Structural Determinants and Their Impact on Competitive Balance in Five Major European Women's Soccer Leagues

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Structural Determinants and Their Impact on Competitive Balance in Five Major European Women's Soccer Leagues

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Business, Economics, and Society

Abstract

This study investigates competitive balance in five major European women's soccer leagues—Women's Super League (WSL) (England), Première Ligue (France), Frauen-Bundesliga (Germany), Toppserien (Norway), and Damallsvenskan (Sweden)—over the period 1997 to 2023. Using the Herfindahl-Hirschman Index (HHI), its deviation (dHHI), and a fixed-effects regression model with league and year controls, the analysis explores the effects of salary caps, league expansions, promotion/relegation systems, professionalization, and participation in the Union of European Football Association (UEFA) Women's Champions League (UWCL). The results show that salary caps and league expansions enhance competitive balance, while promotion/relegation and an increase in player talent concentration reduce parity. The impact of professionalization and UWCL participation is insignificant. These findings provide valuable policy recommendations for promoting parity and supporting the sustainable development of women's soccer leagues.

KEYWORDS: (Competitive Balance, Women's Soccer, Herfindahl-Hirschman Index)
JEL CODES: (Z20, Z21, Z22)

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1. Introduction

Competitive balance, the equitable distribution of success among teams, is a critical component of sustainable and engaging sports leagues. While men's sports, including the National Football League (NFL), National Basketball Association (NBA), Major League Baseball (MLB), and European men's soccer, are extensively studied, research on women's professional soccer remains limited. This gap is particularly notable as women's soccer undergoes rapid development, highlighting the need to understand how competitive balance impacts its growth and sustainability.

Existing studies, such as those by Rottenberg (1956) and Neale (1964), have emphasized the economic importance of outcome unpredictability in sports. More recent research has explored mechanisms like salary caps, revenue-sharing, and promotion/relegation systems, though much of this analysis has yet to incorporate women's leagues. Although Mondal (2023) explored competitive balance in women's soccer up to 2018, recent years of immense growth remain understudied.

This paper focuses on competitive balance in five major European women's soccer leagues—England's Women's Super League (WSL), France's Première Ligue, Germany's Frauen-Bundesliga, Norway's Toppserien, and Sweden's Damallsvenskan—spanning from 1997 to 2023. Using the Herfindahl-Hirschman Index (HHI) and its deviation (dHHI) as metrics, I analyze how factors such as salary caps, league expansions, promotion/relegation, professionalization, and participation in the UEFA Women's Champions League influence competitive balance.

2. Literature Review

Research on competitive balance in professional sports has examined its impact on league profitability, fan engagement, and long-term sustainability. Competitive balance refers to how evenly success is distributed among teams, with greater balance leading to more unpredictable outcomes—a key driver of fan interest and fuel for league revenues. The concept of competitive balance, a foundational idea in sports economics, was first introduced by Rottenberg (1956). He emphasized that unpredictability in game outcomes is crucial for maintaining fan interest. Neale (1964) expanded on this, arguing that competitive balance creates a unique market structure in sports where the value of the games depends on the uncertainty of their outcomes. Both scholars highlighted the importance of competitive balance for the long-term economic viability of sports leagues. Building on these foundational ideas, researchers have studied how different league structures—such as salary caps, revenue-sharing models, and player drafts—affect competitive balance. In North American sports leagues like the NFL and NBA, salary caps and revenue-sharing systems aim to distribute resources more equitably among teams, preventing wealthier franchises from dominating. Fort (2006) found that these mechanisms are essential for maintaining the unpredictability of game outcomes, which is key to sustaining fan interest and league revenues.

Larsen, Fenn and Spenner (2006) took this analysis further by examining the NFL, particularly the effects of free agency and the salary cap on competitive balance. Their study used metrics such as the Gini coefficient and the deviations of the Herfindahl-Hirschman Index (dHHI) to measure the distribution of success among teams. They found that the introduction of free agency and the salary cap in 1993 improved competitive balance as teams' win rates became more evenly distributed.

In European football, however, competitive balance faces significant challenges due to the absence of salary caps and substantial financial disparities between clubs. Gasparetto, Mishchenko, and Zaitsev (2023) showed that in leagues like the Premier League and La Liga, financial inequality and concentrated talent have led to a few teams consistently outperforming others and achieving disproportionate success. This lack of competitive balance reduces the unpredictability of match outcomes, weakening fan engagement and, in turn, harming league profitability. Research by Rottenberg (1956) and Fort and Quirk (1995) support this claim, highlighting that leagues dominated by a few teams see diminished fan interest due to reduced outcome uncertainty, which negatively impacts revenues.

Despite financial controls, achieving full competitive balance remains difficult, particularly in leagues like the NBA. Berri, Leeds, and Mondello (2005) argued that while financial mechanisms such as salary caps and revenue-sharing are important, they may not fully address competitive imbalances due to factors such as the scarcity of certain types of talent. In the NBA, for instance, the limited number of elite tall players leads to natural talent imbalances that exacerbate competitive disparities between teams. This suggests that even with strong financial controls, leagues may struggle to fully achieve competitive balance if other factors—such as talent distribution—remain unequal.

While much of the research on competitive balance has traditionally focused on men's sports, this review shifts focus to professional women's soccer in Europe, where economic structures and league dynamics present unique challenges and opportunities. In leagues such as Première Ligue, La Liga F, and England's Women's Super League, competitive balance is shaped by the financial support provided to teams connected to major men's clubs, uneven investment across teams, and different

levels of professionalization (Mondal, 2023). Top women's clubs such as Olympique Lyonnais, FC Barcelona, and Chelsea FC Women have leveraged the resources of their affiliated men's teams, creating significant financial disparities that often result in these clubs dominating their respective domestic leagues (Smith, 2021). This imbalance concentrates talent and success in a few elite teams, leaving smaller, less financially supported clubs struggling to remain competitive (Gasparetto, Mishchenko, & Zaitsev, 2023).

This concentration of resources and success reduces outcome unpredictability, which is essential for maintaining fan interest and league profitability (Fort, 2006). Research on men's sports shows that predictable outcomes reduce fan engagement, and similar effects are now being observed in women's soccer. Studies such as François et al. (2022) further explore this by comparing competitive balance in the UEFA Men's and Women's Champions League. They find that while women's soccer has made strides toward greater competitive balance, significant gaps still exist, particularly in the depth of player talent and financial resources available to women's teams compared to men's teams. As women's soccer continues to grow rapidly, the global market for professional women's sports is expected to generate over $1 billion in 2024 (Deloitte, 2023). Understanding how competitive balance develops in women's professional soccer leagues will be crucial for ensuring the sport's continued expansion and addressing the financial inequalities that persist between clubs.

Mondal employs several statistical tools, including the Herfindahl Index of Competitive Balance (HICB), the standard deviation of win percentages, and the win dispersion ratio, to analyze competitive balance in women's soccer. The study finds that competitive balance remained relatively stable across most leagues. However, leagues such as England's Women's Super League and Germany's Frauen-

Bundesliga exhibited notable differences in concentration and dominance, driven by financial disparities and uneven resource allocation.

These findings point to the critical role of structural factors, such as league organization and financial inequalities, in shaping competitive balance. Furthermore, Mondal identifies two key determinants: dominance (consistent success of a small group of teams) and concentration (the equality of competition across all teams). While most leagues showed stability in these measures, leagues like Norway's Toppserien demonstrated improvement in competitive balance, attributed to reduced dominance and increased parity.

This study builds on Larsen et al.'s framework to identify key determinants of competitive balance in leading European women's soccer leagues. While Mondal's analysis concluded in 2018, the present research extends from 1997 to 2023, capturing an era of accelerated growth driven by increased media exposure, sponsorship, and investment—particularly following the 2019 FIFA Women's World Cup.

3. Theory and Methodology

To measure competitive balance, Depken (1999) adapts the Herfindahl-Hirschman Index (HHI), a widely used economic measure of market concentration, by introducing the deviation of the HHI (dHHI) from the "most equal distribution" of wins. He demonstrates that the HHI is mathematically linked to the standard deviation of wins, where a higher HHI reflects a greater concentration of wins among fewer teams and, consequently, a lower competitive balance. The HHI is widely utilized by economists to assess firm dominance in industries such as banking (Gilbert, 1984), airlines (Borenstein, 1989; Evans & Kessides, 1993), and cigarettes (Sumner, 1981; Sullivan, 1985) and is calculated as the quadratic summation of all firm market shares in an industry.

HHI is defined below in Equation 1:

$$HHI = \sum_{i=1}^{N} MS_i^2 \quad (1)$$

where MS_i represents the market share of the *i*-th firm and *N* is the number of firms. In some industries, obtaining output data for all firms poses challenges, complicating accurate HHI calculations. Contrastingly, European women's soccer leagues—the Women's Super League (England), Première Ligue (France), Frauen-Bundesliga (Germany), Damallsvenskan (Sweden), and Toppserien (Norway) — offer readily available data on total points. A team's market share is calculated as its proportion of total league wins or points in a season. Following the work of Larsen et al. (2006) and Depken (1999) HHI is defined in Equation 2 as:

$$MS_i = \frac{Wins_i \text{ or } Points_i}{Total\ League\ Wins\ or\ Points} \quad (2)$$

where MS_i represents the market share of the *i*th team, $Wins_i$ *or* $Points_i$ is the number of wins or points for the *i*th team*, and Total League Wins or Points* refers to the total number of wins or points accumulated across all teams in the league.

Depken (1999) critiques the standard deviation of winning percentages for its inability to adjust for a change in the number of teams in a league. As new teams enter a league, the standard deviation may artificially inflate, distorting the analysis of competitive balance. To address this, Depken introduces the deviation of the HHI (dHHI), which accounts for the downward bias in HHI caused by an increasing number of teams. The dHHI adjusts the HHI by subtracting the reciprocal of the number of teams (n), in a league for a given year, as shown in Equation 3:

$$dHHI = HHI - \left(\frac{1}{n}\right) \quad (3)$$

The HHI is artificially biased downwards when there is an increase in the number of teams. In order to correct for this, Depken uses the dHHI instead. Perfect parity, as described by Quirk and Fort (1995), occurs when all teams win half their games, producing a dHHI value of 0.5. In sports, the upper and lower bounds of HHI and dHHI differ from traditional industries. As Larsen et al. (2006) explain, in a monopoly, an HHI value of 1 represents a single firm controlling the market, while 0 indicates perfect competition. In sports, even a team that wins all its games cannot monopolize all league wins, and a team that loses every game cannot drive the HHI to zero, as other teams will share victories. In the context of European women's soccer leagues, even dominant teams, such as Olympique Lyon, cannot monopolize wins due to the league structure. Lower HHI and dHHI values indicate greater parity and a more balanced league, while higher values reflect dominance by a few teams, reducing competitive balance. This framework highlights the unique competitive characteristics of sports leagues compared to traditional industries.

Larsen et al. (2006) adapted Depken's methodology, to analyze how various factors influenced the NFL's competitive balance over time. They utilized Gini coefficients, HHI deviations (dHHI), and regression models to evaluate the effects of

player talent distribution, the introduction of free agency, the implementation of salary caps, league expansions, and player strikes. Their findings provide evidence that the introduction of free agency, coupled with the implementation of a salary cap, contributed to improving competitive balance in the NFL. Additionally, the study highlights the importance of playing talent distribution across teams as a key factor affecting balance.

Building on Larsen et al.'s (2006) approach, this study adapts its framework to examine the determinants of competitive balance in European women's soccer leagues from 1997 to 2023. By focusing on factors such as professionalization, salary caps, league expansion, promotion and relegation systems, and participation in the UEFA Women's Champions League (UWCL), this research aims to identify how structural and contextual variables shape competitive dynamics in women's soccer.

3.1. Methodology

The dependent variable, dHHI, measures deviations from an equal distribution of wins and indicates shifts in competitive balance, as outlined in the theoretical framework. Match-level data—covering wins, draws, losses, goals scored, and goals conceded—were gathered from official league websites for the Women's Super League[1], Première Ligue[2], Frauen-Bundesliga[3], Toppserien [4], and Damallsvenskan[5], as well as from the Rec Sports Soccer Statistic Foundation (RSSSF) Archive[6], and

[1] Available at https://womensleagues.thefa.com/
[2] Available at https://www.fff.fr/competition/engagement/424635-arkema-premiere-ligue/phase/1/index.html
[3] Available at https://www.dfb.de/frauen/ligen-frauen/google-pixel-frauen-bundesliga
[4] Available at https://toppserien.no/
[5] Available at https://www.obosdamallsvenskan.se/
[6] Available at https://www.rsssf.org/

then aggregated annually. The dataset covers these five European women's leagues from 1997 to 2023.

The model used for this study is as follows:

$$dHHI_{it} = f(HHIGf, HHIGa, Prof_{it}, ProRel_{it}, UWCL_{it}, SalCap_{it}, Expand_{it}, Covid_{it}.) \quad (4)$$

The definitions and descriptive statistics of the variables in Equation 4 are displayed in Table 1. dHHI is the deviation of the HHI from the equal distribution of wins in year *t*, as described in Equation 3.

Table 1: Variable Definitions and Descriptive Statistics

Variable	*Definition*	M	SD
dHHI	Deviation of the Herfindahl Hirschman Index	.026	.095
$HHIGf_t$	Herfindahl Hirschman Index of goals scored by each team	.119	.093
$HHIGa_t$	Herfindahl Hirschman Index of goals allowed by each team	.117	.095
$Prof_t$	Dummy variable (1 = professional contracts offered, 0 otherwise)	.429	.469
$ProRel_t$	Dummy variable (1 = promotion/relegation exists, 0 otherwise)	.978	.148
$UWCL_t$	Dummy variable (1 = UEFA Women's Champions League participation, 0 otherwise)	.852	.357
$SalCap_t$	Dummy variable (1 = salary cap enforced, 0 otherwise)	.074	.263
$Expand_t$	Dummy variable (1 = league expansion year, 0 otherwise)	.037	.189
$COVID_t$	Dummy variable (1 = season disrupted by COVID-19, 0 otherwise).	.037	.189

The professionalization of women's soccer leagues plays a crucial role in standardizing player contracts and operational structures. This study captures the effects of professionalization through the dummy variable Prof, which assigns a value of 1 in seasons when leagues implement professional contracts and 0 for years without. Leagues vary in their degree of professionalization, ranging from fully professional status to a mix of semi-professional and professional contracts. For

instance, the WSL mandated full-time contracts for all players in 2018–2019, building on its initial introduction of professional contracts in 2011. The Première Ligue began its shift toward professionalization in 2009, while the Frauen-Bundesliga has steadily moved in this direction since 1990, though it remains only partially professionalized. The Toppserien and Damallsvenskan also maintain a blend of full-time and semi-professional players. By providing professional contracts, leagues can standardize training, player development, and resource allocation, ultimately reducing talent disparities. Accordingly, the model predicts a negative coefficient for Prof, as increased professionalization likely decreases the dHHI and enhances the overall competitive balance.

Promotion and relegation systems foster competitive intensity by advancing high-performing teams to higher leagues and demoting underperforming ones. These systems, represented by the dummy variable ProRel, assign a value of 1 during seasons when promotion and relegation occur and 0 for seasons without. In the context of English men's professional soccer, Noll (2002) highlights that promotion and relegation enhance competitive incentives for clubs at all levels but also increase financial instability for relegated teams, which often face significant revenue losses and resource constraints. Additionally, some teams promoted to higher leagues find themselves unable to compete effectively due to financial limitations. Promotion and relegation systems have structured the Frauen-Bundesliga, Toppserien, Damallsvenskan, and Première Ligue since their inception. In contrast, the WSL initially adopted a licensing system when it replaced the FA Women's Premier League as the top tier in 2011. This system excluded promotion and relegation during its first three seasons (2011–2013). The WSL reintroduced promotion and relegation in 2014, aligning with its original structure. The predicted coefficient for Pro_Rel is

positive. Although promotion and relegation may strengthen competitive balance in the long term, their immediate impact can increase disparities, as newly promoted teams often enter higher leagues with limited resources and talent, ultimately lowering overall competitive balance.

The regulation of financial disparities through salary caps serves to promote parity within leagues by limiting excessive spending by dominant teams. The dummy variable Sal_Cap represents the presence of a salary cap, assigning a value of 1 in seasons with a cap and 0 in seasons without it. This analysis focuses on the WSL, the only league in the dataset with a salary cap. Introduced in 2014, this "soft" cap limits spending on wages to 40% of a club's turnover, including revenue from the parent club. The salary cap in the WSL aims to foster competitive balance by preventing wealthier clubs, particularly those backed by Premier League teams, from outspending smaller clubs, but it has also raised concerns about limiting player wages and investment (Whyatt & Morgan, 2023). The predicted coefficient for Sal_Cap is negative, as salary caps are expected to lower dHHI, enhancing competitive balance.

League expansion alters the competitive landscape by introducing new teams, increasing the number of participants, and redistributing talent across a larger pool. Fishman (2002) notes that while expansions often disrupt competitive balance in the short term, the negative impact diminishes as new teams stabilize and integrate within the league. Over time, this integration contributes to a more equitable distribution of talent, fostering improved competitive balance. In the NFL, expansion drafts are employed to redistribute talent, requiring existing teams to make certain players available for selection by new teams (Larsen et al., 2006). This process helps expansion teams establish a baseline level of competitiveness, promoting a more balanced league structure. Although European women's soccer leagues do not utilize

expansion drafts, the natural recruitment and development of players over time can achieve similar long-term effects, allowing new teams to gradually close the gap with more established clubs.

In this study, only the Toppserien and the WSL underwent expansions during the data period. To account for the potential impact on competitive balance, the dependent variable dHHIt is used to correct for the downward bias in the Herfindahl-Hirschman Index (HHI) that often accompanies league expansions. Consistent with Depken's (1999) approach, expansion is treated as an exogenous variable, represented by the dummy variable Expand, which takes a value of 1 in seasons when new teams join the league and 0 otherwise. By increasing the number of participants and dispersing talent across a broader set of teams, league expansion is expected to enhance competitive balance over time. As new teams integrate and become competitive, the disparities caused by their initial entry diminish, leading to more evenly distributed competition. This supports the prediction of a negative coefficient for Expand, reflecting the long-term potential of league expansions to improve balance within women's soccer leagues.

Participation in high-profile competitions like the UEFA Women's Champions League (UWCL) reflects club prominence and resource concentration. The model uses the dummy variable UWCL to represent participation in the competition. It assigns a value of 1 to seasons with league participation and 0 to seasons without. Established in 2001, the UWCL has experienced substantial growth, with attendance at the 2023 Barcelona vs. VFL Wolfsburg final reaching 33,147. Olympique Lyonnais exemplifies the dominance often associated with UWCL success, securing six UWCL titles between 2015 and 2022 and 17 Première Ligue championships between 2007 and 2024. Such achievements highlight the concentration of talent and resources

among top-performing teams. These insights support the predicted positive coefficient for UWCL, reflecting an increase in dHHI. and negatively impacted competitive balance as resources were concentrated among top teams.

Larsen et al. (2006) emphasize the critical role of talent distribution in determining a league's competitive balance. To account for this, the model includes measures of talent dispersion. Depken (1999) applied Herfindahl-Hirschman Index (HHI) metrics in Major League Baseball to evaluate the concentration of offensive talent (runs scored) and defensive talent (runs allowed), providing a framework for assessing talent distribution. Building on Depken's approach, this study adapts the HHI framework to analyze talent concentration in European women's soccer leagues. Offensive talent is measured using HHIGf, the HHI of goals scored by each team in year *t*, while defensive talent is captured by HHIGa, the HHI of goals allowed by each team in year *t*.

Equations (5) and (6) extend this analysis to quantify the distribution of player talent across the WSL, Première Ligue, Frauen-Bundesliga, Toppserien, and Damallsvenskan.

HHIGf is described in Equation 5 as:

$$HHIGf_t = \sum_{i=1}^{n} \left(\frac{Goals\ Scored_i}{Total\ Goals\ Scored\ in\ the\ League} \right)^2 \quad (5)$$

Where Goals Scored_i represents the total goals scored by team *i* in year *t* , which is divided by the total goals scored in the league. If offensive talent is concentrated among a few teams, those teams score the majority of goals in the league, leading to higher HHIGf_t values. A greater concentration of offensive talent corresponds to a lower competitive balance and higher values of the dependent variable, dHHI. This indicates that dominance in offensive performance reduces parity

within the league. Hence, the predicted sign for $HHIGf_t$ is positive, as greater offensive concentration corresponds to reduced parity.

Similarly, defensive talent concentration is measured using the Herfindahl-Hirschman Index for points allowed ($HHIGa_t$):

$$HHIGa_t = \sum_{i=1}^{n} \left(\frac{Goals\ Allowed_i}{Total\ Goals\ Allowed\ in\ the\ League} \right)^2 \quad (6)$$

Where $Goals\ Allowed_i$ is the total goals conceded by team *i* in year *t* , divided by the total goals conceded in the league. Higher $HHIGa_t$ values indicate that a few teams dominate defensively by conceding fewer goals, while weaker teams allow disproportionately more. As with $HHIGf_t$, greater defensive concentration reduces competitive balance, leading to increased dHHI. The predicted sign for $HHIGa_t$ is also positive, as greater defensive concentration corresponds to reduced parity.

The concentration measures of $HHIGf_t$ and $HHIGa_t$ primarily capture player talent but also reflect influences from factors like coaching, training staff, and organizational support. These factors illustrate how more than just player performance shapes talent concentration and affects competitive balance within leagues

4. Results and Analysis

To estimate the model, a fixed-effects least squares regression approach is employed. The corresponding Stata code used for the analysis is included in the appendices for reference. This methodology accounts for unobservable factors that could bias results by incorporating fixed effects for both league and year. League fixed effects control for structural, cultural, and historical characteristics unique to each league, while year-fixed effects capture the influence of external shocks and time-specific events. By isolating these factors, the model ensures that the estimated coefficients for explanatory variables accurately reflect their true impact on competitive balance.

Notably, the dummy variable for 2020, introduced to evaluate the potential impact of COVID-19, was statistically insignificant, indicating that the pandemic had no measurable effect on competitive balance during the sample period. Similarly, other year-specific dummy variables were generally insignificant, suggesting that there were no substantial time-based shocks affecting league parity. Econometric diagnostics validated the reliability of the regression results. White's test for heteroskedasticity revealed no evidence of heteroskedasticity, confirming that the variance of errors is consistent across observations. Additionally, the Breusch-Godfrey test showed no significant autocorrelation, ensuring that the standard errors do not need to be adjusted for serial correlation. Results for these tests are provided in Appendix A, while the regression outcomes are summarized in Table 2

Table 2. Fixed effects least squares regression results

Linear regression

dhhipts	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
hhigf	.248	.106	2.34	.021	.038	.458	**
hhiga	.734	.104	7.04	0	.527	.94	***
prof	.005	.005	0.94	.349	-.006	.016	
expand	-.024	.008	-2.89	.005	-.04	-.007	***
sal_cap	-.014	.008	-1.83	.071	-.029	.001	*
uwcl	.007	.011	0.59	.554	-.016	.029	
pro_rel	.022	.011	2.05	.043	.001	.043	**
2	.006	.007	0.96	.338	-.007	.02	
3	-.008	.005	-1.68	.096	-.017	.001	*
4	-.003	.007	-0.38	.703	-.016	.011	
5	-.007	.006	-1.22	.224	-.019	.005	
1997b	0	.	.	.	.	.	
1998	-.002	.009	-0.20	.841	-.019	.016	
1999	-.005	.009	-0.52	.607	-.022	.013	
2000	-.006	.009	-0.69	.494	-.024	.012	
2001	-.021	.014	-1.47	.146	-.049	.007	
2002	-.009	.014	-0.64	.525	-.038	.019	
2003	-.007	.014	-0.53	.601	-.036	.021	
2004	-.008	.014	-0.54	.589	-.036	.021	
2005	-.008	.014	-0.54	.588	-.036	.021	
2006	-.008	.014	-0.54	.587	-.036	.021	
2007	.01	.015	0.70	.485	-.019	.04	
2008	-.012	.015	-0.82	.416	-.041	.017	
2009	-.007	.014	-0.48	.632	-.035	.021	
2010	-.006	.014	-0.43	.667	-.035	.022	
2011	-.011	.014	-0.79	.431	-.04	.017	
2012	-.012	.014	-0.85	.399	-.041	.016	
2013	-.013	.014	-0.87	.387	-.041	.016	
2014	-.029	.014	-2.02	.046	-.057	-.001	**
2015	-.017	.014	-1.20	.232	-.046	.011	
2016	-.007	.014	-0.47	.641	-.035	.022	
2017	-.003	.014	-0.19	.847	-.031	.026	
2018	-.008	.014	-0.53	.596	-.036	.021	
2019	-.007	.014	-0.47	.642	-.035	.022	
2020	-.015	.015	-1.00	.318	-.044	.014	
2021	.008	.015	0.51	.614	-.022	.037	
2022	0	.014	-0.03	.977	-.029	.028	
2023	.002	.013	0.17	.867	-.023	.028	
Constant	-.107	.015	-7.05	0	-.138	-.077	***

Mean dependent var	0.026	SD dependent var	0.095
R-squared	0.985	Number of obs	135
F-test	170.410	Prob > F	0.000
Akaike crit. (AIC)	-741.868	Bayesian crit. (BIC)	-631.467

*** *p<.01*, ** *p<.05*, * *p<.1*

The variable for HHIGf, measuring offensive concentration, is positive and statistically significant at the 5% level. This result indicates that a greater concentration of offensive talent among a few teams reduces competitive balance, as

reflected by higher dHHI values. Similarly, HHIGa, representing concentration of defensive talent on a few teams, is positive and statistically significant at the 1% level, showing that defensive dominance by a small number of teams exacerbates competitive disparities. These findings align with the hypothesis that both offensive and defensive concentration decreases competitive balance within leagues.

League structure also plays a critical role. The promotion and relegation variable (ProRel) is positive and statistically significant at the 5% level, suggesting that leagues with promotion and relegation systems experience reduced competitive balance. This result aligns with the expectation that newly promoted teams often face resource and talent deficits, leading to a concentration of wins among top-performing teams. Conversely, the salary cap variable (SalCap) is negative and statistically significant at the 10% level, demonstrating that salary caps enhance parity by limiting financial disparities and fostering a more equitable distribution of player talent. The league expansion variable (Expand) is also negative and statistically significant at the 1% level, indicating that expansions enhance competitive balance by redistributing talent across a larger pool of teams.

The analysis yielded statistically insignificant results for variables as well. The UEFA Women's Champions League participation variable (UWCL), is statistically insignificant, suggesting that a league's involvement in the competition does not directly affect domestic competitive balance. One possible explanation is that the effects of UWCL participation are more indirect and long-term, influencing factors like player recruitment and sponsorship deals rather than immediate domestic league performance. Similarly, the professionalization variable (Prof), which reflects the adoption of professional contracts by leagues, is statistically insignificant. While professional contracts were expected to level the playing field across teams, the data

indicates no measurable impact on league parity during the sample period. This result may reflect the incomplete or uneven implementation of professional contracts.

Overall, the model explains 98.5% of the variation in competitive balance, as reflected in the R-squared value, underscoring its robustness and validity. The findings underscore the significance of structural policies, such as salary caps and league expansions, in promoting competitive balance, while also revealing the disruptive effects of promotion and relegation systems on parity. While the results generally align with theoretical expectations, the study recognizes limitations in fully capturing the complex and evolving interactions between these factors over time. Despite these challenges, the empirical analysis comprehensively evaluates the hypothesis, offering strong support for the conclusions drawn.

5. Conclusion

This research examines the impact of structural and performance-based factors on competitive balance in five major European women's soccer leagues—WSL, Première Ligue, Frauen-Bundesliga, Toppserien, and Damallsvenskan—over the period of 1997 to 2023. Evidence indicates that salary caps enhance competitive balance by reducing financial disparities and promoting a more equitable distribution of player talent among teams. League expansion also appears to improve competitive balance, with results suggesting that the introduction of new teams redistributes talent and fosters parity over time. In contrast, promotion and relegation systems negatively affect competitive balance, as newly promoted teams often struggle to compete with well-established clubs. Offensive and defensive concentration, measured by HHIGf and HHIGa, significantly reduces competitive balance as dominance in either area increases win concentration.

The professionalization variable, which reflects the introduction of professional contracts, is statistically insignificant, indicating that adopting professional contracts has not had a measurable effect on competitive balance. This may be due to inconsistencies in the implementation of professional contracts across leagues. Similarly, the variable for participation in the UEFA Women's Champions League (UWCL) is statistically insignificant, suggesting that the influence of international competition is overshadowed by domestic factors such as league structures and resource allocation. Additionally, the inclusion of league and year-fixed effects, including 2020, which accounted for the impact of COVID-19, had no measurable effect on competitive balance, underscoring the dominance of structural factors within the leagues themselves.

This study contributes to the growing body of research on competitive balance by providing empirical evidence on the effects of structural policies and talent distribution in women's soccer leagues. By highlighting the importance of salary caps and league expansion, as well as the nuanced effects of promotion and relegation systems, it offers practical insights for policymakers. The findings provide a foundation for further research on optimizing league policies to foster parity, particularly in the context of increasing professionalization and expansion within women's sports.

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7. Appendices

Appendix A: Testing For Heteroskedasticity

White's test for Heteroskedasticity
imtest, white

H0: Homoskedasticity
Ha: Unrestricted heteroskedasticity
chi2(135) = 135.00
Prob > chi2 = 0.4838
Cameron & Trivedi's decomposition of IM-test

Source	chi2	df	p
Heteroskedasticity	135.000	135	0.484
Skewness	43.070	37	0.228
Kurtosis	3.080	1	0.079
Total	181.150	173	0.320

BREUSCH – PAGAN TEST FOR SERIAL CORRELATION.
Linear regression

ehat	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
ehat1	.012	.009	1.36	.178	-.006	.029	
ehat2	.014	.009	1.54	.126	-.004	.031	
ehat3	.045	.074	0.60	.551	-.103	.192	
ehat4	.048	.076	0.63	.53	-.104	.2	
ehat5	.014	.074	0.18	.854	-.134	.161	
hhigf	.229	.074	3.10	.003	.082	.375	***
hhiga	.767	.072	10.64	0	.624	.91	***
prof	.003	.002	1.47	.144	-.001	.007	
expand	-.018	.005	-3.76	0	-.027	-.008	***
sal_cap	-.014	.004	-3.90	0	-.022	-.007	***
uwcl	-.011	.01	-1.11	.271	-.03	.009	
pro_rel	.025	.006	4.33	0	.013	.036	***
Constant	-.106	.011	-9.31	0	-.129	-.083	***

Mean dependent var	0.027	SD dependent var	0.105
R-squared	0.993	Number of obs	110
F-test	1098.345	Prob > F	0.000
Akaike crit. (AIC)	-700.657	Bayesian crit. (BIC)	-665.550

**** p<.01, ** p<.05, * p<.1*

Appendix B: Stata Code

```
summarize dhhipts hhigf hhiga prof expand sal_cap uwcl pro_rel i.leaguenum i.year

regress dhhipts hhigf hhiga prof expand sal_cap uwcl pro_rel i.leaguenum i.year

predict resid

generate ehat=resid

generate ehat1=L.ehat

 generate ehat2=L.ehat1

generate ehat3=L.ehat2

generate ehat4=L.ehat3

generate ehat5=L.ehat4

regress ehat ehat1 ehat2 ehat3 ehat4 ehat5 hhigf hhiga prof expand sal_cap uwcl pro_rel
```