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Abstract

Three of the most celebrated football leagues in the world include the English Premier League (EPL), Italy's Serie A, and Spain's La Liga. To date, little football research has been conducted that attempts to determine why these leagues are so successful. What is it that the EPL, La Liga, and Serie A do that fosters such a high caliber of play, and what pitch factors, if any, either (1) contrast or (2) connect these prestigious leagues? The paucity of rigorous inquiry has not deterred popular speculation—common folklore has not waited for hard data. Experts rush to characterize the perceived performance characteristics of these leagues with little hesitation. And these assumptions have, to some degree, taken on a life of their own: football's answer to urban legend.

This paper searches for key similarities and differences between these leagues that are bolstered by statistically significant findings as well as evidence to identify the key pitch factors that are associated with a team's ultimate success within its respective league.

KEYWORDS: English Premier League, La Liga, Serie A, multiple regression, ANOVA, retrodictive regression model

INTRODUCTION

Three of the most celebrated football leagues in the world include the English Premier League (EPL), Italy's Serie A, and Spain's La Liga. These three leagues have dominated both the most prestigious individual FIFA Ballon d'Or World Football Player of the Year Award and the esteemed team trophy of the UEFA Champions League. In fact, during the past 11 years, players from these three leagues have won all of the Ballon d'Or, as eight of the ten teams were winning the Champions League.[1]

To date, limited football research has been conducted that attempts to determine why these leagues are so successful (Andersson, Edman, and Ekman, [2005]; Barros and Leach [2006]; Crowder, Dixon, Ledford, Robinson [2005]). What is it that the EPL, La Liga, and Serie A do that fosters such a high caliber of play and what game measures, if any, either (1) contrast or (2) connect these prestigious leagues? The paucity of rigorous inquiry has not deterred popular speculation—common folklore has not waited for hard data. Experts rush to characterize the *perceived* performance characteristics of these leagues with little hesitation. And these assumptions have, to some degree, taken on a life of their own: football's answer to urban legend. For example, if one is easily persuaded, you might believe that the EPL is the fastest game with the tightest, toughest marking, while the Spanish League is the most skilled—a veritable collection of football artists (Bilotta [2010]; Espitia-Escuer, García-Cebrián, and Lucía [2006]; FIFA.com [2010]; Rich [2010]; Sheringham [2010]). Also, Serie A teams are generally thought to play a more conservative game and prefer to use the counterattack as a primary offensive weapon; the Italians are quick to get 10 men behind the ball as soon as they achieve a 1-0 lead and readily settle for a low-scoring result—to "not concede" is the unspoken motto of Serie A (Ball [2006]; Gray and Drewett [1998]; Trapattoni [2000]; Vialli and Marcotti, [2006]; Wilson [2008]).

Regardless of how appealing any of these characterizations might be, there has been no compelling evidence to provide support for these notions. This paper searches for key similarities and differences between these leagues that are bolstered by statistically significant findings as well as evidence to identify the key game measures that are associated with a team's ultimate success within its respective league.

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[1] A broader assessment using the three Ballon d'Or finalists for each of these eleven years shows that 32 out of the 33 play for clubs in these leagues. Additionally, 16 of the 20 teams in the finals are from the same three leagues.

METHODS

Unlike indexes, such as the Opta, Actim, and Castrol measures that are widely used to rate individual player performance, the primary assessment of team performance is based on the actual league points earned over the season (Oberstone [2009]). This approach replaces the largely "black box" nature of the player rating systems with a transparent model that uses the end-of-season team table points (Jones, James, and Mellalieu [2004]; McHale and Scarf [2007]).

The methods used include multiple regression modeling to identify the specific game measures *within each league* that make statistically supportable contributions to team performance as measured by the league table points earned during the 2008-2009 season. Additionally, the specific game measures that differentiate performance *between these three league*s are discussed using analysis of variance (ANOVA).

Pitch factor data for each of the three leagues, provided by Opta Sports, is examined to see what specific measures, if any, make a statistically significant contribution to the ultimate success of the team. Although there are hundreds of measures available, only those that make significant contributions to a football club's success—*as measured by table points earned*—are considered as being of primary importance. There is no effort made to develop a rating system that generates an index or single measure of goodness in this paper (Dobson, Goddard, and Persistence [2003]). Instead, the aim is to uncover the specific cluster of game measures that best explain why some teams excel while the others do not, in terms of the team points earned over the 38-game season.

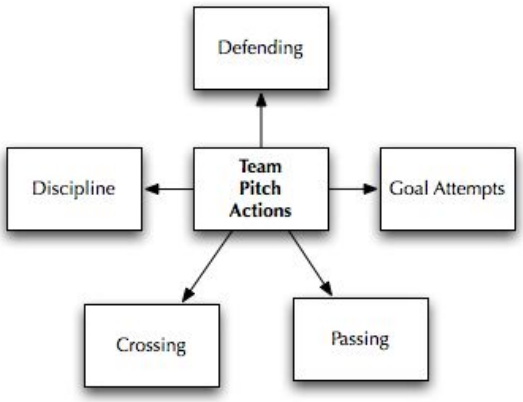

Figure 1. Basic pitch factor families for measuring team performance.

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The five clusters presented in Figure 1 illustrate the primary families of game measures used in this study. The hundreds of measures contained in the Opta database for these clusters, in combination with only twenty teams in each league, establish a maximum limit of 18 variables for this study. The array of game measures ultimately selected is shown in Figure 2.[2]

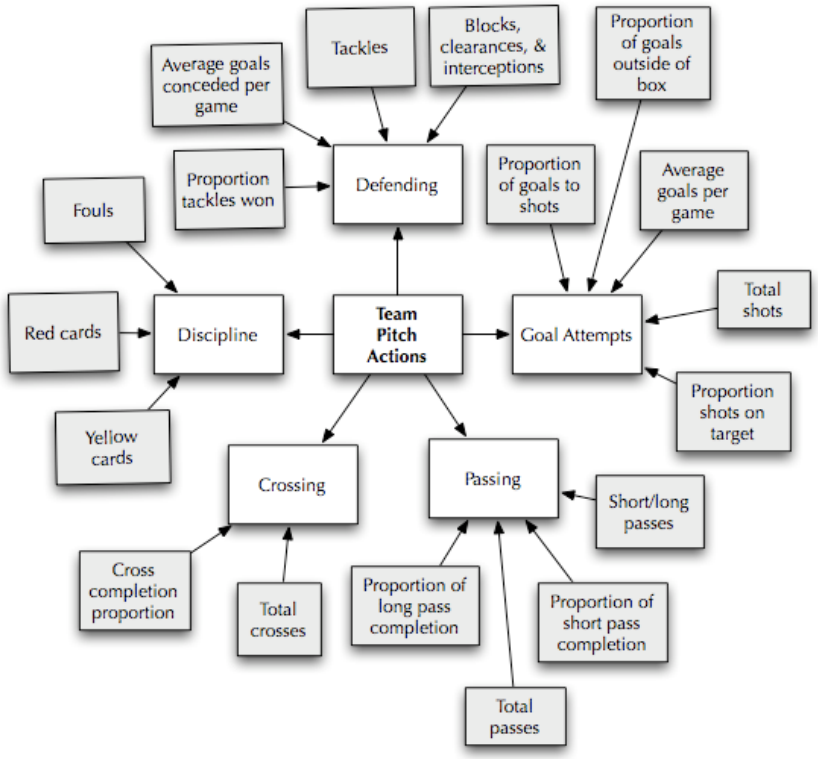

Figure 2. Multiple regression model of 18 game measures.

[2] Although the basic Opta Sports database includes about 25 pitch measures, a portion were eliminated for reasons of redundancy to achieve the final 18 factors, e.g., "number of shots on target" and "total number of shots" made "percent of shots on target" unnecessary.

INTRALEAGUE MULTIPLE REGRESSION ANALYSIS OF PITCH FACTOR CONTRIBUTIONS

A linear multiple regression analysis is conducted for each league that establishes a viable model comprised of a statistically significant set of game measures ($p < 0.05$).[3] It is important to note that it is typically preferred to use only a small proportion of predictor variables in developing this type of model—ideally one-tenth to one-twentieth the size of the sample.[4] Since the football leagues of interest have twenty teams, adopting this approach would limit the study to the use of no more than one or two game measures for our model. For this reason, this requirement is cautiously relaxed for purposes of *practical exploration.* At the end of the model development, assessments will be made concerning the ultimate usefulness of these findings (Winston [2004]).

EPL REGRESSION MODEL

The linear regression model developed for the EPL yields strong overall results with a model p-value<<0.00, R^2=0.97, and statistically significant contributions from all six regression variables (p-value<0.02 (Table 1). An illustration of the retrodictive scatter diagram and radar chart is presented in Figure 3 and Figure 4, respectively, illustrate the strong association between the predictor variables with the actual team performance of league points earned during the season.

EPL Regression Statistics	
Model p-value	3.14E-09
R Square	0.97
Adjusted R Square	0.96
Standard Error	3.76
Observations	20

EPL Model Parameters	*Model Coeff*	*Standard Error*	*t Stat*	*p-value*	*Lower 95%*	*Upper 95%*
Intercept	140.65	30.05	4.68	0.00	75.73	205.56
Percent goals to Shots	269.35	46.37	5.81	0.00	169.17	369.52
Total crosses	0.74	0.27	2.70	0.02	0.15	1.34
Ave goals conceded	-35.86	3.24	-11.08	0.00	-42.85	-28.87
Tackles	1.31	0.47	2.78	0.02	0.29	2.34
Percent tackles won	-122.14	41.97	-2.91	0.01	-212.80	-31.48
Blocks, clearances, etc.	-0.51	0.19	-2.76	0.02	-0.91	-0.11

Table 1. Final six-variable multiple regression model for EPL 2008-2009

3 All three regression models developed in this paper were assessed to insure that collinearity issues are not significant (VIF<10) and that the model residuals are, essentially, normally distributed.

4 http://www.statsoft.com/textbook/multiple-regression/ - achoice

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LA LIGA REGRESSION MODEL

The final regression model consisting of ten game measures for La Liga is shown in Table 2. The strength of this model—beyond the extremely high coefficient of determination (R^2=0.98) for team performance, an overall model p-value<<0.00, and all individual regression variables providing p-values<0.01—is illustrated in the scatter diagram (Figure 5) and radar chart (Figure 6) for the 2008-2009 La Liga season.

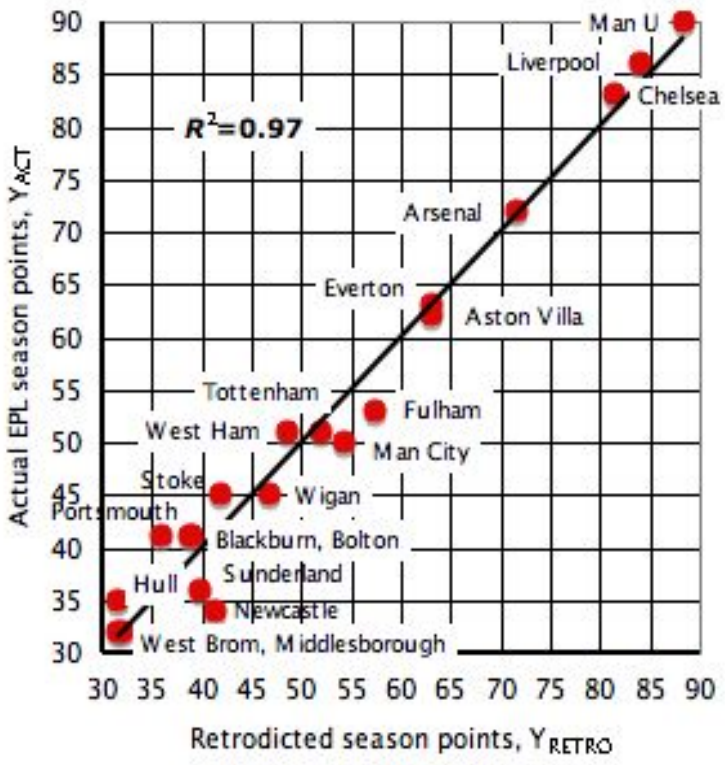

Figure 3. EPL retrodictive scatter diagram for 2008-2009 season.

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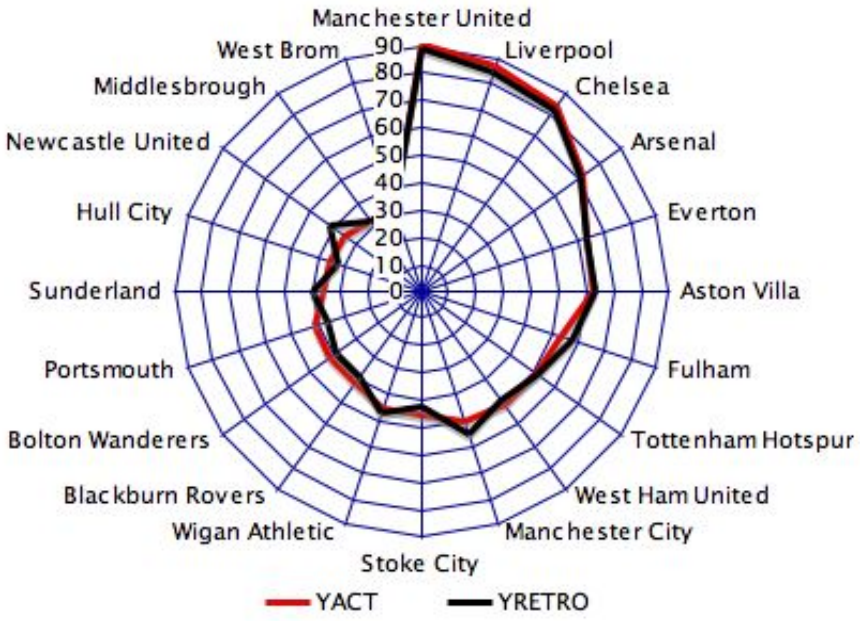

Figure 4. EPL radar chart of retrodictive regression model of 2008-2009 season.

La Liga Regression Statistics	
Model P-value	3.73E-06
R Square	0.98
Adjusted R Square	0.95
Standard Error	3.20
Observations	20

La Liga Model Parameters	*Model Coeff*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	19.14	28.30	0.68	0.52	-44.88	83.15
Shots (excl blocked shots)	0.26	0.03	8.89	0.00	0.20	0.33
Percent goals outside box	-204.03	25.08	-8.14	0.00	-260.75	-147.30
Total passes	0.00	0.00	3.33	0.01	0.00	0.01
Ratio of short/long passes	-6.48	1.64	-3.95	0.00	-10.20	-2.77
Total crosses	-0.08	0.01	-7.62	0.00	-0.10	-0.05
Ave goals conceded	-49.03	6.85	-7.15	0.00	-64.53	-33.52
Tackles	-0.10	0.02	-3.96	0.00	-0.15	-0.04
Blocks, clearances, etc.	0.05	0.01	6.00	0.00	0.03	0.07
Fouls	0.12	0.03	4.47	0.00	0.06	0.18
Red cards	-2.44	0.53	-4.57	0.00	-3.64	-1.23

Table 2. Final ten-variable multiple regression model for La Liga 2008-2009 team performance.

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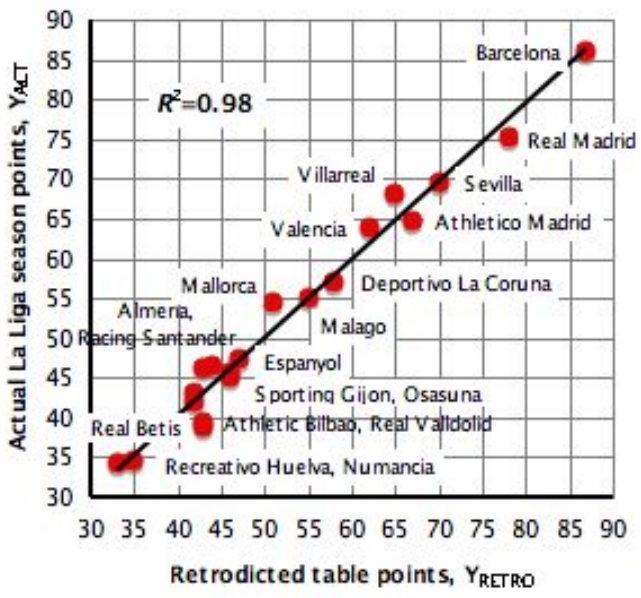

Figure 5. La Liga retrodicted scatter diagram for 2008-2009 season.

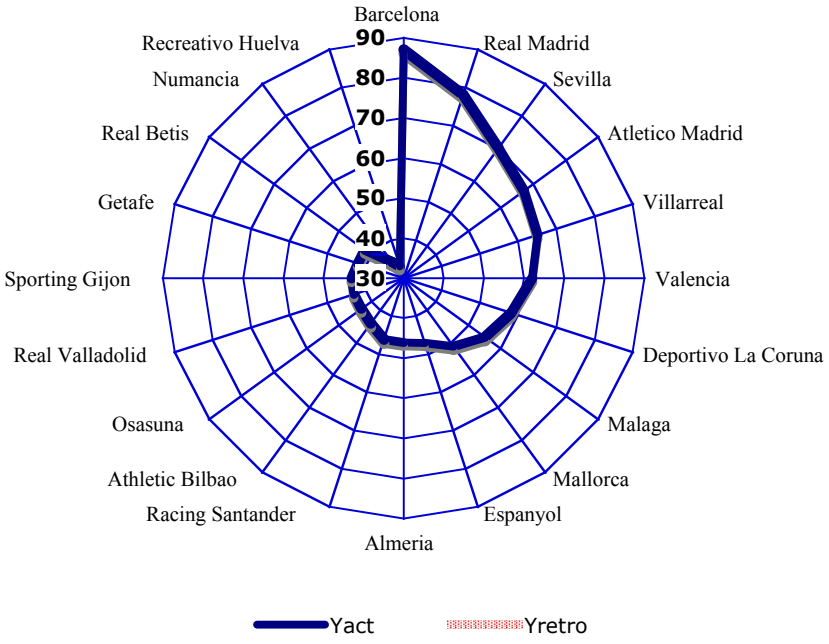

Figure 6. La Liga radar chart of retrodictive regression model of 2008-2009 season.

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SERIE A REGRESSION MODEL

The regression model for Serie A, consisting of only three independent variables, yields a similarly strong result as the other leagues and is presented in Table 3. The coefficient of determination (R^2=0.97) and overall model p-value<< 0.00, along with individual regression variables of p-values < 0.01—is illustrated in the scatter diagram (Figure 7) and radar chart (Figure 8) for the 2008-2009 season.

Regression Statistics	
Model P-value	4.94E-12
R Square	0.97
Adjusted R Square	0.96
Standard Error	3.09
Observations	20

Model Parameters	*EPL Model Coefficients*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-6.04	10.31	-0.59	0.57	-27.89	15.81
Shots (excl blocked shots), X_2	0.13	0.01	9.49	0.00	0.10	0.16
Percent goals to Shots, X_4	291.90	36.15	8.07	0.00	215.27	368.54
Ave goals conceded, X_{14}	-23.48	3.35	-7.01	0.00	-30.58	-16.38

Table 3. Final three-variable multiple regression model for 2008 2009 Serie A

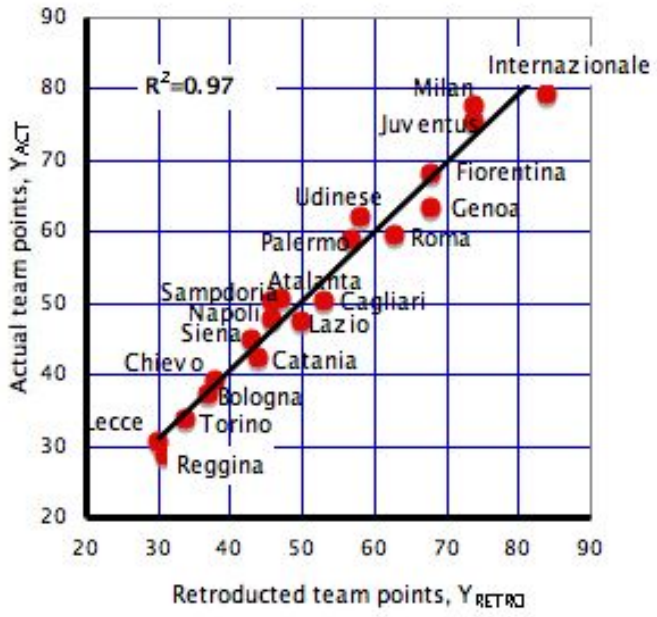

Figure 7. Serie A retrodictive scatter diagram for 2008-2009 season.

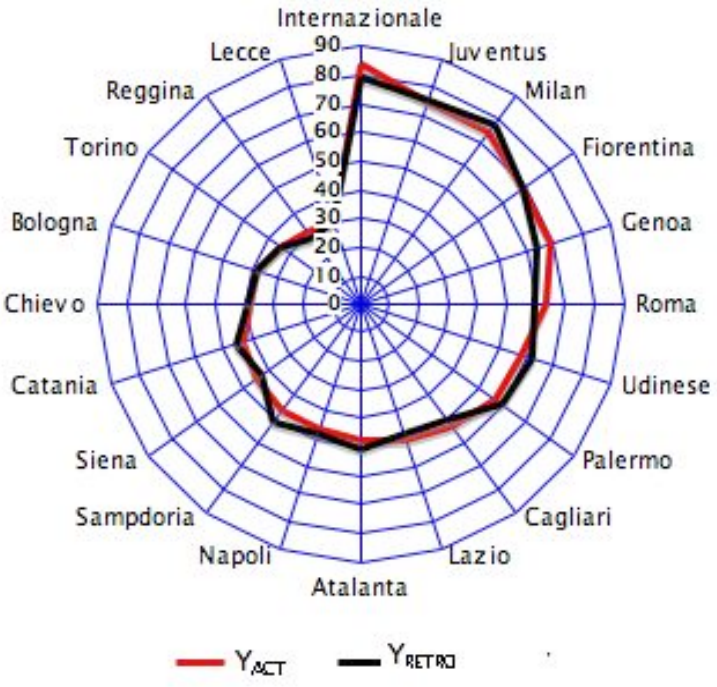

Figure 8. Serie A radar chart of retrodictive regression model of 2008-2009 season.

A collective comparison of the three regression models for each league is presented in Table 4. Although there are shared, common game measures between several of the models, most play a unique role. A sampling of the findings include:

1. The *average goals conceded per game* is a factor in all three-league models. It is interesting to note that the coefficients of this shared variable are surprisingly similar, although the sensitivity to goals yielded is more pronounced in La Liga where a 0.50 goals per game increase would cost them approximately 24.5 league points—essentially equivalent to falling from a Champions League finish to the middle of the table. A similar change in Serie A would result in less than a 12 point decline in league points that could easily drop the team in the standings by 3 or 4 positions—enough to be ineligible for important cup play.
2. Although the *number of shots taken per game* is not a significant factor in the EPL, it carries twice the impact in La Liga as for Serie A, e.g., two extra shots per game will increase a team's table position by 2.6 points in La Liga compared to 1.3 points increase in Serie A.

	Pitch Factor	EPL	La Liga	Serie A
Goal Attempts	Ave Goals per game	ns	ns	ns
	Shots (excl blocked shots)	ns	0.26	0.13
	Prop Shots on Target	ns	ns	ns
	Prop Goals to Shots	269.35	ns	291.91
	Prop goals outside box	ns	-204.03	ns
Passing	Total passes	ns	0.00	ns
	Ratio of short to long passes	ns	-6.48	ns
	Short pass completion prop	ns	ns	ns
	Percent possession	ns	ns	ns
	Long pass completion prop	ns	ns	ns
Crossing	Total Crosses	0.74	-0.08	ns
	Cross Completion Prop	ns	ns	ns
Defending	Ave goals conceded per game	-35.86	-49.03	-23.48
	Tackles	1.32	-0.10	ns
	Prop Tackles Won	-122.14	ns	ns
	Blocks, Clearances & Interceptions	-0.51	0.05	ns
Discipline	Fouls	ns	0.12	ns
	Yellow Cards	ns	ns	ns
	Red Cards	ns	-2.44	ns

Table 4. Statistically significant pitch factor coefficients of multiple regression models for EPL, La Liga, and Serie A 2008-2009 season.

3. The *tackles per game* have opposite effects in the EPL and La Liga, i.e., averaging two more tackles per game in the EPL would lift the table standing by about 2.6 points but cause a 0.16 points decline in La Liga. This may be viewed as an enigma, however sometimes the number of game tackles indicates the lack of possession while other situations reflect strong defending.
4. The *percentage of goals scored outside the box* is only significant in La Liga and has a strong, negative impact. It suggests that the more a team needs to rely on scoring from distance, the worse off it is since these are typically lower percentage attempts. A two percent increase in goals scored from outside the box will result in an approximate four-point drop in table points earned for a La Liga club.

INTERLEAGUE ANALYSIS OF VARIANCE (ANOVA): DEFINING THE SIMILARITIES AND DIFFERENCES IN THE STYLE OF PLAY BETWEEN THE EPL, LA LIGA, AND SERIE

A One-way analysis of variance (ANOVA) is employed to compare game performance data to reveal the key differences and similarities between English, Italian, and Spanish football. A special focus is placed on addressing the popular cha-

racterizations associated with and assumed about the leagues in terms of real, statistically supportability findings.[5] If statistically significant relationships are found, the Tukey-Kramer test is applied to determine which specific league pairings are significant as well as those that are not.

The collection of findings between the three leagues for all pitch variables is provided in Table 5 and includes the following observations:

1. The EPL has a significantly lower percentage of shots on target than the other two leagues. It would not be prudent to assume that this reflects a lower shot accuracy of EPL players or, conversely, better marksmen in the other leagues. A possible explanation might be attributed to tighter marking in the EPL than the other leagues. However this is not substantiated. The fact is, simply, the shot accuracy in both La Liga and Serie A is higher than that of the EPL (p-value<0.01).
2. La Liga is significantly more successful than the EPL at converting shot attempts into goals (p-value<0.03).
3. Serie A excels at passing accuracy. The Italian top league makes significantly more accurate short passes than La Liga (p-value<0.02) and more accurate long passes than both La Liga and the EPL (p-value<<0.00).
4. Both the EPL and Serie have a higher average number of tackles per game than La Liga (p-value<<0.00).
5. Serie A has the highest percentage of successful tackles among all leagues. Additionally, La Liga also has a significantly higher rate of successful tackles than the EPL (p-value<<0.00).
6. The EPL has the highest percentage of blocks, clearances, and interceptions (p-value<0.01).
7. The EPL has the lowest number of fouls, yellow cards, and red cards per game than each of the other leagues. La Liga has fewer fouls than Serie A while Serie A has fewer yellow cards than La Liga (p-value<<0.00).
8. There is no statistically significant difference among the three leagues regarding any of the game measures that reflect goal attempts. This includes (1) the number of shots taken per game, (2) percentage of shots on goal, and (3) percent goal conversion from shots taken.
9. The average number of goals conceded per game is only marginally significant when comparing the EPL and La Liga, i.e., the EPL allows fewer scores per game (p-value=0.07). There is no significant difference between goals concessions of the EPL and Serie A or between La Liga and Serie A.

[5] The league data are assessed to insure that normal distribution and equal population variance requirements are satisfied.

10. The three leagues have nearly identical crossing characteristics. The only difference is that La Liga tends to cross the ball more than Serie A (*p*-value=0.06).

						Tukey-Kramer Findings		
	Pitch Action	EPL	La Liga	Serie A	p-value	EPL v La Liga	EPL v Serie A	La Liga v Serie A
Goal attempts	Ave goals	1.24	1.45	1.30	0.22	ns	ns	ns
	Shots	406.05	401.20	404.35	0.97	ns	ns	ns
	% shots on target	0.41	0.45	0.44	0.01	La Liga > EPL	Serie A > EPL	ns
	% goals to shots	0.12	0.14	0.12	0.02	La Liga > EPL	ns	ns
	% goals outside box	0.13	0.15	0.16	0.19	ns	ns	ns
Passing	Total passes	390.18	361.47	374.84	0.35	ns	ns	ns
	Ratio of short to long passes	5.69	5.67	5.78	0.95	ns	ns	ns
	Short pass completion %	0.80	0.79	0.82	0.01	ns	ns	Serie A > La Liga
	Long pass completion %	0.49	0.50	0.59	0.00	ns	Serie A > EPL	Serie A > La Liga
Crossing	Total crosses	23.98	23.21	25.48	0.06	ns	ns	Serie A > La Liga
	Cross completion %	0.23	0.22	0.23	0.68	ns	ns	ns
Defending	Ave goals conceded	1.24	1.45	1.30	0.07	La Liga > EPL	ns	La Liga > Serie A
	Tackles	22.08	19.55	20.97	0.00	EPL > La Liga	ns	Serie A > La Liga
	% tackles won	0.74	0.78	0.80	0.00	La Liga > EPL	Serie A > EPL	Serie A > La Liga
	Blocks, clear-ances & interceptions	60.69	53.15	54.83	0.00	EPL > La Liga	EPL > Serie A	ns
Discipline	Fouls	12.69	16.85	18.61	0.00	EPL < La Liga	EPL < Serie A	La Liga < Serie A
	Yellow cards	1.55	2.70	2.25	0.00	EPL < La Liga	EPL < Serie A	Serie A < La Liga
	Average games played between red cards	12.06	5.17	6.18	0.00	EPL < La Liga	EPL < Serie A	ns

*Note: 05<p≤.10 is viewed as having practical significance; ns=not significant

Table 5. ANOVA comparison of pitch factor performance differences between EPL, La Liga, and Serie A for 2008-2009 season.

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RESULTS

PART I: MULTIPLE REGRESSION MODELS—WITHIN LEAGUES ANALYSIS

Statistically significant, multiple regression models are successfully developed for the English Premier League, Italy's Serie A, and Spain's La Liga. All three models retrodictively account for the league points earned by each team in their respective league with considerable accuracy: each league model provided R^2-values>0.96, with overall model p-values<<0.00 and all independent variables in each model delivering p-values<0.05. Although each model is unique, an examination of the array of statistically significant variables (game measures) that comprise each reveals overlap of measures as well as distinctly unique associations.

Although there are important limitations and pitfalls associated with stepwise regression, the models developed are not used for prediction but, instead, for attempting to describe team success in terms of league points earned a posteriori. To follow the strictest of regression model building rules would be to essentially forgo the attempt to do so given the limited team sample size of each league.

The durability of the model will be examined using subsequent season data as it becomes available. Unlike many sports, the extensive data needed to conduct football analyses are not found in the public domain and must be privately purchased at significant expense from the several data collection organizations that specialize in this business, e.g., Opta Sports, ProZone, and PA Sport (McHale and Scarf [2005]; Bradley, O'Donoghue, Wooster and Tordoff [2007]; Valter, Collins, McNeill and Cardinale [2006]).

PART II: ANOVA—BETWEEN LEAGUE ANALYSIS

The stereotypical characteristics that have been established over time—with or without substantiating evidence—are addressed in the paper which suggest the following findings:

The popular assumption is that Serie A is primarily defensive and uses the counterattack to win games. Its mottos are "do not concede" and getting "ten behind the ball" as soon as a goal is scored. However, the data suggests this is not so. In fact, Serie A has a more attacking game than the EPL on the average—they score more (although not significantly so) and they are the statistically significant best passing league of the three. Serie A also makes the highest percentage of successful tackles of all leagues.

The EPL is characterized as the toughest marking, fastest game among the three leagues. It is supposed to be a hard-nosed league compared to the more elaborate and skilled playing style of La Liga. They are. They make the highest number of tackles among the leagues and do so significantly more effectively than

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La Liga although not Serie A. The typecast, however, seems to hold reasonably well. It is interesting that given this faster paced, tougher marking description, the EPL has significantly fewer fouls, yellow cards, and red cards than the other leagues. The commonly presumed, toughest league plays comparatively clean football. Or, conversely, the EPL may have the more lenient referees.

La Liga does, indeed, score more goals per game than the other leagues although not statistically different. However they also have the highest percentage of shots on target and the highest conversion of shots converted into goals and do so with statistical significance when compared to the EPL and also Serie A with respect to the former factor (shots on target). The "fanciest" league has earned its image as attacking artists.

Arguably, some of the most interesting findings are those game measures that do not statistically separate the three leagues: (1) the total number shots taken per game, (2) the percentage of goals scored outside the box, (3) the number of passes per game, (4) ratio of short-to-long passes, (5) cross completion percentage, and (6) the number of goals scored per game.

The follow-up study using the newly available 2009-2010 season data that will test the longitudinal resiliency of the current findings has begun.

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