 2 presents the dataset's composition and characteristics. Following this, Section 3 presents results. Section 4 concludes.

2 Data

I used web-scraping techniques to collect soccer and ice hockey match data from Flashscore.com (Livesport Ltd., Czech Republic), aiming for the broadest possible coverage across matches, countries, and leagues. The dataset includes all available data up to the concluded 2023–24 season.

Soccer shootouts are relatively rare, as league matches can end in draws, and international club competitions often resolve ties through home-and-away formats. Of 2,079,248 soccer matches in the Flashscore dataset (1970–2024), only 18,544 (0.89%) ended in a penalty shootout. In men's major knockout cup competitions in England (Football Association Challenge (FA) Cup, English Football League (EFL) Cup, Football Association (FA) Community Shield), France (Coupe de France), Germany (Deutscher Fußball-Bund (DFB) Pokal), Italy (Coppa Italia), and Spain (Copa del Rey), 1,782 of 30,848 matches (5.78%) concluded with a shootout. In contrast, shootouts are more common in North American ice hockey, where they are used to decide regular-season games. Of 93,668 recorded US and Canadian ice hockey matches, 6,974 (7.45%) were decided by a shootout.

Historical match data on Flashscore.com typically includes only basic details, such as team names, dates, and final scores. However, detailed records of penalty shootout actions required for this analysis are more limited. The main dataset consists of 7,116 soccer shootouts in which the reported kick sequences align with the documented outcomes on the source website and comply with the Fédération Internationale de Football Association (FIFA) rules for

shootout conclusions. The data primarily covers shootouts after the 2003 rule change, which allowed the coin toss winner to choose the shooting order, replacing the previous system where the toss directly determined it. The resulting endogeneity issue (also see Bhaskar, 2009; Palacios-Huerta, 2014) is discussed in Online Appendix Section A.1.

Given data quality variability and rule differences across leagues and seasons, the ice hockey analysis focuses on North-American leagues (see Online Appendix Section A.2). The analysis includes U.S. leagues—the National Hockey League (NHL), American Hockey League (AHL) (since the 2014–15 season), and the ECHL (formerly named the "East Coast Hockey League" until 2003, included since the 2015–16 season)—as well as Canadian leagues—the Ontario Hockey League (OHL), Western Hockey League (WHL), and Quebec Major Junior Hockey League (QMJHL). These leagues follow largely consistent rules, including a best-of-three shootout format and home team discretion on shooting order (NHL, 2023; OHL, 2023). The dataset comprises 4,407 shootouts since 2010, with around 400 per year from 2014 onward, except during pandemic-affected seasons (see Table A.7; Online Appendix). Online Appendix Section A.1 provides additional information about shootout rules in both sports.

3 Results

This section analyzes the first-mover advantage in soccer and ice hockey, testing the null hypothesis that both the first- and second-moving teams have an equal 50:50 chance of winning. Applying the theoretical framework by Apesteguia and Palacios-Huerta (2010, Online Appendix B) suggests that shootout dynamics could differ between the two sports.

In the basic version of their model, the first team (F) always has an advantage over the second team (D) because the probability of scoring when tied or leading (p) is assumed to be higher than the probability of scoring under pressure (q), with p and q identical for both teams. In the case of a soccer penalty shootout, where the conversion rate is about 75% (see Online Appendix Section A.7), the model assumes that the second-shooting team is typically under pressure after the first attempt, as both fans and teammates expect a goal. A missed shot can create an almost insurmountable disadvantage, increasing the likelihood of choking and a resulting advantage for the first-mover, represented by the assumption that $q < p$.

However, allowing p and q to differ between the first and second teams introduces the possibility of alternative outcomes (Apesteguia and Palacios-Huerta, 2010). Theoretically, this could be relevant in ice hockey shootouts, where the conversion rate is much lower (~30%) and the second team often takes its first shot with the score still tied. In such a low-scoring contest, each remaining attempt is more likely viewed as an opportunity to gain an advantage rather than an absolute necessity to score, suggestive of a different psychological dynamic. Thus, in many shootouts, the second team may perceive an advantage, given that it has more opportunities to score after the first team's frequently unsuccessful attempt. If

these dynamics generate psychological momentum, the second team's conversion probability at a favorable intermediate score p_D may significantly exceed that of the first team (p_F), potentially leading to a second-mover advantage.

3.1 Overview

Table 1: Shootout Data

Competition/Nation Group	[1] Number of shootouts	[2] Relative Freq. First Team Wins	[3] two-sided p-value (binomial test)
Soccer (Flashscore data). —			
UEFA Top 5	1445	0.502	0.895
UEFA Top 5 + Argentina & Brazil	2126	0.503	0.745
UEFA Top 10	1956	0.508	0.469
UEFA Top 10 + Argentina & Brazil	2637	0.507	0.413
KLS Competitions	623	0.504	0.873
European Club Competitions	192	0.536	0.348
World Cup	78	0.526	0.734
Euro	80	0.438	0.434
ABBA Trials	44	0.568	0.451
All Penalty Shootouts	7116	0.502	0.785
Supplemented with KLS (2012) data. —			
KLS Competitions (all)	1151	0.195	0.205
KLS Competitions (pre-2003)	540	0.132	0.132
All Penalty Shootouts	7627	0.504	0.478
Ice Hockey (Flashscore data). —			
Selected North-American Leagues	4407	0.489	0.148
NHL	1663	0.494	0.659

Notes: The table summarizes the quantity of soccer and ice hockey shootouts, categorized by competition groups or countries. The first column shows the total shootouts, the second details the proportion won by the first-kicking (soccer) or first-shooting (ice hockey) team, and the third column presents the p-value from a two-sided binomial test for a 50:50 win probability. Competitions include youth and women's variants like the Euro U17 Women. The UEFA Top 5 (based on 2023 Men's ranking) covers England, Spain, Germany, Italy, and France, while the Top 10 adds the Netherlands, Portugal, Belgium, Scotland, and Austria. KLS refers to competitions studied by Kocher, Lenz, and Sutter (2012), including the Euro, Champions League, Europa League, Europa Conference League, World Championship, Copa América, Gold Cup, Africa Cup of Nations, and Asia Cup, as well as national tournaments like Germany's DFB Pokal, England's FA Cup, EFL Cup, and FA Community Shield, and Spain's Copa del Rey. European (UEFA) Club Competitions feature the Champions League, Champions League Women, Europa Conference League, Europa League, and the UEFA Super Cup. ABBA refers to a penalty shootout sequence tested in various competitions like the 2017 UEFA European Under-17 and Under-19 Championships, English EFL Cup, EFL Trophy, EFL playoff matches during the 2017-18 season, and the Netherlands' KNVB Beker for 2018-2019. Soccer statistics below "Supplemented with KLS (2012) data" include the data from Kocher, Lenz, and Sutter (2012).

Table 1 provides a summary of shootout data across various competition categories for both sports, detailing the number of shootouts (column 1), the relative frequency of first-mover victories (column 2), and the results of binomial tests against the null hypothesis of a 50:50 split. In soccer, the first-kicking team wins 50.2% of the time (p = 0.785) across 7,116

matches in the Flashscore data. Focusing on competitions studied in Kocher et al. (2012) ("KLS") in the Flashscore data, the first-kicking team wins 50.4% of shootouts (p = 0.873). In the supplemented data with pre-2003 shootouts from Kocher et al. (2012), the first-kicking team wins 50.4% (p = 0.478) across all 7,627 shootouts. There is no significant difference (p = 0.379, two-sided t-test) in the proportion of matches won by first-kicking teams between the pre-2003 period (M = 0.533, N = 540) and the post-2003 period (M = 0.507, N = 611) in the KLS competitions.

In ice hockey, the first team wins 48.9% of shootouts (p = 0.148), with similar results across competition groups. However, in the subgroup of 825 AHL matches, there is some evidence of an advantage for the second-shooting team (p = 0.037) (see Online Appendix Table A.9).

A drawback of relying solely on traditional significance tests, where the null hypothesis assumes no effect, is that while the absence of an effect can be rejected, it is not statistically supported (Lakens, 2017). Misinterpretation of test outcomes often leads to erroneous assertions in research suggesting no effect based solely on a non-significant test result, which may frequently result from insufficient sample size. Table A.6 in the Online Appendix shows that mean equivalence tests (Dinno, 2017; Lakens, 2017) reject the idea of a substantial first-mover advantage. Specifically, these tests reject the hypothesis that the first-mover's winning probability deviates by more than 1.6 percentage points in soccer (1.8 percentage points when including the Kocher et al. (2012) data) and 2.9 percentage points in hockey from a 50:50 split, at a 1% significance level.

3.2 Regression analysis

The results remain robust when using probit regression analyses.[1] Figure 1 plots the marginal effects of an indicator variable set to one if a team started the shootout, with the dependent variable being a binary outcome indicating whether the team won (one) or lost (zero). The figure presents results for multiple data subsets listed on the y-axis, with two regression specifications for each subset. Both specifications (red and blue markers) control for home team status, while the blue markers additionally adjust for relative team strength using pre-match betting odds to infer each team's objective winning probability. This probability is computed as the inverse of a team's odds divided by the sum of the inverses of the odds for all three possible outcomes—home win, draw, and away win—thus incorporating the bookmaker's margin:

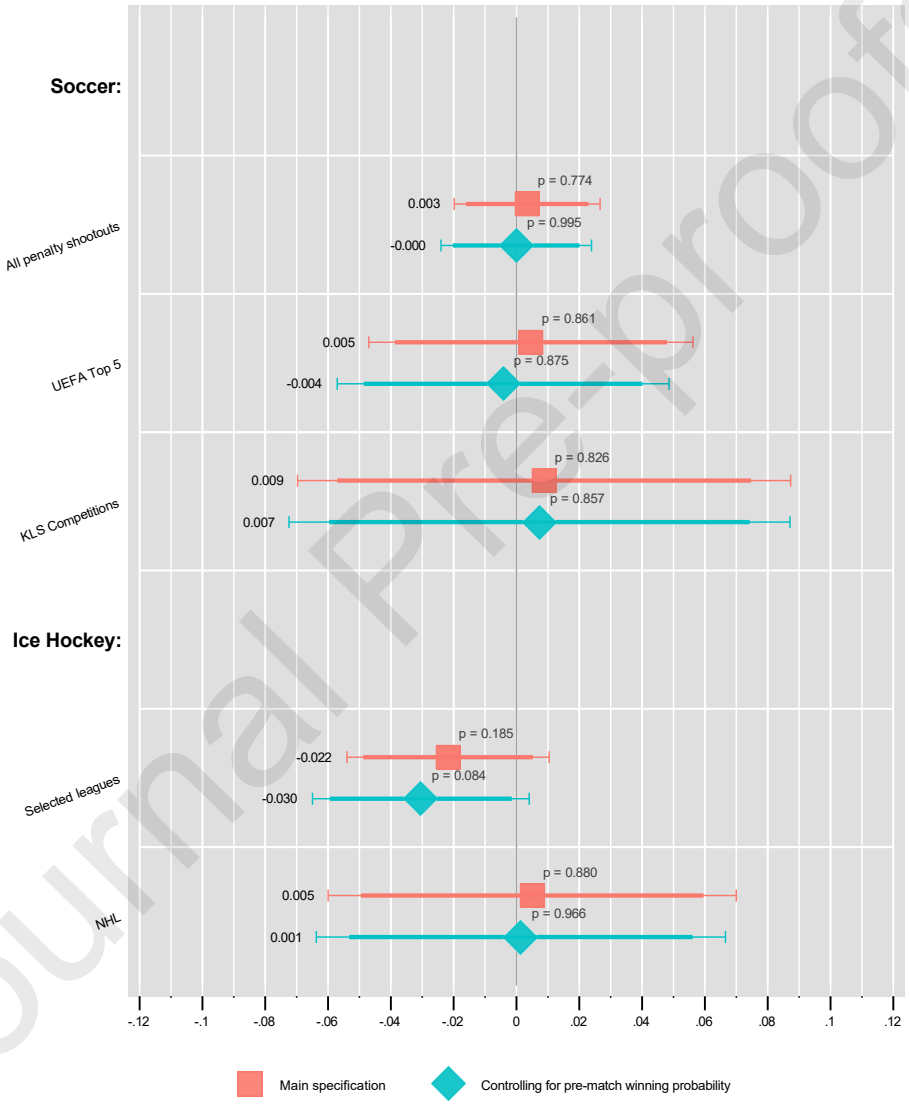
$$winprob_{home} = \frac{\frac{1}{Odds_{home}}}{\frac{1}{Odds_{home}} + \frac{1}{Odds_{draw}} + \frac{1}{Odds_{away}}}, \quad (1)$$

[1]The corresponding regression tables are available in Section A.4 of the Online Appendix.

with an analogous calculation for the away team. Since each shootout contributes two observations—one for the home team and one for the away team—standard errors are clustered at the match level, following Kocher et al. (2012).

Consistent with the simple statistical tests, the regression results reveal no significant first-mover advantage. Moreover, accounting for relative team ability further increases the p-value in the soccer shootout sample.

Figure 1: Probit-Regression Results: First-Mover Advantage in Penalty Shootouts



Notes: This figure displays the marginal effects of a binary indicator set to one if a team started the shootout, estimated from separate probit regressions for each subset listed on the y-axis. The legend indicates that blue markers represent regressions controlling for team winning probabilities based on pre-match odds, while red markers represent regressions without this control. The dependent variable is a binary outcome, where one indicates a shootout win and zero indicates a loss. The dataset comprises 7,116 soccer shootouts from Flashscore, with associated odds data available for 6,665 of them. Additionally, it includes 4,407 ice hockey shootouts, of which 3,932 have corresponding odds data. The lines extending from the coefficient markers represent 95 percent (thick lines) and 90 percent (thin lines) confidence intervals. Standard errors are clustered at the match level. Significance is denoted as: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

3.3 Additional results on gender, the ABBA pattern, and individual shots

The data further allows to contribute to several discussions in the existing literature. First, while Santos (2023) reported a notable second-mover advantage in both women's and youth soccer, analyzing 64 and 128 shootouts, respectively, the present data shows different results. In 342 women's soccer competitions, the first-moving team wins 172 times (50.3%, p = 0.957). In youth soccer shootouts, the first-kicking team prevails in 130 out of 277 cases (46.9%, p = 0.336).

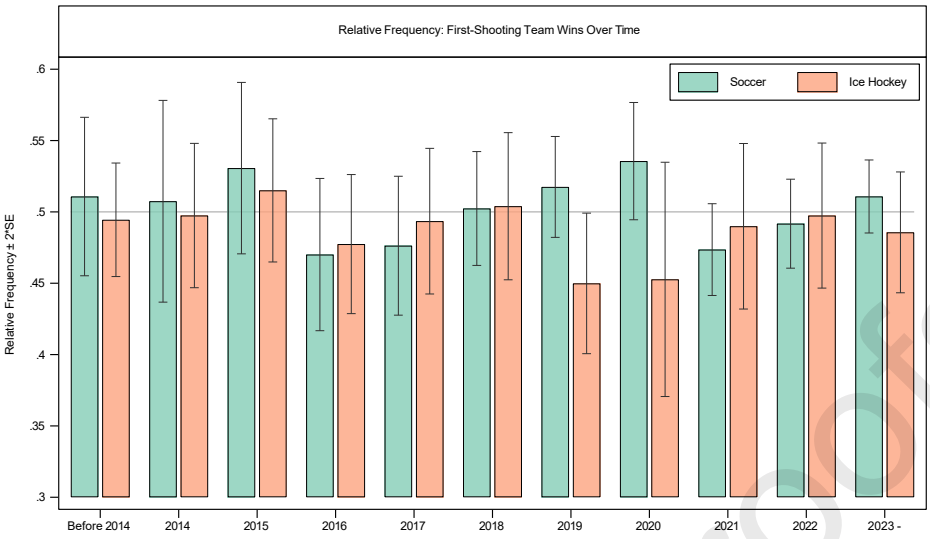
Second, between 2017 and 2019, an alternative format, where teams alternate in an A,B,B,A pattern, was tested in various competitions to address concerns about an inherent advantage of kicking first. In 44 shootouts following this sequence, the first-kicking team won 56.8% of the time (25 shootouts), with no statistically significant deviation from a 50:50 split (p = 0.451).

Third, Figure 2 illustrates the proportion of first-mover victories in penalty shootouts across soccer and ice hockey from pre-2014 to mid 2024. The trend is non-systematic, with win rates for first-movers fluctuating slightly above or below 50% across different years, similar to results in Kocher et al. (2012) for earlier years. Binomial tests support these observations (see Online Appendix Table A.7). In soccer matches, no significant first- or second-mover advantage is observed in any year, with the lowest p-value recorded in 2020 (p = 0.091). In ice hockey, most years show no advantage, but in 2019, the data suggest a second-mover advantage (p = 0.048). These fluctuations appear random, underscoring the need for large samples to reduce the risk of spurious findings.

Fourth, despite the common perception of shootouts as random, winning probabilities derived from pre-match odds strongly predict shootout outcomes (see Online Appendix Section A.4). This aligns with Krumer (2020) finding that higher-ranked teams are more likely to win.

Fifth, regression analyses in Online Appendix Section A.3 show no significant effect of a team's trailing or leading status on conversion rates. Additionally, the conversion rate on potentially game-deciding kicks does not differ (column 1, Table A.1), contrasting with findings by Arrondel et al. (2019). Consistent with the match-level finding in soccer that favorites win more often, teams favored by pre-match betting odds also have higher scoring probabilities on individual kicks (column 2). The findings for individual shots in ice hockey regarding trailing, leading, and decisive attempts qualitatively align with those in soccer but do not show higher conversion rates for favored teams.

Figure 2: Share of Penalty Shootouts Won by First-Shooting Team Over Time



Notes: This figure displays the proportion of penalty shootouts won by the first-shooting team in both soccer and ice hockey, spanning the 11 periods from "before 2014" through 2023 (until the end of the 23-24 season) as indicated on the x-axis. The soccer data encompasses the following counts for each period: 325, 201, 277, 351, 422, 629, 800, 590, 965, 1029, and 1527 shootouts. For ice hockey, the respective counts for the same periods are 633, 392, 398, 421, 385, 377, 409, 148, 298, 388, and 558 shootouts.

4 Conclusion

Conflicting findings in the literature underscore the need for large-sample evidence on the first-mover advantage in penalty shootouts, where psychological pressure may cause second-movers to choke (Apesteguia and Palacios-Huerta, 2010; Kocher et al., 2012; Arrondel et al., 2019). However, in a low-scoring shootout like in ice hockey, greater pressure may theoretically fall on the first-mover, potentially giving the second-mover an advantage (Apesteguia and Palacios-Huerta, 2010; Kolev et al., 2015). The present analysis finds no clear advantage for either the first- or second-mover in either sport. Furthermore, equivalence testing (Lakens, 2017) dismisses the hypothesis of a first-mover winning probability differing by more than 1.8 percentage points in soccer (and 2.9 percentage points in ice hockey) from a 50:50 ratio, providing evidence of non-existence rather than merely highlighting a lack of evidence.

This study's data, which primarily consist of soccer penalty shootouts from 2011 onward, contrasts with earlier research that focused on matches from 2003 and earlier, dating back to the introduction of penalty shootouts in 1970. These recent data reflect the current, highly professionalized state of global soccer. While it remains unclear whether the passage of time has influenced the presence of a first-mover advantage, previous research (Kocher et al., 2012; Santos, 2023) has already cast doubt on its significance in shootouts from their introduction through the early 2000s, using larger datasets than those employed by Apesteguia and Palacios-Huerta (2010). It appears plausible that professional clubs, responding to the influential findings of Apesteguia and Palacios-Huerta (2010), have further diminished any

first-mover advantage—if it ever existed—by adopting strategies aimed at equalizing winning probabilities, such as investing in mental training to enhance players' resilience regardless of shooting order (Thelwell et al., 2005; Vealey, 2007; Palacios-Huerta, 2014). However, this remains speculative, as the present analysis finds no significant difference in first-mover advantages between recent and historical matches. Future research should explore contexts where first-mover advantages arise in dynamic contests and assess how leading or lagging influences motivation across tasks of varying complexity as penalty shootouts may offer an oversimplified analogy for more complex processes, such as innovation in firms.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author used Grammarly Pro and ChatGPT in order to improve the language of the paper. After using these services, the author reviewed and edited the content as needed and takes full responsibility for the content of the publication.

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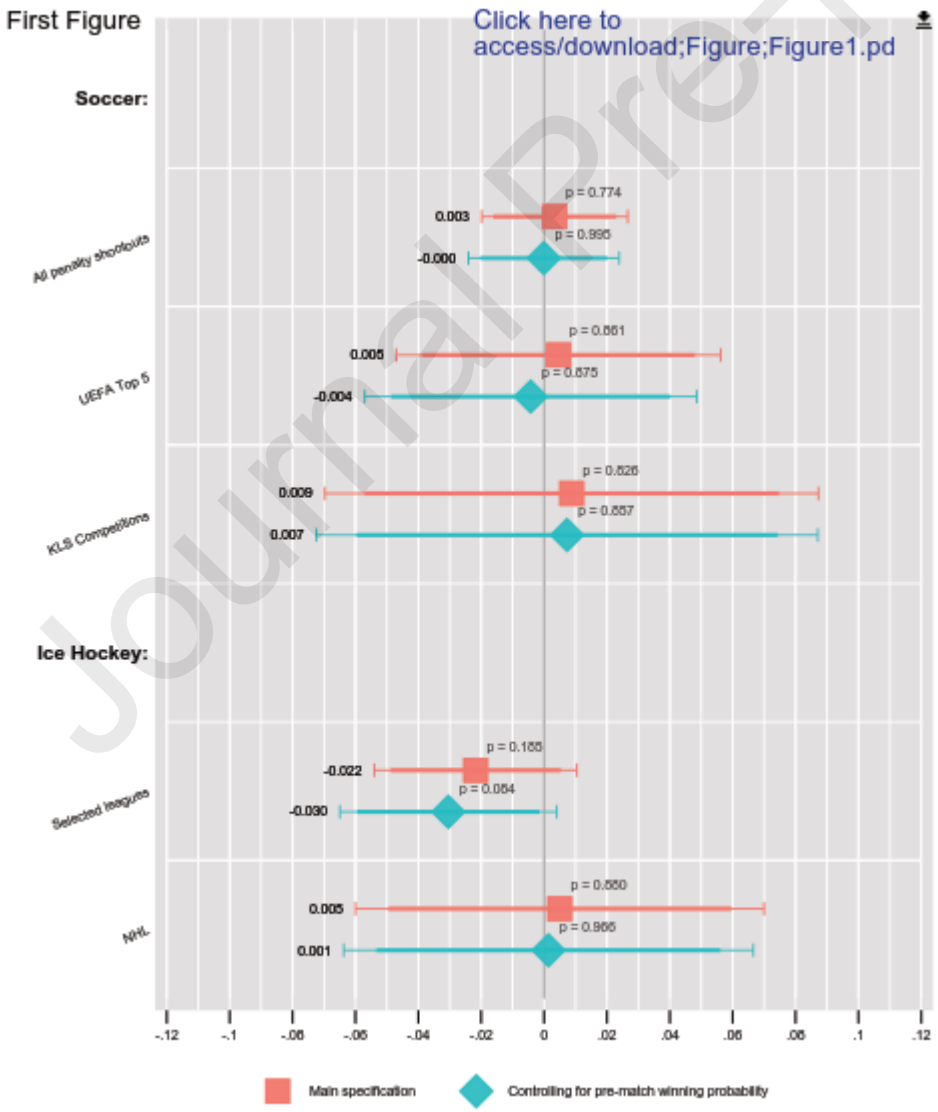
Highlights

- Equivalence tests reject significant first-mover effects in shootouts.
- Similar results emerge in soccer and ice hockey shootouts.
- Controlling for odds-based team ability does not affect conclusions.
- No first-mover advantage in youth or women's subgroups was found.



Second Figure