THE DETERMINANTS OF FOOTBALL PERFORMANCE IN EUROPE

by

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ABSTRACT

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Football (soccer) performance is commonly believed to be based on player talent and franchise finances. However, there may be factors exogenous to football influencing football performance. The aim of this study is to show that on-field performance is influenced not only by the usual factors such as player talent and franchise finances, but also by factors such as the wealth of the nation, the size of the population, the degree to which football is part of the culture, and taxation policies. Using regression analysis as the main method to substantiate my claim, this study will focus on the performance of leagues in comparison to their counterparts in other nations. I will limit the scope of the study to leagues affiliated with the Union of European Football Associations (UEFA).

To Sarah Hochstätter, I miss you

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Chapter 1: Introduction

Football performance is commonly believed to be based on player talent and franchise finances.[1] Teams with more talented players tend to be more successful, and franchises with greater spending power are able to procure and keep these talented players. Talent and finances are important, but might there be non-football factors influencing the performance of domestic teams? Indeed, I intend to show that football performance of domestic teams is influenced not only by the usual factors such as player talent and franchise finances, but also by exogenous factors, such as the wealth of the nation, the size of the population, the degree to which football is part of the culture, and tax policies.

Theory suggests that the wealth of a nation influences the performance of its domestic football teams because wealthier individuals will spend more of their time and money on leisure activities (Houston and Wilson, 2002: 939-943). These authors show that there is a clear positive relationship between success in leisure activities and the amount of resources invested in them. In terms of football, this means that, as wealth increases, a nation is expected to devote more resources to its football teams.

Population size and football culture are two interrelated factors, both having potential effects on football performance. A relatively large population is instrumental to improving football performance because it increases the chances of talented athletes being born within that nation (Bernard and Busse, 2004: 413). Yet, without a prevalent football culture, few of these athletes will focus on football. The lack of success of China's domestic teams is a primary example of a highly populous nation with little

[1] Throughout this paper, I will refer to soccer by its international term, football.

interest in football. In fact, since 2005 only one Chinese domestic team has been featured in the semi-finals of the elite Asian club competition (AFC, 2012).

Taxation policy indirectly influences football performance because high tax rates discourage player immigration. Due to the substantial salaries they earn, most players are placed in high tax brackets regardless of what nation they play in (Kleven et al., 2010: 7). In Europe, where migration barriers are low, it is relatively easy for players who have earned a substantial amount of income to seek residence in a nation with a lower tax rate. A nation that is able to offer tax breaks to foreign workers or simply a lower tax rate in relation to other nations should be able to attract more players to their league. More importantly, since a player's salary reflects the valuation of their skill and talent, being able to attract these types of players with lower taxes will strengthen domestic teams and improve football performance.

Even though football performance can be measured in a myriad of ways, generally, they can be categorized into two groups: "quality of play" and "points accumulated." "Quality of play" is an aesthetic measure of performance and is highly subjective because it is contingent on the audience. If the audience enjoys the type of football that the team is exhibiting, then the team will be considered to have performed well regardless of the end result. "Points accumulated" is simply the number of points a team is able to amass over the course of a season. Unlike "quality of play", "points accumulated" has a sense of objectivity as it is merely a numerical value. I use "points accumulated" to measure football performance throughout this paper.

Unlike previous research, which has focused either on national team performance or the performance of individual teams, I examine the performance of a nation's football league in relation to its counterpart in other nations. Since domestic teams have fewer limitations than national teams in terms of the players they can field, a study such as mine could serve as an upper bound for the degree to which each of the factors, discussed above, influence football performance. Throughout my analysis, I only use leagues that are affiliated with UEFA.[2] I narrow my scope not only to ensure a degree of uniformity in the standard and structure of the leagues, but also because of the availability of accurate data on these European countries and leagues.

The main method I will be using to substantiate my claim is regression analysis. I will use wealth, population, football culture, and taxation policy as explanatory variables for the dependent variable “football performance”. The relationship I am attempting to show between “football performance” and the explanatory variables can be visualized in the following equation:

$$\textit{Football Performance} = f\,(\textit{Wealth, Population, Football Culture, Population * Football Culture, Taxation}) \quad (1.1)$$

Wealth, *population*, *football culture*, and the interaction between *population* and *football culture* are expected to have a positive relationship with *football performance*, whereas a high income *tax* will influence *football performance* negatively.

This study is structured as follows. Chapters 2 and 3 will mostly include background information with chapter 2 focusing on football and UEFA and chapter 3 giving a review of current relevant literature. Chapter 4 will explain my theoretical model and chapter 5 will focus on the assumptions of linear regression. Chapter 6 will discuss

[2] UEFA stands for Union of European Football Associations and is the governing body of European football. Chapter 2 discusses UEFA and how it operates.

and interpret the regression results and chapter 7 will conclude this study and look at possible future studies.

Chapter 2: Background Information

The following chapter is meant to serve as an introduction to the world of football. Here, I will be covering topics that perhaps are common knowledge among football fans, but are nevertheless vital to my research. First, I will differentiate between national teams and domestic teams. Next, I will describe the general structure of domestic leagues across Europe. Then, I will provide some background information on the Union of European Football Associations and the different competitions they host. Finally, I will examine UEFA's system of ranking its affiliated leagues.

2.1 National Teams versus Domestic Teams

Football is played at two levels, a national and a domestic one. A nation's national team is strictly comprised of citizens of that nation.[3] Domestic teams are teams that are members of a nation's football league. Unlike national teams, players from all parts of the world are able to represent a domestic team. Domestic teams are usually called Clubs due to the fact that, for the most part, they are more than just football entities and have representative teams across different sports. Table 2.1 below summarizes the way football in Europe is structured between national and domestic teams.

[3] For the complete rules on player eligibility see FIFA Statues, Regulations Governing the Application of the Statutes, Section VII, Article 16 (FIFA Statues, 2008: 64).

Table 2.1: Structure of European Football

Team	Eligible Players	Domestic Competition	International Competitions
Domestic Club/Team	Any individual	Domestic League	UEFA Champions and Europa League
National Team	Citizens only	None	World Cup and Euro Cup

2.2 Football League Format in Europe

Almost every country in the world has some sort of official football league. While no two leagues are the same, in Europe, the format is the same across all leagues. Every season each team plays all the other teams in their league twice, once at home and once away from home. The winner of the league is determined strictly through the number of points earned. Thus, the team with the most points at the end of the season wins the league. Teams earn points by either winning or drawing games. Three points are awarded for winning a game and one point is awarded for drawing a game.

2.3 Union of European Football Associations

The Union of European Football Associations (UEFA) was founded in Basel, Switzerland on June 15, 1954, when several key football associations decided to combine their resources in order to establish co-operation between football associations.[4] Since then, UEFA has steadily grown to include fifty-three different football associations across Europe and limited parts of Asia (UEFA, 2012a).

[4] A football association is the governing body of football within a country.

UEFA is European football's governing body, and is entrusted to manage and organize football across Europe. UEFA has developed several different laws that not only ensure that football is played according to the official rules of the sport, but also spur competition between teams and leagues. For instance, UEFA has implemented several rules on stadium and field maintenance to increase the security of spectators and players alike. More recently, in an effort to bridge the quality gap between richer and poorer clubs, UEFA developed rules that limit the amount of money teams can spend on players.

In addition to ensuring that football is played according to the official rules, UEFA sponsors several different tournaments for its affiliates. Every four years it sponsors the Euro Cup in which European national teams play against each other over the course of a month. Additionally, every season UEFA sponsors two international club level competitions, the UEFA Champions' League (Champions League) and the UEFA Europa League (Europa League).

2.4 The UEFA Champions League and the UEFA Europa League

UEFA's first international club competition was called the UEFA Champions Club Cup and was inaugurated in 1955 (UEFA, 2012b). The UEFA Champions Club Cup originally only allowed the winners of certain leagues to participate. However, as the popularity of football increased, several other clubs were invited to participate. In order to accommodate the increase in the number of participants, the format of the competition was completely revamped in 1991 and the competition was renamed to UEFA Champions League (UEFA, 2012b).

The Champions League is structured to have four different stages, the qualifying stage, the group stage, the knockout stage, and the final. The qualifying stage consists of three rounds where each team plays one home game and one away game per round. In the group stages, the ten winners of the qualifying stage are joined by twenty two automatic entrants and drawn into eight groups of four teams. Each team plays two games against the other teams in their group, once at home and once away from home. The two teams with the most points in their groups move on the knockout stage. The knockout stage, much like the qualifying stage, consists of three rounds where each round a team plays two matches, one at home and one away, against another of the sixteen teams remaining from the group stages. The two teams remaining after the knockout stage contest the final, a single game, in a venue determined prior to the start of the competition (UEFA, 2012b).[5]

The UEFA Cup, the predecessor of the current UEFA Europa League, was first established in 1971 and encompassed several more teams than the UEFA Champions Club Cup (UEFA, 2012c). When UEFA began to increase the number of teams participating in the UEFA Cup, the Cup developed several formatting issues such as several groups having more teams than other groups. In order to remedy this situation, UEFA restructured the competition in 2009 and renamed it the UEFA Europa League (UEFA, 2012c).

The Europa League is structured similarly to the Champions League. However, in order to compensate for the larger number of teams participating, the Europa League has more rounds and more groups. For example, the qualifying round has a fourth round

[5] See Table A.1 in Appendix A for a visual representation of the structure of the Champions League starting at the group stages.

called the play-off round from which thirty-one teams advance to the group stage where they are joined by automatic entrants. Additionally, there are twelve instead of eight groups of four in the group stage. Finally, the knockout stage also has one additional round of games (UEFA, 2012c).[6]

2.5 The UEFA Coefficients

UEFA has implemented several systems to rank its affiliates. These "coefficients" are used to rank teams and nations/leagues according to their past performances in UEFA Competitions. While a team's ranking is determined by its own performances, a nation's ranking is not determined by national team performances. Instead, a nation is ranked by the performances of its league's clubs at both club wide competitions.

UEFA refers to the nation's ranking as the Country Coefficient Ranking or the Associations' Coefficient Ranking. The Country Coefficient Ranking (CCR) is a qualitative measure used by UEFA to rank its affiliated leagues. Each nation's coefficient is determined through an intricate process that makes use of a league's clubs performance in both the Champion's League and the Europa League over the last five years. UEFA (2012d) describes their method of calculating a nation/league's coefficient as follows:

1. "Each team gets two points for a win and one point for a draw (points are halved for matches in the qualifying and play-off rounds).
2. Clubs that reach the round of 16, quarter-finals, semi-finals or final of the UEFA Champions League, or the quarter-finals, semi-finals or final of the UEFA Europa League, are awarded an extra point for each round.

[6] See Table A.2 in Appendix A for a visual representation of the structure of the Europa League starting at the group stages.

3. In addition, four points are awarded for participation in the group stage of the UEFA Champions League and four points for qualifying for the round of 16" (UEFA, 2012d).

The number of points obtained by clubs is divided by the number of clubs representing a league in the current seasons Champions and Europa League. The resulting average is then added to the averages of the previous four seasons to obtain the coefficient (UEFA, 2012d).[7]

2.6 Participation in UEFA Champions and Europa League

The number of teams that represent a league and the stage at which they enter either competition is strictly determined by the Country Coefficient Ranking. The three highest ranked leagues are able to send four teams to the Champions League while the lowest ranked league is only allowed to send one team. Moreover, teams from higher ranked leagues enter the competitions at later stages. For instance, three of the four representatives from the top three leagues enter the Champions League at the group stage but the representative of the lowest ranked league enters in the first round of the qualifying stage.

[7] See Table A.3 in Appendix A for the 2011 UEFA Country Coefficient Ranking

Chapter 3: Literature Review

3.1 Football Performance

There are several studies on the determinants of sports and football performance at the national team level. However, there are only a few proxies available to measure football performance. Hoffman et al. (2002: 263), Houston and Wilson (2002: 941), Macmillan and Smith (2007: 207), and Leeds and Leeds (2009: 382) use the FIFA/Coca-Cola ranking of national teams and Torgler (2004: 9) makes use of the total number of points earned in World Cup tournaments.[8] I recognize that these studies focus only on the performance of national teams, whereas my own study will focus on the performance of leagues. However, I also recognize that understanding the determinants of national team performance is beneficial to my study because the logic behind using certain proxies in the studies above can be implemented to determining the proxies I should use.

Of the studies I examined, only two did not deal with the determinants of national team performance, but rather focused on the performance of domestic teams. Mourao (2010: 230) implemented his own ranking of UEFA affiliated teams as a proxy for football performance of specific regions in Europe. Castellanos et al. (2007: 76) used the probability of a city hosting a UEFA Champion's League participating team as a proxy for football performance.[9] While these two studies focus on the performance of teams rather than leagues, they are similar to my study in that they only encompass teams in leagues that are affiliated with UEFA.

[8] FIFA stands for Fédération Internationale de Football Association and is the governing body of football around the world. For a more thorough explanation of FIFA and the FIFA/Coca-Cola ranking visit FIFA's official website (FIFA, 2012).
[9] For an in-depth explanation of the Champions League see chapter 2.

3.2 Explanatory Variables

Previous studies have used a large number of different explanatory variables. However, there are a few variables that were common to most studies, such as a measure for the wealth of a nation, the size of the population, and the importance of football to the nation's culture.

Even though there are a variety of proxies to measure the wealth of a nation, the results are similar across all studies. Houston and Wilson (2002: 941) and Torgler (2004: 9) used Gross Domestic Product (GDP) per capita. Leeds and Leeds (2009: 382), Mourao (2010: 230), and Castellanos et al. (2004: 76) opted to use the natural logarithm of GDP per capita as their proxy for wealth.[10] Lastly, Hoffman et al. (2002: 263) and Macmillan and Smith (2007: 207) decided to use Gross National Product (GNP) per capita. All studies concluded that the wealth of a nation was both positive and, more importantly, statistically significant at least at the 10% level.[11] These results show that any study on football performance must include some sort of measure for the wealth of a nation.

Researchers try to capture the effect that population size has on football performance in one of two ways, the absolute value of population size or the natural logarithm of population size.[12] Surprisingly, while all studies found the natural logarithm of population size to be statistically significant at the 1% level, Hoffman et al. (2002: 263) found the absolute value of population size as an explanatory variable to be statistically insignificant. However, Hoffman et al.'s results are challenged by Macmillan

[10] The natural logarithm is a mathematical function that serves as a normalizer between numbers. It increases the value of lower numbers while decreasing the values of larger numbers.
[11] Significance at the 10% level implies that the result lies at extreme values of the normal distribution, thus indicating that this result is highly unlikely an outcome of chance.
[12] Absolute value of population simply means the numerical value of population. I use the term absolute value as a method to differentiate from the natural logarithm.

and Smith (2007) who claim the results are biased due to the small sample size Hoffman et al. used and the manner in which this sample was selected. In order to correct for this bias, Macmillan and Smith reran Hoffman et al.'s regression and found that, given a larger sample size and the addition of a quadratic value of population, the absolute value of population size becomes statistically significant (2007: 207). Coincidentally, Hoffman et al. and Macmillan and Smith were the only authors to make use of the absolute value of population, which leads me to believe that the natural logarithm of population is a better proxy for the pool of talent.

The majority of studies included a measure for the football culture within the nation. However, mixed results were obtained from the studies. Torgler used the number of years the nation has been a member of FIFA as a proxy for football culture and showed that it was statistically significant at the 1% level (2004: 9). Leeds and Leeds (2009) and Houston and Wilson (2002), on the other hand, used the same proxy but attained statistically insignificant results. The contradicting results between Torgler, Leeds and Leeds, and Houston and Wilson cast doubt as to whether the years as a member of FIFA is a suitable proxy for football culture.

Torgler (2004: 9) and Leeds and Leeds (2009: 382) also used a second proxy to measure football culture, a variable to indicate whether a nation has hosted the World Cup. In this case, both studies concluded that hosting a World Cup positively affects football performance in a statistically significant manner at the 1% level. The fact that there were no studies contradicting each other lends its support to hosting a World Cup as a more suitable football culture proxy.

The interaction between football culture and a nation's population is examined by Hoffman et al. (2002) and Macmillan and Smith (2007). Hoffman et al. looked at the interaction between population and a binary variable to distinguish the Latin culture from other cultures due to the predominant football culture in Latin nations. They found their interaction term to be positive and statistically significant at the 5% level (2002: 263). Macmillan and Smith (2007) used the same interaction term on an expanded sample size yielding similar results to Hoffman et al.; however, significance level dropped to 10% (2007: 207).

I could not locate an article that focused on taxes as a determinant of football performance directly, but Kleven et al. (2010) indirectly show how taxation influences football performance by examining the effects of income tax on worker and player mobility patterns. Because high income taxes discourage workers from migrating to a nation, Kleven et al. conclude that, by providing tax breaks to foreign workers, a nation should be able to attract more and better players to their league (2010: 29). Consequently, having better players raises the level of competition and improves football performance.

3.3 Implications

The studies reviewed indicate the proxies that work well and the proxies that should be avoided when looking at the determinants of football performance. Due to Hoffman et al.'s results, the natural logarithm of population size appears to be a superior proxy over the absolute value of population.[13] The football culture is another variable where the proxy must be chosen with care. Hosting the World Cup was statistically

[13] Chapter 5 shows that the population size is right skewed, and is normalized through a logarithmic transformation.

significant in all the studies in which it was used, whereas number of years in FIFA had mixed results across studies. The only interaction term used interacted population size with a binary variable distinguishing the Latin culture from other cultures. While the interaction term was shown to be statistically significant, I have my doubts as to whether the Latin variable is a good measure of football culture. This variable looked at Spanish speaking nations. In Europe, only Spain has Spanish as its official language. Therefore, perhaps a new proxy should be found and interacted with population size. Finally, income taxes is a variable that should be included in a study on football performance such as mine because of the implications different income tax rates have on player mobility and thus on football performance.

Chapter 4: Theoretical Model

In this chapter I present the baseline for my model on football performance. I describe in detail how I will measure football. Furthermore, I explain the proxies used to measure the effect of wealth, size of the pool of talent (population), popularity of football (football culture), and taxation policy on football performance.

4.1 Football Performance as a Dependent Variable

Previous research has quantified football performance by using, among other measures, the FIFA/Coca-Cola ranking of national teams. I too considered using this ranking for my study. However, due to the focus of my research being domestic teams affiliated to UEFA, I found this ranking to be inadequate for my research. Instead, I use a proxy for football performance that is original to my study. Taking advantage of UEFA's extensive database, I will quantify football performance through UEFA's Country Coefficient Ranking. Recall from Chapter 2 that this ranking assigned a numerical value to a nation based on the performances of its teams in both the UEFA Champions League and the UEFA Europa League. Therefore, in my model, the dependent variable is the actual coefficient that each nation was assigned under UEFA in 2011, a variable which I denote as *Football Performance*. [14]

4.2 Explanatory Variables

Wealth of the nation can be measured in several different ways such as Gross Domestic Product (GDP), Gross National Product (GNI), GDP per capita, and GNI per capita. Due to the nature of how GDP and GNI are calculated, these two measures would be biased towards countries with a higher population. Therefore, any measure of wealth

[14] See Figure A.3 in Appendix A for the UEFA ranking of countries.

of a nation needs to account for the size of the population. Migration within Europe can be accomplished with relative ease, especially in the European Union; therefore, a measure such as GNI per capita which only accounts for the income generated by a nation's citizens is also inappropriate for my study. Thus, I have decided to proxy the wealth of a nation using its GDP per capita in 2008, a variable which I denote with *GDP*.

A nation's population is used to measure the size of the pool of available talent within that nation. Studies that included *population* as a proxy yielded different results depending on the proxy they used. As shown in chapter 3, the population of a nation is not an adequate proxy on its own due to the large range of numbers. Due to most European countries having small populations, the population variable is right skewed. However, by taking the natural logarithm of the population I am able to effectively normalize the population variable. Hence, in my model I will be using the natural logarithm of population in 2008, a variable which I will denote as *LNPOP*.

In order to measure the effect that the popularity of football has on football performance, I develop my own proxy. Success at the international level will increase the popularity of any sport within that nation. Nevertheless, unless a nation can build upon that success, the sport will fail to further develop. By looking at the number of years that have passed since a nation has been present at the Euro Cup Final, I not only account for international success of a nation, but also ensure that the success was relatively recent. I will denote this variable as *Football Culture*.

It is well known that professional athletes receive a high salary. Football players are no different and, consequently, are placed in the highest tax bracket regardless of what nation they reside in. Yet, there are certain countries that provide tax breaks to foreign workers and thus incentivize immigration (Kleven, 2010: 17). I would like to for these tax breaks; unfortunately, the sheer number of nations and the intricacy of taxation policies make it unfeasible to accurately represent each nation. Therefore, the next best solution, and the one I settled on, is to look at the highest tax rate for each nation in order to encompass the largest number of football players. I will denote this variable as *Tax*.

Lastly, as discussed in Chapter 3, there may be a need for an interaction term between the measure of pool of talent and football culture. My model accomplishes this interaction through the multiplication of the *LNPOP* and the *Football Culture* variables.

Table 4.1: Summary of Variables and Proxies

Variable	Proxy	Code	Year	Source
Football Performance	UEFA Country Coefficient	*Football Performance*	2011	UEFA
Wealth	GDP per capita	*GDP*	2008	Various[15]
Population	Natural Log of Population	*LNPOP*	2008	World Bank
Football Culture	Number of Years since Appearance in Euro Cup Final	*Football Culture*	1960-2013	UEFA
Taxes	Highest rate of Income Tax	*Tax*	2012	Various[16]

[15] World Bank, Welsh Government, National Statistics of Faroe Islands
[16] IMF, Deloitte, UK Census, and various others

Table 4.1 above provides a summary of the variables and the proxies I will be using.

Using the aforementioned variables, my baseline model becomes:

$$\textit{Football Performance} = \beta_0 + \beta_1(\textit{GDP}) + \beta_2(\textit{LNPOP}) + \beta_3(\textit{Football Culture}) + \beta_4(\textit{LNPOP})*(\textit{Football Culture}) + \beta_5(\textit{Tax}) \quad (4.1)$$

Chapter 5: Methods and Assumptions

The validity of my linear regression results is contingent on several different assumptions about the dataset and variables. These assumptions are no multicollinearity among the regression variables, continuous variables must follow a normal distribution, the relationship between the dependent variable and each independent variable must be linear, errors or residuals need to be normally distributed, and have the same variance (called homoscedasticity). In the following section, I detail the process of checking my dataset, variables, and regression as a whole for each of these assumptions.

5.1 Relationship Between Football Performance and Each Independent Variable

First I look at whether a relationship exists between each of the independent variables and the dependent variable. From Table 5.1 I see that all of the independent variables except for *GDP per Capita* have a statistically significant correlation to *Football Performance*. This result tells us that there is no linear relationship between *GDP per Capita* and *Football Performance*. However, previous research that has included this proxy yielded statistically significant results and therefore I see no reason to remove this variable.

Table 5.1: Correlation between Football Performance and Independent Variables

		GDP per capita (constant 2000 US$)	Population, total	Football Culture	Highest Tax
Football Performance	Pearson Correlation	.031	.701**	.534**	.344*
	Sig. (2-tailed)	.825	.000	.000	.012

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

5.2 Multicollinearity

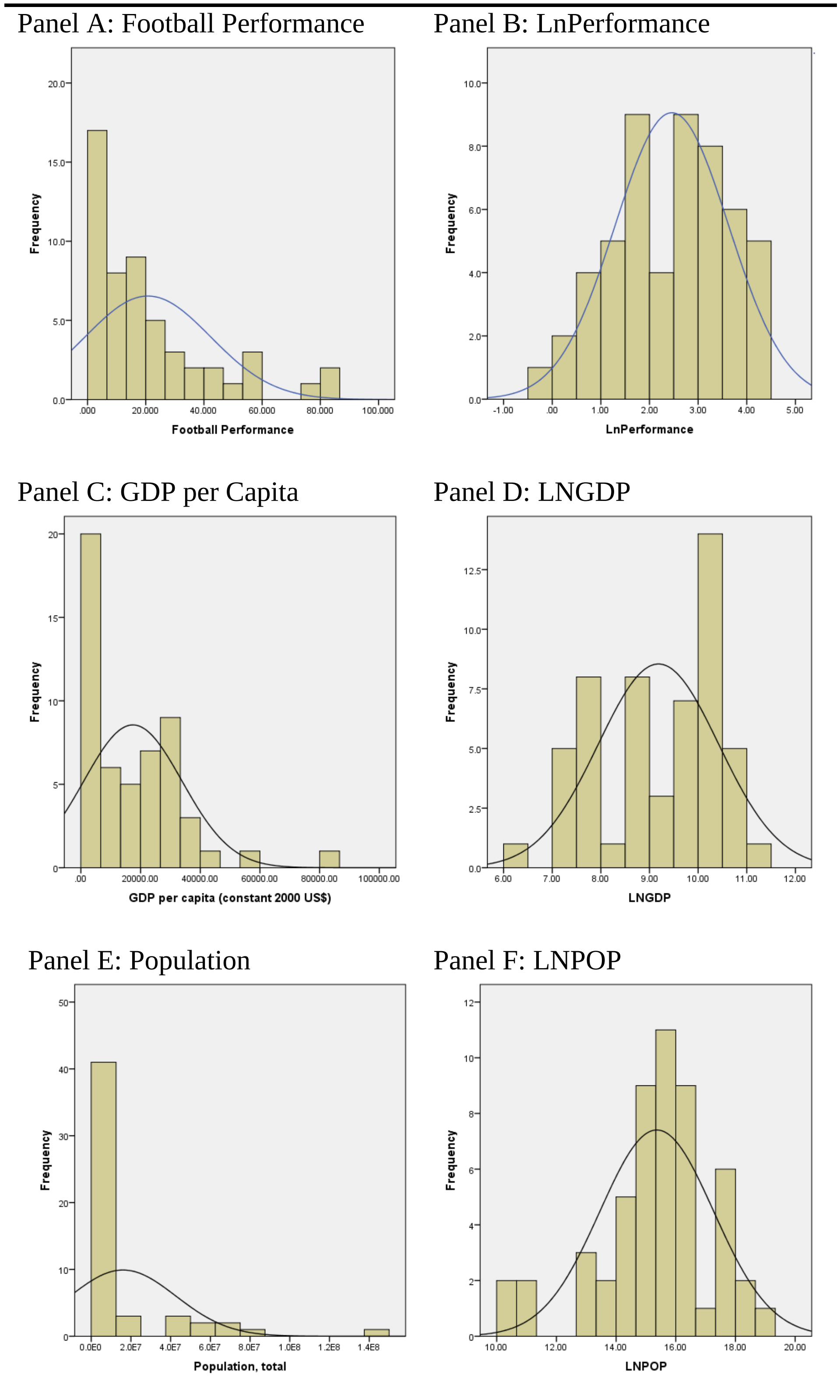
Table 5.2 : Correlation Matrix

		GDP per capita (constant 2000 US$)	Population, total	Football Culture	Highest Tax
GDP per capita (constant 2000 US$)	Pearson Correlation	1			
	Sig. (2-tailed)				
	N	53			
Population, total	Pearson Correlation	-.131	1		
	Sig. (2-tailed)	.351			
	N	53	53		
Football Culture	Pearson Correlation	-.275*	.384**	1	
	Sig. (2-tailed)	.046	.005		
	N	53	53	53	
Highest Tax	Pearson Correlation	.504**	.058	.054	1
	Sig. (2-tailed)	.000	.679	.700	
	N	53	53	53	53

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Linear regression assumes that there is no multicollinearity between independent variables. Multicollinearity occurs when a correlation of .9 or higher exists between two independent variables (Adams, 2007). Examining Table 5.1, I see that while some of the independent variables are correlated, none of them are correlated enough to alter the no-multicollinearity assumption.

Figure 5.3: Histogram of various variables before and after logarithmic trasnformation.



5.3 Normal Distribution

Linear regression assumes that all continuous variables follow a normal distribution. Figure 5.3 above displays histograms for all the continuous variables in my model. Through simple inspection of the histograms I can see that none of these variables are normally distributed. Therefore, I decided to transform all my non-normally distributed variables using the natural logarithm function.

The natural logarithm function is used to normalize right skewed data because it expands small values and contracts large value. The results of my transformations are displayed in panels B, D, and F of Figure 5.3. Cleary, after the natural logarithmic transformation, all three continuous variables relatively closely follow a normal distribution.

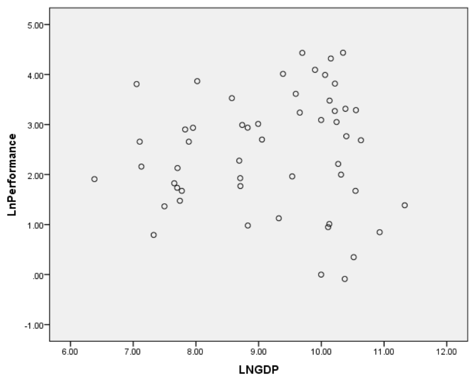
5.4 Linearity

For obvious reasons, linear regression assumes that all independent variables have a linear relationship with the dependent variable. The existence of a linear relationship between two variables can be established by analyzing scatterplots of the two variables.

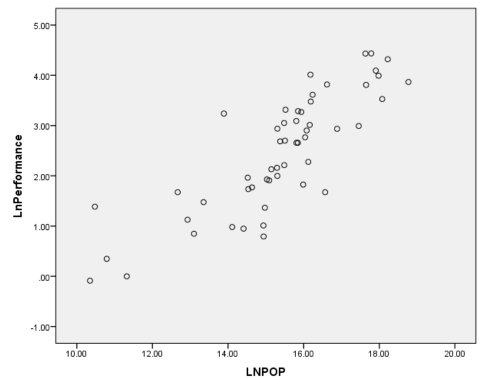
Panel A in Figure 5.4 is a scatterplot of the dependent variable *LnPerformance* vs. the independent variable *LNGDP* and panel B is a scatterplot of the *LnPerformance* vs. *LNPOP*. Focusing on panel B, I see that there is a clear positive linear relationship between the two variables. However, panel A does not display a linear relationship. In fact, there appears to be no discernible relationship between *LnPerformance* and *LNGDP*. Similarly, *LnPerformance* vs. *LNTAX,* does not display a linear relationship.

Figure 5.4: Scatterplot of *LnPerformance* vs. various independent variables

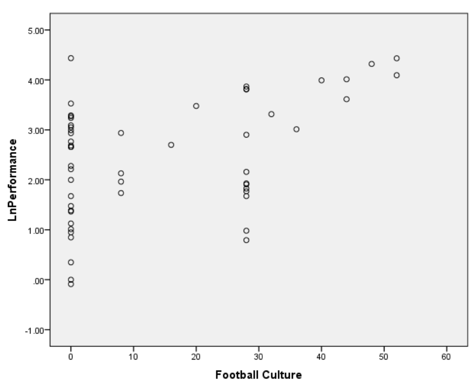
Panel A: *LnPerformance* vs. *LNGDP*



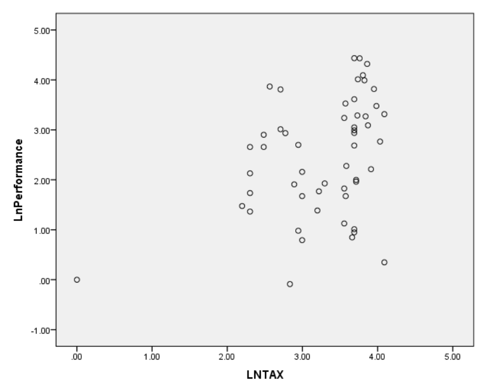
Panel B: *LnPerformance* vs. *LNPOP*



Panel C: *LnPerformance* vs. *Football Culture*



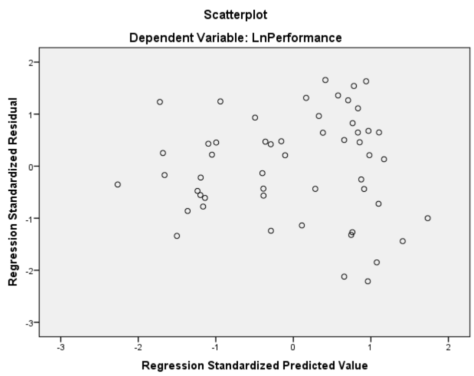
Panel D: *LnPerformance* vs. *LNTAX*



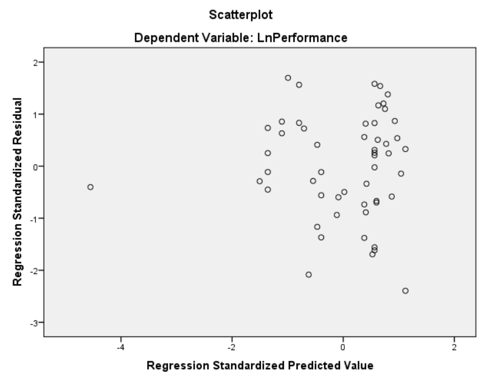
Previous literature (Macmillan and Smith, 2007, Hoffman et al., 2002, and Houston and Wilson, 2002) included a squared term for the wealth variable in order to account for the non-linear relationship with football performance. Following their lead, I too include a squared term in my regression called, *LNGDPSQRD*. Since there are no previous empirical studies relevant to this topic, I have decided to also include a squared term for the tax variable, *LNTAXSQRD.*

Figure 5.5: Scatterplots of Regression Standardized Residuals vs. Regression Standardized Predicted Value.

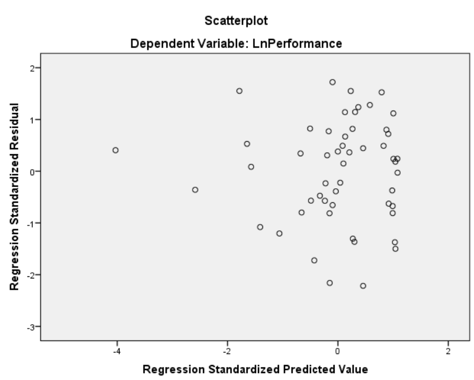
Panel A: *LnPerformance* = x(*LNGDP*)



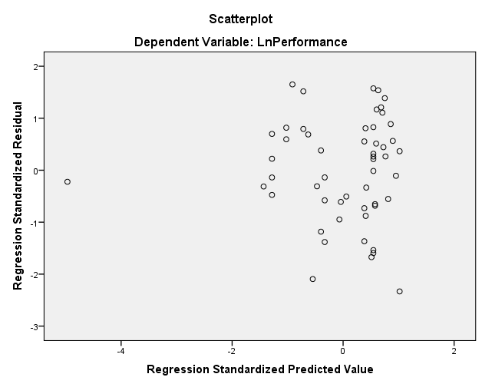
Panel B: *LnPerformance* = x(*LNTAX*)



Panel C: *LnPerformance* = x(*LNGDP*) + y(*LNGDP*)^2



Panel D: *LnPerformance* = x(*LNTAX*) + y(*LNTAX*)



2

In order to check whether or not adding the squared terms to the regression would indeed account for the lack of a linear relationship between the dependent variable and the independent variables, I examine a scatterplot of the Regression Standardized Residual (the difference between the observed value in my dataset and the fitted value on the regression function) vs. the Regression Standardized Predicted Value (the fitted value on the regression function). Panels A and B in Figure 5.5 are scatterplots generated from regressions without squared terms. In other words, the residuals on these scatterplots come from regressing the variable *LNGDP* on *LnPerformance* and the variable *LNTAX* on *LnPerformance*, respectively. Panels C and D display scatterplots generated from regressions that include the squared terms for the variables *LNGDP* and *LNTAX*. Since these are residual plots, I am no longer looking for linear relationships. Instead, I am looking for a random distribution of points. Examining Panels C and D I see that the data points tend to cluster towards the left of the graph indicating the existence of some sort of pattern. Therefore, I have decided to remove both squared terms from my regression model and only include the linear terms.

The linear term of the independent variables cannot capture the entire curvilinear relationship between *LnPerformance* and *LNGDP* and *LNTAX*. However, it can still capture the linear part of the relationship. Consequently, including non-linear variables only weakens my results rather than completely invalidating them (Adams, 2007).

Accounting for the necessary changes that I have to make in order to fulfill some of the assumptions of linear regression, I summarize my new variables in Table 5.6. Having checked the main assumptions of multiple linear regression for each individual continuous variable, I being checking the relevant assumptions for the regression as a whole. The assumptions that I will be checking are normality of error or residuals and homoscedasticity.

Table 5.6: Summary of Variables and Proxies

Variable	Proxy	Code	Year	Source
Football Performance	Natural Log of UEFA Coefficient	*LnPerformance*	2011	UEFA
Wealth	Natural Log of GDP per capita	*LNGDP*	2008	Various[17]
Population	Natural Log of Population	*LNPOP*	2008	World Bank
Football Culture	Number of Years since Appearance in Euro Cup Final	*FootballCulture*	1960-2013	UEFA
Interaction Between Population and Football Culture	LNPOP*Football Culture	*LNPOPxFootballCulture*		
Taxes	Natural Log of Highest Income Tax Rate	*LNTAX*	2012	IMF, Deloitte

5.5 Normality of Errors or Residuals

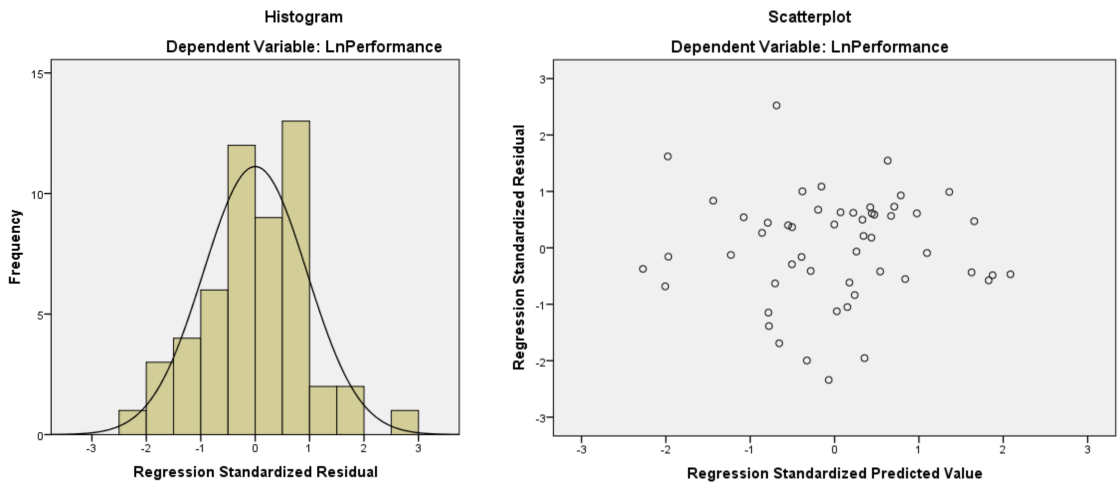
I can check whether or not the residuals of a regression are normally distributed by examining a histogram of the residuals. Panel A in Figure 5.7 clearly portrays that the standardized residuals of the regression closely follow a normal distribution.

[17] World Bank, Welsh Government, and National Statistics of Faroe Islands

Figure 5.7: Histogram of Regression Standardized Residuals and Scatterplot of Regression Standardized Residuals as a function of Regression Standardized Predicted Value

Panel A: Histogram of Regression Standardized Residuals

Panel B: Scatterplot of Regression Standardized Residuals as a function of Regression Standardized Predicted Value



5.6 Homoscedasticity:

Examining the scatterplot of the Regression Standardized Residuals vs. Regression Standardized Predicted Value in Figure 5.7 panel B, I can see that the residuals seem to be slightly wider towards the center of the plot. This indicates that the regression suffers from mild heteroskedasticity. While ideally I would want a regression that is completely homoscedastic, having mild heteroskedasticity does not invalidate my results, it merely weakens them (Princeton University, 2007).

5.7 Generalized Model

Taking into consideration all the necessary changes that I have to make to the base model (4.1) in order to satisfy the different assumptions of linear regression, I come up with the following generalized equation:

$$LnPerformance = \beta_0 + \beta_1(LNGDP) + \beta_2(LNPOP) + \beta_3(Football\ Culture) + \beta_4(LNPOP)*(Football\ Culture) + \beta_5(LNTAX) \quad (5.1)$$

Chapter 6: Results

The following chapter summarizes and formally interprets the results of my regression. Unfortunately, I encountered several unexpected outcomes which led us to reevaluate some of the explanatory variables. Consequently, I decided to run a second regression excluding some suspect variables. Finally, I also include a subsection on potential lurking variables that I have omitted and a section on the limitations of not only the regression model, but also the regression results and possible reasons for these limitations.

6.1 Results

Before going into detail on the statistical significance and interpretation of each individual variable, it is important to check whether the regression, as a whole, is statistically significant. Referring to Table 6.1 I see that the ANOVA test for the regression as a whole is statistically significant at the P <.001 level.

Table 6.1: Statistical Significance of regression (ANOVA)

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	54.574	5	10.915	31.563	.000[b]
Residual	16.253	47	.346		
Total	70.828	52			

a. Dependent Variable: LnPerformance

b. Predictors: (Constant), LnPOPxCulture, LNTAX, LNPOP, LNGDP, Football Culture

Table: 6.2: Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.878[a]	.771	.746	.58806

a. Predictors: (Constant), LnPOPxCulture, LNTAX, LNPOP, LNGDP, Football Culture

b. Dependent Variable: LnPerformance

Table 6.2 displays the R-Squared and Adjusted R-Squared statistics for my regression. R-Squared reports the percentage of the variation from the geometric mean of the dependent variable that is caused by the independent variables. Specifically, an R-Squared value of .771 is interpreted in the following manner: 77.1% of the variation from the geometric mean in *LnPerformance* can be explained by the independent variables used in my model.

R-Squared increases proportionally to the number of explanatory variables. In order to account for the systematic increase due to the number of explanatory variables, I observe the Adjusted R-Squared measure. The adjusted R-Squared only increases if the independent variables are actually responsible for the variation in the dependent variable. Therefore, with an Adjusted R- Squared of .746 I see that my independent variables explain the majority of the variation in the *LnPerformance*.

The results of my regression are displayed in Table 6.3. Substituting the Unstandardized B Coefficients into the generalized equation (5.1) I get the following equation

$$\begin{aligned} LnPerformance \;=\; & -7.532 + .232(LNGDP) + .496(LNPOP) - .038(Football\ Culture) \\ & + .044(LNTAX) + .003 LnPOPxCulture \end{aligned} \quad (6.1)$$

Table 6.3: Coefficients

	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	-7.532	1.374		-5.483	.000
LNGDP	.232	.100	.246	2.326	.024
LNPOP	.496	.063	.809	7.839	.000
Football Culture	-.038	.061	-.561	-.628	.533
LNTAX	.044	.157	.027	.283	.778
LnPOPxCulture	.003	.004	.680	.750	.457

a. Dependent Variable: LnPerformance

Before interpreting the regression results, I note that, the only variables that were statistically significant were *LNGDP* and *LNPOP*, at the $P < .05$ level and $P < .001$ level, respectively. Moreover, when examining *Football Culture*, *LNTAX*, and *LnPOPxCulture*, I see that they all have relatively high P values.

Since most of the variables in my regression were converted using the natural logarithm function, their interpretation is not straight forward, and even though converting the variables using the exponential function is very tempting, the resulting equation cannot be interpreted. For example, converting Equation (6.1) using the exponential function yields the following equation:

$$Performance = e^{-7.532} + (GDP)^{.232} + (POP)^{.496} - e^{.038(Football\ Culture)} + (TAX)^{.044} + (LNPOPxFootball\ Culture)^{.003} \qquad (6.2)$$

Consequently, I decided against using the exponential function to re-transform my independent variables and just interpret the results of the logarithmic equation. The interpretations of the coefficients of a logarithmic regression do not represent the effect on the dependent variable in absolute values. Instead, they represent the percent change in the dependent variable given a 1% increase in the independent variable. For simplicity, I only look at the percent change given a 100% increase in the independent variable. Using the coefficient of *LNGDP* as an example, I say that a 100% increase in *LNGDP* will lead to a 23.2% increase in *LnPeformance* (Evans, 2010: 3).

Since *Football Culture* did not need to be transformed using the natural logarithm, its interpretation differs from the other variables. Traditionally, the coefficient of a variable like *Football Culture* represents the percentage increase in *LnPerformance* due to a one unit increase in *Football Culture* (Evans, 2010: 3). However, *Football Culture* has an interaction term with *LNPOP* that also needs to be considered. Taking the partial derivative of *LnPerformance* with respect to *Football Culture* provides insight into the effect that *Football Culture* has on *LnPerformance*:

$$\frac{\partial LnPerformance}{\partial Football\ Culture} = -.038 + .003LNPOP \qquad (6.3)$$

As shown in Equation (6.3), the effect that *Football Culture* has on *LnPerformance* is codependent on *LNPOP*. Formally, such a coefficient is interpreted as follows: each additional unit of *Football Culture* changes *LnPerformance* by a percentage equal to the difference between 3.8% and .3% of the given level of *LNPOP*. Similarly, the effect that *LNPOP* has on *LnPerformance* is dependent on *Football Culture*.

Table 6.4: Interpretation of Coefficients of Equation (6.1)

Variable	Coefficient	Statistical Significance Level	Interpretation
LNGDP	.232	P < .05	A 100% increase in *LNGDP* increases *LnPerformance* by 23.2%
LNPOP	.496 +.003*Football Culture*	P < .001	A 100% increase in *LNPOP* increases *LnPerformance* by a percentage equal to 49.6% plus .3% of the given level of *Football Culture*
Football Culture	-.038 + .003LNPOP	P < .6	For each additional unit of *Football Culture*, *LnPerformance* changes by a percentage equal to the difference between 3.8% and .3% of the given level of *LNPOP*
LNTAX	.044	P < .8	A 100% increase in *LNTAX* increases *LnPerformance* by 4.4%

Table 6.4 provides a summary of the interpretations of each of the independent variables.

There are several unexpected results in my regression. For example, *LNTAX*, while statistically insignificant, has a positive coefficient. One would expect, *ceteris paribus*, higher tax rates to discourage top athletes from playing in a country. Nevertheless, my results show that higher taxes increase the dependent variable. Yet, a more surprising result is that despite having a linear relationship and a statistically significant correlation with *LnPerformance*, *Football Cuture* is statistically insignificant. Furthermore, due to its negative coefficient, it can potentially decrease *LnPerformance*.

In fact, as shown before, *Football Culture* is codependent on *LNPOP* thus in order to discover the level of *LNPOP* necessary for *Football Culture* to start having a positive effect on *LnPerformance*, I set the coefficient of *Football Culture* to 0 and solve the subsequent equation:

$$0 = -.038 + .003LNPOP \tag{6.4}$$

By solving (6.4) I see that a country must have a *LNPOP* value of at least 12.66 or, in other words, a population of at least 315,000 before *Football Culture* begins to have a positive effect on *LnPerformance*, a result which is counterintuitive to previous studies. Currently, in our dataset, there are five observations that do not surpass this population benchmark, San Marino, Liechtenstein, Faroe Islands, Andorra, and Iceland.

I decided to further explore the anomaly presented by the negative sign on the *Football Culture* coefficient by removing the interaction term between *LNPOP* and *Football Culture* and re-running the regression. Equation (6.5) generalizes this new regression:

$$LnPerformance = \beta_0 + \beta_1(LNGDP) + \beta_2(LNPOP) + \beta_3(Football\ Culture) + \beta_4(LNTAX) \tag{6.5}$$

Table 6.5: Statistical Significance of Regression (ANOVA)

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	54.380	5	13.595	39.674	.000[b]
Residual	16.448	48	.343		
Total	70.828	52			

a. Dependent Variable: LnPerformance

b. Predictors: (Constant), LNTAX, LNPOP, LNGDP, Football Culture

Much like in the original regression, I begin by checking whether my regression, as a whole, is statistically significant. As shown in the last column (Sig.) of Table 6.5, the ANOVA test for the regression as a whole is statistically significant at the P < .001 level.

Looking at the Adjusted R-Squared statistic in Table 6.6 I see that the independent variables are responsible for 74.8% of the variation in the dependent variable. Moreover, the Adjusted R-Squared statistic of this regression is slightly higher than the Adjusted R Square statistic of my original regression (.746), thus indicating that my new model is better at explaining the variation from the geometric mean in the dependent variable and therefore validating the removal of the interaction term.

Table 6.6: Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.878[a]	.768	.748	.58538

a. Predictors: (Constant), LnPOPxCulture, LNGDP, LNPOP, Football Culture

b. Dependent Variable: LnPerformance

The coefficients of my improved regression are displayed in Table 6.7. Substituting the Unstandardized B Coefficients into the new generalized model yields the following equation:

$$LnPerformance = -8.133 + .268(LNGDP) + .521(LNPOP) + .007(Football\ Culture) + .009(LNTAX) \quad (6.6)$$

There are many insights I can draw from Table 6.7. For example, although *Football Culture* is still considered statistically insignificant, its P value has dropped to P = .182 which is considerably better than its previous P = .533 value. What is more, the sign of its coefficient is now positive. Additionally, *LNGDP* also experienced a drop in P value, from P =.024 to P = .003. However, the P value for *LNTAX* increased from P = .778 to P = .951.

Table 6.7: Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	-8.133	1.110		-7.328	.000
LNGDP	.268	.087	.284	3.076	.003
LNPOP	.521	.054	.849	9.674	.000
Football Culture	.007	.005	-.107	1.355	.182
LNTAX	.009	.149	.006	.062	.951

a. Dependent Variable: LnPerformance

Table 6.8: Interpretation of Coefficients of Equation (6.6)

Variable	Coefficient	Statistical Significance Level	Interpretation
LNGDP	.268	P < .005	A 100% increase in *LNGDP* increases *LnPerformance* by 26.8%
LNPOP	.521	P < .001	A 100% increase in *LNPOP* increases *LnPerformance* by 52.1%
Football Culture	.007	P < .2	For each additional unit of *Football Culture, LnPerformance* increases by .7%
LNTAX	.009	P < .99	A 100% increase in *LNTAX* increases *LnPerformance* by .9%

The interpretations of the new coefficients are analogous to the interpretations of the coefficients in the original regression. Table 6.8 summarizes the interpretations of these new coefficients.

Removing the interaction term between *LNPOP* and *Football Culture* seems to have solved the issue of a negative coefficient for *Football Culture*. This new regression does not allow any values of *Football Culture* to have a negative effect on *LnPerformance*. Furthermore, it has increased the coefficient of both *LNGDP* and *LNPOP*, while also decreasing the coefficient of *LNTAX*. Unfortunately, not all anomalies were resolved since *LNTAX* still has a positive coefficient.

6.2 Limitations and Lurking Variables

My regression model has certain limitations which could be responsible for some of the anomalies found in the results. First, my dataset is limited by the relatively small number of observations (there are 53 UEFA affiliates). I believe that the size of my dataset is responsible for the statistical insignificance of *Football Culture*. Second, the variable *LNTAX* is an extreme simplification of the actual tax system in European countries. Ideally, I would have been able to account for tax breaks available to foreign players; perhaps including a dummy variable for the existence of such tax breaks would have provided a better model and a more realistic coefficient. However, such an undertaking would have required an expansive knowledge of the tax system in all 53 affiliated countries.

There are certain lurking variables that could not be accounted for without violating the assumptions of linear regression. For example, the UEFA Coefficient from previous years will influence the current UEFA Coefficient, but would have probably led to multicollinearity with various independent variables. The number of teams representing a nation in European competitions could also have an effect on the UEFA Coefficient and should have been included in the regression model. Unfortunately, including such a variable would also have led to multicollinearity with other independent variables.

Finally, perhaps the greatest limitation to my regression model was the lack of well behaving variables. I was forced to transform the majority of my variables in order to satisfy the assumptions of linear regression. By transforming the variables using the natural logarithm function, I changed the interpretation of each coefficient. While I hoped that my coefficients would provide the effects of each explanatory variable in absolute terms, the logarithmic transformation limited me to only observe the percent change in the dependent variable given a 100% increase in the independent variable.

Chapter 7: Conclusion

Football performance is commonly believed to be determined by player talent and franchise finances. However, in this paper, I explored the possibility that exogenous factors such as, wealth of a nation, population size, popularity of football, and taxation policy also influence football performance.

I examined whether these exogenous factors influenced the performance of teams affiliated with the Union of European Football Associations (UEFA). Using linear regression as the method to substantiate my claim, I found that the wealth of a nation and its population have a statistically significant influence football performance. Popularity of football, or the degree to which football is engrained in a nation's culture, is not statistically significant as I measured it, but I still believe it has a lasting effect on football performance. Surprisingly, taxation policy did not have any effect on football performance.

There are several different opportunities for further research in this area. The first would be to try different proxies for explanatory variables. For example, a different proxy for the popularity of football could be implemented. Similarly, I believe that a proxy such as disposable income per capita would be a more precise measure for the wealth of a nation. Another method to furthering this research would be to develop a time series regression which included previous UEFA Coefficients as an explanatory variable.

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Appendix A

Table A.1: Structure of UEFA Champions League starting at the Group Stages.

	Group Stages	First Knock Out Round	Quarter Final	Semi Final	Final
Number of Teams	32	16	8	4	2
Number of Games per team	6 (H/A)	2 (H/A)	2 (H/A)	2 (H/A)	1 (PV)
Number of Teams progressing	16	8	4	2	1

Legend:
H/A = Home and Away
PV = Predetermined Venue
Source: UEFA

Table A.2: Structure of EUFA Europa League starting at the Group Stage

	Group Stages	First Knock Out Round	Second Knock Out Round	Quarter Final	Semi Final	Final
Number of Teams	64	32	16	8	4	2
Number of Games per team	6 (H/A)	2 (H/A)	2 (H/A)	2 (H/A)	1 (PV)	
Number of Teams progressing	32	16	8	4	2	1

Legend:
H/A = Home and Away
PV = Predetermined Venue
Source: UEFA

Table A.3: UEFA Country Coefficient

Country	Coefficient (2011)	Country	Coefficient 2011
England	84.41	Bulgaria	14.25
Spain	84.186	Hungary	9.75
Germany	75.186	Finland	9.133
Italy	59.981	Georgia	8.666
Portugal	55.346	Bosnia and Herzegovina	8.416
France	54.178	Ireland	7.375
Russia	47.832	Slovania	7.124
Netherlands	45.515	Lihuania	6.875
Ukraine	45.133	Moldova	6.749
Greece	37.1	Azerbaijan	6.207
Turkey	34.05	Latvia	5.87
Belgium	32.4	Macedonia	5.666
Denmark	27.525	Kazakhstan	5.333
Switzerland	26.8	Iceland	5.332
Austria	26.325	Montenegro	4.375
Cyprus	25.499	Liechtenstein	4
Israel	22	Albania	3.916
Scotland	21.141	Malta	3.083
Czech Republic	20.35	Wales	2.749
Poland	19.916	Estonia	2.666
Croatia	18.874	Northern Ireland	2.583
Romania	18.824	Luxembourg	2.333
Belarus	18.208	Armenia	2.208
Sweden	15.9	Faroe Islands	1.416
Slovakia	14.874	Andorra	1
Norway	14.675	San Marino	0.916
Serbia	14.25		