

## Home Field Advantage in Women's International Football

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**Abstract:** *The paper estimates the size of the home field advantage in international women's football and its temporal variability, using 4,416 matches from 1980 through 2022. We document overall home advantage, home advantage over time, and home advantage across geography. Over the entire sample period, the average home advantage is 52.3%. However, home advantage started out very high, declined to less than 60% by the 1980s and experienced further declines throughout the decades after. We show that home advantage differs across geography. Our analysis concludes that the home advantage in international women's football has statistically converged to that in international men's football. We postulate that this convergence was aided by knowledge, tactics, nutrition, and physical training accumulated in over a century of international men's football.*

**Keywords:** sports; women's football; soccer; home field advantage; international football

**JEL Classifications:** Z81, Z20

### Introduction

Home field advantage has been documented in numerous sports across various geographies and time spans. There have been several psychological and sociological explanations for why the home team in a sporting event regularly wins more often than the away team. This paper briefly outlines these various explanations and then tests for home field advantage in women's international football, which has become more popular and competitive since the turn of the 21st century.

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Home advantage is an interesting topic because, in its absence, the number of wins in a matchup of two evenly matched teams should not, over a large enough sample of games, be statistically different from a fifty-fifty split. When a lower quality team plays at home against a superior team, home advantage might be large enough to overcome the mismatch. In the case of women's international football, home advantage appears to have started out very high and has attenuated over the past thirty years. While home advantage in women's international football appears to be larger than in men's international football, thereby reducing the uncertainty of match outcome, the home advantage does not appear high enough to significantly reduce the in-arena and television audience for women's international football matches.

Home advantage has been described as arising from familiarity with the arena and its idiosyncrasies, the lack of travel that the home team needs to undertake, the support of friends, family, and fans in greater numbers than the visiting team, by coaches and players feeling safer to take greater risks during the game, and an evolutionary biological argument that humans defend their home with more ferocity than those who seek to "attack" it (Pollard, 1986). Still other arguments come through sociology in that home advantage is the result of how society rewards masculine attributes such as aggressiveness, which could lead to a difference in home advantage for men's and women's sports (Leite and Pollard, 2020, and Leite, 2023).

Economists have suggested that home advantage might arise because the away team tends to share less in away match revenue and therefore has less motivation to perform at top potential, especially if the match is one of several away matches in a row (Atkinson, et al, 1988). Provided teams are profit maximizers, home advantage might decline after moving to a new stadium if the novelty effect of a new stadium draws attendance despite team quality; in this case team owners might cut high quality players after moving to a new stadium, thereby reducing home advantage. Following the same reasoning, a nostalgia effect might draw more attendance in the last years of an older stadium which might reduce the home advantage of the team before moving out of an older stadium.

Leagues might adjust rules so that home advantage is enhanced or attenuated, depending on the league's view of how overall demand for the sport is impacted by home advantage. For example, if home advantage is the outcome of reduced away fan attendance, then leagues might mandate that a minimum number of tickets be available for away fans. Leagues might mandate more equitable treatment of away team players when it comes to changing rooms, medical facilities, and food services. Leagues might also mandate salary caps and salary floors to try to enhance the competitive balance of the league overall in an attempt to mitigate home advantage.

This paper adds to the literature focusing on high-stakes women's football by testing for home advantage in women's international football and distinguishing across time periods and geographic organizations. We find that there is a distinct home advantage in women's international football but that the generic home advantage has been

secularly declining since the early 1970s. While home advantage in women's international football remains higher than the home advantage observed in men's international football, the difference in the two home advantages is declining quickly, suggesting that the women's international football environment is maturing to a level that is similar to that of the men's international football environment. We now turn to a discussion of the previous literature on home advantage and its impact in women's sports.

## Previous Literature

Home advantage has historically been investigated in men's sports, perhaps primarily because of a lack of large sample sizes for women's sports. However, over time women's sports have become more common and popular, with the result being a larger pool of larger samples that can be used to test for home advantage in women's sports. As reported by Leite, et al. (2021), a wide range of women's sports have been investigated, including collegiate basketball, field hockey, and softball (Gayton, et al. 1987), collegiate basketball in Canada (Kozub and Corlett, 1990), collegiate basketball in the United States (Madrigal and James, 1999), USA collegiate gymnastics (Baghurst and Fort, 2008), USA professional basketball (Moskowitz and Wertheim, 2011), professional volleyball in Brazil (Campos et al. 2014) and Germany (van Meurs, et al., 2023), and professional football (Leite and Pollard, 2020). A study by Yu et al. (2020) analyses home advantage in Chinese women's professional and finds that matches between same-level teams improves technical performance indicators, especially scoring indicators. Yu, et al. (2021), finds that home advantage significantly impacts set outcomes and technical performance indicators, affecting coaches' strategies for both home and away matches.

However, not all studies find a different influence of home field advantage in women's sports. Wunderlich, et al. (2024) find evidence of home field advantage in German team tennis but there is no difference across gender. There appears to be no home field advantage in Swedish Chess (Sörqvist, et al., 2013) or in Israeli chess (Zak, 2023) but neither tested for differences across gender.

Previous studies of women's football find that the home advantage is approximately 55-60%, substantially greater than the approximately 44% win rate of home teams in men's football and slightly higher than home advantage in North American men's sports (Pollard and Gomez, 2014). Krumer and Smith (2022) analysed the effect of playing behind closed doors as a result of COVID-19 restrictions in Swedish women's Damallsvenskan soccer league and found weak evidence of a slightly reduced home advantage in women's soccer games without crowds, but stronger effects of away teams receiving more yellow cards than home teams. On the other hand, Smith (2021) suggests there was little change in home field advantage in the Swedish and Norwegian elite soccer leagues during COVID-19 restrictions and that there was less

of an improvement in the women's game than in the men's game, perhaps attributable to smaller pre-COVID-19 crowds in the women's game in those countries.

Yet, previous studies have generally not focused on the temporal pattern of home advantage in women's international football; van Meurs, et al. (2023) is a noticeable exception in covering 25 years of German professional volleyball for both the men's and women's game. There may be reasons to expect that home advantage has been declining over time in women's international football as the sport has matured over the past several decades. The first sanctioned women's international football match in the modern era was held in 1969 between home team Italy and visiting team France (Italy won 1-0). Thereafter, the number of women's international football matches remained relatively low, not topping over 100 matches worldwide in a given year until 1995, four years after the first official FIFA women's World Cup in 1991. Indeed, there are no recorded international matches played in 1972, 1973, 1974, 1976, and 1978. After the FIFA World Cup in 1995, the number of women's national teams increased along with the number of matches played in a given year (well over 120 per year by the mid 2000s and culminating with a maximum of 349 international women's matches in 2018). As more national teams were started and the skill sets of the athletes involved increased, the home advantage might be expected to converge toward that of the men's game, which had been played for approximately 70 years longer than the women's game. We now turn to a discussion of home field advantage and its potential causes and effects.

### **Home Advantage: Causes and Effects**

The sport psychology literature asserts that home advantage is a common place in professional and amateur sports for three main reasons (Pollard, 1986). First is the fatigue that the away team suffers from traveling and, perhaps, sleeping in unfamiliar places. The fatigue from travel can arise naturally because of the time it takes to travel to the airport or bus/train station, the physical time of travel, and then the time it takes to travel from arrival location to accommodations or the stadium itself. However, more fatigue can arise if the team arrives one or more days before the match such that the players, coaches, and managers of the away team are sleeping in unfamiliar and perhaps uncomfortable accommodations. This would reduce the effectiveness of any sleep that is obtained and could translate into relatively poor performance on the pitch (see Fowler et al., 2014). Another impact of travel is the number of time zones crossed which can move the physical clock forward or backward compared to the body clocks for the away team (Walsh, 2013). For example, if an away team traveled across four time zones to play a match and arrived one day in advance, a 1pm start could effectively be either 9am or 5pm for the away team. This has been shown to impact the relative performance of the away team.

A second source of home advantage is the tactics and strategies chosen by the two teams (Carron and Paradis, 2014). Coaches might choose to be more aggressive in their style of play when coaching at home. On the other hand, a coach of the visiting team might naturally choose more defensive tactics. Both of these incentives might contribute to a net home advantage even if the away team is staffed with superior players.

A third source of home field advantage is in familiarity with the grounds, in particular how the grounds might interfere with the play of the game or how sound and weather might affect the flow of the game. In the case of baseball, the lack of uniform stadium dimensions leads to angles and rebounds that might be unfamiliar to visiting team players which might provide an advantage to the home team when they are on the offense; perhaps epitomized most famously by the left field “Green Monster” wall of the Boston’s Fenway Park, home of Major League Baseball’s Boston Red Sox (Jones & Dodge, 2014). Likewise, if home team players are familiar with the same angles and caroms they might have an advantage when the home team is on the defense. In the case of ice hockey, it has been shown that some arenas have patches of slow ice because of idiosyncrasies of the coolant system or how lighting systems influence temperature on the ice (Biskup, 2010). In the case of basketball, there have been examples of dead spots on the court where the ball does not bounce as readily as in other areas of the court (see Elliott, 2023, for an explanation). In the case of American football, it has been documented that certain stadiums have idiosyncratic drainage issues or wind issues that can influence both the offense and the defense during a game (Winner, 2022). All these examples could provide an advantage to home players to the extent that away team players are unaware of the problems or how to adjust to them.

The final source of home advantage is the home fans. Home fans offer encouragement to home team players, offer discouragement or distraction to away team players, and can influence the flow of the game through their intimidation of the referees. The so-called social pressure that referees feel from the home team fans has been documented in several studies. A particularly fruitful set of studies focused, primarily, on social pressure in men’s professional football matches during the COVID-19 pandemic and the restrictions placed on fans during the later parts of the 2019/20 season and into the 2020/21 season. The large number of matches played behind closed doors allows for a test of whether home advantage declined during the pandemic. Of the 21 studies mentioned by Reade et al. (2021), plus one additional study (Bilalic et al., 2021), all find that home advantage decreased during matches when the crowds were absent. While these studies cannot test for the existence or the importance of fatigue or familiarity with the grounds, the COVID-19 natural experiment has provided overwhelming evidence that social pressure is a not only a real issue in association football but also in the National Hockey League, the National Football League, and Major League Baseball in North America.

In this paper, we aim only to document the existence of home field advantage and its evolution from 1980-2022 and to test whether home field advantage in women's international football has converged to the home field advantage in men's international football. Future research will focus on the aforementioned potential causes of home field advantage in women's international football. Therefore, while we do not expressly test for whether any of these reasons for home advantage apply to women's international football, there is no reason to suspect that the influences would be dissimilar to those observed in other sports, whether they be male or female oriented. Rather, in this paper we seek to document whether home advantage exists in women's international football, has home advantage been changing over time (either increasing or decreasing), and whether home advantage in women's international football is distinctly different from home advantage in men's international football. We now turn to a discussion of our data and empirical methodology.

## **Data and Methodology**

The history of women's international football is intriguing as it had tremendous popularity in England during World War One. However, women's international football was essentially destroyed for much of the interwar and post World War II era by restrictions on when and where women could play football in many countries of the world. Not until 1971 did FIFA officially recognise women's football and the first Women's World Cup was held in 1991, hosted by China.<sup>1</sup>

The data used in this study reflect all competition and tournament international women's matches from 1980 through 2022.<sup>2</sup> The data were obtained through the Creative Commons database originally generated by Mart Jürisoo in 2019 and updated through 2022.<sup>3</sup> We augmented the Jürisoo data with match information provided by Garin (2019) for the five Mundialito (Little World Cup) tournaments held in Japan in 1981 and in Italy in 1984, 1985, 1986, and 1988.<sup>4</sup> In total, the sample contains 4,416 observations spanning the period of 1980-2022.<sup>5</sup>

Each match observation contains the date of the match, the designated home team, the designated away team, the final score of the home and away teams, the competition or tournament with which the match was associated, the city and country in which the match occurred, and whether the match site was designated as neutral. In competition and tournament play, the host country's team is always designated as the home team; such matches are not designated as neutral site matches. However, in competition and tournament play, when non-host country teams are involved, one team is designated the home team and the other the away team; such matches are designated as neutral site matches.

Home advantage in professional and amateur sports has a long history in the sports psychology literature. While there are several ways to measure home advantage (see

Matos, et al., 2019, for a review of various methods), we follow Pollard (1986) and use the unconditional percentage of matches (games) won by the designated home teams. Home advantage is therefore defined as

$$HomeAdvantage_t = \frac{HomeWins_t}{MatchesPlayed_t},$$

where  $HomeWins_t$  is the number of designated home teams that win in a given calendar year,  $MatchesPlayed_t$  is the number of matches played in a given calendar year, and  $t \in [1980, 2022]$ . The resulting  $HomeAdvantage_t$  falls between zero and one and reflects the percentage of home matches won by the home team. As there are three possible outcomes to a match,  $AwayAdvantage$  can be measured by replacing  $AwayWins_t$  for  $HomeWins_t$  in the numerator; in this case  $AwayAdvantage$  would measure the percentage of matches that are won by the designated away team. Home (away) advantage is deemed positive (negative) if the percentage of home matches is statistically greater (less) than 50% (Pollard, 1986).

We aggregate matches by year for the entire sample period and then investigate home advantage based on annual aggregates. We also investigate whether home advantage differs by geographic region by comparing qualifying matches for major tournaments that occur in Europe, Asia, Africa, Oceania, and the Americas during the sample period. We also focus on FIFA and UEFA sponsored tournaments, the FIFA World Cup finals, the Mundialitos, and the Summer Olympics to test for home advantage. These tournaments might have lower home advantage because in these tournaments non-host-country teams can be designated as the home team although these “home teams” do not necessarily enjoy the advantages of rest, familiarity, and overwhelming fan support that might alter match outcomes.

If the aforementioned causes of home advantage are mainly driven by the location of the match and the relationship between the home team and its stadium, city, and environs, then home advantage is expected to be much lower during tournament finals matches such as the UEFA EUROs, the CONCACAF Gold Cup, the CONMEBOL Copa America, the CAF African Cup, the OFC Nations Cup, and the AFC Asian Cup, as the influences on home advantage are essentially gone for the majority of teams, except for the host country's team (see Brown, et al., 2002, for a discussion on home advantage when hosting the FIFA World Cup).

After calculating home advantage for the entire sample period, for each year of the sample period, and for each competition and tournament, we test several null hypotheses pertaining to home advantage in women's international football. Our first null hypothesis is that home advantage does not exist for the entire sample period:

*H1: Home advantage does not exist in women's international football over the period 1980-2022.*

We test null hypothesis H1 by using a standard t-test that the home team's win percentage averages more than 0.5 during the sample period.



Our second set of null hypotheses test for home advantage in international women's football during matches played in each of the five decades represented during the sample period:

*H2: Home advantage does not exist in women's international football for matches played during each of the five decades represented in the period from 1980-2022.*

We test null hypotheses H2 by using separate standard t-tests that the team win percentage of matches played during the 1980s, 1990s, 2000s, 2010s, and 2020s.

Our third set of null hypothesis is that home advantage in international women's football does not exist for individual geographies and tournaments, neutral site matches:

*H3: Home advantage does not exist in specific competitions and tournaments and in neutral site matches over the period 1980-2022.*

We test null hypotheses in H3 by using separate standard t-tests that the home team win percentage is greater than 0.5 in each of the competitions, tournaments, and in neutral site matches during the sample period.

Our final null hypothesis is that home advantage in women's international football has not been changing over the sample period:

*H4: There is no temporal pattern to home advantage in women's international football over the period 1980-2022.*

We test null hypothesis H4 in two ways by regressing annual home win percentage, across all matches, against time (in a linear model) and time and time-squared (in a quadratic model). If the quadratic model rejects H4, we can use the estimation results to estimate when home advantage was minimised (or maximised) during the sample period.

Our final analysis compares home advantage in international women's football to that of international men's football and tests for convergence using the methodology introduced by Phillips and Sul (2007). Men's international play started in 1872 but there were only one, two, or three matches played until 1882, when five matches were played. We use 1893 as the starting date of our men's sample so that it matches with the corresponding years of the women's game relative to 1980. We graphically and statistically compare home advantage in the men's game contemporaneous with the women's game from 1980-2022 but also consider how home advantage evolved in the first fifty-three years of the men's sample with how home advantage evolved during the 43 years of the sample period. We next turn to the presentation and discussion of our empirical results.



Results and Discussion

Table 1 reports the results of home winning percentage, home losing percentage, and draws for the entire sample period. A test of H1 indicates that we reject the null at the five percent significance level, as indicated in Table 1. Therefore, the data suggests that there is a home advantage in women’s international football for the period 1980-2022. Figure 1 depicts the annual home winning and home losing percentages over the sample period. As can be seen in Figure 1, home advantage started above 60% in 1980 and then experienced a dramatic decline throughout the 1980s and into the early 1990s. Home field advantage increased to be above 60% in the late 1990s and early 2000s before declining and stabilizing in the 2010s to the end of the sample period. By the end of the sample period, home advantage had started to trend upwards slightly but had not reached the levels of the 1980s and late 1990s.

Table 1: Overall Home Advantage in Women’s International Football 1980-2022

Variable	Mean	Std. Deviation
Home Win	0.523*	0.499
Home Loss	0.338	0.473
Draw	0.138	0.345

Notes: Sample of 4,416 competition and tournament international women’s football matches from 1980-2022.  
\* indicates home win percentage is greater than 0.5 with a t-test of 3.103 and p<0.05.

Figure 1: Home Advantage in Women’s International Football 1980-2022

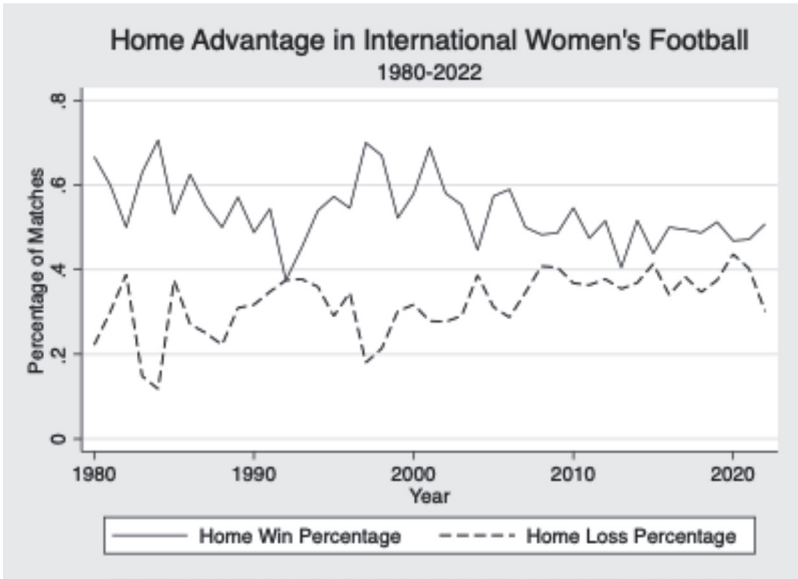


Table 2 reports home advantage starting in the 1980s through the 2020s. In each decade we test for whether there was a home advantage, that is that home win percentage is greater than 0.5. In the early decades of the sample, we reject the null H2 that there was no home advantage in the matches played in that decade. However, we cannot reject the null of no home advantage for matches played during the decade of the 2010s nor during the early years of the 2020s. One might be concerned that the decade of the 2020s only has three years included and therefore suffers from low power. However, there are 276 matches included in the sample from that abbreviated decade, and therefore lower power less than 0.2 might induce a Type II error. However, as Figure 1 depicted, home advantage seemed to be falling in the later years of the sample, so a higher powered test with more observations might not overturn this result.

Table 2: Home Advantage in Women's International Football by Decade (1980s-2020s)

Decade	Home Win Percentage Home	Home Loss Percentage Home	H0: Home Win Percentage = 0.50
1980s	0.58	0.25	2.984*
1990s	0.55	0.31	3.055*
2000s	0.54	0.33	2.886*
2010s	0.49	0.37	-0.631
2020s	0.48	0.39	-0.722

Notes: Sample of 4,416 competition and tournament international women's football matches from 1980-2022. Home advantage measured as home win percentage relative to 0.50. The decade of the 2020s runs through 2022. \* indicates home win percentage is greater than 0.5 with  $p < 0.05$ .

Table 3 reports home advantage across the various competitions and tournaments in the sample. Although categorizing matches is always somewhat arbitrary, here we identify matches that take place during a qualifying competition, e.g. the Asian Cup Qualifiers, which can take place in multiple countries over time, and a championship tournament, e.g., the Asian Cup Championship, which usually has a limited number of competitors, and which generally occurs in a single country over a specific period of time. We also distinguish matches that contribute to FIFA World Cup qualifying and those that occur during the FIFA World Cup Finals, matches that occur during the Summer Olympic Games, the Mundialitos, and the annual Algarve Cup held in Portugal. There are several other short-lived tournaments and competitions that are included in the data but are generally included in the neutral site designations, e.g., the 12 matches associated with the Tournoi de France, the 2 matches associated with the Cyprus Cup, and the 4 matches associated with the Basque Country Women's Cup.

Table 3: Home Advantage Across Geography 1980-2022

Geography	No. of Games	Home Win Percentage	H0: Home Win Percentage = 0.50
Africa Qualifiers	473	0.526	1.149
Africa Championship	189	0.597	2.737*
Asia Qualifiers	500	0.606	4.846*
Asia Championship	359	0.643	5.667*
European Qualifiers	1,511	0.466	-2.603*
Europe Championship	153	0.503	0.081
North & Central America Qualifiers	319	0.667	6.349*
North & Central America Championship	174	0.672	4.831*
South America (Copa America)	157	0.624	3.203*
Oceania Championship & Nations Cup	116	0.551	1.115
FIFA World Cup Qualifiers	456	0.508	0.374
FIFA World Cup Championship	284	0.539	1.307
Olympics	130	0.538	0.876
Mundialito	40	0.725	3.146*
Portugal (Algarve Cup)	551	0.477	-1.065
Neutral Site	1,897	0.559	5.201*

Notes: Sample of 4,416 competition and tournament international women's football matches from 1980-2022. The Championships, the Olympics, the Mundialito, and the Algarve Tournament in Portugal take place in a single country. All other geographies entail multiple countries and generally align with FIFA confederations. Neutral site matches occur across 79 countries and can be included in one of the other geographies.  
\* indicates  $p < 0.05$ .

The first competitions (denoted as qualifiers in our taxonomy) and tournaments (denoted as championships in our taxonomy) listed in Table 3 are essentially aligned with the geographically-oriented FIFA football confederations; therefore, qualifiers take place across many countries whereas the tournaments, most often, occur in a single country.<sup>6</sup>

The t-tests reported in the last column of Table 3 test the various nulls embodied in H3. As can be seen, the Africa Qualifiers, the European Championships, and the Oceania Championship are competitions and tournaments that display no statistically significant home advantage. While the European qualifiers actually display a negative and statistically significant home *disadvantage*, all other competitions and tournaments associated with the FIFA confederations display positive and statistically significant home advantage.

In contrast, those tournaments which are located in a specific host country in which teams are arbitrarily designated as home or away teams, have no statistically

significant home advantage. In the case of the Summer Olympics, home advantage is 0.538, in the case of the FIFA World Cup Championship home advantage is 0.539, and in the case of the Portuguese based Algarve Cup, home advantage is 0.477. Interestingly, the home advantage during the FIFA World Cup Qualifiers, in which teams are playing across multiple countries and across large variance in quality, is only 0.508. However, it might be that there is sufficient variation in team quality and sufficiently high stakes involved for the national teams that home advantage is eroded to being insignificant.<sup>7</sup> On the other hand, the matches associated with the Mundialitos did present a positive and statistically significant home advantage of 0.725.

The evidence suggests that, in general, home advantage appears to exist in women's international football but that home advantage has been declining over time perhaps because of the nature of the competition or tournament in which the matches are played, e.g., the Olympics, or that home advantage might be falling over time because of improved parity and quality among the women's international teams as evidenced by no statistically significant home advantage evident in the 2010s or early 2020s.

Table 4 reports the estimation results of the linear and quadratic regression models used to test H4. The overall significance of both models is apparent with F-test statistics against the null of no overall statistical significance of 10.85 and 5.33, respectively, both statistically significant at the five percent level. In the linear model H4 is rejected and there appears to be a secular decline in home advantage over time; the parameter estimate on the time trend is -0.003 with a standard error of 0.001 (statistically significant at the five percent level).

Table 4: Regression Results

Variable	Linear Model	Quadratic Model
Time	-0.003* (0.001)	-0.002 (0.004)
Time Squared		-0.0002 (0.00007)
Constant	0.595* (0.020)	0.591* (0.030)
Notes: Dependent variable is average home win percentage for a given year. Sample consists of 43 annual observations from 1980-2022. Time starts in 1980 and is indexed by one annually. * indicates $p < 0.05$ against the null hypothesis that the parameter is equal to zero.		

The quadratic model suggests that home advantage has been declining over time but at an increasing rate. The linear parameter estimate is -0.002 with a standard error of 0.004 (statistically insignificant at the five percent level) and the quadratic parameter estimate is -0.00002 with a standard error of 0.00007 (also statistically insignificant at the five percent level). While individually insignificant, a joint test that the two parameters are equal to zero is rejected ( $F=5.33$ ,  $p < 0.05$ ) rejecting H4 in the quadratic model as well. The combined marginal impact of time on women's home

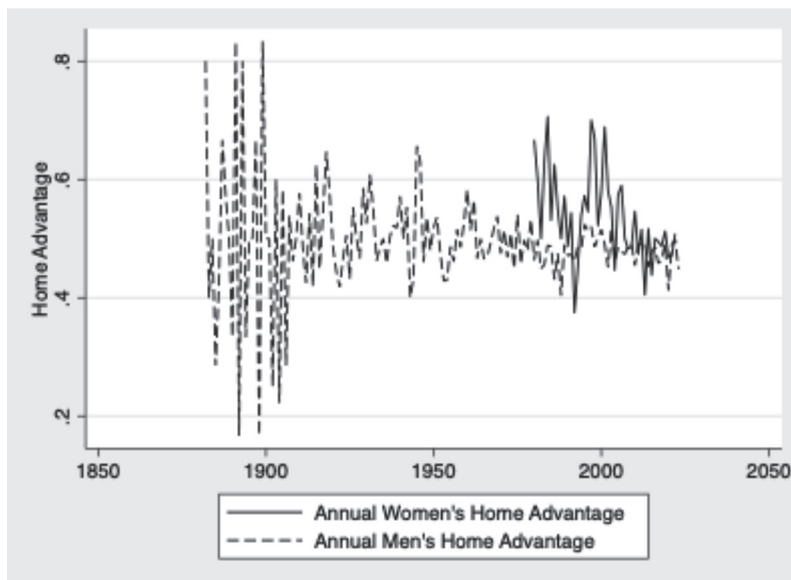
field advantage is -0.3 percentage points per year, consistent with the effect found in the linear model.<sup>8</sup>

### *Convergence in Men's and Women's Home Advantage in International Football*

Our last analysis of home advantage in women's international football is to compare the trend of home advantage in women's international football compared to men's international football. The first men's international football matches occurred in 1872, but we use 1893 as the beginning of the men's sample because that is the year that corresponds to 1980 relative to the first sanctioned women's match in 1969.

We use two methods of comparing the progression of women's home advantage to that of men's home advantage. Figure 2 plots annual home advantage for both men and women from 1893 through 2022, although the women's sample starts in 1980. As can be seen, home advantage in the early years of international women's football was much higher than what had obtained in men's football at the time. However, in the early years of men's football it seems that home field advantage was much higher and with much greater variance than the corresponding years in women's football. This might suggest that the knowledge base about football, including tactics, training, nutrition, etc. was larger and more widely disseminated by the time the women's game is coming into form in the early 1980s so that there was not as great a variance in home field advantage from year to year in the women's game.

Figure 2: Historical Men's and Women's Home Advantage (1882-2022)



Perhaps the magnitude of home field advantage is influenced by the development of the game for each gender, i.e. the overall state of the women's game in 1980 might correspond to the state of the men's game in 1893. Figure 3 plots the home advantage for the 43 years of the women's game starting in 1980 and the corresponding 43 years of the men's game starting in 1893. Figure 3 shows that the size of the home advantage in men's game experienced significant volatility in the early years, but oscillated around a constant value of approximately 50%, unlike the women's game where there was an obvious downward trend early in the sample period, an increase in the middle of the sample period, and then secular decline in the latter part of the sample period.

Figure 3: Evolution of Men's and Women's Home Advantage  
(First 44 Years of Annual Play)

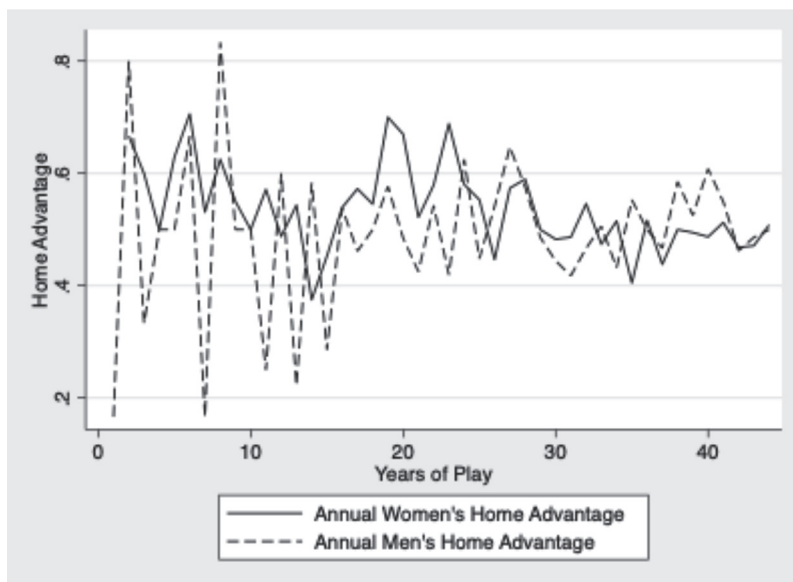
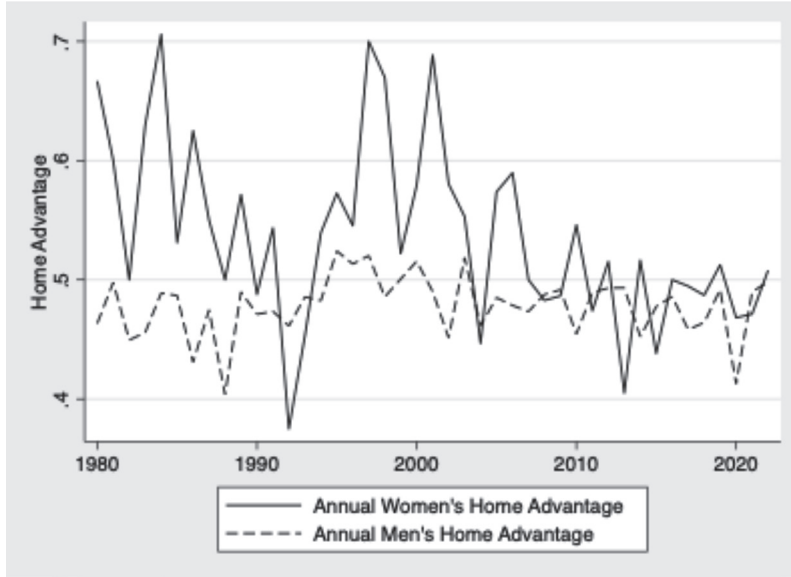


Figure 4 depicts the home advantage for men's and women's international football from 1980 through 2022 and shows that the home advantage in the men's game remains somewhat stable, often falling below 50% in a given year, whereas the home advantage in the women's game starts high, quickly falls, then increases, but starting in the mid-2000s appears to converge to the home advantage displayed in international men's football.

Figure 4: Evolution of Men's and Women's Home Advantage (1980-2022)



While the ocular estimator suggests that there might have been convergence in home advantage across the men's and women's game, we implement the formal log-t statistical test for convergence developed by Phillips and Sul (2007) and implemented in Stata by Du (2017). Phillips and Sul introduced a new econometric methodology by focusing on transitional behavior within a panel, stressing heterogeneity and different speeds of convergence across units. Unlike other tests of convergence, such as beta-convergence, the Phillips and Sul approach do not assume uniform transition paths for all units.

The main contributions of Phillips and Sul (2007) are two fold. First, they develop a Log-t Convergence test which examines whether individual units in a panel converge to a common steady state over time. Second, they introduce the concept of "club convergence" wherein subgroups of units converge to distinct steady states.<sup>9</sup>

The Log-t Convergence test determines whether a group of units (in our application, womens' international football and men's international football) converge to a common steady state. The test investigates the dynamics of the panel relative to the cross-sectional average over time, thereby allowing for heterogeneity and non-linear transition paths across units.

Define the relative transition coefficient  $h_{i,t}$  for unit  $i$  and time  $t$  as:

$$h_{i,t} = \frac{x_{i,t}}{\frac{1}{N} \sum_{j=1}^N x_{j,t}},$$



where  $x_{i,t}$  is the observed variable for unit  $i$  in time  $t$ ,  $N$  is the number of units in the panel, and  $h_{i,t}$  measures the relative position of group  $i$  in time  $t$  to the cross-sectional average at time  $t$ . One then calculates the cross-sectional variance ratio as:

$$V_t = \frac{1}{N} \sum_{i=1}^N (h_{i,t} - 1)^2,$$

where the panel converges to a common steady state if as  $t \rightarrow \infty$ ,  $V_t \rightarrow 0$ .

Phillips and Sul (2007) then propose a log-variance regression that tests for convergence. This entails regressing the natural log of  $V_t$  over time against deterministic natural log trend in the form of a simple regression:

$$\log(V_t) = \alpha + \beta \log(t) + u_t,$$

where  $\beta \geq 0$  indicates convergence and  $\beta < 0$  indicates no convergence. Therefore a simple t-test on the hypothesis that  $\beta < 0$  is a test of the null hypothesis of no convergence. The test accommodates heteroskedastic and autocorrelation robust standard errors. As shown by Phillips and Sul (2007), the limiting distribution of the log-t test statistic is standard normal.

In our application, the test entails two time series, one describing home advantage of men's international football and one describing home advantage of women's international football. We first implement the convergence test on the data reflecting the first 43 years of the sample period for the women's game with the corresponding first 43 years of the men's game, starting in 1893 (the data depicted in Figure 3). In this case, the null hypothesis of non-convergence is rejected: the slope parameter on the deterministic time trend is 0.813, with a test statistic on the deterministic time trend is 0.64, which is greater than -1.645 (the critical value of the standard normal distribution at  $\alpha = .05$  for a one-sided test that the slope parameter is less than zero). This suggests that the home field advantage enjoyed during the first years of the women's game converged with the home field advantage enjoyed during the first years of the men's game.

As a robustness check, we apply the convergence test to the data describing home advantage for both women's and men's international football from 1980-2022. Again, the null hypothesis of non-convergence is rejected: the slope coefficient on the deterministic time trend is 1.32, the test statistic is 1.24, which is greater than the critical value of -1.645. This suggests that the home field advantage enjoyed in the women's game converged on that enjoyed in the men's game during the latter part of the 20th century and the first part of the 21st century.

How do we interpret these convergence results? The first result suggests that the evolution of home advantage might be a function of how many matches or how many years of matches have been played in the sport, regardless of when the sport starts and who is playing. However, because we see convergence when we use contemporaneous data, it might be that women's international football tactics, strategy, and training are

contemporaneously informed by those same elements in men's international football. This could occur through shared coaching, training, or player interactions. Another possibility is that improved transportation, higher quality accommodation for visiting teams, and improved pitches and stadiums, some or all of which are enjoyed by both the men's and women's games, have contributed to a reduction in home advantage in both the men's and women's games. These possibilities invite future research into whether and how they might have contributed to the convergence in home advantage between the two sports. We now turn to some final thoughts and conclusions arising from our empirical analysis.

## Conclusions

This paper is the first to document home field advantage in women's international football using a sample of 4,416 matches from 1980 through 2022. We first document the overall percentage of home wins during the sample period is 52.3% which is statistically greater than 50%, which is not the same home advantage observed during the sample period in international men's football. The home advantage in international women's football declined precipitously over the decades: in the 1980s, home advantage averaged 58% but by the 2020s home advantage averaged 48%. We also show that home advantage differs across the various confederations where countries are grouped according to geography. Not only do home advantages differ across geographical regions, the home advantage is sometimes greater than 50% and other times not. This suggests there might be frictions that limit the decline in home field advantage in the women's game in certain regions relative to others. This, too, is a topic for future research.

We graphically inspect the time series of home advantage in women's international football compared to that in men's international football. It appears that home advantage had greater and persistent variance in the early years of the men's game that is not replicated in the early years of the women's game. However, when looking at home advantage in the women's game starting in 1980, it appears to converge to the home advantage of the men's game. We formally test whether home advantage in women's international football has converged with home advantage in men's international football using two sets of data and the convergence test developed by Phillips and Sul (2007). The first test is based on the 43 years of the sample period which starts in 1980, 11 years after the first sanctioned women's matches, and the corresponding 43 years of the men's game that starts in 1893, 11 years after the first matches in the men's game. In this case, convergence is supported by the data, suggesting that the women's game and the men's game experienced a similar evolution in its early years. This might reflect a natural evolution in home advantage as a sport matures, regardless of when the sport starts and who is playing.

When using contemporaneous data that describe home advantage in the two sports from 1980-2022, the period during which women's international football matured, we also find convergence. This might reflect a sharing of contemporaneous football tactics, strategy, and training that is transferred to the women's game through coaches, trainers, and player interactions, and vice-versa. In addition, increased quality of transportation, accommodation for visiting teams, and the quality of the pitches and stadiums, which might be enjoyed in both the men's and women's games, might reduce home field advantage in both women's and men's international football. These possibilities encourage future research in home field advantage in women's international football.

## **Declarations**

### *Funding*

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

### *Conflicts of interest/Competing interests*

There is no conflict of interest/Competing interests

### *Availability of data and material*

The data that support the findings in this study are available at <https://www.kaggle.com/datasets/martj42/womens-international-football-results>, or from the authors themselves.

### *Code Availability*

The computer program results are shared through the tables in the manuscript.

### *Authors' Contributions*

**Depken:** conceptualization, validation, software, formal analysis, data curation, writing. **Globan:** conceptualization, data curation, writing.

## NOTES

- <sup>1</sup> See Depken and Globan (2023) for a more detailed discussion on the evolution of competitiveness of women's international football.
- <sup>2</sup> We do have data of matches played in 1969, 1970, 1971, 1975, 1977, and 1979. However, the several years without any games played reduces the efficacy of studying the evolution of home field advantage over the years. Therefore, we restrict our sample to be from 1980-2022. We dropped 61 matches from the potential larger, and the home win percentage in these matches was high at 78.6% (with  $p < .05$  that home win percentage equals 0.5). These 61 matches were hosted by 17 countries, 8 of which in Europe. Denmark alone hosted 12 matches and won 11 of them. This suggests that there is a lot of noise in the home field advantage in the early years of women's international football.
- <sup>3</sup> The database resides at [www.kaggle.com/datasets/martj42/womens-international-football-results](http://www.kaggle.com/datasets/martj42/womens-international-football-results), last accessed Oct 2023.
- <sup>4</sup> The Mundialito tournaments were not sponsored by FIFA, but in retrospect were a proof-of-concept that a wider women's World Cup tournament could be feasible. In 1991, FIFA sponsored the first official women's World Cup hosted by China.
- <sup>5</sup> There were many "friendly" matches played during the gap years and during other years in the sample period. We do not have information on most of the friendlies that were played and therefore we do not include these matches in this study.
- <sup>6</sup> The FIFA confederations are as follows: Asian Football Confederation (AFC) comprised of 47 countries in Asia; Confederation of African Football (CAF) comprised of 56 countries in Africa; Confederation of North, Central American, and Caribbean Association Football (CONCACAF), comprised of 41 countries; Confederación Sudamericana de Fútbol (CONMEBOL), comprised of ten countries; Oceania Football Confederation (OFC) comprised of 13 countries; and Union of European Football Associations (UEFA), comprised of 55 countries.
- <sup>7</sup> Most qualifying competitions entail drawing teams into different groups of varying sizes, depending on the competition. Generally speaking, teams are ranked by their FIFA coefficients, which reflect their quality in recent play, and sorted into pods. Each pod contains teams of similar quality and each group is composed of teams from each pod. Therefore, each group has a team of "top quality" and then the remaining teams come from the lower quality pods. Depending on the competition, the various groups could have very high variance in quality, which, in turn, could reduce home advantage. A subject of future research is to compare the variance in quality in men's and women's qualifying group play to test the conjecture that women's competitions generally have higher variance in quality during qualifying play during the group stage which influences home advantage during women's qualifying competitions.
- <sup>8</sup> A topic for future research is to investigate whether the uptick in home advantage in women's international football toward the end of our sample period is maintained or is simply random fluctuations around the lowest home advantage in women's international football obtained in 2010.
- <sup>9</sup> This is a topic for future research in women's football. Herein we focus only on convergence between home field advantage in women's international football and men's international football.

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