

**Efficiency in the European Football Leagues:  
Evidence from DEA Model between the Years 2016  
and 2020**

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## **ABSTRACT**

This study aimed at measuring the efficiency and productivity of the most successful football clubs in the Big Five Leagues of Europe. Data Envelopment Analysis (DEA) and Malmquist Total Factor Productivity (MPI) index were conducted to measure efficiency and productivity for the investigated football clubs within the European Football leagues and the Turkish super League between the years 2016 and 2020.

The empirical results show that the performance of the most successful football clubs of the Big Five Leagues of Europe and the Turkish Super League are efficient and productive in terms of technical efficiency and productivity between 2016 and 2020. The results also indicate that Galatasaray, Beşiktaş, Manchester United, Arsenal, FC Bayern München, Borussia Dortmund, FC Schalke 04, and Olympique Lyon clubs are the most efficient football clubs in the investigated seasons.

**Keywords:** Efficiency measurement; Data envelopment analysis; European Football leagues

## ÖZ

Bu çalışma, Avrupa'nın Beş Büyük Ligindeki en başarılı futbol kulüplerinin verimlilik ve üretkenliğini ölçmeyi amaçlamaktadır. 2016-2020 yılları arasında Avrupa Futbol ligleri ve Türkiye Süper Ligi'nde yer alan futbol kulüplerinin etkinlik ve verimliliğini ölçmek için Veri Zarflama Analizi (VZA) ve Malmquist Toplam Faktör Verimlilik analizi kullanılmıştır.

Ampirik sonuçlar, Avrupanın beş büyük Ligi ve Türkiye Süper Ligi'nin en başarılı futbol kulüplerinin 2016-2020 yılları arasında teknik verimlilik ve üretkenlik açısından verimli ve üretken olduğunu göstermektedir. Sonuçlar ayrıca Galatasaray, Beşiktaş, Manchester United, Arsenal, FC Bayern München, Borussia Dortmund, FC Schalke 04 ve Olympique Lyon kulüplerinin araştırılan sezonlarda en verimli futbol kulüpleri olduğunu gösteriyor.

**Anahtar kelimeler:** Verimlilik ölçümü; Veri zarflama analizi; Avrupa futbol ligleri

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# Chapter 1

## INTRODUCTION

### 1.1 Purpose of the Study

In this study, we will determine the level of efficiency or inefficiency of the domestically most successful football clubs of the Big Five Leagues of Europe (Manchester United, Liverpool, Arsenal, Manchester City, and Chelsea from English Premier League, FC Bayern, Borussia Dortmund, and FC Schalke 04 from German Bundesliga, Juventus, Milan, and Inter from Italian Serie A, Real Madrid, Barcelona, and Atletico Madrid from Spanish La Liga, and Paris Saint Germain and Olympique Lyon from French League 1) and The Turkish League(Fenerbahçe SK, Galatasaray, Beşiktaş, Trabzonspor). The reason of adding the most successful clubs of Turkish League into this study is, these clubs have a huge fan base around the world and according to the view of most of the football authorities, Turkish League is considered as the 6<sup>th</sup> biggest league of Europe in terms of revenue created. This point will be discussed further in literature review chapter. When we investigate previous studies, we see that there are lots of efficiency measurement studies have done regarding the football or other areas of sports by comparing one club or enterprise to the other. The main difference of this research from the others is, this research will give readers a very recently updated insight about the efficiencies and productivities of the giant clubs by including all of them in this research and encompassing the years between 2016 and 2020. We hope that this study will be very interesting for the readers.

## **1.2 Significance of the Study**

Football has transformed from a popular sport into a huge industry especially since the previous two decades. This transformation has brought various challenges to football clubs. In the past, the success of historically big clubs were linked to the passion of fans and the big players of the clubs and also good tactics on the pitch but nowadays the success is not merely linked to the emotions or tactics, the financial power also play a huge role in the success of the football clubs. Hence, managing a football club has also become like managing a business enterprise and this situation brought prominence of running an efficiency analysis in order to determine the efficiency levels of football clubs. By doing so, the owners of clubs can see whether if they manage their clubs successfully or not. This type of analysis can help the owners of football clubs to be aware of the pros and cons of their management abilities. In this context, the investigation of valuable European and Turkish League football clubs by Data Envelopment Analysis method will contribute to the literature on football efficiency analysis.

## **1.3 Definitions**

**Effectiveness:** The extent to which targets are reached and problems are solved.

**Efficiency:** It is a process of consuming the lowest amount of inputs for capturing the largest amount of outputs. Efficiency is related to the use of all inputs for producing any given output, by including personal time and energy. Efficiency is a measurable concept that can be determined by the ratio of useful output to total input. It aims to minimize the waste of resources like physical materials, energy and time, while achieving the desired amount of output.

Performance: It is a concept that quantifiably and qualitatively specifies what an individual or group doing a job can achieve, and achieve with that job for its intended purpose. Performance is an indicator of the extent to which an individual or group can achieve the goals and standards set for them in the direction of the goal they want to achieve with this work.

Technical Efficiency: It is a *situation* in which a *company* or a *particular machine produces the largest possible number of goods* with a given *time, materials, and labor*.

Scale Efficiency: It is the potential productivity gain from achieving optimal size of a firm or an enterprise. A unit is scale efficient when its size of operations is optimal so that any modifications on its size will be reducing efficiency.

Inputs: They are something to be put into the system for operating.

Outputs: The *amount of goods and services, or waste products, that are produced by a particular economy, industry, company, a system, machine or worker*.

## **1.4 Delimitations and Limitations**

### **1.4.1 Delimitations**

- The power of this work is mostly in the Data Envelopment Analysis that is used. This approach is popular because of converting various inputs into various outputs without concerning the correlation between inputs and outputs (Murillo-Zamorano, 2004).
- Based on the previous sentence, we are freely able to decide for the variables to be used in this analysis.

- The researchers are free about deciding to use either primary or secondary data.

#### **1.4.2 Limitations**

- The data used in this analysis has been captured from a secondary data resource so all the lacks of advantage of secondary resource can be found in the dataset.

### **1.5 Conclusion**

To sum up everything discussed in this introductory chapter, this study will show us a very recent efficiency analysis results (period of 2016-2020) of the most popular football clubs of Europe and the Turkish League. From this perspective, it would be very interesting study which will contribute to the football clubs efficiency analysis literature. The details of the analysis will be discussed in the upcoming chapters.

### **1.6 Research Structure**

This study will consist of five units; the first unit is a general introduction. Unit two follows with literature review. Unit three will spell out the data, model, and methodology used in this analysis. Unit four will show us and explain the empirical results of this study and lastly in unit five, a general conclusion and some inferences from this study will be given.

## Chapter 2

### LITERATURE REVIEW

#### 2.1 Introduction

Football, which is the biggest sport, is changing drastically since the 1990's. The characteristic of football, the organization of clubs, the structure of revenues, the characteristics of fans, the qualities of stadiums, the physical and technical capacities of football players, the structure of the ball, in short, football as a whole and its philosophy are changing. The veteran footballers of the past are now being replaced by industrial footballers who earn millions of dollars annually and have each become icons. Again, pure football, which was performed as an art in the past, has been replaced by "work" with very different characteristics. The annual revenues and external effects created by this changing structure total hundreds of billion dollars. Change and development in football becomes very important when the cake is so big. In this changing and evolving structure, European clubs, in particular, are looking to further increase their share of the football pie. Senior clubs, in particular, are turning to restructuring in a way that maximises their profits and benefits. The management of football clubs, which today have become business organizations and have reached budgets of hundreds of millions of dollars, is no longer managed by the old classic methods. Conventional managers of the classical management approach face the situation of leaving their place to more modern and professional managers. Because in today's industrial football, running sports clubs like running a family business is far behind. Football has become an industrial line of business, exposing it to significant

changes in economic, financial, legal and organizational aspects. This chimney-free industry, together with its external effects on a global basis, generates an annual revenue of about two hundred billion dollars. We have to say industry, whether we want it or not, in an area where so much revenue is generated (Akşar & Merih, 2008:p2) .This change and transformation shows us that football clubs have now evolved from an ordinary sporting organization to an economic organization. In this study, "efficiency" analysis of the top 6 teams of the five major leagues of Europe and the Turkish league will be carried out. Afterwards, the comparison of the efficiencies of the big five leagues and Turkish League and some recommendations will be given.

## **2.2 Concept of Efficiency**

Operating efficiency, by definition, refers to ‘doing things right’ , by the ability of organization in considering minimum level of input and achieving maximum level of output (Rossi , Goosens , Tanna & Addesa , 2018 ) . In other words, efficiency can be defined as minimum waste . Also in a technical perspective, efficiency in production is the achievement of largest amount of output by consuming restricted or minimum amount of inputs (Ferraresi, Garcia-Cebrian , Lera-Lopez & Iraizoz , 2017 ) . When combining operating and technical efficiency by definition, it can be concluded that efficiency investigates the ratio of inputs to outputs regarding the topic of interest.

## **2.3 Efficiency Definition within the Football Content**

The efficiency concept in football is mainly considered as a production function , teams are assumed as business enterprises which adopt a production process by considering “sporting success” as output , by combining various playing and non-playing inputs (Rossi , Goosens , Tanna & Addesa , 2018 ) . A similar perspective has been adopted by the various researchers. According to the perspective of Ferraresi , Garcia-Cebrian , Lera-Lopez & Iraizoz (2017) , the most popular way of assesing

football performance is looking to outcome. In assessing football efficiency, sport results can be considered as output and revenues of the clubs are input . Some researchers, such as Haas (2003), have addressed more technical details in their analysis of production efficiency in football . In the perspective of football, discussions about the potential performance of a team with a given playing and management talent, as well as comparisons between the actual performance and the possible one are common. These discussions ultimately run along one of the most fundamental economic concepts, namely productive efficiency Haas (2003). In the analysis of Haas , the quality and quantity of football players and as well as intelligence of a possible headcoach of a club in terms of applying appropriate tactics on the pitch and taking correct substitutional decisions while analysing the game from the bench has taken into account . This research was an era in the efficiency analysis within the context of football because many critical factors that determine the outcome of a team on the pitch has been investigated.

## **2.4 Types of Efficiency**

An efficient market occurs when the assets are utilized in accordance to capture maximum amount of services and goods by minimizing the cost. The economic efficiency is a relative term with the previous explanation; an economy is productive when more goods produced and services offered to society while consuming same or even lower amount of inputs. Efficiency of scale, productive efficiency, technical efficiency, allocative efficiency, dynamic efficiency and social efficiency are the most popular and useful types of efficiencies who has been discovered by the various economists. (Greco, 2017).



The first type of efficiency to be investigated is the scale efficiency. In this efficiency type, as the production increases cost per unit falls. This impact has a restrain; beyond this restrain the increase of production will not payoff for scale efficiency. The another type of efficiency is productive efficiency. This type of efficiency occurs when a producer consumes lower amount of inputs to capture outputs relative to other producers. This can be achieved through a progress in technology, lower labor cost, or negligible waste in production.

Technical efficiency is another type of efficiency which is widely used in football efficiency analysis like in previous studies of (Barros & Leach, 2007). A prerequisite for allocative efficiency, technical efficiency depicts production that has the most reduced possible opportunity cost. Material and labor resources are not wasted within the generation of products or administrations in actually efficient production. When it's accomplished, technical efficiency permits for but doesn't ensure allocative efficiency. When a society's esteem for certain good or service (the sum they pay for it) is in balance with the cost of assets utilized to deliver it, it is called allocative efficiency. It's ordinarily accomplished not by accident but when a society designates its assets to creating what society values most.

Economists use dynamic efficiency, which is a new terminology, to depict a market in long term. Dynamic efficiency exists when customers in a society are able to achieve higher quality products and services in compare to any other society. Dynamic efficiency can be obtained through research and development, and cheap and high-quality production of products by the time. The final type of efficiency to be discussed is the social efficiency that can be achieved when the advantage of creating a product will not be exceeded the bad impacts of production for the consumers. In other words,

the social efficiency is linked to externalities that are the exterior impacts of creation of goods and these impacts can either be positive or negative.

## **2.5 Big Five Football Leagues of Europe and the Turkish League**

Europe can be considered as the heart of football. Despite the huge talent pool of South American countries like Brazil, Argentina, Colombia, Uruguay, Paraguay, Chile, and Mexico, football mainly has been industrialized in Europe continent. Arguably, the economic development and superiority of European countries in compare to South American countries lies under this circumstance. Many giant European clubs set up scouting networks in the huge talent pool of South American countries and enter competition among each other to gather footballing talent from South America. Recently, scouting networks of European giants has been jumped to African and Asian countries to gather footballing talent at even cheaper prices. These circumstances created the terminology “BIG FIVE EUROPEAN LEAGUES” because most of the European giant football clubs are cumulated in these five leagues, namely English Premier League, Spanish La Liga , Italian Serie A , French League 1 , and German Bundesliga. Turkish League can be considered as the 6<sup>th</sup> biggest league of Europe because this league hosts a few of the European giants. According to Terrien & Andreff , (2019) , European football league’s competition is amazingly critical among big five European leagues .This competition among the leagues are regarding the competitiveness of clubs. Unfortunately, Turkish League has not caught these big five leagues yet. After these points, these six football leagues will be briefly investigated.

### **2.5.1 English Premier League**

England takes its place in the football literature as the cradle of football. Thanks to this very deep-rooted football culture , England has over time the most competitive and richest football league in the world in terms of income distribution , broadcasting

revenue , average game attendance , the name of this league is the English Premier League . The English Premier League has a fair League culture , hosting the giant clubs of world football such as Manchester United , Liverpool, Arsenal , Manchester City, Chelsea and these giants are in a huge competition for league title. The English Premier League is the football association which generates largest amount of profits, not as it were in Europe but moreover around the globe, and has the wealthiest club of the world which is Manchester United (Barros & Leach, 2007 ) .

### **2.5.2 Spanish La Liga**

The Spanish La Liga league is one of the top 5 leagues in Europe. In the opinion of many football authorities, it contains the two largest clubs in the world, Real Madrid and Barcelona. Although the Spanish league is basically based on the rivalry of Real Madrid and Barcelona, this league has become even more competitive with strong clubs coming from behind, such as Atletico Madrid ,Valencia , Real Sociedad, also winning titles. As it were three decades back, in 1990 ‘The Spanish Sports Law’ was brought for ensuring the professionalization of the clubs in Spain. Also in 1991 a new decree was brought to make almost all of the football clubs a sport stock company except Real Madrid, Barcelona, Athletic Bilbao and Osasuna (Guzman , 2006).

### **2.5.3 Italian Serie A**

The Italian Serie A League is seen as one of the five most important leagues in Europe. Its giant clubs have been in great competition until the 2010s, and this competition has made the Italian league popular. Until the 2010s , especially Juventus , Milan , Inter trio's giant competition made this league attractive , both positively affected the success of the Italian national football team and provided a stronger representation of Italian clubs in European Cups. Apart from these 3 giant clubs , more modest clubs such as Fiorentina , Torino , Bologna , Genoa also had successful periods decades ago,

which led to an increase in the number of champion teams . In addition to all these positive developments, the Italian league has experienced dark days. The Calciopoli Scandal , which broke out in 2006 , negatively affected the brand value of the Italian League , Juventus, the most champion team in Italy , was relegated for match-fixing. The Calciopoli Scandal badly influenced Italian league with specific respect to participation figures. Amid the period of study, the Serie A normal attendance for each competition was under 25,000; which is the lowest amount among the top European Leagues (Rossi, Goosens , Tanna & Addesa , 2018 ).

#### **2.5.4 German Bundesliga**

The German Bundesliga is the top football league of Germany, and this league is also one of the big five leagues of Europe. Bundesliga is famous with high spectator attendance levels, the teams like Borussia Dortmund, FC Bayern , Schalke 04 and even modest clubs like Borussia Mönchengladbach , Bayer Leverkusen and Hoffenheim have spectator attendance levels more than many English Premier League clubs. Germany is a football country which gives prominence to young player development and made huge amount of investments for the younger age groups like building facilities, bringing best trainers for education and player development for younger groups, and blending these actions perfectly. As a result of this perfect infrastructure, German League became one of the best leagues on the world in terms of quality of football, quality of players, and also quality of head coaches. FC Bayern has a huge dominance on this league, actually they do not have any “Giant” rival throughout the history, but the team which finishes league as second also celebrates this result because they consider themselves as the champion of Germany because there is a stereotype in the minds of every stakeholders of football in Germany: “It is impossible to beat FC Bayern”. Despite non-competitive atmosphere of the league, Bundesliga still maintain

its popularity and in recent years, the improvement of Borussia Dortmund brings some action and competition to this popular football league.

### **2.5.5 French League 1**

According to most of the football authorities, The French League 1 is among the big five European leagues. In compare to other big leagues, this league can be considered as ordinary or modest, because the value created in this league is relatively lower. Historically, the prosperous players in this league generally make transfer to other big leagues, mostly to English Premier League. Some big stars like Didier Drogba, Thierry Henry, Patrick Viera were purchased by giant English clubs in their peak periods of their careers. It can be easily seen that, French League is a prominent step for prosperous young players to reach giant clubs of Europe. Hence, this league is import oriented, in other words, this league creates its value by the sales of talented players and generating income from this operation. If we look at the domestic competition, up until 2010's, this league has ample of champions and historically there is a huge competition among Saint Etienne, AS Monaco, Olympique Marseille, Olympique Lyon, and Paris Saint Germain. After the purchase of Paris Saint Germain by Arabic businessman El-Halifi, the sporting success of the club has increased, and club put an embargo to the League Tittles after 2010. This development reduced the competitive edge of the league. Nowadays, the situation is the same, but again, this league can be considered as a talented player factory.

### **2.5.6 Turkish Super League**

The Turkish Super League is the top league of Turkey, and according to many football authorities, this league is the best league of Europe after the big five leagues. This situation is the result of the amount of money circulation in this league; the contributions of sponsorships especially to giant Istanbul clubs, the contribution of the

spectators to the football clubs through matchday revenues, merchandising revenues, grants in some special campaigns for clubs, and broadcasting revenues. This revenue constitutes the 2,8 % of the total European football GDP (Akşar & Merih , 2008:p15). The quality of football in this league can be criticized in compare to big five leagues , but the popularity of this league comes from the giant clubs in terms of fan base that compete for league title in every season. These giant clubs are 3 Istanbul giants (Fenerbahçe, Galatasaray , and Beşiktaş) and “the champion of Anatolia” Trabzonspor. Among these giant clubs , especially Fenerbahçe and Galatasaray are among the most popular clubs on the world in terms of fan base. If we investigate the competition for title in this league deeply, it can easily be seen that the league titles were mainly shared among Fenerbahçe , Galatasaray, Beşiktaş, and Trabzonspor. In last decade, Bursaspor and Medipol Başakşehir won a league title and number of champions in this league became 6, and these events brought more competition to this league. Since the competition brings quality to a league, The Turkish League can be considered as a developing league in terms of competition. Finally, to be honest, there is still a gap between the big five European Leagues and The Turkish League and maybe in one day , this gap will be narrowed.

## **2.6 The Football Efficiency System**

As a result of the popularity and the industrialization of the football globally, the studies on the football efficiency has also became popular. All of these analyses were done with inspiration from the pricelessly valuable studies of Debreu (1951) and Farrell’s (1957) who put forth the definition of the concept of “efficiency”. The results of the efficiency analysis between other football clubs create the base of scores that will be shown at the graphs of rankings of football clubs. The optimal distance from the boundary is calculated, and the disparities between these values determine each

football club's efficiency level. Efficiency, according to these authors, is defined as a certain level of attachment observed inside a production process when compared to a certain criteria of optimality. This method has aimed to calculate an expansion or reduction in input or output that is related to a level of output or input vectors given. If we think about the DMU's that are the sources or inputs or outputs in football industry, some definitions can be given to technical efficiency, scale efficiency, allocative efficiency, or scope efficiency. In this paper, our focus will be on technical efficiency that communicates the capacity of Decision Making Units for producing finest or most noteworthy amount of results from an affiliation of input and managerial skills and managerial knowhow. It can also be defined as utilization of limited number of sources for capturing huge amount of sporting success. Efficiency in the context of football, our goal is to increase technical efficiency, without reducing quality, with the same level or less inputs. For example, to increase the efficiency of a football club at the given level of total revenue, staff costs and other inputs without decreasing sporting results (Guzman & Morrow , 2007).

## **2.7 The Football Efficiency**

When we examine the international sports literature, it is seen that various efficiency analyses related to sports were carried out. The first empirical evidence in a average production function framework was found in the study of Scully (1974) who investigated the baseball players' performance. By utilizing the rate of matches won to display the yield of management and team, capital and team spirit as input sources, Scully's work was the first to apply a production function to show empirical evidence. The previous researches which are based on the popular sports of US, the availability of data permits researchers to categorise individual commitments and measure the statistics regarding the competitions (Atkinson, Stanley, & Tschirart, 1988; Chatterjee,

Campbell, & Wiseman, 1994; Krautmann, 1990; McCormick & Clement, 1992; Ruggiero, Hadley, & Gustafson, 1996; Scott, Long, & Somppi, 1985; Zak, Huang, & Sigfried, 1979; Zech, 1981). The dearth of empirical research on other professional sports from other countries is explained by their intrinsic presence, such as rugby and football, which are famous for team interplay and complementarity of individual responsibilities within teams. (Carmichael & Thomas, 1995; Schofield, 1988).

The econometric or parametric approach and the non-parametric approach are the two modern approaches to measuring efficiency. We may find numerous articles in which the econometric approach to football performance analysis has been used. Dawson et al. (2000), for example, looked at efficiency of management in British football and estimated a range of development frontiers. They used the winning rate as an output and other indicators of player efficiency as input. Barros and Leach (2006b, 2007) looked at stochastic cost frontiers for the English Premiership, using the number of goals scored during the season as well as attendance records as yields. Ascari and Gagnepain (2007) estimated average wage conditions in Spanish football, using a stochastic frontier model to test the effects of clubs' rent-seeking behavior on their costs experimentally. Out of the papers applying a non-parametric approach, we begin with Espitia-Escuer and Garcí'a-Cebrian (2004), DEA is used to decompose the performance of Spanish clubs in the first division league into technical efficiency and scale efficiency. They use the amount of points scored during the league season as output. Barros (2003) investigates the impact of incentive regulation on sports organization training practices, focusing on both technical and allocative performance. Finally, Haas(2003b) examines the effectiveness of the Major League in



the United States, while Barros and Santos (2003) calculated Malmquist records for Portuguese sports organization training events.

The DEA bootstrapping strategy which is the unused sort of DEA strategy, created by Simar and Wilson (1999, 2000, 2007), allows us to take advantage of DEA's preferences when conducting statistical hypothesis testing on DEA productivity ratings. The SFA method's broad sample requirements are solved in this way. A research isn't limited to estimating efficiency; instead, it employs a second-stage regression to better illustrate the changes in effectiveness. As a result, the research paper can use a creative double bootstrapping technique to account for the DEA efficiency scores' dependence problem, which periodically violates the regression analysis' model assumption. The main goal is to replace the inaccuracy of the regression standard errors estimators with bootstrapped estimates of these standard errors. Some researchers like Barros& Garcio-del-Barrio,2010, ; Halkos & Tzeremes ,2013, ; Barros, Assaf& Sa-Earp ,2010, ; Kounetas (2013) ; Ferraresi ,Garcia-Cebrian , Lera-Lopez & Irazioz ,2017, applied Two-stage double bootstrapped methodology of Data Envelopment Analysis in their valuable researches.

## **2.8 Importance of Measuring Efficiency in Football**

The main objective of this study is to conduct an efficiency analysis of the five major European leagues and the Turkish league's top championship winning teams and to contribute to the literature on football efficiency by obtaining possible conclusions as a result of this analysis. By using these important European football clubs in this study, we aim to make this study more interesting. The concept of efficiency has become an even more important concept than ever, especially in "industrial football", which speaks of itself as today's chimney-free industry. In past years, played football as a

visual feast for the audience , nowadays, sponsors, club presidents and senior administrators, publishers , organizations, states , and even the passion of the fans has colors investing , football has become a huge industry. While this is the case also in all conditions of this investment and the survival of this industry in order to avoid collapse of the financial and economic analysis, identify some things that went wrong, correct is corrected by making inferences, it is crucial that the road be continued. This is exactly the purpose of this study, which we have established on the concept of "efficiency", which is the term of Economics.

## **2.9 Conclusion**

In this latest section of our literature review, many factors that can be considered important in the analysis of efficiency in the football wheel can be mentioned. From these factors, it is vital that the input factors and output factors that we will use in our data envelopment analysis are correctly selected. Various input and output factors have been used in many past studies mentioned in this unit. In some studies, financial combinations were used, and in others, factors that come from the essence of football were used in a more technical sense. In our study, factors that are a kind of blending of concepts that come from the essence of financial and football were used. The aim of our study in this direction is to produce a valuable analysis by keeping today's industrial football concepts in the business without going too far out of the spirit of football.

## **2.10 Research Structure**

Chapter two showed some literature review. Chapter three will spell out the data, model, and methodology. In Chapter four we will show and explain the empirical results. Finally, last chapter will be consist of a general conclusion and a managerial recommendation.

## Chapter 3

### MODEL, DATA, AND METHODOLOGY

#### 3.1 Introduction

This chapter is going to explain research methodology used in order to achieve the goal of the study. The aim of the study is calculating the efficiencies of the most successful football clubs of the big five leagues of Europe and Turkish league by using DEA. In order to achieve the goal, the solution should be carefully tested based on this purpose. Finally, we'll look at the model that was used for this research, as well as how the data was obtained and the methodology that was used.

#### 3.2 Model

In this study, the Data Envelopment analysis (DEA) will be used to measure the efficiency of most successful football clubs of big five leagues of europe and turkish league. As can be seen from the works of these researchers Dantzig (1951), Farrell (1957), and Charnes, Cooper, and Rhodes (1978), it was thanks to them for creating the Data Envelopment Analysis (DEA), and it has been a major business or organization analysis instrument used in calculating how efficient enterprises operate since that time. Their work pioneered a linear relative piecewise output function that can be used to assess a company's performance. Over the years, the DEA model has appeared in a number of articles with the aim of determining efficiency. The most important feature of data enveloping analysis is that it can analyze multiple inputs and outputs simultaneously. This analysis is executed successfully, even if the inputs and outputs are unrelated to each other (Murillo-Zamorano, 2004). This makes data

enveloping analysis available to all kinds of institutions. There are two main types of DEA;

### 3.2.1 Output Orientate Model

In case of the inputs were kept same or are minimized, this is known as output orientation. As an outcome, the final result is heavily reliant on the output variable. A plot of the outputs/inputs ratio in CRS yields a linear piecewise graph of the enterprise under investigation, which is referred to as the production function or production frontier. Since no unit on the frontier can produce more outputs than the others provided the same amount of inputs, this situation implies that all units on the frontier are efficient. The efficiency or inefficiency of our output variables will be shown by the results of output orientation.

### 3.2.2 Input Orientate Model

Similarly, the variable return to scale VRS, where, in contrast to the CRS, the yields are settled and the inputs adjust as a result, is known as input orientate model (Banker, Charnes, & Cooper, 1984). One significant difference among Constant and Variable Returns to Scale is that in the coming stages, the introduction preference has a significant effect on performance, while in the former, it does not. The two introductions are extremely important to these considerations since some of the variables are set and others are variable. Following that, we will modify our approach to include the CRS method under the VRS assumptions, resulting in the linear programming model which will be utilized for calculating the efficiency by DEA.

$$\begin{aligned}
 & \text{Maximize} \quad \phi_k + \varepsilon \sum_{r=1}^s S_r + \varepsilon \sum_{i=1}^m S_i \\
 & \text{subject to} \quad \phi_k y_{rk} - \sum_{j=1}^n \lambda_j y_{rj} + s_r = 0, \quad r = 1 \dots s
 \end{aligned}$$

$$x_{ik} - \sum_{r=1}^n \lambda_j x_{ij} - s_i = 0, \quad i = 1 \dots m$$

$$\sum_{j=1}^n \lambda_j = 1,$$

$$\lambda_j, s_r, s_i \geq 0 \quad \forall j = 1 \dots n; \quad r = 1 \dots s; \quad i = 1 \dots m$$

Where  $s$  and  $m$  denote outputs and inputs, respectively.  $Y_{rk}$  denotes the number of outputs  $r$  produced by unit  $k$ , while  $x_{ik}$  denotes the quantity of input  $i$  consumed by unit  $k$ . where  $s_r, s_j$ , in that order, are the slacks of outputs and inputs.  $1/\phi_k$  measures the technical efficiency of unit  $k$ ; if  $k$ 's efficiency score is 1 and all slacks are zero, it is efficient. For example, DEA emphasizes on a constant return to scale, consider the basic instance of our investigated each football team producing three outputs each season: amount of points won, league rank, and number of trophies won.  $Y_1$  number of points won that are giving us good outcomes or degree by using the input  $X_1$  average number of game attendance,  $Y_2$  rank in the league captures the annual total revenue of the football clubs using the inputs  $X_2$  total revenue of each club,  $Y_3$  number of domestic trophies won is linked to the input  $X_3$  number of personnel in football club.

### 3.2.3 Specification of Outputs and Inputs

We will discuss two crucial issues in this section: input/output definition and calculation, as well as the importance of input/outputs choices in the DEA system. These considerations can be seen as input and output description and measurement issues in the estimation of football efficiency. Data availability is an important criteria in choosing inputs and outputs (Barros & Leach, 2007). Furthermore, how do football clubs distinguish between controllable and uncontrollable inputs, such as environmental factors? Now we'll deal with these two issues. The first is to conduct an

efficiency evaluation without isolating the controllable from the uncontrollable, as DEA does most of the time in football. However, since the outcomes that we got do not encompass or consider the environment, specially while bad environmental factors exist, results would become overestimated and underestimated. Also we address the issues through a two-stage process in which we first use a collection of controllable inputs and evaluate their efficiency within the DEA. In addition, statistical approaches are used to analyze the efficiencies in relation to the uncontrollable inputs. In terms of precision, results from previous studies indicate that two-stage DEA efficiencies are slightly better than one-stage DEA efficiencies (Barros, Assaf & Sa-Earp , 2010). There have been several distinctions in previous literatures on football performance, varying from data used and so on. The following section provides a summary of these studies.

#### **3.2.4 Studies based on Non-frontier Techniques**

Two DEA specifics can be chosen in accordance to number of findings, whose vary from year to year. One option is a traditional DEA, which shows how to estimate DEA per football season for those leagues where necessary source is available to gather; other option is panel data estimation, which shows how to estimate DEA only for seasons where league data is available. It's important to note that picking one of the two options can have an impact on the outcome. Because the most relevant European leagues reveal enough data to be measurable, there is a selection bias within the league sample due to missing information for certain leagues. Incorrect insights about effective management can emerge as a result of under-sampling of failure. (Denrell, 2003).

### 3.3 Data

The data used in this master's thesis is secondary data gathered from a variety of sources such as “Transfermarkt (n.d)” and “ Investing.com (n.d)” for the seasons between 2017 and 2020. This is the basis of our analysis. The variables are described and defined in the Table 1 below.

Table 3.1: Variables and their definitions

Variables	Definition of the variables
<u>Outputs variables</u>	
1. Points won	The number of points collected in investigated football seasons
2. Rank	The ranks of the football clubs in their domestic leagues in investigated seasons
3. League Title	Number of domestic league championship of the football clubs in investigated football seasons
<u>Inputs variable</u>	
1.Average Game Attendance	The average of game attendance of spectators of each football club in investigated football seasons
2. Total Revenue	Total amount of revenue earned by each football club in investigated seasons.This amount is the total of broadcasting revenues, matchday revenues, merchandising revenues, and revenue generated from sponsorships.
3.Number of Personnel in Football Team	Total of the number of players (squad width), number of coaches in technical staff, number of doctors in health service, and number of professionals who manages football team such as sportive director.

Data on these variables was collected from 2017 to 2020, which is a reasonable period of time to determine whether or not a football club is successful. This study enables us to do a comparative efficiency analysis of most of the popular football clubs of Europe.

### **3.4 Methodology**

#### **3.4.1 Research Design**

Data enveloping analysis was first created by Farrel in 1957 with the proposal for a ‘boundary production function’ as an arrangement for the ‘average performance criterion’, and after that created by Charnes, Banker and Rhodes in 1978. Data enveloping analysis is a linear programming-centric method, which is an analysis method that helps make the most appropriate decision by creating the relative performance of decision mechanisms in situations where it is difficult to compare input-output values measured with different values or with different measurement ends. The overall structure of data enveloping analysis is based on the contribution of similar decision mechanisms to the decision step, and the decision units subject to analysis have similar functions for the same goal, work under the same conditions, and the factors that define the efficiency of all elements in the group are the same, except for differences in their size and density. Selecting decision-making mechanisms that primarily handle similar decisions and have a similar organization is the base for processing data enveloping analysis (Charnes and Cooper, 1988). In the context of our research (efficiency of football clubs), multiple inputs and outputs are supported by DEA, and we have three input and three output variables in this analysis. Generalizing single production function for estimating a distance function is another trait of the DEA. In our case, the distance function is extremely important because of the following benefits. It makes no assumptions about the firm's behavior, such as avoiding issues like profit maximization and cost minimization, which cannot be



generalized to the efficiency of a football club. This means that the DEA will overcome the lack of understanding and uncertainty regarding inputs in football. The hypothesis under consideration in this study necessitates a procedure that considers the investigated football clubs' overall efficiency or inefficiency, as well as seasonal or annual efficiency. The characteristics of DEA mentioned above perfectly gives us insights that answer the hypothesis and, as a result, the research query. As a result of the congruency between its methods and the research hypothesis, this study adopted the DEA.

### **3.4.2 Research Procedure**

In this thesis, points won each season, rank in the league, and as a consequence of previous two outputs the number of domestic league titles in prevailing seasons of research are included as outputs of the analysis. For the inputs, total annual revenues, average game attendance, and number of personnel were considered for each football club. By determining these inputs and outputs, we were aimed to measure how efficiently and effectively football clubs convert their annual revenues, power and passion of their spectators, and physical and mental abilities of every single member of their football team into sporting success. In general, the word “sporting success” varies from clubs to clubs but for the football clubs included in this analysis , sporting success is “domestic league title” because our justification in determining football clubs for this analysis is choosing the most popular and successful clubs of the big five leagues of Europe and the Turkish league.

### **3.4.3 The methods of Data Presentation and Analysis**

DEAP 2.1 was used to compile the data from the numerous input and output variables. The analysis is run with assumption that all the inputs affect the production function

of the investigated football clubs and hence the efficiency of these football clubs. Generally, the measurement of efficiency in football are carried by using the DEA.

### **3.5 Conclusion**

To sum up everything discussed in this chapter, we initially strived to explain the model that will be used in our research in detail. While doing these explanations, we also presented mathematical application or formula of our model and showed how this model works mathematically. After explaining our model, we explained the data of our research. In this part, we initially talked about the sources of data and then we defined our variables of data. As stated above, the input variables of our data are average number of game attendance, total annual revenue of football clubs, and number of staff assigned in football clubs. The output variables of our data are number of points won, rank in the league, and number of domestic trophies won in each investigated football season. In the last part of this chapter, we explained the methodology followed in this research. We explained how this research designed and the procedure of this research in detail. After all of these critical discussions made in this chapter, next chapter will present us the empirical results which arised from the discussed points in this chapter.

### **3.6 Research Structure**

After discussing the data, model, and methodology used in this study, in next section (Chapter Four) we are going to show the empirical results and give some inferences. In the Chapter Five which is the last section, we will give a general conclusion about this study and show the references of this study.

## Chapter 4

### EMPIRICAL ANALYSIS

#### 4.1 Introduction

In this chapter, we are going to focus the measurement and evaluation of the technical efficiency and productivity levels of the top clubs of the big five league of the Europe and the Turkish league. In calculating the efficiencies of the investigated football clubs, we applied Data Envelopment Analysis (DEA) and for the productivities of the football clubs, we applied Malmquist Total Factor Productivity (MPI) index. A program (DEA program) that is mentioned in the previous chapter applied to the inputs and outputs that we explained in the data section. The Technical Efficiency coefficient of the investigated football clubs was calculated using a technical assumption of constant returns to scale.

#### 4.2 Interpretation of DEA Results

Table 4.1 shows average technical efficiency and scale efficiency scores of the biggest clubs of the Big Five League of the Europe and the Turkish League over the period 2016 to 2020. In terms of technical efficiency and scale efficiency, the average score of the investigated football clubs is 0.82 and 0.94 respectively. When we investigate the average technical efficiency scores of investigated football clubs, we see that Fenerbahçe SK, Beşiktaş, Trabzonspor, Manchester United, Liverpool, Arsenal, FC Bayern München, Borussia Dortmund, FC Schalke 04, Paris Saint Germain, and Olympique Lyon clubs are technically efficient. On the other hand, when we investigate the average scale efficiencies of the investigated football clubs, we can

obtain slightly more accurate and comprehensive efficiency results because scale efficiency is the ratio of overall efficiency and technical efficiency. Therefore if we look at the average scale efficiencies of football clubs, we see that Beşiktaş , Trabzonspor , Manchester United , Arsenal , FC Bayern München , Borussia Dortmund , FC Schalke 04 , and Olympique Lyon clubs are the most efficient football clubs in the investigated seasons.

Table 4.1: Average DEA Technical Efficiency and Scale Efficiency Results Between 2016 and 2020

<b>Inputs</b>		
Average Game Attendance		
Total Annual Revenue		
Number of Personnel in Football Club		
<b>Outputs</b>		
Points Won		
Rank		
League Title		
<b>DMU's</b>	<b>Technical Efficiency</b>	<b>Scale Efficiency</b>
Fenerbahçe SK	1.00	0.921
Galatasaray	0.60	0.99
Beşiktaş	1.00	1.00
Trabzonspor	1.00	1.00
Manchester United	1.00	1.00
Liverpool	1.00	0.55
Arsenal	1.00	1.00
Manchester City	0.83	0.91
Chelsea	0.81	0.57
Real Madrid	0.67	0.99
Barcelona	0.92	0.92
Atletico Madrid	0.94	0.96
Juventus	0.77	0.99
Milan	0.37	0.97
Inter	0.60	0.99
FC Bayern München	1.00	1.00
Borussia Dortmund	1.00	1.00
FC Schalke 04	1.00	1.00
Paris Saint Germain	1.00	0.99
Olympique Lyon	1.00	1.00
<b>MEAN</b>	0.82	0.94

Total factor productivity (TFP) scores based on the Malmquist index are shown in Table 4.2 for the 2016-2017 football season. The average efficiency score of the investigated football clubs this season is 0.83, according to the results. According to Malmquist TFP results, in 2016-2017 football season, Fenerbahçe, Beşiktaş, Trabzonspor, Manchester United, Liverpool, Arsenal, FC Bayern München, Borussia Dortmund, FC Schalke 04, Paris Saint Germain, and Olympique Lyon clubs are productive among the investigated clubs.

Table 4.2: Malmquist Total Factor Productivity Results for 2016-2017 Season

<b>Inputs</b>	
Average Game Attendance	
Total Annual Revenue	
Number of Personnel in Football Club	
<b>Outputs</b>	
Points Won	
Rank	
League Title	
<b>DMU's 2016-2017</b>	<b>Malmquist Total Factor Productivity Results</b>
Fenerbahçe SK	1.00
Galatasaray	0.60
Beşiktaş	1.00
Trabzonspor	1.00
Manchester United	1.00
Liverpool	1.00
Arsenal	1.00
Manchester City	0.83
Chelsea	0.81
Real Madrid	0.66
Barcelona	0.92
Atletico Madrid	0.94
Juventus	0.77
Milan	0.37
Inter	0.60
FC Bayern München	1.00
Borussia Dortmund	1.00
FC Schalke 04	1.00
Paris Saint Germain	1.00
Olympique Lyon	1.00
MEAN	0.83

Table 4.3 represents the TFP scores of investigated football clubs based on Malmquist index for the 2017-2018 football season. The result shows us that the average TFP score for this football season is 0.89. Among the investigated football clubs , for this season , Fenerbahçe SK, Galatasaray, Liverpool, Manchester City, Real Madrid, Atletico Madrid, Milan, Inter, FC Bayern München, Borussia Dortmund, FC Schalke 04, and Paris Saint Germain clubs are productive.

Table 4.3: Malmquist Total Factor Productivity Results for 2017-2018 Season

<b>Inputs</b>	
Average Game Attendance	
Total Annual Revenue	
Number of Personnel in Football Club	
<b>Outputs</b>	
Points Won	
Rank	
League Title	
<b>DMU's 2017-2018</b>	<b>Malmquist Total Factor Productivity Results</b>
Fenerbahçe SK	1.00
Galatasaray	1.00
Beşiktaş	0.98
Trabzonspor	0.85
Manchester United	0.93
Liverpool	1.00
Arsenal	0.79
Manchester City	1.00
Chelsea	0.74
Real Madrid	1.00
Barcelona	0.81
Atletico Madrid	1.00
Juventus	0.64
Milan	1.00
Inter	1.00
FC Bayern München	1.00
Borussia Dortmund	1.00
FC Schalke 04	1.00
Paris Saint Germain	1.00
Olympique Lyon	0.93
MEAN	0.89

Table 4.4 shows us the TFP scores of football clubs that were examined in this study for the 2018-2019 football season. The average TFP score is 0.94. According to the results for this season, Fenerbahçe SK, Galatasaray, Trabzonspor, Manchester United, Liverpool, Arsenal, Manchester City, Chelsea, Real Madrid, Barcelona, Atletico Madrid, Juventus, Milan, Inter, FC Bayern München, Borussia Dortmund, Paris Saint Germain and Olympique Lyon clubs are productive.

Table 4.4: Malmquist Total Factor Productivity Results for 2018-2019 Season

<b>Inputs</b>	
Average Game Attendance	
Total Annual Revenue	
Number of Personnel in Football Club	
<b>Outputs</b>	
Points Won	
Rank	
League Title	
<b>DMU's 2018-2019</b>	<b>Malmquist Total Factor Productivity Results</b>
Fenerbahçe SK	1.00
Galatasaray	1.00
Beşiktaş	0.77
Trabzonspor	1.00
Manchester United	1.00
Liverpool	1.00
Arsenal	1.00
Manchester City	1.00
Chelsea	1.00
Real Madrid	1.00
Barcelona	1.00
Atletico Madrid	1.00
Juventus	1.00
Milan	1.00
Inter	1.00
FC Bayern München	1.00
Borussia Dortmund	0.89
FC Schalke 04	1.00
Paris Saint Germain	1.00
Olympique Lyon	1.00
MEAN	0.94

On the other hand, Table 4.5 shows us the TFP scores based on Malmquist index for 2019-2020 football season. In spite of the unexpected breaks for the leagues because of the coronavirus pandemic, the average TFP score of these giant clubs remains the same as previous season which is 0.94. According to the results for this interesting season, Fenerbahçe SK, Galatasaray, Trabzonspor, Manchester United, Liverpool, Arsenal, Manchester City, Chelsea, Real Madrid, Barcelona, Atletico Madrid, Juventus, Milan, Inter, FC Bayern München, Borussia Dortmund, Paris Saint Germain and Olympique Lyon clubs are productive.

Table 4.5: Malmquist Total Factor Productivity Results for 2019-2020 Season

<b>Inputs</b>	
Average Game Attendance	
Total Annual Revenue	
Number of Personnel in Football Club	
<b>Outputs</b>	
Points Won	
Rank	
League Title	
<b>DMU's 2019-2020</b>	<b>Malmquist Total Factor Productivity Results</b>
Fenerbahçe SK	1.00
Galatasaray	1.00
Beşiktaş	0.77
Trabzonspor	1.00
Manchester United	1.00
Liverpool	1.00
Arsenal	1.00
Manchester City	1.00
Chelsea	1.00
Real Madrid	1.00
Barcelona	1.00
Atletico Madrid	1.00
Juventus	1.00
Milan	1.00
Inter	1.00
FC Bayern München	1.00
Borussia Dortmund	0.89
FC Schalke 04	1.00
Paris Saint Germain	1.00



Olympique Lyon	1.00
MEAN	0.94

For each total average score, Table 4.6 provides the average technical efficiency and productivity scores from both the DEA and the Malmquist index, with technical efficiency scores lower than productivity values. In terms of production, the physical and human resources used in the investigated football clubs outperformed performance.

Table 4.6: Average Results for DEA and Malmquist Index

<b>Football Clubs</b>	<b>DEA Average technical score</b>	<b>Malmquist Index Average productivity score</b>
Total	0.82	0.90

Low efficiency scores occur within this setting, as shown by the values less than 1. As a result, it is important to examine the factors that contribute to football clubs' decreasing efficiency ratings. The excess employee size relative to annual total revenue is most important determinant for low efficiency score. Despite an improvement in productivity, when we look at the literature we see that an excess number of workers as well as excess expenses relative to annual sales in an organization reduces performance.

## Chapter 5

### CONCLUSION

#### 5.1 Final Remarks

Scores of the DEA to determine the level of efficiencies of the most successful football clubs of the Big Five Leagues of Europe and the Turkish Super League indicate us that many football clubs in this study are efficient and productive ( most of the efficiency results are 1 or around 1) for technical efficiency and productivity terms between 2016 and 2020.

On the other hand, some of the football clubs were seemed to be inefficient in some seasons. The reason of the inefficiency can be explained by the on pitch factors like inadequate performance of new transfers, bad form of the key players of the teams, and inadequate performances of coaches like wrong substitutions or putting wrong squads on the pitch. Another factors of inefficiency can be factors that are seen off the pitch. The disharmony between the expectations of spectators and club's management is among these factors that results as low level of average game attendance is a prominent factor which causes lower level of revenue (matchday revenues, broadcasting revenues, merchandising revenues) and hence inefficiency. If the low level of revenue combines with an expensive squad (when the club is unable to fulfill financial obligations towards the squad and other staff of the football team) the result would be disaster as it is seen some of the Italian and Turkish clubs when we look at the average DEA technical efficiency scores of the investigated clubs (Table 4.1).

After discussing the reasons of efficiency and inefficiency, we can have some inferences such as;

First, the inefficiency score can be explained by looking at the number of personnel in a football club. As the number of staff in a football club increases, in a case of failure in a season, the result will be inefficiency.

The second conclusion is based on the idea that, in general, the combination of optimal number of staff in accordance to the annual total revenue gives us the positive results of efficiency. Also, we can add that, as the level of revenue increases, the risk of mismatch between the number of staff in accordance to the annual total revenue decreases and hence the result will be efficiency.

## **5.2 Policy Implications**

Out of the inferences discussed in the previous section, some policy implications can be deducted as follows: Since the excess number of staff in a football club reduces the level of football club efficiency, the management of a football club or the manager of the football club could determine an optimal number of staff considering the objectives or targets of the football club. For instance, a football club that competes in either domestic and European competition could be needed more players in team and hence more professionals recruited in the technical staff under the management. At same time the club's total annual income must be considered, otherwise the level of efficiency could be low. This situation highlights the importance of taking the right policies by the managers in terms of efficiency in a football club.

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